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BRIDGE DISASTERS IN AMERICA: THE CAUSE AND THE REMEDY

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Содержание

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BRIDGE DISASTERS IN AMERICA

Nearly all of the disasters which occur from the breaking down of bridges are caused by defects which would be easily detected by an efficient system of inspection. Not less than forty bridges fall in the United States every year. No system of public inspection or control at present existing has been able to detect in advance the defects in these structures, or to prevent the disasters. After a defective bridge falls, it is in nearly every case easy to see why it did so. It would be just about as easy, in most cases, to tell in advance that such a structure would fall if it ever happened to be heavily loaded. Hundreds of bridges are to-day standing in this country simply because they never happen to have received the load which is at any time liable to come upon them.

A few years ago an iron highway bridge at Dixon, Ill., fell, while a crowd was upon it, and killed sixty persons. The briefest inspection of that bridge by any competent engineer would have been sure to condemn it. A few years later the Ashtabula bridge upon the Lake Shore Railroad broke down under an express train, and killed over eighty passengers. The report of the committee of the Ohio Legislature appointed to investigate that disaster concluded, first, that the bridge went down under an ordinary load by reason of defects in its original construction; and, secondly, that the defects in the original construction of the bridge could have been discovered at any time after its erection by careful examination. Hardly had the public recovered from the shock of this terrible disaster when the Tariffville calamity added its list of dead and wounded to the long roll already charged to the ignorance and recklessness which characterize so much of the management of the public works in this country.

There are many bridges now in use upon our railroads in no way better than those at Ashtabula and Tariffville, and which await only the right combination of circumstances to tumble down. There are, by the laws of chance, just so many persons who are going to be killed on those bridges. There are hundreds of highway bridges now in daily use which are in no way safer than the bridge at Dixon was, and which would certainly be condemned by five minutes of competent and honest inspection. More than that, many of them have already been condemned as unfit for public use, but yet are allowed to remain, and invite the disaster which is sure to come. Can nothing be done to prevent this reckless and wicked waste of human life? Can we not have some system of public control of public works which shall secure the public safety? The answer to this question will be, Not until the public is a good deal more enlightened upon these matters than it is now.

It has been very correctly remarked, that, in order to bring a disaster to the public notice, it must be emphasized by loss of life. The Ashtabula bridge fell, and killed over eighty persons; and a storm of indignation swept over the country, from one end to the other. No language was severe enough to apply to the managers of the Lake Shore Railroad; but if that very bridge had fallen under a freight-train, and no one had been injured, the occurrence would have been dismissed with a paragraph, if, indeed, it had received even that recognition. In February, 1879, a span one hundred and ten feet long of an iron bridge on the Chicago and Alton Railroad at Wilmington fell as a train of empty coal-cars was passing over it, and three cars were precipitated into the river, a distance of over thirty feet. No one was injured. Not a word of comment was ever made in regard to this occurrence. Suppose, that, in place of empty coal-cars, the train had consisted of loaded passenger-cars, and that one hundred persons had been killed. We know very well what the result would have been. Is not the company just

as much to blame in one case as the other? On the night of the 8th of November, 1879, one span of the large bridge over the Missouri at St. Charles gave way as a freight-train was crossing it, and seventeen loaded stock-cars fell a distance of eighty feet into the river. Two brakemen and two drovers were killed. This bridge, says the only account that appeared in the papers, did not break apparently, for the whole span "went down" with the cars upon it. It could hardly make much difference to the four men who were killed, whether the bridge broke down, or "went" down. Not a word of comment was ever made in the papers outside of Missouri in regard to this disaster. Suppose, that, in place of seventeen stock-cars, half a dozen passenger-cars had fallen from a height of eighty feet into the river, and that, in place of killing two brakemen and two drovers, two or three hundred passengers had been killed. Is not the public just as much concerned in one case as in the other?

Suppose that a bridge now standing is exactly as unsafe as the Ashtabula bridge was the day before it fell, would it be possible to awaken public attention enough to have it examined? Probably not. About two years ago an attempt was made to induce one of the leading dailies in this country to expose a wretchedly unsafe bridge in New England. The editor declined, on the ground that the matter was not of sufficient interest for his readers; but less than a month afterwards he devoted three columns of his paper to a detailed account of a bridge disaster in Scotland, and asked why it was that such things must happen, and if there was no way of determining in advance whether a bridge was safe, or not?

This editor certainly would not maintain, that, in itself, it was more important to describe a disaster after it had occurred than to endeavor to prevent the occurrence; but, as a business man, he knew perfectly well that his patrons would read an account giving all of the sickening detail of a terrible catastrophe, while few, if any, would wade through a dry discussion of the means for protecting the public from just such disasters. The public is always very indignant with the effect, but does not care to trouble itself with the cause; but the effect never will be prevented until the cause is controlled; and the sooner the public understands that the cause is in its own hands, to be controlled, or not, as it chooses, the sooner we shall have a remedy for the fearful disasters which are altogether too common in the United States.

In a country where government controls all matters on which the public safety depends, and where no bridge over which the public is to pass is allowed to be built except after the plans have been approved by competent authority, where no work can be executed except under the rigid inspection of the best experts, nor opened to the public until it has been officially tested and accepted, it makes little or no difference whether the public is informed, or not, upon these matters; but in a country like the United States, where any man may at any time open a shop for the manufacture of bridges, whether he knows any thing about the business, or not, and is at liberty to use cheap and insufficient material, and where public officers are always to be found ready to buy such bridges, simply because the first cost is low, and to place them in the public ways, it makes a good deal of difference. There is at present in this country absolutely no law, no control, no inspection, which can prevent the building and the use of unsafe bridges; and there never will be until the people who make the laws see the need of such control.

There is no one thing more important in this matter than that we should be able to fix precisely the blame in case of disaster upon some person to whom the proper punishment may be applied. If every railway director, or town or county officer, knew that he was held personally accountable for the failure of any bridge in his charge, we should soon have a decided improvement in these structures. If we could show that a certain bridge in a large town had been for a long time old, rotten, worn out, and liable at any moment to tumble down, and could show in addition, that the public officers having charge of such a bridge knew this to be the case, and still allowed the public to pass over it, we can see at once, that, in case of disaster, the blame would be clearly located, and the action for damages would be short and decisive. Once let a town have heavy damages to pay, and let it know

at the same time that the town officers are clearly accountable for the loss, and it is possible that it would be willing to adopt some system that should prevent the recurrence of such an outlay.

To see what may be accomplished by an efficient system of public inspection, it is necessary to know something in regard to the structures to be inspected. We have now in common use in this country, both upon our roads and our railroads, bridges made entirely of iron, bridges of wood and iron combined, and occasionally, though not often nowadays, a bridge entirely of wood; and these structures are to be seen of a great variety of patterns, of all sizes, and in every stage of preservation. Of late so great has been the demand for bridge-work, that this branch of engineering has become a trade by itself; and we find immense works fitted up with an endless variety of the most admirably adapted machine-tools devoted exclusively to the making of bridges of wood, iron, steel, or all combined. As in all division of labor, the result of this specialization has been to improve the quality of the product, to lessen the cost, and to increase the demand, until many of our large firms reckon the length of bridging which they have erected by miles instead of feet. As usual, however, in such cases, unprincipled adventurers are not wanting, who, taking advantage of a great demand, do not hesitate to fit up cheap shops, to buy poor material, and to flood the market with a class of bridges made with a single object in view, viz., to sell, relying upon the ignorance—or something worse—of public officials for custom. Not a year passes in which some of these wretched traps do not tumble down, and cause a greater or less loss of life, and at the same time, with uninformed people, throw discredit on the whole modern system of bridge-building. This evil affects particularly highway bridges. The ordinary county commissioner or selectman considers himself amply competent to contract for a bridge of wood or iron, though he may never have given a single day of thought to the matter before his appointment to office. The result is, that we see all over the country a great number of highway bridges which have been sold by dishonest builders to ignorant officials, and which are on the eve of falling, and await only an extra large crowd of people, a company of soldiers, a procession, or something of the sort, to break down.

Not many years ago, a new highway bridge of iron was to be made over one of the principal rivers in New England. The county commissioners desired a well-known engineer, especially noted as a bridge-builder, to superintend the work, in order to see that it was properly executed. The engineer, after inspection of the plans, told the commissioners plainly that the design was defective, and would not make a safe bridge; and that, unless it was materially changed, he would have nothing to do with it. The bridge, however, was a cheap one, and, as such, commended itself to the commissioners, who proceeded to have it erected according to the original plan; and these same commissioners now point to that bridge, which has not yet fallen, but which is liable to do so at any time, as a complete vindication of their judgment, so called, as opposed to that of the engineer who had spent his life in building bridges.

An impression exists in the minds of many persons, that it is purely a matter of opinion whether a bridge is safe, or not. In very many cases, however,—perhaps in most,—it is not at all a matter of opinion, but a matter of fact and of arithmetic. The whole question always comes to this: Is the material in this bridge of good quality? Is there enough of it? Is it correctly disposed, and properly put together? With given dimensions, and knowing the load to be carried, it is a matter of the very simplest computation to fix the size of each member. We know what one square inch of iron will hold, and we know, also, the total number of pounds to be sustained; and it is no matter of opinion, but one of simple division, how many times one will go into the other.

But it may be asked, Can the precise load which is coming upon any structure be exactly fixed? are not the circumstances under which bridges are loaded very different? Bridges in different localities are certainly subjected to very different loads, and under very different conditions; but the proper loads to be provided for have been fixed by the best authority for all cases within narrow enough limits for all practical purposes. Few persons are aware of the weight of a closely packed crowd of people. Mr. Stoney of Dublin, one of the best authorities, packed 30 persons upon an area of a little less than

30 square feet; and at another time he placed 58 persons upon an area of 57 square feet, the resulting load in the two cases being very nearly 150 pounds to the square foot. "Such cramming," says Mr. Stoney, "could scarcely occur in practice, except in portions of a strongly excited crowd; but I have no doubt that it does occasionally so occur." "In my own practice," he continues, "I adopt 100 pounds per square foot as the standard working-load distributed uniformly over the whole surface of a public bridge, and 140 pounds per square foot for certain portions of the structure, such, for example, as the foot-paths of a bridge crossing a navigable river in a city, which are liable to be severely tried by an excited crowd during a boat-race, or some similar occasion." Tredgold and Rankine estimate the weight of a dense crowd at 120 pounds per square foot. Mr. Brunel used 100 pounds in his calculations for the Hungerford Suspension Bridge. Mr. Drewry, an old but excellent authority, observes that any body of men marching in step at from 3 to 3-1/2 miles an hour will strain a bridge at least as much as double the same weight at rest; and he adds, "In prudence, not more than one-sixth the number of infantry that would fill a bridge should be permitted to march over it in step." Mr. Roebling says, in speaking of the Niagara Falls Suspension Bridge, "In my opinion, a heavy train, running at a speed of 20 miles an hour, does less injury to the structure than is caused by 20 heavy cattle under full trot. Public processions marching to the sound of music, or bodies of soldiers keeping regular step, will produce a still more injurious effect."

Evidently a difference should be made in determining the load for London Bridge and the load for a highway bridge upon a New-England country road in a thinly settled district. A bridge that is strong enough is just as good and just as safe as one that is ten times stronger, and even better; for in a large bridge, if we make it too strong, we make it at the same time too heavy. The weight of the structure itself has to be sustained, and this part of the load is a perpetual drag on the material.

In 1875 the American Society of Civil Engineers, in view of the repeated bridge disasters in this country, appointed a committee to report upon The Means of Averting Bridge Accidents. We might expect, when a society composed of some hundreds of our best engineers selects an expert committee of half a dozen men, that the best authority would be pretty well represented; and such was eminently the case. It would be impossible to have combined a greater amount of acknowledged talent, both theoretical and practical, with a wider and more valuable experience than this committee possessed. The first point taken up in the report is the determination of the loads for which both railroad and highway bridges should be proportioned. In regard to highway bridges, a majority of the committee reported that for such structures the standard loads should not be less than as shown in the following table:—

SPAN.	POUNDS PER SQUARE FOOT.		
	CLASS A.	CLASS B.	CLASS C.
60 feet and less	100	100	70
60 to 100 feet	90	75	60
100 to 200 feet	75	60	50
200 to 400 feet	60	50	40

Class A includes city and suburban bridges, and those over large rivers, where great concentration of weight is possible. Class B denotes highway bridges in manufacturing districts having well-ballasted roads. Class C refers to ordinary country-road bridges, where travel is less frequent and lighter. A minority of the committee modified the table above by making the loads a little larger. The whole committee agreed in making the load per square foot less as the span is greater, which is, of course, correct. It would seem eminently proper to make a difference between a bridge which carries the continuous and heavy traffic of a large city, and one which is subjected only to the comparatively light and infrequent traffic of a country road. At the same time it should not be forgotten, that, in a large part of the United States, a bridge may be loaded by ten, fifteen, or even twenty pounds per

square foot by snow and ice alone, and that the very bridges which from their location we should be apt to make the lightest, are those which would be most likely to be neglected, and not relieved from a heavy accumulation of snow. In view of the above, and remembering that a moving load produces a much greater strain upon a bridge than one which is at rest, we may be sure, that, as the committee above referred to recommend, the loads should not be less than those given in the table. We can easily see that in special cases they should be more.

Конец ознакомительного фрагмента.