



Deficient Bridges in Illinois

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By Drake E. Warren

Editor's Note: The infrastructure needs in Illinois are many. Highways continue to crumble, water treatment plants and sewage treatment plants are out of date, power plants and pipelines are aging, and many state buildings are in need of major repair. However, a singular tragic event in another state in August 2007 focused attention on one very important component of the state's infrastructure – bridges. Because of this public focus, we have decided to concentrate our analysis of infrastructure needs on the condition of Illinois' bridges.

The collapse of the I-35W bridge over the Mississippi River in downtown Minneapolis in August 2007 focused attention on the deteriorating condition of much of the nation's transportation infrastructure. While the collapse of a heavily traveled interstate is a rare event, tens of thousands of bridges across the country are in as poor or worse condition than the I-35W bridge. Furthermore, a similar number of bridges have obsolete designs or have seen traffic increase beyond their designed capacity.

Illinois is not immune to the problems of aging bridges. While the conditions of Illinois' most heavily traveled bridges compares favorably to those in neighboring states, Illinois has an especially large number of bridges that were not designed to handle current levels of traffic. These infrastructure problems do not mean that Illinois bridges are on the verge of collapse; however, they do indicate that the traffic capacity and safety of Illinois bridges are compromised by current demand. These problems will only get worse as bridges age further and demand increases. Large amounts of money are necessary to simply repair and rebuild bridges to fix these deficiencies.

The Condition of Illinois Bridges

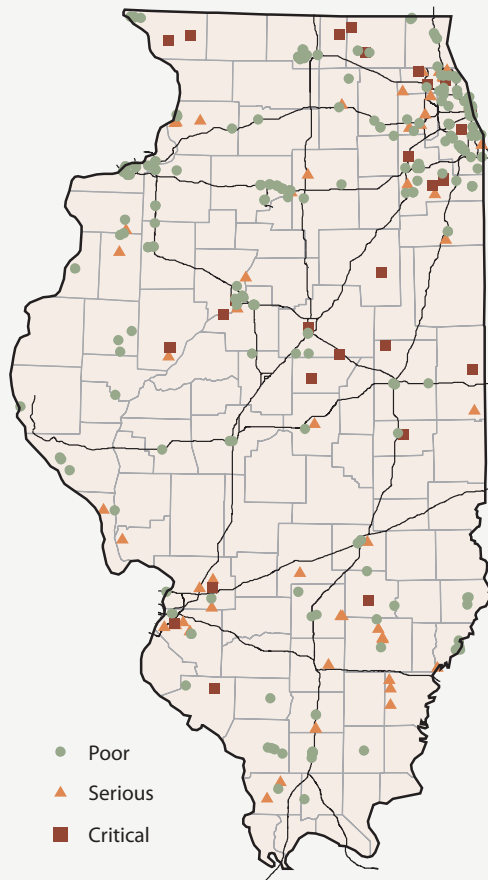
Every bridge in the United States is evaluated across a number of different conditions. These ratings are collected by the Federal Highway Administration (FHWA) and distributed in the annually produced National Bridge Inventory (NBI) database.

The structural condition of bridges is measured by rating the condition of the deck (where vehicles travel), superstructure (support underneath the deck), and substructure (foundation). A rating of "poor" or worse for any condition means that the bridge is considered "structurally deficient," which is a condition that may make a bridge eligible for Federal Highway Bridge Replacement and Rehabilitation Program (HBRRP) funds. The condition of the superstructure of the I-35W bridge was rated as "poor" while the deck was rated "fair" and the substructure was rated "satisfactory."

There are 673 Illinois bridges in the NBI that have a condition rating of the deck, superstructure, or substructure worse than "poor." These ratings are "serious" (local failures are possible), "critical" (bridge closure may be necessary), "imminent failure," and "failed." Only four of these bridges are on interstates while 402 are on local roads. No interstates are included in the 192 bridges rated critical or worse.

Figure 1 shows the geographic distribution of bridges with a condition rating of "poor" or worse on Illinois' interstates and other principal arterials. These bridges are most common in densely populated northeast Illinois, but they are also common in other regions such as sparsely populated southern Illinois.

Figure 1
Lowest condition rating of bridges carrying interstates or other principal arterials



Bridge Deficiencies: Illinois Compared to Its Neighbors

A bridge may also be eligible for HBRRP funds if it is rated as “functionally obsolete.” This designation is made after rating design elements such as the deck geometry, the approach roadway, and the underclearance based on current design standards and current traffic demand. Older bridges have outdated designs and were often designed for lower levels of traffic. According to the FHWA, replacement bridges average 2.2 times the deck area of previous bridges due to widening of the bridge and increasing its length in order to meet present design stan-

dards. Functionally obsolete bridges continue to be in fair condition or better, but their design is inadequate for present traffic demand. This obsolescence creates a burden on traffic flow and compromises safety.

Table 1 shows statistics about the deficiencies of bridges in Illinois and its neighbors. In addition to the percentage of bridges that are structurally deficient or functionally obsolete, the percentage of total vehicle crossings across bridges is included using



Table 1
Comparison of the Deficiency Status of Bridges in Illinois and Neighbors

State	Number	Structurally Deficient		Functionally Obsolete	
		% Bridges	% Traffic	% Bridges	% Traffic
All Bridges					
Illinois	21,650	11%	9%	8%	24%
Indiana	16,680	12%	5%	11%	18%
Iowa	21,008	24%	10%	7%	13%
Kentucky	10,725	12%	12%	24%	20%
Michigan	9,411	18%	18%	13%	17%
Minnesota	7,871	13%	6%	5%	10%
Missouri	19,298	23%	10%	15%	23%
Ohio	26,050	11%	5%	15%	23%
Wisconsin	11,800	11%	7%	7%	12%
Interstate Bridges					
Illinois	1,948	6%	6%	14%	26%
Indiana	1,440	4%	3%	14%	19%
Iowa	561	11%	10%	15%	15%
Kentucky	647	14%	15%	13%	15%
Michigan	1,152	17%	18%	11%	13%
Minnesota	647	4%	7%	7%	8%
Missouri	883	4%	7%	20%	24%
Ohio	2,083	3%	3%	18%	19%
Wisconsin	1,034	8%	8%	10%	10%
Other Principal Arterial Bridges					
Illinois	1,826	12%	12%	11%	21%
Indiana	1,418	6%	7%	11%	15%
Iowa	1,405	7%	7%	8%	11%
Kentucky	1,110	4%	4%	17%	20%
Michigan	1,484	14%	15%	14%	17%
Minnesota	889	3%	4%	6%	11%
Missouri	1,850	8%	9%	17%	20%
Ohio	2,830	5%	5%	17%	22%
Wisconsin	1,832	4%	4%	9%	13%



Illinois ranks well in most measures of structurally deficient bridges.

the daily traffic counts in the NBI. In Illinois, only 8 percent of bridges are functionally obsolete, but 24 percent of vehicles that drive across a bridge are crossing a functionally obsolete bridge. This disparity indicates that heavily traveled bridges in Illinois are more likely to be functionally obsolete, but also means that fixing a small number of heavily traveled bridges will improve conditions for a large share of traffic. This disparity is common across all neighboring states, but no state has a disparity as big as that of Illinois.

Illinois ranks well in most measures of structurally deficient bridges. Among all bridges, 11 percent are structurally deficient and 9 percent of traffic is traveling on structurally deficient bridges, which is close to the median of the listed states. Interstate bridges are in much better condition. Only 6 percent are structurally deficient, which ranks in the middle of the states and much lower than states like Michigan. The condition of other principal arterial bridges, however, warrants structurally deficient status in 12 percent of bridges and traffic, which is second highest among the listed states.

Illinois fares much worse in terms of its share of functionally obsolete bridges. While the fraction of such bridges is about average or better, no state has a greater share of its vehicles crossing a functionally obsolete bridge. Interstate bridges are particularly problematic, as 26 percent of all interstate bridge crossings in Illinois are across such bridges.

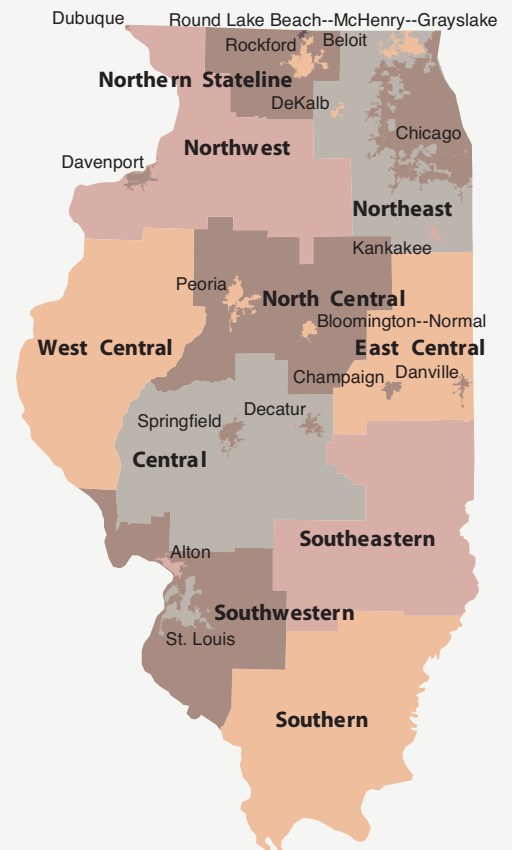
Regional Deficiencies in Illinois

In order to perform comparisons of bridges in Illinois regions, all bridges were assigned to either one of the 10 Governor's Economic Development Regions or one of the 16 Census Urbanized Areas in Illinois shown in Figure 2. A comparison of the deficiency status of all bridges within the state is given in Table 2. Nine percent of all bridge crossings in the Chicago area are across structurally deficient bridges, which is about the same as

Illinois as a whole. Some regions fare slightly better and some much worse. For example, 21 percent of bridge crossings in Peoria are across these bridges, which is worse than any of the listed states as a whole. Aside from Chicago, regions in the northern third of the state tend to fare poorly, most having 10 percent or more of their bridge crossings on structurally deficient bridges.

The Chicago area has the highest proportion of bridges and vehicle crossings on functionally obsolete bridges at 27 percent and 31 percent respectively. These shares are similar to those of interstates and other principal arterials (not shown), which indicates that

Figure 2
Governor's Economic Development Regions and Census Urbanized Areas in Illinois



obsolete bridges are a problem across many types of bridges in Chicago. The Urbanized Areas tend to have the highest percentages of bridges and traffic on these bridges. This is not surprising because these areas tend to have spatially concentrated growth that creates high demands on infrastructure not designed for such traffic. The more rural economic development regions have much smaller proportions of functionally obsolete bridges.

A closer examination of bridges carrying interstates in Illinois is shown in Figure 3 and Figure 4, for the entire state and the Chicago area respectively. A similar pattern

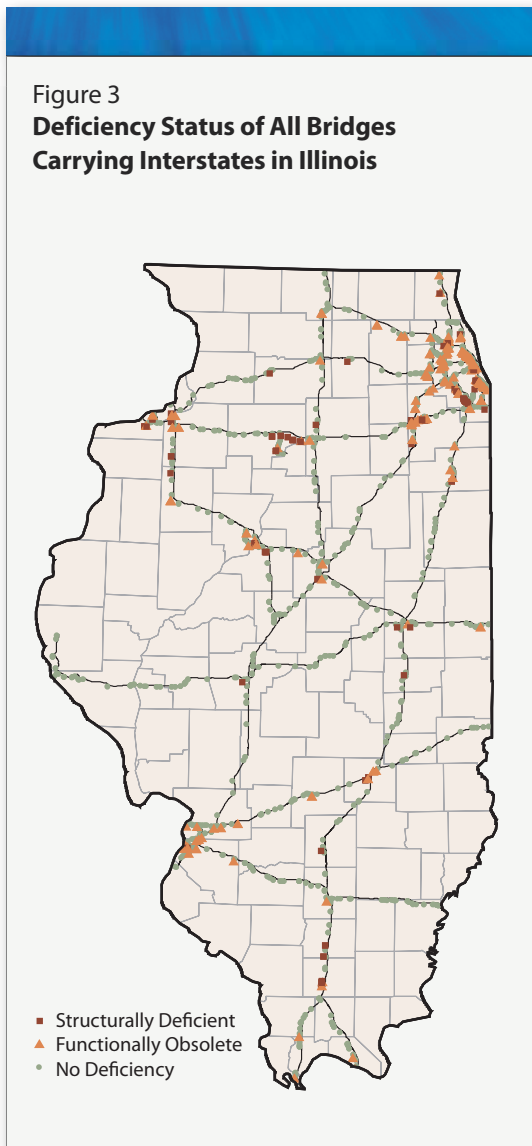
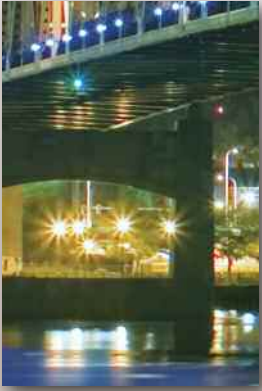


Table 2:
Deficiency status of all bridges across regions and urbanized areas of Illinois

State	Number	Structurally Deficient		Functionally Obsolete	
		% Bridges	% Traffic	% Bridges	% Traffic
All Bridges					
Alton	61	5%	4%	11%	7%
Beloit	19	5%	5%	0%	0%
Bloomington-Normal	111	13%	7%	13%	12%
Central	2,197	14%	5%	4%	3%
Champaign	78	4%	4%	17%	22%
Chicago	2,251	13%	9%	27%	31%
Danville	75	17%	7%	19%	20%
Davenport	121	16%	14%	14%	19%
Decatur	99	8%	6%	14%	13%
DeKalb	28	11%	16%	11%	11%
Dubuque	3	33%	1%	0%	0%
East Central	1,894	8%	6%	2%	1%
Kankakee	57	5%	6%	21%	17%
North Central	1,761	9%	5%	3%	4%
Northeast	1,107	6%	10%	7%	13%
Northern Stateline	522	5%	2%	5%	5%
Northwest	2,162	10%	14%	6%	7%
Peoria	196	17%	21%	8%	11%
Rockford	215	19%	15%	8%	8%
Round Lake Beach-McHenry-Grayslake	51	12%	14%	18%	19%
Southeastern	2,527	12%	8%	6%	6%
Southern	2,511	13%	12%	5%	6%
Southwestern	1,208	10%	7%	8%	9%
Springfield	114	12%	8%	7%	5%
St. Louis	399	7%	4%	18%	19%
West Central	1,894	11%	10%	5%	7%

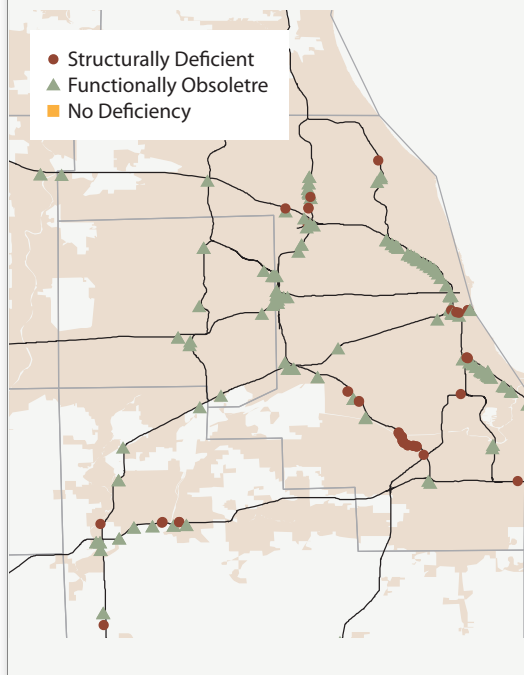
exists throughout the state where interstate bridges tend to have no deficiencies in rural areas, whereas urban areas (usually places where interstates intersect) are more often functionally obsolete due to the high demands caused by those urban areas. This is especially true in Chicago and St. Louis. Structurally deficient bridges tend to be more randomly spaced, although there are clearly clusters. For example, there are a number of structurally deficient bridges on I-80 west of the I-39 junction, on I-74 between Peoria and the Quad Cities, and on I-57 south of Carbondale.

The map of interstates in the Chicago area in Figure 4 (pg. 45) shows that a substantial portion of the bridges carrying the busiest interstates are functionally obsolete. For example, the entire stretch of the Kennedy Expressway (I-90/94) and the Chicago Skyway (I-90) is filled with functionally obsolete bridges. Also, structurally deficient



The largest obstacle to repairing or replacing deficient bridges is the billions of dollars it will cost in Illinois alone.

Figure 4
Deficiency Status of All Bridges Carrying Interstates in the Chicago Area



bridges exist in clusters here as they do in other parts of the state. A large number of these carry the Tri-State Tollway (I-294) to the northwest of where it intersects I-57. The area around the junction of the Tri-State and Northwest Tollway (I-90) also contains a large number of these bridges.

Most of the Kennedy Expressway bridges were replaced in the early 1990s. Despite this, nearly all have deficiencies in their underclearance, and about half in their deck geometries.

Data for the Tri-State Tollway still contain information about bridges built in 1958. The bridges to the northwest of I-57 are being rebuilt or widened in Phase II of the I-294 Rebuild & Widen project, which began in 2007.

Costs of Repairing or Replacing Bridges

The largest obstacle to repairing or replacing deficient bridges is the billions of dollars it will cost in Illinois alone. This cost, coupled with the high cost of repairing surface roads,

places a heavy burden on ailing state, local and federal budgets.

Estimating these costs is difficult without in-depth study and design of the bridge improvements. For example, in the NBI the I-35W bridge has a reported cost of about \$22 million to remove deficiencies via repair. This proposed repair was later deemed insufficient, and the current projected cost of replacing the bridge is more than 10 times as much. Even with these estimates, bridge construction – like any major infrastructure project – is subject to substantial cost overruns. Further difficulties arise when estimating aggregate costs in states or regions because many deficient bridges do not have an estimated cost of improvement in the NBI. Also, some states (other than Illinois) do a poor job at correcting coding errors made by state and local agencies during the collection of the data.

Table 3 provides estimates of the costs of repairing and replacing deficient bridges in Illinois and its neighbors under the assumption that bridges without estimates would cost the same as the average cost to fix or replace bridges in the same service level. (Michigan and Ohio are not included due to a lack of estimates in the NBI.) The total cost of repairing or replacing all structurally deficient and functionally obsolete bridges in Illinois is about \$3.8 billion, which is the most of any state listed. The majority of costs come from functionally obsolete bridges (\$2.0 billion), which cost more than \$500 million more to fix than those in any other state. A large part of this discrepancy is due to the high average cost per bridge (\$1.20 million) for repairing these bridges.

Table 4 breaks down estimated costs to repair and replace bridges on interstates and other principal arterials in the top three most expensive regions of Illinois for each category. The Chicago area is the only region that has an especially large cost to improve structurally deficient interstate bridges (\$186 million). Functionally obsolete interstates are

a much bigger problem. The cost in the St. Louis area is estimated to be \$1.3 billion, which is driven by several nearly mile-long bridges in East St. Louis carrying I-64/I-70/I-55 to the Mississippi River crossing. The Chicago area also has a high total cost to fix functionally obsolete interstates (\$535 million) and other principal arterials (\$488 million). Both the Chicago and St. Louis area have rather high costs to fix structurally deficient other principal arterials at \$174 million and \$132 million respectively.

Conclusion

The State of Illinois has many bridges that have a structural deficiency. Compared to its neighbors, Illinois has an especially large number of bridges – usually in urban areas – that are functionally obsolete because of their old age or traffic volumes that overwhelm their design. While neither of these conditions suggests a high likelihood that a bridge will fail like the I-35W bridge in Minneapolis, they indicate that traffic across Illinois bridges is often hampered by their condition or design. Both types of bridges are likely to increase congestion and reduce safety. For example, structurally deficient bridges may require weight limits. Furthermore, structurally deficient bridges impose higher maintenance costs on transportation departments.

Fixing the deficiencies in these bridges will cost billions of dollars. Fortunately, these deficiencies tend to be concentrated on heavily traveled bridges, so fixing relatively few bridges will benefit a much larger share of the traffic and the cost per vehicle will be low. For example, the cost per daily vehicle crossing of fixing structurally deficient and functionally obsolete interstate bridges in the Chicago area is \$67 and \$36 respectively. This money could be raised easily with modern tolling technology that would not impede traffic and would not burden government transportation budgets. Hence, there is an opportunity for private firms to lease these roads and fix the bridges at a

Table 3
Estimated costs of replacing all structurally deficient and functionally obsolete bridges across entire states

State	% With Estimates	Cost per bridge (mil)	Cost per daily vehicle	Projected Cost (mil)
Structurally Deficient				
Illinois	76%	\$0.67	\$174	\$1,765
Indiana	92%	\$0.40	\$233	\$866
Iowa	78%	\$0.30	\$195	\$1,577
Kentucky	65%	\$0.46	\$255	\$574
Minnesota	67%	\$0.78	\$170	\$658
Missouri	86%	\$0.41	\$319	\$1,853
Wisconsin	89%	\$1.29	\$133	\$2,530
Functionally Obsolete				
Illinois	59%	\$1.20	\$140	\$2,007
Indiana	66%	\$0.36	\$47	\$623
Iowa	69%	\$0.25	\$148	\$491
Kentucky	69%	\$0.46	\$95	\$1,210
Minnesota	76%	\$0.84	\$59	\$371
Missouri	79%	\$0.38	\$185	\$1,460
Wisconsin	80%	\$0.34	\$196	\$1,321

Table 4
Three Illinois regions with highest estimated costs of replacing all structurally deficient and functionally obsolete bridges

Area	% Included	Cost per bridge (mil)	Cost per daily vehicle	Projected Cost (mil)
Structurally Deficient Interstate				
Chicago	50%	\$4.4	\$67	\$186
Northwest	62%	\$0.9	\$94	\$24
Peoria	60%	\$1.3	\$50	\$13
Functionally Obsolete Interstate				
St. Louis	50%	\$41.1	\$1,426	\$1,316
Chicago	60%	\$3.3	\$37	\$535
Southern	75%	\$1.7	\$128	\$14
Structurally Deficient Other Principal Arterial				
Chicago	85%	\$2.7	\$80	\$174
St. Louis	100%	\$16.5	\$1,595	\$132
Southern	83%	\$1.4	\$259	\$33
Functionally Obsolete Other Principal Arterial				
Chicago	47%	\$3.7	\$120	\$488
St. Louis	64%	\$4.0	\$290	\$56
Southern	100%	\$10.3	\$1,888	\$52



Fixing the deficiencies in these bridges will cost billions of dollars. Fortunately, these deficiencies tend to be concentrated on heavily traveled bridges, so fixing relatively few bridges will benefit a much larger share of the traffic and the cost per vehicle will be low.

profit (such as the City of Chicago leasing the Skyway for \$1.81 billion), which would actually provide funds for other transportation projects. Alternatively, these deficient bridges could be left as they are, costing users via the reduced service-level of the bridge, which appears to be what happened with the bridges in East St. Louis. Those bridges were improved throughout the 1990s but remain functionally obsolete. In this case, the benefits of removing the deficiencies might not be worth the high cost of removing them.

Unfortunately, the state's highway needs are not limited to just bridges. Other parts of the roads also suffer from deficiencies that will also cost billions of dollars to fix.



Drake Warren is a Ph.D. candidate in the Department of Agricultural and Consumer Economics and a research assistant in the Regional Economics and Public Policy Research Group at the University of Illinois at Urbana-Champaign. His research interests include the application and development of GIS, spatial data analysis and econometric methods to regional economics, public policy evaluation and transportation. His dissertation research examines the impacts of small commercial airports on regional economies.