Embedded Values

Sagrario Gonzalez was at the Central Library on State Street in Springfield, Massachusetts, near closing time on December 3, 2014. As many loving adults are prone to do, she brought her niece and daughter to enjoy the library's children's section. Springfield was the home of Theodor Geisel, better known as Dr. Seuss. It has a great children's section.

It was lightly raining when they left the library, the December kind of rain that stings when the wind whips it against your neck. Their vehicle was in the library's parking lot, directly across the street from the front door. As Gonzalez walked down the front steps, two small children in tow, she made a fateful decision.

At the bottom of the library steps was a sidewalk. To get to her vehicle, Gonzalez could walk the 275 feet south to the traffic signal, push the button and wait for the light to turn in her favor, cross the four lanes of State Street, and then proceed back up the street another 275 feet to the parking lot.

She could do that, or she could do what most people seem to do when they leave the library. She could follow a well-worn path through the grass, step over a small decorative fence erected along the

side of the street, wait for a gap in the traffic, and then quickly walk, maybe run, across State Street to the parking lot.

The quickest path between two points is a straight line. With the rain coming down, darkness well established, and the bedtime hour fast approaching on a school night, Gonzalez chose the quicker route. It was the wrong decision.

The group was struck by a vehicle while crossing State Street. Sagrario Gonzalez's daughter and niece were taken to the hospital with serious injuries. Gonzalez survived, as did her niece. Tragically, Destiny Gonzalez, the seven-year-old daughter of Sagrario Gonzalez and her husband, Luis, was killed.

I will never forget that night. I was in Springfield, having just given a public lecture on behalf of the nonprofit Strong Towns. I was homesick for my family, especially my two daughters, who were roughly the same ages as the pair of young girls who had been struck. It was 10 days before Christmas. My heart ached, and it still does, for Sagrario Gonzalez.

It was not her fault.

The Crossing

What happened that night on State Street seems obvious. In a karmic world where we all, to one degree or another, must live with the consequences of our decisions, it's easy to see how Gonzalez made a series of bad choices.

She could have walked to the traffic signal, but she didn't. Traveling four feet per second with two kids in tow, it would have taken her roughly one minute and ten seconds to get there. Depending on her luck, she might not have had to wait at all to cross if the light happened to be green in her direction. If it was red, she might have been there another minute, perhaps longer. It would have taken an additional minute and ten seconds to walk back along the opposite sidewalk. To walk to the signal instead of crossing directly meant it would take an additional two to four minutes to get to her car.

Two to four minutes. That is what was saved by crossing directly in the middle of the block instead of walking to the signal — one dead, one seriously injured, and lives forever damaged. It seems like an

extraordinarily high price to pay for what could casually be described as impatience.

That's not to suggest that crossing the street mid-block was effortless. To cross in front of the library, Gonzalez had to walk around a row of shrubs. To reach the street, she also needed to step over a small fence, nothing more than a couple of decorative chains hanging between posts. These obstacles were put there to discourage people from crossing in this location, a fact that is self-evident to anyone who chooses that route.

We can think of these obstacles as a warning: DO NOT CROSS HERE. Gonzalez did not heed this clear warning.

From curb to curb, State Street is 40 feet wide in this location. At a normal walking speed, the three of them would be exposed to traffic for at least 12 seconds, assuming that they could proceed in one smooth crossing.

That is 12 seconds in an area where Gonzalez knew that a traffic signal would not be stopping oncoming traffic. She also had to have known that at least some of these drivers might not anticipate people crossing mid-block, especially at that hour. Those drivers would not be alert for the possibility that she and the girls would be there.

Of the four lanes on State Street, two convey traffic to the north and two to the south. Crossing safely here requires one to time a gap within the multidirectional traffic flow, a task made more difficult at night. What often happens in these situations is that the person crossing can anticipate the gap only in the two nearest lanes. They venture out and often find themselves trapped in a traffic lane, fully exposed, waiting for the furthest two lanes to provide the gap that they need to finish the crossing.

Sagrario Gonzalez had done this crossing many times. She knew all of this. Everyone in Springfield knows this, and most of us, if we visited the site and looked at it, would intuitively understand it as well.

What Gonzalez did was very dangerous. She did it despite the clear warnings. She did it to save a couple minutes of time. She did it despite having two small children in her care, young people who would face the risk with her and pay a heavy price.

This was Gonzalez's choice. It is easy to say this was Gonzalez's fault.

Too easy. It wasn't her fault.

Hidden Values

That night Sagrario Gonzalez made fateful decisions about how to navigate an environment where her existence was, at best, an afterthought, and at worst, a nuisance. The options she had available to her were the result of the underlying values applied to the design of State Street — values reflected in similar environments across North America and wherever around the world American design practices are being emulated.

The professionals who design streets follow a practice codified in the decades since the Great Depression. Engineers who do this work learn it as a practice, as a body of technical knowledge that has been amassed over generations. While one book or another of engineering standards is often referred to as "the bible" by those who use them, that reference is due more to their centrality to the practice of engineering than to the type of wisdom imparted.

While the religious debate passages of the Bible, contrasting different teachings in a search for deeper truth, the codes of an engineering manual are more like a cookbook. If you wish to make a certain type of chocolate cookie, a cookbook will provide the common ingredients found in cookies and the specific way to arrange them for a particular recipe. Likewise, if you wish to build a certain type of street, an engineering manual will explain the way to assemble all of the components so that you get the desired outcome.

What is expected in a religious text, but not in a cookbook, is deeper meaning. Few people question the underlying values contained in a fruit salad recipe. None search for hidden truth in the list of ingredients for a souffle. The recipes in a standard cookbook do not have an underlying ideology or belief system attached to them. A cookbook is viewed as value free. It is merely instructions for assembling ingredients into finished foods.

Transportation professionals consider their texts, and by extension their entire profession, as being similarly value free. This is wrong.

At the foundation of traffic engineering is a collection of deeply infused values. These values are so deep, and so core to the profession, that practitioners do not consider them values. They bristle at the suggestion. For practitioners, these values are merely self-evident truths — something like gravity that it is not necessary to believe in because it just is.

These values are expressed in the range of options that engineers consider, the way that they discuss different approaches, and the transportation systems that they build. This would not be a problem, and we could allow this entire profession to retain their sacred texts and practices unchallenged by heretical viewpoints, if they could find a way to address the damage traffic engineering is doing to our communities.

They cannot do this for a simple reason: The damage being done is the culmination of those values. The injuries and deaths, the destruction of wealth and stagnating of neighborhoods, the unfathomable backlog of maintenance costs with which most American cities struggle, are all a byproduct of the values at the heart of traffic engineering. Addressing the damage requires addressing the values, but you cannot address something that you deny even exists.

The underlying values of the transportation system are not the American public's values. They are not even human values. They are values unique to a profession that has been empowered with reshaping an entire continent around a new, experimental idea of how to build human habitat.

Let us identify those values.

The Design Process

When an engineer sits down to design a street, they begin the process with the design speed. I have been in countless meetings where engineers presented technical design sheets and even in-depth studies for a street project. Never, and I mean never, was any elected official or any member of the public asked to weigh in on the design speed.

Never once did I hear one of my fellow professional engineers say, "So, what are you trying to accomplish with this street in terms of speed?"

No. The design speed is solely the purview of the engineering professional, with a preference for accommodating higher speeds over lower.

Why?

Choosing a design speed is, by its nature, an application of core values. When we pick a speed, we are selecting among different, competing priorities. Is it more important that peak traffic move quickly, or is it more important to maximize the development potential of the

street? Do we compromise the safety of people crossing on foot in order to obtain a higher automobile speed, or do we reduce automobile speed in order to improve safety for people outside of a vehicle?

These are policy decisions, and like all policy decisions, they should be decided by some duly elected or appointed collection of public officials. In a democratic system of representative government, representatives of the people should be provided the full range of options and be allowed to weigh them against each other. That rarely happens, and I have never heard of an instance where it has happened for a local street.

Many of my engineering colleagues will reply that they do not control the speed at which people drive — that travel speed is ultimately an enforcement issue. Such an assertion should be professional malpractice. It selectively denies both what engineers know and how they act on that knowledge.

For example, professional engineers understand how to design for high speeds. When building a high-speed roadway, the engineer will design wider lanes, more sweeping curves, wider recovery areas, and broader clear zones than they will on lower-speed roadways. There is a clear design objective — high speed — and a professional understanding of how to achieve it safely.

There is rarely any acknowledgment of the opposite capability, however: that slow traffic speeds can be obtained by narrowing lanes, creating tighter curves, and reducing or eliminating clear zones. High speeds are a design issue, but low speeds are an enforcement issue. That is incoherent, but it is consistent with an underlying set of values that prefer higher speeds.

Once the engineer has chosen a design speed, they then determine the volume of traffic they will accommodate. How many motor vehicles will this street be designed to handle? This is the second step of the design process, and the second instance where the design professional independently makes a decision that is, at its heart, a value decision.

Standard practice is to design the street to handle all of the traffic that routinely uses it at present, plus any increase in traffic that is anticipated in the future. There is no consideration given as to whether that is too much traffic for the street, and rarely is there a conversation of whether other alternatives should be considered. If traffic is present, it is the traffic engineer's calling to accommodate it. No nonprofessional is given an opportunity to suggest otherwise.

Now that they have identified the design speed and traffic volume, the traffic engineer consults one of the books of standards to determine how to assemble a safe street. Given a certain speed and volume, how does the design cookbook indicate the street's ingredients be assembled? Within the design process, the answer to that question is, by definition, safe. Any other design would generally be considered a compromise of safety.

The final step of the design process then is to take the "safe" design and determine how much it will cost. This dollar amount is the price for a responsible street design. Any questioning of this minimum effort would be considered a reckless endangerment of human life.

Now we have the traffic engineering profession's values as expressed in the design process. In order of importance, those values are traffic speed, traffic volume, safety, and cost.

I have presented the profession's values in this way to dozens of audiences, comprising thousands of people, across North America. I then ask them to identify their values. These are mixed audiences of professionals and nonprofessionals, people involved in local government decisions and those who are not. There is always a broad consensus (Table 1.1).

I ask them to think about a street where they live, or one where they shop or like to go out to eat. I then ask them to shout out, in unison, which value they consider most important as applied to that street. The answer, overwhelmingly, is safety.

And of course, it is. Most humans, including most traffic engineers when they stop to consider what is being asked, would sacrifice much of the street's performance in terms of speed or volume in order to make it safer. Safety is the top value nearly all people apply to street design.

As we continue, I ask for them to shout out their second most important value. Again, there is no real ambiguity. Nearly everyone chooses "cost."

Again, most Americans today would sacrifice the ability of someone to drive at speed, and the capacity of a street to accommodate a specific volume of traffic, to have a more cost-effective design. I acknowledge that this collective response may differ from the preferences of the individual driving the street,[1] but there are always competing interests between an individual and society. In public policy, we routinely ponder such tradeoffs.

While safety and cost are the top values for nearly everyone, the third value expressed by the groups with whom I have interacted is perhaps the most telling. I ask, "In a tradeoff between speed and

Table 1.1 Values Applied to the Design of Streets*

Current Practice	Most Humans
Design Speed	Safety
Traffic Volume	Cost
Safety	Traffic Volume
Cost	Design Speed

* In order of priority, highest priority first.

volume, would you prefer a design that moves fewer vehicles at a higher speed, or one that moves more vehicles but at reduced speed? Would you emphasize speed or volume?" The answer, overwhelmingly, is "volume."

And that makes sense. To the extent that the street is used to convey traffic,[2] sacrificing the number of cars that can pass through in a given time frame just so those drivers can go faster is counterproductive by any meaningful measure. If we can slow down traffic speeds, and it means that more vehicles can pass through and people arrive at their destinations sooner, why would we not do that? Most people would.

The values of the design process — the values applied to street design —are not values that most people would identify with. I would assert that this includes most traffic engineers, which suggests that design professionals are not morally deficient people but simply that they have accepted these underlying values without debate, internal or otherwise.

State Street was designed using a process that values speed and volume above safety. Sagrario Gonzalez was expected to overcome this design. A different set of values, a more human set of values, would not have put that burden on her.

Biased Language

As an engineer, I have worked on any number of improvement projects. I've improved roads. I've improved streets. I've improved parking lots, frontage roads, and alleys. Like King Midas, everything I and my fellow engineers work on, we seem to improve.

At least that is how we describe what we do. As I write this, my city is seeking bids for what they say in the official notice is a "street improvement project." It does not seem like an improvement to me, nor to many people who unsuccessfully fought against it, yet formally it is called an *improvement*.

The project involves the widening of a residential street. The many young families who live there believe that the changes will dramatically increase automobile speeds, which already seem too fast. To widen the street, quite a few mature trees will be removed, and the city has acquired part of the front yards of many of these neighbors, often against their will. To add insult to injury, to help fund the project, these aggrieved property owners are being forced to pay the city a special assessment fee of thousands of dollars. This is the kind of experience that makes my "Conversation with an Engineer" video seem universal.[3]

What makes this project an improvement? In my eyes, it is a diminishment. Yet, from beginning to end, it has been presented by the city engineer as an improvement project. The subtle bias of this language provides another glimpse at the values embedded within the engineering profession.

From the perspective of the design professional, the current street is "substandard" because, given the design speed the professional has chosen and the number of vehicles they want to accommodate, it does not meet the recipe in the design cookbook. The way to "fix" the "substandard" street is to "improve" it to be consistent with the recipe.

This is merely a reinforcement of the underlying values already discussed, but in a way that manipulates the conversation in favor of the engineer's perspective. Who would want something to be substandard? Who could possibly be against improving things? Yet, obviously, whether a project makes things better depends entirely on a person's perspective.

Instead of a "street improvement project," why not just call it a "street project." Or, if we need an adjective, how about a "street modification project." If the profession is free of values, as its practitioners claim, such a change in language should not be the least bit threatening.

The same goes for the word "enhancement." For example, when we "enhance the clear zone," what we really mean is that we are removing all of the trees within a certain distance of the roadway edge. This may indeed be an enhancement to the person wanting to drive quickly through that area, but it may also be a huge diminishment for the person who uses those trees as a sound and visual buffer between their home and the traffic. Why don't we just say, "remove the trees"?

I think the reason is abundantly clear. For the design professional with speed of travel as the highest value, removing the trees from alongside the road is an enhancement. It allows traffic to move at higher speeds. In the eyes of the traffic engineer, "remove the trees" focuses on a negative, and "enhance the clear zone" focuses on a positive, all while being an equally valid yet still value-free, description.

Even deeply technical terms like "Level of Service" are projections of the underlying value system. When evaluating the performance of a street using Level of Service, the traffic engineer will consider how well things are operating from the perspective of the driver. The street is then given a grade, like an academic course, with A being the best and F signifying failure. Level of Service A means that traffic flows freely with no hindrance, while Level of Service F merely means that travel time for the driver is not predictable.

Never mind that Level of Service A is often horrific for people trying to cross a street on foot. And never mind that a high level of service generally means a lower level of financial productivity for the community (higher costs, lower financial return), especially on local streets.[4] For the engineer who values traffic speed above all else, there is no conflict in using this grading system to prioritize "improvements."

When engineers do not recognize their own values and how they are being projected in the words they use, we must do that for them by correcting their language to remove the bias.

Understanding the Bias

One of my colleagues who has repeatedly done that is Ian Lockwood. Ian is a transportation engineer with Toole Design, one of the country's leading engineering firms working outside of the current transportation paradigm. His work on changing the language within the profession has inspired and informed me and many others. In a 2017 essay for the *ITE Journal*, he wrote:

> The field of transportation engineering and planning has its own biased language. Much of the technical vocabulary regarding transportation and traffic engineering was developed between 1910 and 1965. The foreword of the Highway Capacity Manual, first published in 1965, states, "Knowledgeable professionals, acting in concert, have provided the value judgements needed to. . .and have established the common vocabulary. . ."

> Notice the acknowledgment of making "value judgments" and the purposeful development of a "common vocabulary." The period prior to 1965 was the golden age of the automobile in the United States. Automobiles were equated to freedom, mobility, and success. Accommodating automobiles at high speeds became a major priority in society and, thus, a major priority for the transportation engineering profession. It is no coincidence that these values were built into the transportation vocabulary.[5]

While civil engineering itself is one of the oldest professions, with techniques and insights dating back thousands of years, the subspecialty of traffic engineering is very young. Some of its earliest practitioners are still alive today. This was an entirely new pursuit, developed on the fly, in a period of tumultuous change.

Coming out of the Great Depression and World War II, the United States desperately needed a program that would keep the economy going. While the war had created jobs and economic output, demobilization threatened to shift the economy right back into depression. The redirection of American industry and capital from war-making into suburbanization created a kinetic growth machine that fueled a postwar boom.

We built a new version of America, one centered around the automobile, transforming an entire continent in a generation. Traffic engineers were tasked with making transportation in this newly imagined approach work. To do that, they needed to standardize nearly every component of this system so that it could be recreated, at scale and with urgency, across a vast continent. It is difficult to overstate how monumental an undertaking this was, nor how astounding their success was in accomplishing it.

In those early days, significant gain in travel speed could be achieved merely by improving driving surfaces and roadway conditions. With new highways connecting distant places, an increase in speed also meant an increase in overall mobility; people could reach more places with the same amount of time investment. Distances previously unheard of were now being routinely traveled by millions of Americans. Under these conditions, focusing on increasing speed was an easy proxy for increasing mobility.

In the decades immediately after World War II, increased mobility was driving economic growth. Whether it was families living in new housing in the suburbs, the ability of employees to switch jobs more easily, or the capacity for farmers, loggers, and miners to get their materials to distant markets, the fact that Americans could reach more places in less time provided accelerating levels of prosperity.

This notion became a self-evident truth embedded within the traffic engineering profession. Out of it sprung many beliefs that are now orthodoxy. These include the following:

- Faster speeds are better than slower speeds.
- Access to distant locations by automobile is more important than access to local destinations by walking or biking.
- Accommodating a full range of movement for large vehicles is more important than minimizing construction costs and increasing safety for people walking.
- At intersections, minimizing delay for automobile traffic is more important than minimizing delay for people walking or biking.
- Economic growth is a greater priority than community wealth preservation or financial productivity.

Today, the American transportation system is fully mature. We finished building the interstate system over four decades ago. The easy mobility gains have long been tapped. We are now left almost exclusively with expensive modifications that provide comparably modest changes in travel time, a theoretical benefit that is quickly denuded by shifting traffic patterns. To the extent that it once was, designing for speed is no longer a proxy for increasing mobility.

Yet these core insights of the early profession persist. State Street was designed for speeds far in excess of what is even legal there. The entire street is built to favor commuters driving into Springfield from distant locations in the morning and departing in the opposite direction at the end of the workday, prejudicing the person who lives close to the downtown and commutes on foot in the process. This is not only dangerous, but it has also had a disastrous impact on property values within the core of the city.

The lane widths, recovery areas, and turning radii at the intersections are designed for the ease of large vehicles, even though they are infrequent, and even though this design makes State Street more dangerous for drivers at nonpeak times, and more dangerous at all times for people walking and biking. Each intersection where assistance to cross the street is provided, the burden of delay is shifted away from the driver on State Street and to the person walking, even at the hour when Sagrario Gonzalez was making her decision on where to cross.

We cannot in good conscience blame Sagrario Gonzalez for the tragedy that occurred on State Street. She was navigating a space that

was, at best, indifferent to her and her children's safety. At worst, it was outright hostile. It remains that way to this day, as do most local streets in the United States.

We can be generous in our interpretation of history and thereby more understanding of how the traffic engineering profession came by its core set of values. Even so, these values must be acknowledged if only so that they can be consciously set aside in favor of a more modern and universal set of human values.

The Strong Towns Approach

Traffic engineers are a critical part of designing transportation systems, but the values of the public need to dominate decision-making. Value decisions need to be stripped out of the design process and given over to nonprofessionals, preferably elected officials and the people living within the community— those directly affected by the design.

Table 1.2 gives an example of who should make what kind of decision during a street design process.

Elected officials must be given the ability to set the values for the project. It is their responsibility, on behalf of the people they serve, to establish the automobile design speed, the number of vehicles that should be accommodated, the size of vehicle that should be considered in the design, and the degree of deference that should be shown to people walking or biking at a given intersection. These are not design decisions; they are value decisions.

We must also insist that engineers use value-free descriptions for the work they are doing. If they are proposing to widen the street, it should be called a "street widening" and not a "street improvement." If they are cutting down all of the trees adjacent to the street, it should be

Table 1.2 Who Makes the Decision?

Nonprofessionals	Technical Professionals
Design Speed	Pavement Thickness
Design Volume	Pavement Cross Slope
Design Vehicle Size	Lane Width
Intersection Priority	Bituminous Mixture

called "tree removal" and not brought forth as an "enhancement." The goal for everyone is to communicate as clearly, factually, and value-free as possible. Elected officials must insist on this.

The burden and responsibility of making value decisions should not rest with technical professionals. Traffic engineers are incapable of representing the complexity of human experience that needs to be considered in a street design. That is especially true when industry orthodoxy is adhered to. This is not so much a statement on the engineering profession as it is an acknowledgment that city streets are the frameworks of human habitat, a complex-adaptive environment that must harmonize many competing interests.

As I will demonstrate in upcoming chapters, if we align the design approach with the values of the community, we can reduce death, create places of greater prosperity, spend less money on transportation, and get a better functioning system. We can do all of this, but only if we address the underlying values of the design process. To build a strong and prosperous community, local leaders must assert their community's values and see them reflected in the transportation system.

State Street in Springfield is designed with the wrong values. Its purpose is to move a high volume of automobiles at speeds much higher than what is safe for that area. Instead, it should be redesigned to prioritize safety. The value decisions for State Street were made without presenting the value options to elected officials, let alone the community at large. Both almost certainly have different priorities.

More information on State Street in Springfield, including maps, photos, and supporting documentation, is available at www.confessions.engineer.

Notes

1. This will be discussed in greater detail in Chapter 7, "Intersections and Traffic Flow."
2. There is way more to a street than moving traffic. We'll discuss this more in Chapter 5, "Great Streets."
3. See the Introduction for more on this video.
4. More on this in Chapter 5.
5. *ITE Journal*, January 2017. https://tooledesign.com/wp-content/uploads/2019/02/ite_language_reform-by-ian-lockwood-pdf.pdf

The Difference Between a Road and a Street

The following words and phrases, when used in this Manual, shall have the following meanings: 225. Street — See Highway

— Manual on Uniform Traffic Control Devices[1]

Destiny Gonzalez was killed on State Street. There are many reasons we call it a "street" instead of something else. Likely, that is the name given to it in the original plat: the initial layout and design of the city of Springfield. That would make the designation of "street" a tradition more than anything else.

Some communities use "street" for places that are more residential — or less residential. It is often used in parts of the community that are designed with a network of grids, although not always. When used in places that also use terms like *lane*, *access*, *boulevard*, or *drive*, it might just be a random choice. For State Street, it could also be a preference for alliteration.

What is not often seen is calling something in the center of town a "road." I am not saying that it never happens, but when one thinks of a road, it is often in the context of the "open road," the conjecture of a more expansive kind of space.

Before I became a civil engineer, this is how I understood things: Streets were in the city and roads were outside them. I grew up on a farm, so we lived on Mapleton Road. My grandmother lived in town on I Street NE. It seemed clear to me that roads were rural and streets were urban.

Clear, until I began designing transportation systems.

Hierarchical Networks

Traffic engineers and transportation planners classify streets and roads according to their status in a hierarchy. Classification is determined based on how much traffic the street or road handles, or how much it is expected to handle.

The smallest of these with the least amount of traffic are called "locals." They provide access to "collectors," which collect traffic and funnel it to "arterials." Sometimes a community will have "major arterials," which is another step up the ladder of intensity. Theoretically, these different streets form a cascading system with many small streets emptying into fewer large streets.

- Locals
- Collectors
- Arterials
- Major Arterials

There is an obvious tradeoff in this hierarchy between what engineers call "mobility" and what they refer to as "access." Consider a cul-de-sac, the ultimate local street. A cul-de-sac provides plenty of access to the properties along it, but it does not provide much in the way of mobility. It is a dead-end street that is not expected to handle many vehicles. In contrast, an interstate is the ultimate major arterial, providing lots of capacity for vehicles to move at high speeds but with limited access to adjacent property.

With these two as the extreme endpoints, a standard classification analysis gently blends the tradeoff between mobility and access as we move from cul-de-sac to interstate. We can impair the mobility of the interstate to provide a bit of access, and we can give up some local access on the cul-de-sac to improve our mobility. This is a simple and comfortable relationship best represented in Figure 2.1.

The relationship in Figure 2.1 is firmly grounded in the profession's priority values of speed and volume. Note the apparent happy compromise in the middle where we can have our transportation cake and eat it, too. Those are the collectors, where there is a lot of access but still plenty of mobility. At least, that is the way a transportation planner might explain it.

Another way is to note that collectors combine high travel speed with complexity. Collectors facilitate the flow of traffic at speeds above what is safe for a local street with a lot of access, yet they provide just enough access to ensure that there will be random starts and stops, turning movements, and people walking around outside of a vehicle. High speeds combined with complexity create environments that are extremely dangerous.

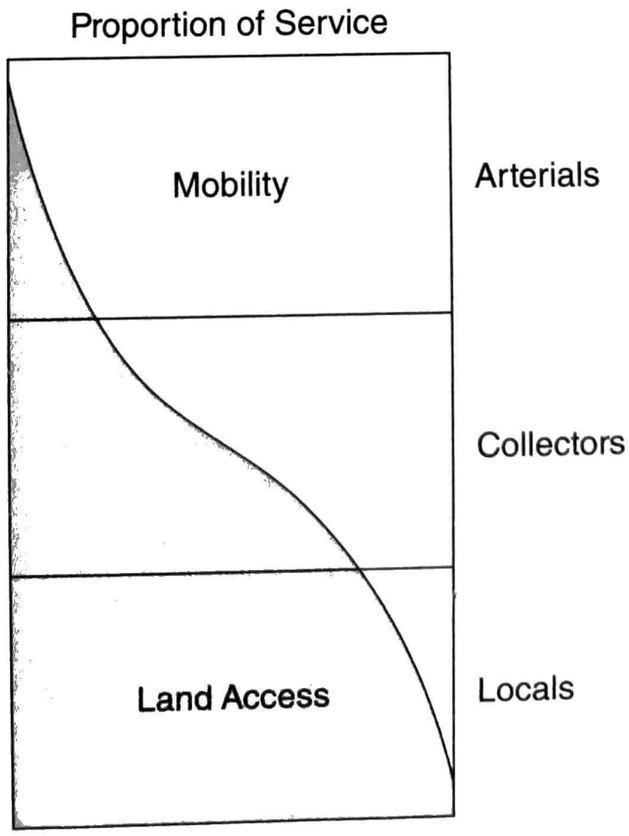

Figure 2.1 Relationship of functionally classified systems in serving traffic mobility and land access.

It would be dangerous enough if State Street were designated a Collector. State Street, which runs through the heart of Springfield, is actually a Principal Arterial, a designation often used for highways.

Roads and Streets

The embedded values of the engineering profession prioritize speed and volume in order to maximize mobility, with the belief that increasing mobility is the ultimate good provided by a transportation system. Discarding these antiquated values also allows one to move beyond the hierarchical classification system to one that creates greater value for a local community.

The starting point is the pre-automobile understanding of the difference between a road and a street.

Road: A high-speed connection between two places
Street: A platform for building community wealth

Think of a modern road as a replacement of the railroad, which, as its name suggests, is a road on rails. A railroad does not have frontage railroads or drive-through railroads. That would obviously be silly. For a railroad, a passenger gets on at one place and off at another, with the road providing a high-speed connection between those two places.

A road creates the greatest value by providing the fastest connection between two places that people want to be. This is done by limiting things that slow down traffic along the road. For a railroad, that means reducing the number of stops, the amount of merging traffic, and congestion along the route. For automobile roads, the concept is the same. The higher the sustained speed, the lower the travel time and the greater the value provided by the road.

While roads connect places, streets are the framework for building a place. Streets provide the greatest value when they create places that people want to be. When people choose to buy land, build something on it, and then maintain and improve what is built over time, they are building measurable wealth within the community. The most accurate measurement for the value of a street is the financial productivity of the land adjacent to it — how much value is created per acre of land that abuts the street?

The tension between achieving mobility and providing access in the current model is rightly replaced with the tension of either building a productive place or connecting productive places. This is a financial constraint more than anything else because the wealth created on the community's framework of streets is what must be tapped to pay for building and maintaining both the streets and the roads.

A railroad, again, is the easiest way to think of this system. During westward expansion, major railroad companies established cities along their train routes. They would do minimal development work to establish the community, mostly laying out the network of streets and establishing lots along them. The railroad company would then sell the lots to pioneers, builders, and speculators, who would pay a premium because of the presence of the railroad and the exclusiveness of being located near one of the stops. The profit from improving the land is what the railroad company used to cover the cost of the rail line.

Without a road, a network of streets will have no value. They will not build any real wealth. A city needs connections to other places for the streets to sustain anything beyond a village level of development intensity. The better these connections, the more value they will provide to these places and the more investment the community will attract and retain.

Similarly, a road that fails to connect places to each other is worthless. A circular train that connects back to itself but does not stop anywhere is merely an exercise in frivolity. Connecting one place to another is the minimum threshold a road must meet to be truly viable. That viability, however, will ultimately manifest, and be measured by, the wealth created in the places that it connects.

Roads and streets are yin and yang for city building. They are at cross purposes and antithetical to each other, but both are necessary for ultimate success. We must have great roads that provide high-speed connections between productive places, places that build wealth and prosperity. We must also have great streets that produce enough wealth not only to sustain themselves, but also to fund a proportionate share of the roads that connect them to other productive places.

Degrading roads to make them more street-like, or degrading streets to make them more road-like, reduces the overall value provided by the transportation system.

Thinking of roads and streets in terms of the value they provide, the functional classification chart in Figure 2.1 should be replaced

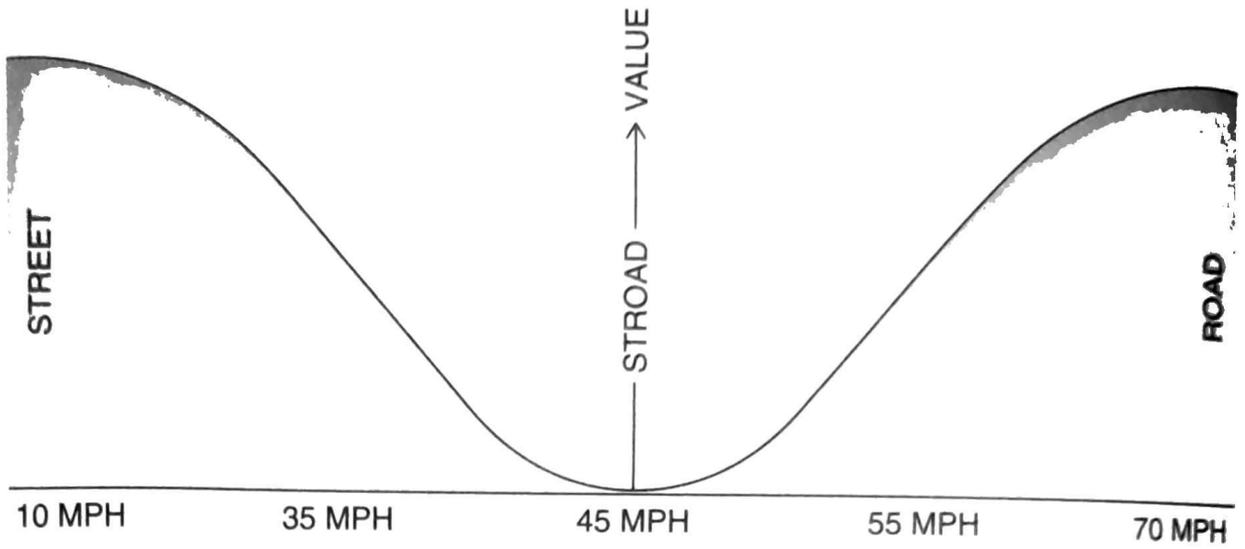

Figure 2.2 Which transportation investment provides the most value?

with the chart shown in Figure 2.2. The chart provided in Figure 2.2 places speed along the horizontal axis and value along the vertical, answering the question: Where do transportation investments provide the most value?

The greatest value is provided where speeds are very low (street) and where they are very high (road). We get the most value from our transportation investments when they are used as the framework for building a productive place, or when they are used to move quickly between productive places. The further an investment strays from these objectives, the less value it provides.

There is a large amount of space in the middle of this chart where increasing speeds reduces value. Once speeds exceed 15 or 20 miles per hour, traffic is moving too quickly for a place to really thrive. Value does not start to be created again until speeds get up above 55 miles per hour; the point where the transportation investment is providing a meaningful level of mobility.

State Street exists in that middle space, as does nearly all of what has been built on the North American continent over the past century. In the classification system of the engineering profession, these are generally called collectors or arterials. I have taken to calling them stroads.

The Stroad

A *stroad* is a street/road hybrid. It is the futon of the transportation system. A futon is an uncomfortable couch that converts into an

uncomfortable bed, something that performs two functions but does neither well. A stroad tries to be both street and road, providing both mobility and access, yet fails miserably at both.

If you are traveling in an automobile faster than 20 miles per hour, but slower than 55 miles per hour, you are most likely traveling on a stroad. Stroads have the wide driving lanes, turning lanes, recovery areas, and other features used to facilitate high speeds on roads. Despite this large investment in asphalt, concrete, steel, and land, nobody is legally allowed to move fast along a stroad. They are typically designated for speeds between 30 and 45 miles per hour, with frequent traffic signals that inflate travel times by stopping traffic entirely.

A stroad also tries to function like a street and provide a platform for building wealth. By providing access to homes and businesses, a stroad creates an environment where individuals and the community make investments in property with the expectation of a return. Yet, because of the speeds, development on a stroad tends to be spread out, which increases the cost of infrastructure and other public services and decreases overall financial productivity. I will discuss the dynamics of financial productivity for a street in more detail in Chapter 6, "Traffic Congestion."

Stroads squander community wealth. They are significantly more expensive to build than a street. For the level of investment, they have a comparably poor financial return and fail to provide a meaningful level of mobility. Yet, the financial impact is far from the only price paid for building stroads.

Stroads are the most dangerous environment we routinely build in our cities. If we applied a fraction of the level of scrutiny to their design that we have to the design of such items as baby carriers, lawn mowers, or beach toys, we would have made radical reforms decades ago. Thousands of people die each year on stroads, with countless more maimed and permanently injured. This happens for reasons that are not difficult to discern.

Stroads facilitate traffic speeds that ensure a high frequency of violent collisions. A collision with a change in speed of 30 miles per hour can result in a severe traumatic brain injury for the driver or passengers, an AIS-4 on the Abbreviated Injury Scale.[2]

For people outside a vehicle, the average risk of severe bodily injury (AIS-4) jumps from 50 percent at just 31 miles per hour to 75 percent at 39 miles per hour. The average risk of death for a person outside a vehicle jumps from 10 percent at an impact speed of 23 miles per hour, to 25 percent at 32 miles per hour and 50 percent at 42 miles

per hour.[3] Obviously, age and health impact an individual's chances of survival, but horrible injury and death are common at speeds that are routine for stroad environments.

On roads the speeds are much greater, but they are achieved in a simplified environment that generously corrects for routine human errors (see Chapter 3, "Whose Mistakes Do We Forgive?"). In contrast, stroad environments have all of the complexity of streets. There are vehicles randomly stopping. There is cross traffic. There are vehicles that make 90-degree turning movements. There are vehicles randomly entering the flow of traffic and there are others that are randomly exiting it.

In auto-based transportation systems, randomness is the enemy of safety, especially as speeds increase. With hundreds of millions of people driving through stroads each day, some of the randomness results in high-speed collisions between two or more vehicles, or between a vehicle and a person outside of a vehicle. The complexity of the stroad environment makes this kind of tragedy inevitable.

For people walking, biking, or using a wheelchair within the stroad environment, the risks are even greater. A person on a sidewalk has no defense at all if a vehicle leaves the roadway at stroad speeds. The person crossing the stroad is even more exposed and vulnerable. That is true even when they cross at designated places and at specified times.

Stroads magnify that vulnerability by making it necessary, yet difficult, to cross. When Sagrario Gonzalez left the library on the evening of December 3, 2014, it was necessary for her to cross the stroad in front of her. Her car was parked where it was supposed to be, in the designated library parking lot on the opposite side of State Street.

While State Street is a street, it is not designed like one. It is also not designed to be a road. State Street is a stroad, so it is designed primarily to facilitate traffic flow at high speeds during peak times while also providing a modest framework for places like the library to exist.

This means that there were four wide lanes to cross with no sanctuary anywhere in the middle. It also means that the traffic signals, the only place where Gonzalez could have crossed with some assistance, are spaced out and timed to keep traffic moving. All of this makes a simple thing like walking to the car frustratingly difficult.

The irony is that stroads are frustrating for everyone, including drivers. Someone driving a stroad is continually presented with mixed messages. The wide and forgiving scale of the design is throttled back

artificially by speed limits and signalized intersections. The turn lanes and wide curb radii make movement easy, yet getting from one building to another often requires lengthy detours, U-turns, and delays. There is a veneer of safety that comes from having plenty of margin for error built into the design, but the complexity of the environment creates an underlying tension that randomly disrupts the comfort.

While engineers have tried, it is impossible to make a stroad safe. State Street in Springfield has one of the highest crash rates in the state of Massachusetts.[4] The only way to improve safety on a stroad is to convert it into a street or a road.

Stroad Conversion

In the years following the death of Destiny Gonzalez, there have been other collisions and near-collisions in the same location on State Street. In response, neighborhood activists in Springfield requested that the city install a flashing crosswalk system, one that a person walking could activate to alert drivers that someone is crossing. I am not in favor of this approach as anything more than a temporary measure. While it may improve things somewhat, it reinforces the underlying danger created by the stroad.

To fix a stroad, there needs to be a decision on whether it should be a street or a road. Do we want this section to be about moving vehicles quickly from one place to another (road) or are we trying to build wealth and productivity within a place (street)? To get out of the stroad zone, we need to improve safety by either increasing or decreasing speed — by changing the design to function as either a street or a road.

State Street should not be converted to a road, but consider what would need to happen if that were the decision. To go from stroad to road, the first thing to be done is to remove access to State Street. That means closing all of the cross streets, dead-ending them before they reach State Street. That would reduce or even eliminate the need for signals because there would be no cross traffic.

All of the entrances to parking lots and drive-throughs that accessed State Street would also need to be closed. There could be no parking along the road, either, because that would create random start-stop conditions as people back in or pull out of open spaces, a condition that would be extremely dangerous at roadway speeds.

To make State Street a proper road, the sidewalks will need to be removed or, at the very least, a physical barrier would need to be erected between the traveled roadway and any space where people are expected to be present outside of a vehicle. There is no way to build safe space where humans are standing, completely unprotected, just feet away from tons of steel being propelled down the road at lethal speeds. The physics of this are not possible.

To protect the roadway investment, the city of Springfield would need to use their planning and zoning authority to regulate building along the corridor. Any new development should not undermine the roadway investment or degrade its capacity to move vehicles quickly from one place to another. Anything built along State Street would need to be accessible from some other side street, alley, or property.

Converting a stroad to a road is a process of simplification. Removing elements of complexity improves safety, allows higher travel speeds, and improves financial productivity by allowing the road to function as a high-speed connection between places. Every American city has miles of stroads that should be converted into roads.

State Street, especially in the vicinity of the Central Library, is not one of them. This is the core of Springfield. The library is surrounded by blocks of homes, businesses, and civic buildings. This is a *place* — the exact thing a framework of streets is trying to improve to grow the community's wealth.

The stroad that is State Street is undermining that wealth, not least by making the area around the library extremely dangerous. To convert State Street from a stroad to a street, the travel speed of the street needs to be reduced to compensate for the complexity of the environment. That means a human speed — something close to 15 and no more than 20 miles per hour.

The design needs to shift to prioritize people walking, those in wheelchairs, and others who are not within a vehicle. This means traffic passing through becomes a lower priority. That will change the emphasis of intersection design, walkway widths, the placement of trees and vegetation, and any number of other design items necessary to enhance the experience of being in that place.

Since the purpose of the street is to build the community's wealth, the city of Springfield will need to use its community development tools to facilitate investment in the neighborhoods around State Street. The objective is to continually improve the wealth there, a condition

closely correlated with the value of the underlying land. As that land value increases, as the place becomes more valuable, a natural redevelopment pressure emerges that attracts investment and generates leaps in financial productivity.

This is an exercise in adding complexity, something I discussed at length in my book *Strong Towns: A Bottom-Up Revolution to Rebuild American Prosperity* (Wiley, 2019). Allowing neighborhoods to respond, incrementally, to stress and opportunity is the path to building broad-based, long-term strength and prosperity. Here's what I wrote in Chapter 8 of *Strong Towns*, "Making Strong Investments":

> To remove as many distortions as possible, to give neighborhoods a chance to evolve, to build wealth in neighborhoods that is not merely transactional but reflected in the net worth of the people living there, cities must allow, by right, the next increment of intensity throughout all neighborhoods, and they must limit by-right development to only the next increment.
>
> The goal is to thicken up neighborhoods, to create feedback loops that allow emergent prosperity to build on itself. No neighborhood can be exempt from change, but no neighborhood should experience radical change all at once. This is the prudent discipline we must impose on ourselves.
>
> Complex systems overwhelmed with resources stop behaving in complex ways. They become merely complicated, losing the feedback mechanisms that drive adaptation. The temptation to work only in bold ways, to embrace instant and comprehensive transformation as a strategy, guarantees eventual atrophy and decline. If our cities are to be truly strong, they must resist the easy path and dedicate themselves to the work.
>
> Cities can and should grow rapidly where that option is available to them, but that growth needs to be one step at a time, not huge leaps in the dark.

The environment around State Street is perfectly situated for such a bottom-up revolution. The buildings are underutilized and atrophied, but quite salvageable. The population trends toward impoverished, but with a high capacity for ingenuity and entrepreneurship. By making State Street a street for the people of Springfield instead of a stroad for commuters, the city can unleash the productive capacity of its citizens and build a prosperous place.

Whether street or road, the city must abandon the stroad approach on State Street and throughout the community. The hierarchical classification system needs to be retired and replaced with an updated understanding of how to make productive transportation investments, as illustrated in Table 2.1.

Table 2.1 Stroad Conversion

Stroad to Street	Stroad to Road
Slow traffic	Limit access
Prioritize people over throughput	Prioritize throughput over access
Build a productive place	Connect productive places
Embrace complexity	Embrace simplicity

Note that the decision on whether a transportation investment is a street or a road is not a technical one. It requires knowledge of the community's goals and objectives, but no technical expertise regarding engineering or design. This is a decision that must be made by an elected body — one directly accountable to the people of the community. It should never be made by technical professionals.

If we leave this decision to traffic engineers and transportation planners, the result will almost certainly reflect the embedded values of their professions. An emphasis on speed and volume creates trade-offs between mobility and access, a tension that technical professionals inherently address by prioritizing speed. It does not take much in terms of added speed to make a street into a dangerous and unproductive stroad.

If State Street were designed to be a street and not a stroad, it is very likely that Destiny Gonzalez would still be alive.

Productive Stroads

I started to develop my understanding of the difference between a street and a road as a teenager visiting Disneyworld. The theme parks and resorts are fantastic places. People pay thousands of dollars to spend time in them. If you stay in one of their resorts, you can walk to everything you want or need, including shops, restaurants, and recreation. The attention to detail in designing those human spaces impressed me as a young man and continues to do so today. These are great places that create enormous wealth for the Walt Disney Corporation.

If you are in Disneyworld in one place and want to visit another place — say a theme park, one of their shopping districts, or another resort — you can quickly drive there on roads that are unencumbered

by excessive amounts of traffic, despite the incredible number of people being transported on them. Part of this is because there are almost no stops along the way. All of the complexity has been removed and what is left is high speed and simple to navigate.

Another reason for the productivity of the roads is that most people do not drive but instead take another form of transit. This could be a bus, monorail, boat, or even an aerial gondola. These systems carry huge numbers of people between productive places, quickly and efficiently, where those people then exit the transportation system and immerse themselves in their place of destination. It is not lost on me that the most successful pre-automobile cities were built in this way, with the roads connecting them being waterways and railroad lines.

It was on my first trip to Paris in 2001 that I experienced a different kind of stroad than what I had come to know from living in North America. One of the most iconic streets in the world, the Avenue des Champs-Élysées, was a stroad back then. It combined the function of both street and road, building wealth and moving traffic, but it did both exceptionally well. The Champs-Élysées is one of the wealthiest and most exclusive streets in all the world.

This productive stroad trick was accomplished with what an engineer would call a slip lane. The outside lanes of the Champs-Élysées, those closest to the buildings, were designed to be streets. There were slow speeds, parking, street trees, and an emphasis on people. In fact, people walked back and forth across these lanes all the time, an indication to me that Parisians and the tourists flooding their city felt secure in this space.

The middle lanes of the Champs-Élysées, the road portion of the stroad, were separated from the slip lanes by wide, tree-lined boulevards. There was physical separation between the street portion and the road portion. This allowed the traffic in the middle to operate safely at relatively higher speeds. (The Champs-Élysées was no highway, but it would not surprise me if traffic safely reached speeds of 45 miles per hour on the road portion.)

The ability to cross the Champs-Élysées was the only real impairment, something for which long delays in signal timing could somewhat compensate. When it was time for people to walk across, they were given a fairly long time to make that crossing. When it was time for drivers to operate their vehicles, they were likewise given a long turn at dominating the space. I was deeply impressed.

Years later, I visited the great incremental developer R. John Anderson when he was living in Chico, California. There he introduced me to the Esplanade, a two-mile stroad through a gorgeous neighborhood. It was a more modest version of the Champs-Élysées, with the interior road lanes physically separated from the street slip lanes by a tree-lined boulevard. The neighborhood along the Esplanade is a great place that makes for pleasant walking, a fact reflected in the high property values.

Five blocks east is Mangrove Avenue, a nasty stroad that runs parallel to the Esplanade. Mangrove Avenue has the gas stations, strip malls, and other auto-oriented businesses typical of American strip development, a style not only less productive financially but far more fragile than that found along the Esplanade. In 2018, both stroads accommodated around 22,000 vehicles a day, despite the radically different design and outlook.

The Champs-Élysées and the Esplanade are exceptions to the norm, but I include them here because they are not only good models to understand, they reinforce the notion that the critical tradeoff is not between access and mobility but between street and road, between building a place and traveling between places.

Incidentally, I had the opportunity to visit Paris again in 2019. This time my wife and I were joined by our daughters. In a way that I am sure is doing long-term psychological damage to my children, I was excited to show them the layout and design of Paris, including the slip lanes along the Champs-Élysées. After building them up to my family and eagerly anticipating them myself, I could not find them anywhere. They were gone.

All the street space that was formerly used for parking and slow-speed driving has now been given over to people on foot. Parisians have wisely decided that the area surrounding the Champs-Élysées is far more valuable when a high number of people can access it on foot, as opposed a lesser number of people accessing it by automobile. Successful experiments in limiting or banning automobiles in parts of the core of Paris are extensions of this realization. The Champs-Élysées is no longer a stroad.

The idea of banning automobiles today on State Street in Springfield is an absurdity, as it is for almost all stroads within North American cities. Our neighborhoods are simply not valuable enough

as places either to warrant or sustain themselves without some automobile access. Yet achieving that level of wealth and productivity must be the goal.

Building great roads and productive streets is ultimately about making the places we inhabit so prosperous, so productive, so valuable, and so inviting that they transcend the need to accommodate the automobile.

The Walt Disney Corporation would never make Cinderella's castle in the Magic Kingdom accessible by car. Whatever added value there is from being able to drive right up to the castle would be dwarfed by the lost value from individual automobiles diminishing the overall experience of the park itself. The park is such a valuable place, the streets within it have created such wealth, that it only needs roads to connect it to other places to thrive.

Springfield is not a theme park. It is a city where people live, work, and occasionally take their kids to the library. The automobile is going to be a reality along State Street for years, likely decades, to come. A reality, but not the goal.

The goal must be to turn the stroad of State Street into a wealth-producing street. That will require a shift in emphasis from moving traffic to building a productive place — one focused on the needs and experiences of the people who live there.

The Strong Towns Approach

Roads are high-speed connections between productive places. Streets are platforms for building wealth within a place. The greatest value in a transportation system is provided when building roads or streets.

A stroad is a street–road hybrid. It contains the elements of both road and street but fails to provide the benefits of either. Stroads are expensive to build and maintain and have low financial productivity. The complexity of the stroad environment combines with high traffic speeds to create environments that are extremely dangerous.

Cities must discard the hierarchical transportation networks and instead identify their streets and their roads. Where hierarchical classification is required for federal or state funding, it should be considered advisory and subordinate to a transportation map that identifies roads and streets within the community.

The decision on whether a transportation investment is a road or a street is a policy decision requiring no technical expertise. That decision must be made by elected officials, individuals who are accountable to the citizens of a community. It should not be made by technical professionals.

More information on streets, roads, and stroads is available at www.confessions.engineer.

Notes

1. https://www.mutcd.fhwa/dot.gov/htm/2009/part1a.htm
2. Nordhoff, Larry S. (2005). *Motor Vehicle Collision Injuries: Biomechanics, Diagnosis, and Management* (Burlington, MA: Jones & Bartlett Learning), page 53.
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