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NEW YORK, SATURDAY, NOVEMBER 4, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

A DISCREDITED THEORY.

After reading the description of the ridiculously small results recently achieved at Sandy Hook in the test of a torpedo shell against a target representing the side of a battleship, as given on another page of this issue, our readers will surely agree with us that Congress should make no further appropriations for experiments with projectiles of this kind. The only effect produced on the trial plate, as the result of bursting 183 pounds of high explosive against it, was a slight indentation, which was due, almost entirely, to the striking energy of the shell itself. While we can well understand that the enormous energy of the gases of explosion of guncotton or nitroglycerine should have caused the idea of exploding a heavy charge against the outside of a battleship to appeal very strongly to the lay mind, we cannot understand why Congress should have authorized this latest trial of the theory, when that theory had been so completely discredited in the tests of the Gathmann torpedo shell some four or five years ago.

Let it now be set down once and forever that not 200 pounds, nor twice 200 pounds, of high explosive is sufficient to "blow the modern battleship out of existence." If the events of the naval conflict in the Far East have taught us anything at all, they have surely taught us this: that unless the charge should be so fortunate as to explode in or at the neighborhood of the magazine, a single torpedo or a single mine will not send a battleship to the bottom, or wreck it beyond the possibility of repair. If anyone doubt this, let him look at the Port Arthur fleet, the ships of which, after receiving some of them not one, but several blows, full and square from the mine and the torpedo, were so far repaired under emergency conditions, as to be able to go forth and fight that seven-hour engagement with the Japanese fleet on August 10.

Modern ship steel is so tough ; the modern system of cellular and compartmental construction is so elaborate; the modern battleship is so big; and its inertia so great, that the detonation of even 400 pounds of high explosive against the side of the ship, as in the case of the "Sevastopol," causes damage which, though extensive, is strictly local, and does not impair the structural integrity of the ship as a whole. The high-explosive armor-piercing shell, which can carry its bursting charge intact through the armor and liberate its energy within the vitals of the ship itself, is the supreme engine of destruction in modern naval warfare; and the thin-walled torpedo shell must be relegated to that museum of discredited inventions, of which the Sandy Hook proving ground contains so many costly exhibits.

ONE YEAR'S OPERATION OF THE SUBWAY.

On October 27 the New York Subway completed its first year of active service, and the statistics of travel and the verdict of the public agree in pronouncing this great engineering work, with one exception, a complete success. During the twelve months, 106,000,000 passengers have been carried, at the average rate of about 300,000 per day. The total number of passengers carried daily on the elevated roads works out at an average of about 717,000 per day, so that a reasonable estimate of the number of passengers carried by the Elevated and Subway combined reaches the enormous figure of over 1,000,000 per day.

The figures for the Subway are the more remarkable when we bear in mind that only a portion of it has been in active operation for the whole twelve months. The Lenox Avenue branch to West Farms, the section from the Brooklyn Bridge to the South Ferry, and about a mile of road north of 135th Street on the Broadway branch, have been in operation only for a portion of the year. The company expects to open the road from 157th Street to the Harlem Ship Canal by January 1, and next year also the important Brooklyn branch from South Ferry to Flatbush and Atlantic Avenues will be put in service. It is reasonable to expect that with these important additions, the total daily travel will amount to an average of 400,000 per day for the year.

It is not often that a great public improvement in transportation such as this scores such a large and immediate success, running far beyond the preliminary estimates of its usefulness. Save for some confusion in the first few days of operation, due to limited switching accommodation at the terminals, and to the restraining hand laid upon the traffic by the excellent system of block signals on the express tracks, there has been but little interruption to the steady flow of travel. This, however, quickly passed away, and the system has been running day and night, for many months, with an absolutely clock-like precision. The speeds, particularly of the express trains, have been rather over than under the estimate, and the new steel cars, introduced for the first time on this road, have been an unqualified success, running with the smoothness of a Pullman car, and coming through such collisions as have occurred, in a way that proves them to be an excellent protection to the life and limb of the passengers.

The Subway, however, has developed one most serious drawback, which during the hot summer months served to divert a measurable proportion of its traffic to the Elevated roads. We refer to the unexpectedly high temperature and its attending "stuffiness" which, in the hottest weather, rendered travel in the Subway, to say the least, extremely uncomfortable. The high temperature is due to the large quantities of heat thrown out by the motors, and developed by the constant use of the brakes. In the winter this heat served to render the Subway temperature comfortable; but as the summer months advanced, it speedily produced the uncomfortable results above referred to. The problem of ventilation is a most serious one, and it has engaged the careful attention of the engineers, and will be made the subject of a forthcoming report. It is gratifying to know that the report will propose a plan which is confidently expected to remedy this serious defect.

MR. HILDENBRAND AND THE MANHATTAN BRIDGE PROBLEM.

At the time that we published illustrations of the new Buda-Pesth bridge, it was not our intention to open the old controversy as to the respective merits of wire cable and eye-bar chain suspension bridges. That problem was very thoroughly investigated some two years ago, and formed the subject of an exhaustive debate by pretty nearly every bridge engineer, who by training and experience was qualified to speak with authority on this subject. The publication of the Buda-Pesth bridge article, however, brought a reply from Mr. Hildenbrand, our editorial comments upon which have induced this engineer to write a reply of considerable length. In his letter of transmission, our correspondent suggests that it would be only justice to him, as well as due to the engineering profession, that we publish his arguments and calculations on which the statements in his former letter were based. The letter will be found on another page, and it is inserted with the understanding that with its publication will close this somewhat belated controversy.

In reading this letter one cannot but be impressed with the courage and fidelity with which the writer pleads for what he himself must feel to be a losing cause; for although political and personal considerations have proved strong enough to reject, in the case of the Manhattan structure, the more scientific and stronger chain bridge in favor of the primitive and now discredited wire type, we are satisfied that if one could take toll of expert engineering opinion both in this country and abroad, it would prove to be almost unanimous in recognizing the theoretical and practical advantages of the eye-bar chain type. We will even go further, and state it as our conviction that the advantages of the rejected design are so elementary, obvious, and material, that if the two designs and the discussion upon them were submitted to any graduating class in engineering at our technical colleges, they would cast their vote, to a man, in favor of the trussed eye-bar chain.

Had it not been for the manifest errors in his argument to prove that the eye-bar chain must weigh over three times as much as the wire cable, we would have let Mr. Hildenbrand's letter pass without comment; but the false premises and fallacious line of reasoning followed in this portion of the letter are such a characteristic example of the "rough-and-ready" methods of argument adopted by the advocates of the wire-cable bridge, and the statements themselves are so very misleading, that this portion of the letter demands an answer.

In estimating the respective breaking strength of the chains and the wire cable, 40 tons per square inch "as accepted by the Bridge Department," is used by Mr. Hildenbrand for the chain, whereas for the ultimate strength of the wire cable, 112 tons, "the actual strength of individual wires in the Williamsburg bridge" is used. This is manifestly an unfair comparison. To place the wire on the same basis as the chain, we must use the ultimate strength of the wire as specified in the contract for the Manhattan bridge, which requires a unit strength of 100 tons to the inch in the body of the wire, and of 95 tons at the splices. This 95 tons to the inch is, therefore, the proper unit for comparison. Multiplying, then, the chain section by 40 we get 22,200 tons as the breaking strength of one chain, and multiplying 265 by 95 we get 25,175 tons as the breaking strength of one wire cable; so that the Manhattan wire cable is not 33 7/10 per cent stronger, as Mr. Hildenbrand would have us believe, but is only 13 4/10 per cent stronger, if judged, as it surely ought to be, on the common basis of contract requirement.

But the contract requirement, as drawn up by the present Bridge Department, is entirely too favorable to the wire cable; for this 95 tons to the square inch shown by the individual wires must not be taken as applicable to the mass of wires, 20 or more inches in diameter, when strung across the towers and banded into cables. It has been proved that wires assembled in a cable do not possess an aggregate strength equal to the sum of the individual wires as developed in the testing machine. That eminent bridge engineer, the late Mr. Morrison, in working out a wire-cable design for the North River bridge, investigated this subject, and found that while the average strength of five wires, separately tested, was 172,588 pounds to the square inch, the strength of straight wire strands of the same quality of steel, with the wires laid parallel, was only from 150,000 to 146,640 pounds to the square inch, the strands showing about 15 per cent less strength than the individual wires. Strands of special plow-steel wire showed only 188,000 pounds to the square inch ultimate strength, as against an average strength of the individual wires of 226,000 pounds to the square inch. Mr. Morrison, very properly, took only 180,000 pounds as the unit stress in proportioning his cables.

No falling off in strength between the test specimen and the whole bar has ever been urged against an eye-bar chain, and hence, to make the comparison a true parallel, 15 per cent must be deducted from the 95 tons to the square inch unit strength as found above.

But a further reduction of 10 per cent must be made in our estimate of the strength of the assembled wires, to allow for the great fiber stress which occurs in the wire cable due to its bending over the edge of the saddles. In the construction of a wire-cable bridge, as soon as the wires have been strung they are heavily clamped and wrapped with wire applied under considerable tension, and any movement of the wires, one upon another, is thereafter impossible. The cable as thus strung and clamped hangs in a certain curve; but when the massive floor and stiffening trusses have been attached to it, and the live load comes upon it, and it lengthens under the high temperatures of the summer season, the cable will deflect and, of course, will be bent down to a more acute angle at the saddles. The bending of the compacted mass of steel 20 inches in diameter (for the heavy clamping and the pressure of the cable at the saddle render it a compact mass) will cause the outer wires at the point of bending over the edge of the saddle to be strained to an extent which calls for an addition of at least 10 to 15 per cent to the section of the cable, in order to provide for these stresses. If, as in the case of the Manhattan bridge, no increase of section has been made, then a lower unit stress should be used in estimating its total strength, the reduction amounting, at the most conservative estimate, based on a simple mathematical examination, to at least 10 per cent. Adding this 10 per cent to the 15 per cent reduction above referred to, we get a total reduction of 25 per cent, which must be considered, if we are to place the chain and the wire cable upon an even basis, as desired by Mr. Hildenbrand. This brings the unit stress down to 71.25 tons to the square inch, and shows the breaking strength of the wire cable to be 18,881 tons, as against 22,200 tons for the eye-bar chain, from which we see the chain is 17.5 per cent stronger than the cable. Adding 17.5 per cent to the section (265 square inches) of the wire cable, in order to cancel this difference (still following Mr. Hildenbrand's method of argument), and, further, adding 10 per cent for the weight of the suspender saddles, sheathing, etc. (which Mr. Hildenbrand omits) we get a total section for the wire cable of 342 square inches, as against 666 square inches (555 + 20 per cent for weight of eyes and pins) for the eye-bar chain. Therefore, the sections are not as 1 to 3.23, as deduced by our correspondent, but as 1 to 1.95; which agrees very well with the proportion of 1 to 2, as stated in our editorial of September 30.

It is scarcely necessary to point out that, with such serious errors existing in his premises, the whole fabric of our correspondent's argument falls to the ground.

If this question were merely academic, no harm