

ONE

CROSSING THE BRIDGE BEFORE WE GET THERE

To have the kind of life we live in the United States and other advanced economies, where we enjoy freedom through mobility, which in turn fosters commerce, and where the built environment is safe for people, we depend on infrastructure. But it is a dependence about which we are largely unaware. Roads, water systems, ports, dams, electrical grids, and other physical public works function quietly in the background. They rarely attract attention because by and large they operate well.

Among the many systems in which we live from health care to finance, and among our daily worries from love to politics, public works provide some of our sturdiest and most reliable support. Love proves fleeting and papyrus turn brittle, but Roman aqueducts still carry water and the US interstate system, like it or not, will dominate our landscape for a long time yet.

Disconcertingly to us, your authors, infrastructure may even seem boring. Streets and water pipes don't get to be national idols, don't have new upgrades released each year, can't be downloaded from your browser, and, when they're doing what they're supposed to, don't cause news. The infrastructure system's quiet dependability lets us forget what an enormous and complex technological achievement it is. Yet, on those who care to pay attention, it can exert a special fascination. In this book, we talk about one of these types of public works, the bridge. Why bridges?

The answer is in part personal: we like them, and one of us, George, has spent a large part of his career researching and teaching about bridges. More to the point, among types of infrastructure, bridges are the kind for which many people most easily acquire affection, and for good reason, though it is hard to express it. There is something stately about them.

Roads hug the earth's surface. Pipelines and tunnels burrow underneath it. But bridges soar through the air, without ever really leaving the ground. On beholders they make a distinct impression. Unlike buildings, which are more numerous but clad with outer surfaces that usually keep the underlying structure hidden, bridges reveal the structural principles that keep them aloft. They are the most visible expressions of engineering as art, or of architecture as science. Some are gateways to regions, symbols for entire cities, and world-renowned monuments in their own right. Some bridges, like some violin concertos, have magnificence that cannot be expressed in words.

While many kinds of human contrivances mar the natural landscape, bridges—even ones that are not particularly famous—are likely to complement it. They provide sequentially shifting panoramas for those crossing them, dramatic objects for those observing them from a shore or embankment, and framed horizons for those looking through or past them. Bridges as structural art are to be appreciated in their own right, but also as environmental art: pieces of artifice that enhance awareness not just of the artwork itself but also of the hills, chasms, torrents, skylines, or forests among which they are situated.

Before they can be art, they are economic infrastructure. They are essential because we move around on the earth and the earth's surface is, fortunately, not a flat and solid expanse. It has gullies, rivers, valleys, hills, swamps, crags, coves, and cliffs that must be crossed if we're to get about. Since we build roads and railways, it is often also wise to make them leap over each other instead of intersecting.

To accomplish that crossing by which it becomes an economic asset, the bridge must first be designed and built as a physical structure—which now needs definition.

WHAT IS A BRIDGE?

In movies when a galloping cavalry reaches a river, the riders inevitably coax the horses to swim across, just their heads above water, even if their mounts are in full armor. This way of crossing the river works, we suspect, only in the movies. Moses developed the method of getting the waters to part, a procedure that is no longer recommended since too many regulatory approvals would be needed. A ferry may be pleasant, if the waves are not too choppy and the wait at the dock not too long. In a pinch, and in the absence of a ferry or rowboat, a brisk swim might do; a catapult is best declined, even in desperation.

A bridge differs from the other ways of getting across in that it is a fixed structure that affords passage across; but, as a tunnel does the same by a rather different route, we have to add that the bridge reaches across

by spanning a gap. By definition, then, a bridge is a structure that affords passage at a height across a gap. Let us now take the three pieces of the definition and consider them each, though in reverse order: the gap to be spanned, that which will make passage across it, and the structure that will support the passers' weight.

For the *gap* that the bridge crosses, a river most readily comes to mind, but it could just as well be a channel, lake, estuary, or the like. Or it may be a chasm, canyon, mining pit, ice crevice, or space between buildings. All these taken together still form a minority of the gaps that bridges cross. Many of the rest are the spaces between the raised sides of a roadway or railway. The curved ramp that raises or lowers traffic at highway interchanges is a bridge, too. So is the elevated highway, sometimes known as a viaduct, which spans the gap as it traverses a row of piers, sometimes casting its shadow over another highway running below.

That to which the bridge affords passage—well, it is people, vehicles, and the goods they carry, perhaps with livestock tagging along. Some bridges are solely for pedestrians and bicycles; a large number are for railways. In present-day America, that to which the bridge gives passage is overwhelmingly automobile traffic. Unless we specify otherwise, when we say “bridge” in this book, we mean one primarily meant to carry motorized road vehicles, though it may carry pedestrians and trains in addition.

The things that cross have weight and momentum. To afford them passage, the bridge must consist of an assembly of parts—a *structure*—that supports the forces acting on it. The structure must carry its own weight, stand up to the loads vehicles impart to it, and resist the forces of winds and waves and of the occasional errant barge that hits a pier. Those who would like to be informed about bridges should be able to understand the basics: the thinking by which engineers decide which kind of structure will safely carry the loads imposed on it.

THE BRIDGE DECISION

Even in a road transportation system as large as America's, we have far more bridges than most would guess, some 600,000 in fact. Every 500 or so Americans owns a bridge, or better put, each American owns a share in the nation's vast bridge portfolio. And that means many decisions have to be made about bridges, whether to build them, upgrade them, or close and replace them. At many places in America, every few years, citizens and their representatives, along with expert advisers, have to make such decisions.

We should pause, however, to consider whether it might be better to burrow underground to the other side than to span the gap above. It is rarely a good idea. Only in exceptional cases is a tunnel the right choice,

for the very practical reason that tunnels are costly. Boring through rock and soil is expensive to start with; the price quickly spikes if the tunnelers run into geological formations they did not expect, something that readily happens underground, where no one is likely to have been before. Tunneling is dangerous for workers, further raising costs. Some danger persists even once the tunnel is in regular operation, not because the tunnel is likely to collapse, but because tunnel accidents are hard to clear, and tunnel fires and chemical spills are eminently to be avoided.

On the plus side for the tunnel, it may take up less space at the entrances than a bridge would, and that is a benefit in places where real estate is expensive. Tunnels are also preferred where storms make surface construction dangerous or where passing ships are so tall that the bridge would have to have very high clearance. Then again, if the channel to be crossed is deep, the tunnel must run correspondingly deeper, requiring long approaches (cars cannot handle angles of descent and ascent that are too steep), so that the tunnel may well have to be longer than a bridge would. At almost all places where there is demand to cross, the right structure by which to get across is the bridge, and in any case it is only bridges we study here.

Now, getting back to the bridge decision, here are the typical options.

First, leave the old bridge alone, but increase maintenance, do some modest restoration, manage traffic better, and if possible persuade people to drive less. Second, reconstruct the bridge, by making structural improvements or expanding it. Third, if the bridge is too deficient, tear it down and replace it, though not in that order, since we need the old one to carry traffic until the replacement is finished. And fourth, the present bridges are fine, but demand has grown, so build a new one, adding to the region's collection of bridges. (If there is no present bridge, the choice is simpler, build or don't build.) Here are the choices once again: leave it and manage traffic, rehab or expand, demolish and replace, or build new.

Simple as the choices are to state, they are complex to make. They differ in important ways from other kinds of public policy decisions, though the differences are variations on a theme. All have to do with making early decisions.

Consider the annual town budget as a kind of public policy: if there is a shortfall, cut some programs or increase taxes. Skip to the local school district that's overenrolled: hire more teachers or maybe throw out some truants. Let's go to the bridge deemed dangerous from corrosion: now what? It takes years to build a new bridge. We have put this in a cavalier way, but the point is serious. When infrastructure has been poorly maintained for too long, or when traffic has built up too much, a patch-up here or there may work for a while, but the reckoning will come, and by then no quick

fix will be possible. Good infrastructure decisions should be made before they are urgently due.

What is more, a bridge is a capital investment. To decide to build or reconstruct means that funds have to be expended this year for an item meant to endure and provide service over decades. We incur a large debt now, though we may not live long enough to experience the benefits. Unlike most policy decisions, which are driven by short-term calculation and the election cycle, infrastructure decisions (though they have current political costs and payoffs) have to be made for the long run.

As compared to other public concerns, like declining exports or increasing influenza cases, infrastructure is different again, because the problems it causes can be anticipated way ahead of time. Infrastructure causes problems not because we're surprised by the unexpected (there are exceptions, of course), but because we've been ignoring the expected.

Since it is expensive and very time consuming to fix the bridge when it is in danger of collapse, we should definitely not—in answer to this chapter's question—wait until we get to it to cross it. On questions of infrastructure planning, we should cross that bridge years before we urgently must.

THIS BOOK

The book that follows is a primer on the considerations at work when we decide whether to build or rebuild a bridge. Since many of the considerations resemble those for other kinds of infrastructure, some readers may also find in this book an introduction to infrastructure decisions in general, with bridges as the running example.

Throughout, we want to share our affection for bridges, which are among the most worthy and loved items in the built environment. The basics of bridge engineering are accessible to anyone who has spent a year or two in college, even if their major had nothing to do with science. To the viewer equipped with those basics, the bridge reveals much more than is otherwise obvious. Some may even become appreciators of bridges, hobbyists of sorts, stopping now and then to gaze at a fine structure. A few, we hope, will take up careers in engineering, planning, or architecture. (But we do not say much about bridge architecture because on that subject, as contrasted to bridge engineering and planning, there are already many books accessible to beginners.)

If we have done our work well, our book should also make clear that a bridge is a product of many professions and multiple analyses: bridge engineering for sure, but also financial analysis, transportation planning, environmental studies, and public policy making. Our book introduces many of the kinds of planning at work. For citizens concerned about making better bridges in their own communities, we offer our book as a guide.

Readers should be aware that, here and there, we give our views, a few of them controversial, on the directions in which we think bridge building and infrastructure policy should go. Where we express opinions (informed ones, we believe), the reader will be able to detect that from the way we write. Our most forceful claim is for the millennial bridge—but let us not reveal too much yet. We invite readers to find out what we mean.

We begin in the next chapter by counting America's bridges. We also estimate the number of sites, in a year, for which decisions have to be made about new construction or rehabilitation.

Then four chapters that follow should be read in a row: they are our engineering chapters. Chapter 3 provides the basics on the forces that bridge spans must resist to stay aloft. The next (chapter 4) explains how basic principles guide the engineer to design the types of bridges all of us observe on our travels. Though bridges are remarkably safe, their design cannot be based on certainty. Chapter 5 introduces the ways in which engineers manage to keep bridges strong, despite uncertainties. The most serious uncertainties arise from the possibility of extreme events, such as floods and earthquakes. These are the greatest challenges to bridge safety, and chapter 6 illustrates the ways in which engineers and other professionals strive to meet them.

Our series of chapters on bridge planning begins with the question: is the bridge worth building in the first place? Chapter 7 seeks to answer the question by introducing cost-benefit analysis for a bridge. This and subsequent chapters can be read in any order. The next (chapter 8) is on transportation planning and uses an extended example to analyze whether traffic pressures justify a new bridge.

The bridge to be built or rebuilt may well raise possibilities of environmental harm. Chapter 9 explains the process by which environmental impact is assessed and asks what could be meant by a "sustainable bridge." In chapter 10, our series on bridge planning ends by investigating a sometimes intractable problem: why a project often creeps along for a decade or more to get from initial studies to the day the ribbon is cut. We conclude the book with what we have already hinted about, our appeal for you to join us in advocating for bridges that span a millennium.

TWO

COUNTING OUR BRIDGES

In this chapter, we ask the question: just how often must big decisions be made about bridges? And to what extent is the United States facing a need for new bridges, bridge reconstruction, and bridge rehabilitation?

The place to go for answers is the National Bridge Inventory (NBI), a database maintained by the Federal Highway Administration to keep tabs on bridge conditions in the states. It assembles data each year from reports submitted by state transportation departments. As infrastructure is long-lasting, the national inventory changes fairly slowly, so the 2011 data, which we are using here, should remain a good indicator for years to come.

The fact that first strikes the eye is that there are over 600,000 bridges in the fifty states plus the District of Columbia and Puerto Rico. This is not even a full count, since the NBI counts only public bridges and leaves out tens of thousands of privately owned railroad bridges. Of the total in the NBI, 98 percent are road bridges, primarily meant to carry automobiles, trucks, buses, etc., though some also have lanes for pedestrians and tracks for trains or subways.

We classified the bridges according to length of the main span, so we could begin assessing the nation's bridge infrastructure challenge. We wanted to know, for example, how many are long enough that they could not have been built—and cannot be rebuilt—simply as girder (or beam) bridges.

To qualify for our classification, the span had to be greater than 20 feet, which is a short starting point since a span of that length barely crosses two road lanes. A 20- to 99-foot main span we classified as “short.” If a bridge has a dozen spans, of which the single longest is 60 feet, then we still classified it as short-span even though the entire bridge is much longer. We classified a span of 100 to 329 feet as “medium,” and 330 and over as “long.” When a bridge exceeds 330 feet, it will almost always have to be

designed as a truss, arch, suspension, or cable-stayed bridge. (We explain these types in chapter 4.)

Of the nation's bridges that fit our criteria, just under 87 percent have main spans in the short range (table 2.1). Even these modest structures make important statements in the landscape. In many towns in America, a 50-foot bridge can be a matter of pride, a public-expenditure concern, and a traffic choke point.

To be sure, longer bridges are the ones that garner the most attention. Of all American bridges, about 13 percent are medium-span, and one-fifth of one percent are long-span. Those numbers aren't peanuts. Medium- and long-span bridges taken together still amount to 61,000 structures, and many of them become deficient or obsolescent each year, raising the specter of rather expensive corrective maintenance or reconstruction.

The bridges aren't equally distributed around the United States. Of the states, Texas has the most, followed by Ohio, with Hawaii and Delaware at the bottom of the list. Alaska ranks low because of vast areas without roads. Cities are more likely to have higher densities of bridges because many sit alongside bodies of water, and almost all are highway and railway hubs, so they need overpasses and underpasses.

Of the top metropolitan areas (by population), the broad New York metropolitan area comes in second in its bridge endowment, with 7,952 bridges. Surprisingly, Dallas-Fort Worth comes in first with 8,888 bridges.

The St. Louis metro area has the greatest concentration of bridges per capita, with 163 per 100,000 people. Pittsburgh barely earns its billing as the "City of Bridges," coming out second with 158 bridges per 100,000 people (table 2.2). Sadly, the Los Angeles metro area comes in quite low and may be said to be bridge-deprived. Bridge trivia this may be, but it also makes the point that some local governments face far more bridge decisions (relative to their population) than others.

Now we consider some of the basic reasons that people in an area might be confronted with bridge decisions.

Table 2.1. U.S. Bridges by Length of Main Span, 2011

<i>Short:</i> 20–99 ft	<i>Medium:</i> 100–329 ft	<i>Long:</i> 330 ft and longer	<i>Total</i>
397,494	60,016	1100	458,610*
86.7%	13.1%	0.2%	100%

Source: National Bridge Inventory (NBI).

*The NBI includes many bridges with main spans shorter than 20 feet. These we excluded from this table.

Table 2.2. Which metro areas have the most bridges? Ranked by bridges per 100,000 population, 2010

		# per 100,000 Pop.	Total bridges
1	St. Louis, MO-IL	163	4583
2	Pittsburgh, PA	158	3724
3	Cincinnati-Middletown, OH-KY-IN	146	3123
4	Dallas-Fort Worth-Arlington, TX	139	8888
5	Houston-Sugar Land-Baytown, TX	103	6145

Source: National Bridge Inventory

IS INFRASTRUCTURE AGING?

It requires little argument to win assent to the idea that the nation’s infrastructure is aging, since everything is aging, including your present authors. For bridges, the pertinent question is whether they are on the average getting older—whether at some time the United States reduced its construction of new or replacement bridges, allowing older bridges to increase as a proportion of all bridges. If so, we have to be concerned about our aging bridges.

We tapped into the NBI to find out. Our findings tell a story that’s more complicated than we expected. The number of bridges built shot up in the 1960s and has declined since then (figure 2.1). The declining number of

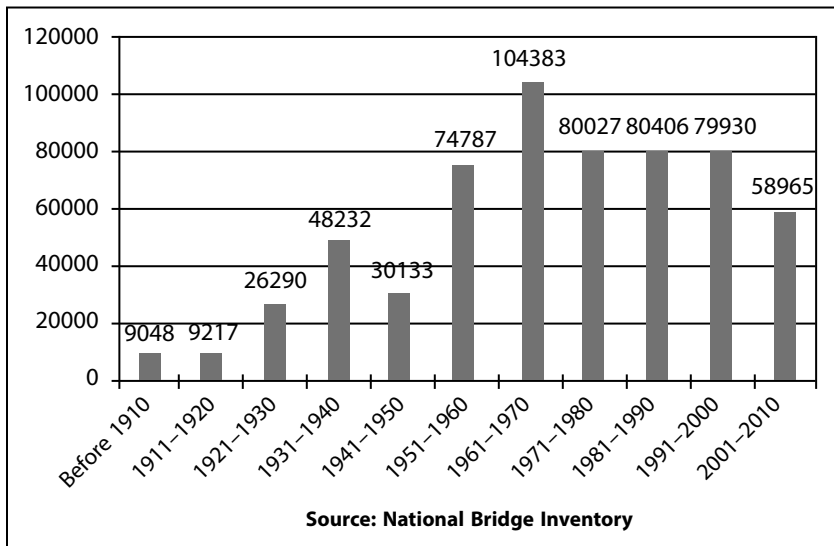


Figure 2.1. US Bridges in 2010 by Decade of Completion.

newly built bridges since the 1960s is not in itself a sign of neglect. Despite the decline in new completions, the bridge stock counted at (mostly) five-year intervals since 1992 (table 2.3) shows steady growth, with a small decline in the final half decade. The current stock of 605,086 represents over a three percent increase in just under twenty years. Some slowing in new bridge completions may be a good sign. It may well indicate that the nation's number of bridges simply has approached the saturation point—by the new century we had bridges at most of the places where we were ever likely to build.

So it's important to draw the right lesson here. The lesson is *not* that America has failed to build enough new bridges in the past three decades. Rather, it is that the spurt of bridge building in the 1960s and 1970s is coming due—these bridges are reaching an age at which they will pose ever more problems.

ARE BRIDGES DEFICIENT?

Old age is just a broad indicator that a bridge may require attention. Decisions on rehabilitation or replacement depend, of course, on actually observed problems. The NBI keeps track of problems, which it divides into two kinds, “structural deficiency” and “functional obsolescence.”

Let's start with the former. For each bridge in the inventory, a state official fills out a form that evaluates the structural condition of the bridge components on a nine-point scale, starting with 9 for excellent. A score of 4 denotes deterioration, such as pieces falling off the structure. Skipping 3, we get to a 2, which indicates deterioration so severe that, subject to close monitoring, the bridge may have to be closed. With a score of 1 the bridge is in imminent danger of failing, so it should be closed to traffic, but may still be repairable. At the bottom, a 0 means the bridge is out of service and cannot be fixed. A bridge with a rating of 4 or below is labeled structurally deficient.

The bridge may, however, be obsolete even if it is structurally sound. For a particular type of road (say an interstate highway) and for a particular daily traffic load, engineers can consult national guidelines to decide

Table 2.3. Public Bridges in the United States, 1992–2011

	1992	1997	2002	2007	2011
US stock of bridges	585,830	596,632	604,233	612,205	605,086

Source: National Bridge Inventory

whether the lanes are wide enough; bridges having lanes that are too narrow by modern standards are considered obsolete. If clearances underneath for road traffic are too low by modern standards; if emergency road shoulders are insufficient or nonexistent; or if the approach roads to the bridge are subject to flooding or have curvature that is too sharp—for any of these reasons, too, a bridge is considered functionally obsolete.

So how do American bridges stack up? In making a judgment, we have to keep in mind that the data is collected by state agencies, which are required to use the same data when asking for federal highway funds. Following NBI instructions, a state official would have to list a bridge as structurally deficient even if the defect does not pose a danger of collapse, or list a bridge with narrow lanes as obsolete even if daily users consider it to be just fine. Then again, some of the deficiencies can be serious indeed.

The result is that 11 percent are structurally deficient and 13 percent are obsolete. Altogether 24 percent of the nation's bridges have one shortcoming or the other or both (table 2.4). It's hard to know whether to read this result as good news or bad news.

The good news is that the percentage of deficient bridges has been declining (table 2.5). Structural deficiency has been dropping steadily from 20.7 percent of bridges in 1992 to 11.2 percent in 2011. Reasons may include increasing quality of the bridge stock brought about by new construction, and better maintenance and inspection. Over the same period, functional obsolescence has remained fairly steady, fluctuating at about 13 percent of bridges.

Despite improvements, 24 percent of bridges were still flawed in one way or another in 2011—that's almost 144,000 bridges! Now the bad news: the bridges built in the 1960s and 1970s are reaching an advanced age, suggesting an accelerating rate at which bridges will become deficient in the coming years (unless ever more is spent on keeping them in good repair).

IS TRAFFIC CONGESTION INCREASING?

A bridge may have to be upgraded or replaced, or an additional bridge may have to be built, for a reason other than deficiency: because it cannot serve the growing traffic pressure (i.e., it is functionally obsolete). Are

Table 2.4. Deficiency in Bridges, 2011

<i>Not Deficient</i>	<i>Structurally Deficient</i>	<i>Functionally Obsolete</i>	<i>Total</i>
461,197	67,526	76,363	605,086
76%	11%	13%	100%

Source: National Bridge Inventory

Table 2.5. Trends in Deficient Bridges

	1992	1997	2002	2007	2011
Number of bridges	572,196	582,751	591,220	599,766	605,086
Structurally Deficient	118,698 20.7%	98,475 16.9%	81,437 13.8%	72,524 12.1%	67,526 11.2%
Functionally Obsolete	80,392 14.0%	77,410 13.3%	81,573 13.8%	79,792 13.3%	76,363 12.6%
Not deficient	373,106 65.3%	406,866 69.8%	428,210 72.4%	447,450 74.6%	461,197 76.2%

Source: National Bridge Inventory

bridges facing increased demands to carry traffic? Though we do not have reliable measurements of traffic exactly at bridges, we do know that through 2007 urban areas were indeed undergoing increased traffic congestion. That observation comes from the *Urban Mobility Report*, a study prepared by the Texas Transportation Institute and published in July 2009. Before accepting the result, the attentive reader must ask what “congestion” means, since it is by no means easy to define.

To gather their data, the Texas researchers studied conditions during peak travel hours, which they defined as 6 to 10 a.m. and 3 to 7 p.m. These are the hours during which about 50 percent of daily travel takes place—it is the time when the most demand is placed on road infrastructure. They then collected traffic data for these time periods at thousands of road segments in 439 urban areas.

For each lane in the road segments studied, they used computer programs to estimate travel times under free-flow conditions (no jams, breakdowns, crashes, or weather problems). With the collected traffic data, they then divided actual travel times during peak hours by the theoretical travel times under the free-flow conditions. The result was the “travel time index.” If it were exactly “1,” it would mean that traffic moved at the free-flow rate. But in all metro areas the index was higher than 1.

The Los Angeles metro area had the highest index—1.49—which meant that travelers on the average spent 49 percent more time traveling during peak hours than they would have under free-flow conditions. To exasperated Angelinos, the index may seem too low. But they must remember that the index includes travelers who hit the road at 6 a.m. and managed to escape the worst of the congestion.

The researchers then multiplied the average daily delay by the number of travel days per year to get average annual hours of delay per traveler. In the Los Angeles area it was 70, in Washington, DC, 62 hours, and in Buffalo, New York, 11 hours. In general, delay increased with size of metro area: the bigger the area, the more the delay. So the 14 very large metro areas averaged a delay of 35 hours per year, while the 16 small metro areas averaged a delay of 19 hours (from Charleston, South Carolina, to Wichita, Kansas) averaged 19.

Now we can get to our question: has congestion been increasing? As we see in figure 2.2, all sizes of metro areas have undergone increases in travel delays. In the 25 years after 1982, very large metro areas saw annual hours of traveler delay more than double.

It is a safe guess from this data that increased congestion overall means particular problems on bridges, because bridges are often traffic chokepoints (see chapter 8), where traffic congestion tends to be especially severe.

INFRASTRUCTURE CRISIS?

Overall, the United States since the 1990s has succeeded in reducing the percentage of structurally deficient bridges, and, of course, this is good news because structural deficiency implies dangers ahead. Then again, the spurt in bridge construction in the 1960s and 1970s is coming due. Many bridges are at an age at which they are accumulating expensive problems, which must be managed with corrective maintenance until reconstruction or replacement becomes essential.

That the percentage of obsolete bridges has fluctuated in the same range for these 20 years is less worrisome in itself. A minor shortfall in

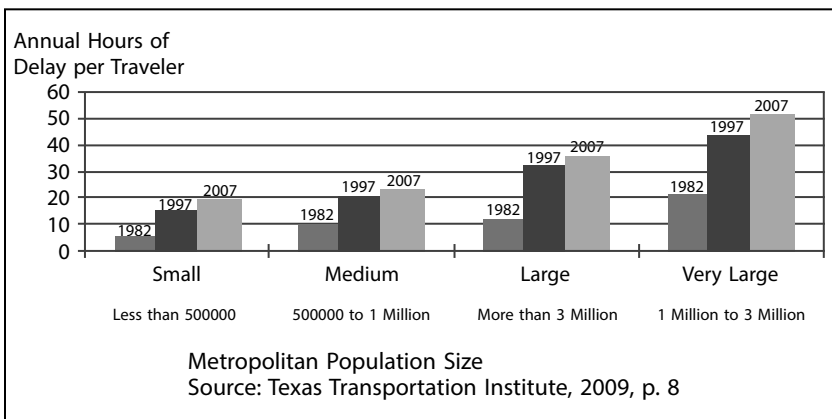


Figure 2.2. Trends in Travel by Metro Size.

achieving current standards may put the bridge in the obsolescent category while adding only marginally to the danger of travel. Then again, we have to keep in mind that the country's stock of bridges has grown. Even if the *percentage* of obsolescence remains steady, the *number* of such bridges has grown.

As we have seen, traffic is growing apace in cities and suburbs, especially in the largest metro areas. The demand does not necessarily have to be met with more bridges. Public transit, better traffic management, and incentives to get out of the car can reduce congestion while avoiding the expense of new structures. But we should not be too sanguine about possibilities for reducing car dependence. Energy crises and fuel-price spikes have come and gone, yet Americans have kept on driving.

Under the combined pressures of obsolete infrastructure and growing traffic demand, states and localities have continued to build new and rehabilitate old bridges. The NBI registers about 8,000 bridge completions per year in the United States, of which about 20 percent are rehabilitations and the rest are newly built or replaced, as shown in table 2.6. As we see in the table, rehabilitations have remained fairly level (with a peak in 2009), but new builds have been declining. With over 144,000 deficient bridges in America (of which 47 percent are structurally deficient and the rest obsolescent), we're chipping away at about 8,000 per year.

Additional bridges join the deficiency list each year, so we are always trying to catch up. And as the bridge stock from the 1960s comes due, the deficiency list will grow unless the United States accelerates the rate at which it builds new bridges. We are not in a bridge infrastructure crisis now, but it is around the corner.

Table 2.6. Bridge Building by Year

	<i>New and Replaced</i>	<i>Rehabilitated</i>	<i>Total</i>
2003	6641	2951	9592
2004	6504	1664	8168
2005	6130	1758	7888
2006	6182	1688	7870
2007	5334	1749	7083
2008	5364	1601	6965
2009	5368	2736	8104
2010*	4061	2421	6482

Source: National Bridge Inventory

*Incomplete data

THE BRIDGE DECISION

From the time that a bridge is proposed through final construction, the state or locality has to go through a labyrinthine process. When the bridge just uses an existing right-of-way and has no effects outside that narrow band, the process can take as little as three years. With lawsuits, budget shortfalls, and environmental controversies, the process can take two decades, if the bridge is ever built at all.

For the 5,000 or so new bridges for which construction is completed in a year (let's not consider rehabilitation now), easily another 20,000 to 30,000 are moving through the process from initial proposal, to community debate, to various stages of environmental study and construction.

What's more, at communities around the country, many more bridges pose problems of disrepair, deterioration, and traffic congestion. So there are additional tens of thousands of crossings over which debates, controversy, and budget battles swirl. What this tells us is that big bridge decisions are pretty common.

The decisions are made in large part by agency staffs and elected officials, but at various points in the decision process, citizens have important roles. For a citizen who wants to be an informed participant, basics come first. We need to know what goes into building a bridge that stands up against gravity's best efforts to pull it down.