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RETROFITTING URBAN ARTERIALS INTO COMPLETE STREETS

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ABSTRACT

With the advent of context sensitive design, the traditional design of urban arterials is being transformed from just moving as many motor vehicles as fast as possible, to consideration of all the users of the entire road right-of-way. This later concept has been dubbed "complete streets" and is fast becoming a popular and challenging alternative to traditional arterial street design. This paper will explore ways to make urban thoroughfares more pedestrian and bicycle friendly and respectful of the surrounding community, while not unduly compromising motor vehicle travel. The major culprit in incompatible urban arterial street design is equating high speed with roadway mobility and capacity. Techniques for designing an arterial street that can control traffic speeds, thus permitting more comfortable and safe pedestrian and bicycle access, will be described.

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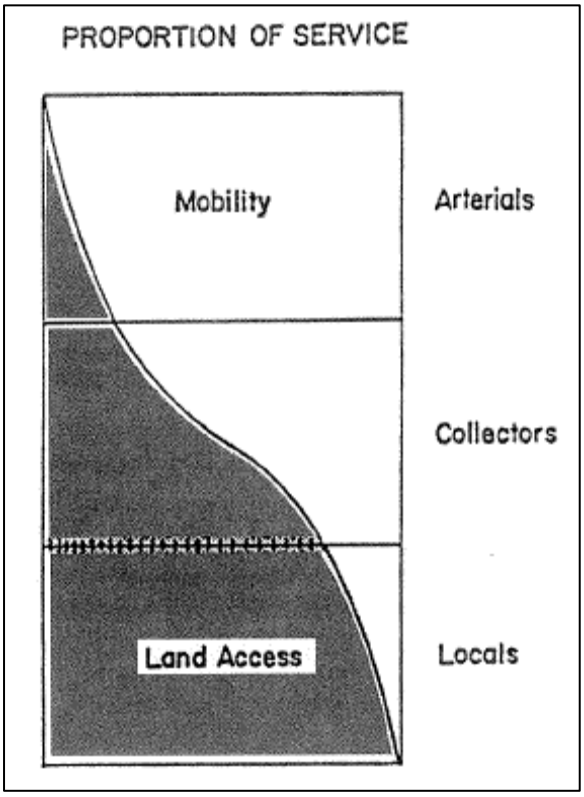
INTRODUCTION

The AASHTO Policy on Geometric Design of Highways and Streets, more popularly known as the Green Book, begins by noting that roadways are classified by operational, functional and geometric types as a necessary communication device. For transportation planning purposes, the grouping of highways and streets by the character of the service or function they provide has proved very useful. Functional classification is based on the concept of hierarchies of movement, with expressways designed to handle the main travel movements, which are characterized by high-speed flows for large traffic volumes, and thence through a system of moderate speed arterials for distribution, collector roads for penetration into the neighborhoods, and finally local access streets where the actual driveway connections take place. *(1)*

FIGURE 11: Proportion of Service *(1)*



The Green Book recognizes that applying this hierarchal system to urbanized areas results in an inherent conflict between serving through traffic movement while providing access to adjacent properties. This conflict has traditionally been depicted as a continuum between providing less mobility and more land access as the street network progresses from arterials through collectors to local streets. (See Figure 1.)

Thus, city streets are being designated as arterials, collectors or locals depending on their place in that area's functional classification system. Those streets designated as arterials are by definition intended to primarily provide mobility, with emphasis placed on operating speed and traffic carrying capacity. This leads to other design requirements that stress access management, wider lane widths, increased turning radii, and minimum interference with traffic movements.

However, these mobility standards seldom include references to pedestrian or bicycle accommodations, transit routes, or other community impacts. This has often led to highways dividing neighborhoods and destroying local businesses in older established communities, and creating sterile, inhospitable wastelands in developing suburbs.

CONTEXT SENSITIVE DESIGN

As a reaction to this unhealthy trend, Context Sensitive Design concepts and the Complete Streets movement has sprung up, and many responsible professional

organizations are working to create and adopt a new arterial street design paradigm for our urban areas. Along these lines, the Institute of Transportation Engineers, in conjunction with the Congress for New Urbanism and FHWA, are developing a new Recommended Practice entitled Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities. *(2)*

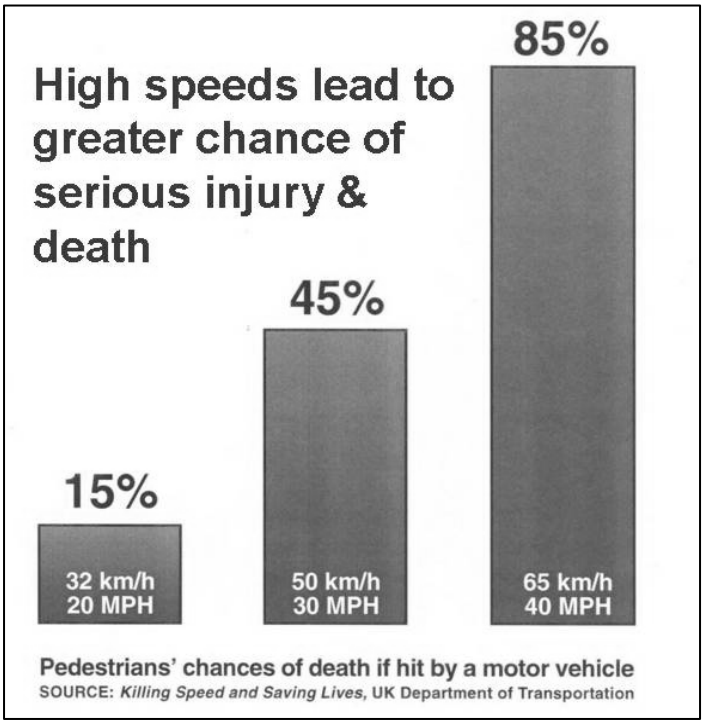
A major premise of this document is that functional classification needs to be replaced by (or at least overlaid with) street typology classifications that are based on the adjacent community characteristics. The adjacent communities would be characterized by transects or urban context zones such as suburban, general urban, urban center and urban core, and the street typology would include the following thoroughfare types – freeway/expressway/parkway, high-speed boulevard, low-speed boulevard, avenue, and street. The overlap with the traditional functional classifications would place the freeways, boulevards and avenues in the Principal Arterial classification; Minor Arterials could include boulevards, avenues and streets; Collectors could cover both avenues and streets; and Local Streets would just be streets, alleys and rear lanes.

While this suggested classification and street typology system is more complex than the current functional classification system, it is also more descriptive of the actual urban roadway network. It is thus more useful in creating an arterial street network that is responsive to the needs of the community it is supposed to serve.

SPEED MATTERS

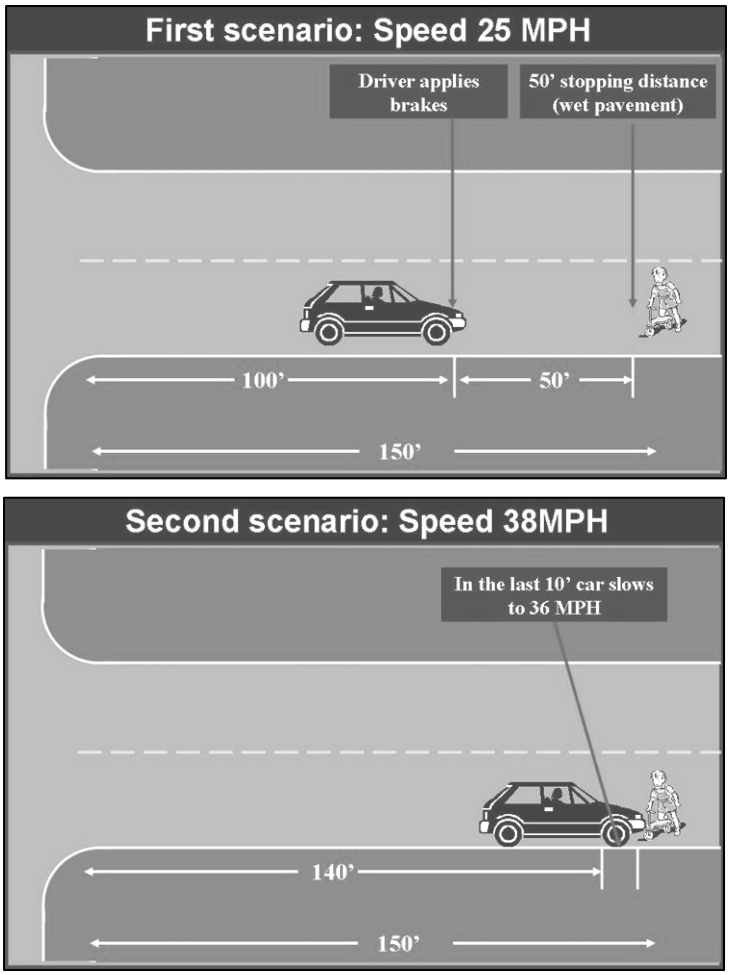
One of the major components of this new design paradigm is selecting a design speed that is appropriate to the actual street typology and location, rather than using a design speed based on some arbitrary functional classification. The conventional wisdom regarding arterial street classification is that in order to maintain mobility to and through our communities, some streets have to be designated as major traffic carriers, or else the entire regional economy will grind to a halt. And travel speed has always been equated as a necessary component of this mobility. However, from a pedestrian safety and community livability standpoint, speed really does matter.

FIGURE 22: Vehicle speed vs. injury & death. ***(3)***



We should all be familiar by now with the chart that shows that a pedestrian being hit by a car traveling at 20 mph has an 85% survivability rate, whereas that same collision with a car going twice as fast, 40 mph, will lower the survivability likelihood of only 15%. (See Figure 2.)

FIGURE 33: Stopping distance *(4)*



This disparity in survivability rate becomes even more important when combined with actual vehicle stopping characteristics. For example, a child darting out 150 feet in front of a car traveling 25 mph gives the motorist 2.5 seconds to react and apply the brakes, during which time the vehicle will travel 100 feet, leaving 50 feet in which to stop. Even under wet pavement conditions, a car can stop in 40 feet at 25 mph, and the child is scared but unhurt. In this same scenario, if the car is traveling 38 mph, the 2.5 second perception-reaction time will take up 140 feet, leaving only 10 feet of stopping distance and a resulting vehicle-pedestrian collision speed of 36 mph and less than a 20% chance that the child will survive the crash. (See Figure 3.)

DEFINING MOBILITY

Given that speeds over 30 mph in urban areas are thus very pedestrian unfriendly, if not downright dangerous, is the only choice to sacrifice mobility for community livability? The answer to this question depends on how we define mobility. In an urban area, roadway capacity and total travel time should be the two primary components used in measuring mobility.

We have all experienced the all too common suburban arterial traffic experience of driving 45 mph, stopping for up to 2 minutes at a traffic signal, accelerating back up to 45 mph, only to stop and wait again a half-mile down the road. This uncoordinated signal system wastes time and fuel and the many stops increase crash rates. While it is easy to provide 45 mph signal progression in one direction, at this speed it becomes more difficult to set up a two-way progression with the shorter signal spacing found in most urbanized areas. If we could coordinate these signals to permit two-way progression at a constant speed of 25 or 30 mph, the total travel time would be roughly the same.

Even if somehow we could provide two-way 45 mph signal coordination, for a 5-mile trip along an arterial corridor the added travel time for a 30 mph trip as compared to a 45 mph trip is slightly over 3 minutes. In the overall scheme of things, how important

is the 3-minute potential delay compared to the proven safety benefits and the city livability advantages that come with the slower traffic speeds? There will be those who drag out the standard travel time delay litany used in so many benefit-cost studies that would equate the 3.33 minutes and a 30,000 ADT and assumed costs of $20/hour with $12.154 million in lost wages to the economy or whatever. However, in reality the loss is only 3.33 minutes per individual for this one trip, for which they are probably not being paid, and which is less than the time they will willingly spend in line at Starbucks getting their morning coffee.

DEALING WITH CAPACITY

The other part of the mobility equation is capacity, with the number of lanes acting as the primary surrogate measurement. At signalized intersections, two lanes in each direction, plus a left turn bay, is not a problem for most pedestrians to cross, provided the pedestrian traffic signals are set for a comfortable walk speed. (More about that later.) And a Level of Service (LOS) of D is a reasonable peak period LOS in an urban area, provided the above-mentioned signal progression can be maintained.

Requiring a LOS of C (or even B) in an urban setting is a waste of tax dollars in constructing unneeded pavement, which in turn increases pedestrian crossing distances (and thus pedestrian crossing times, which impact negatively on signal timing for vehicular traffic), and encourages faster vehicular speeds during the other 22 hours of the day in each direction.

When travel demand requires three moving lanes in each direction and/or double left turn and right turn lanes, the roadway impact on the adjacent community can become severe. From on urban planning standpoint, volumes of these magnitudes usually indicate too few arterial streets serving that particular corridor or a lack of freeway capacity for the longer trips that should not be on the arterial street system to begin with. Although it is recognized that geographic and urban development constraints may require these six-lane arterials in some situations, these conditions should be dealt with early in the planning process for new or developing suburbs, and some compromises and special design measures may be needed in existing corridors where other alternatives exist.

ARTERIAL TRAFFIC CALMING MEASURES

The remainder of this paper will deal with specific design measures that may be used to retrofit urban arterials to make them more pedestrian and bicycle-friendly, and thus more community-friendly. Arterial traffic calming must first deal with controlling vehicular speeds. In addition to timing the traffic signals for a 25 or 30 mph operating speed, other possible speed control measures include:

- Narrower travel lanes – 10 or 11-foot lanes are acceptable for most urban arterials and are just as safe as 12-foot lanes for posted speeds of 35 mph or less *(5)*
- 4-lane to 3-lane road diets for ADTs of 20,000 or less – This makes the more prudent driver the “pace” car for that roadway and greatly improves left turning safety
- Tightening corner curb radii to the minimum needed to provide the “effective” turning radius for an appropriately selected design vehicle – Thus slowing down turning vehicle speeds

- Elimination of any free-flow right turn lanes – Includes freeway entry and exit ramp connections
- Adding new raised medians – Visually narrows the roadway and provides a median refuge for midblock crossings
- Providing median and parkway landscaping – Further visually narrows the roadway and provides a calming effect
- Retaining curb parking – Both for community access and traffic calming
- Curb bulb-outs - Controls parking, shortens pedestrian crossing distances and improves sight lines

PEDESTRIAN CROSSINGS

The next most important element in creating a pedestrian-friendly arterial street is making the pedestrian crossing locations safe, comfortable and more frequent. Pedestrians should not be expected to travel to the closest signalized intersection in order to cross the street. While this may be reasonable in a dense downtown case with signals spaced every 300 to 600 feet, along most urban and suburban arterials these signals are usually spaced no closer than every quarter mile. Requiring pedestrians to travel 1,200 feet or more out of their way to cross a street, adds 5 minutes to the travel time of a pedestrian walking at the average 4.0 fps walking speed. If we were to suggest a 5-minute detour for all automobile traffic, this would be the equivalent of adding a distance of 2.5 miles for a car traveling at 30 mph, and the outrage would be loud and instantaneous.

In urbanized areas, there should be some provision for pedestrians to cross the street at almost every unsignalized intersection. At the very least, on streets with a bus route there should be some provision for pedestrians to cross the street wherever there is a bus stop. (<u>All</u> bus riders need to cross the street either coming or going, assuming they intend to go back home at some point during their travels.)

Many of the suggested pedestrian crossing improvements flow directly out of the traffic speed control measures noted above. They include:

- Narrower travel lanes – To shorten the pedestrian crossing distance and roadway exposure time
- Road diets – To reduce the number of lanes to be crossed
- Tighter corner curb radii – To shorten pedestrian crossing distances and provide space for perpendicular curb ramps
- Adding corner “pork chop” islands where design vehicle turning radii do not permit a small corner radius – To shorten pedestrian crossing distances
- Adding raised medians – To provide pedestrian refuge
- Curb bulb-outs – To shorten pedestrian crossing distances, improve sight lines and provide space for curb ramps

SIGNALIZED INTERSECTIONS

At signalized pedestrian crossing locations, using the now recommended pedestrian walking speed of 3.5 fps to set the Flashing Don’t Walk pedestrian clearance time and 3.0 fps to determine the total Walk/Flashing Don’t Walk time is a basic improvement that should be incorporated everywhere – not just at those locations where some indeterminate number of elderly or disabled pedestrians have been counted.

Universal accessibility means that every individual should be able to safely cross the street wherever they may be, and not be forced to live and work only in communities of like-abled pedestrians. Other tools to make signalized pedestrian crossings safer and more comfortable include:

- Countdown clocks – To finally correct the long standing confusion surrounding the traditional but counter-intuitive Flashing Don't Walk
- Leading pedestrian indications (LPI) – To give pedestrians the authority to start ahead of otherwise non-yielding right turning vehicles
- Accessible Pedestrian Signals (APS) – To provide blind pedestrians with the same notification of pedestrian signal actuation button locations and walk signal phasing information that sighted pedestrians already have

MIDBLOCK CROSSINGS

One other potentially controversial issue that needs to be addressed is midblock pedestrian crossings. I am not proposing every arterial street be equipped with midblock crossings at half-block intervals, nor am I suggesting raised crosswalks, chicanes or other residential street traffic calming measures. However, I am suggesting looking at the surrounding land uses and determining where midblock pedestrians crossings would be appropriate and then decide what level of warning and accommodation would be needed for each situation.

The midblock pedestrian crossing options for arterial streets could include:

- Continental-style crosswalks and pedestrian crossing warning signs – For lightly traveled arterials posted for urban speed limits (25-30 mph)
- Pedestrian-actuated crosswalk warning signs – For more heavy traffic flows
- Raised medians – To allow pedestrians to cross half the street at a time
- Curb bulb-outs – To shorten the crossing distance and provide better sight lines for both motorists and pedestrians
- Pedestrian-actuated HAWK-style signals – Now soon to be adopted in the MUTCD
- Full pedestrian signalization – Which can be programmed to match the signal progression for the remainder of the arterial corridor traffic signals
- Any combination of the various midblock crossing alternatives noted above

TRAFFIC "TAMING"

In conclusion, instead of the concept of "traffic calming" that is used in discussing the design of residential streets, I like the term "traffic taming" to describe the concept of making our arterial streets more pedestrian, bicycle and community friendly. This compilation of suggestions for retrofitting arterial streets into Complete Streets is not meant to be all-inclusive. There are many more solutions available to us once we take seriously the task of designing our arterial roadways for community livability, while retaining a reasonable level of mobility along our most important travel corridors.

The purpose of this paper is to challenge the highway and traffic engineers responsible for planning, designing and constructing our urban street systems to look at all their various design alternatives, and not be straight-jacketed into just one or two design options set by their State DOTs or a narrow interpretation of the AASHTO Green Book. And if this means revising some of our design manuals, then now is the time to

act. If this presentation leads to some constructive discussions and conversations along those lines, then I will have accomplished my immediate goal.

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