side of the 8 feet vestibule is the magazine room 22 feet x 10 feet 6 inches; caretaker's room, 16 ft x 10 ft. 6 in.; and a storeroom. A broad staircase leads to the first floor, and upstairs are found a spacious landing, a lending-library, 35 ft. 6 in. x 22 ft. 6 in.; ladies' room, 25 ft. x 11 ft., and a reference library, 31 ft. x 14 ft 6 in. The lighting arrangements are on the whole good but in this matter the committee will confer with the architect. Lavatories and sanitary arrangements are provided on both floors.

Expanded Steel.

The uses of expanded steel are both satisfactory and pleasant. That at all events is the verdict of every engineer who likes to combine strength with elegance in his design, and of every builder and warehouseman who places economy of construction in the first rank of all things.

Of these uses, one of the most remarkable, by reason of the rapidity of its development, is the combination of the expanded metal with concrete. This constitutes a partnership of materials recent in date, but incomparable in the magnificence of the future before it. Re-inforced concrete, or armoured cement, is to be seen now in floors, roofs, walls, in sewers, bridges, wharves, warehouses, in constructions of every conceivable kind; and for buildings for which artistic adornment is required, no material can be more suitable for the retention of sharpness of outline and clearness of design.

Concrete construction is, of course, not new. The Roman builders were partial to it for they knew its properties. Of all the work they did with it the finest example which has come down to our days is the Pantheon of Rome, a building (the subject of a prominent illustration in our issue of last December), erected by Agrippa in the year 27 B.C. The walls of the circular part of this great structure are nearly 20 feet thick, while there is a hemispherical dome of 142 feet 6 inches span with a circular opening in the centre of about 30 feet in diameter. To-day it does not show a single crack after the heats and frosts of time, the storms of nature, and the tempests of war have beaten upon its bulk and tested its endurance in every conceivable way for 1933 years.

Useful and widely used as it was, the art of building with "pozzuolana" the concrete of our day, was lost in the desert of the centuries that followed the collapse of the Roman Empire—it is a sidelight showing forcibly the tremendous completeness of the sweep made by the disasters under which that Empire perished. Smeaton rediscovered it in 1726, and in the next sixty years the manufacture and use of hydraulic cement made great progress. There were many makers on both sides of the Atlantic, most prominent among whom were Parker the Englishman and White the American. At the end of the period or about 1820 Joseph Aspden, of Leeds, eclipsed all other makers, for he produced the famous Portland cement, so called from its colour resemblance to Portland stone. The new material was recognised as superior, and its superiority to the ancient cement of the Roman days has been admitted. The uses of this material in the engineering of the world are now historical.

To Jean Monier, of Paris, a gardener of great ability and enterprise, is due the credit of the combination of the material with metal. Wanting one day some large pots for the planting of orange-trees, he built some of concrete with wire netting embedded in the material, and found the combination so strong that he determined to follow his invention further afield. He sought the protection of the patent office, received the gold medal of the Paris Exposition, in 1878, and secured the friendship of engineers and the co-operation of capitalists. Presently his reinforced concrete was spread over many tanks, bridges and sewers in France, Germany and Austria, and was finding its way into the "fire-proof" floors of nearly every country of the European continent.

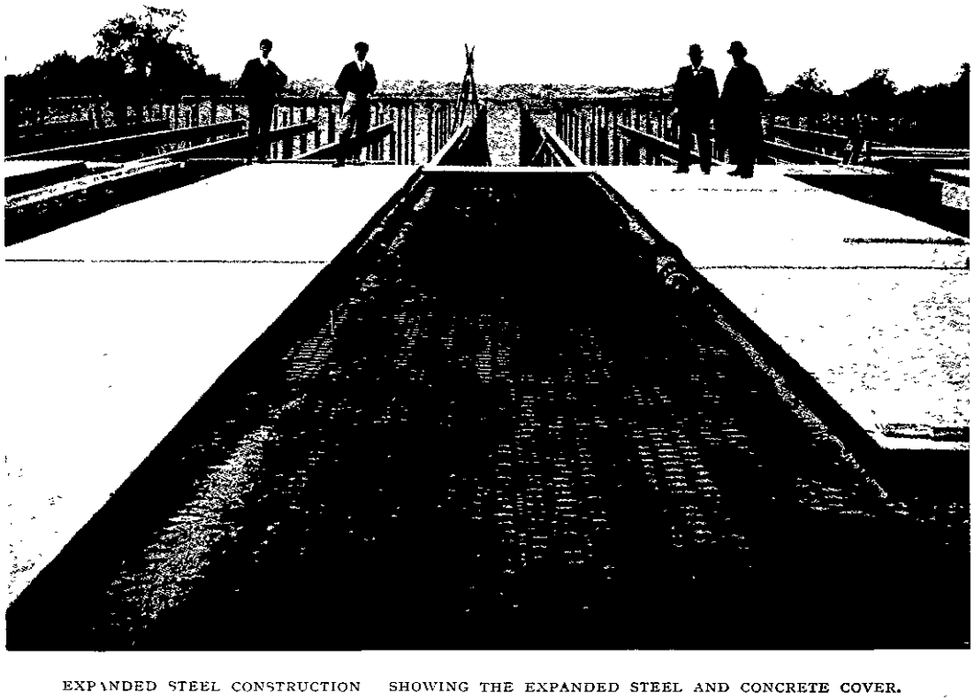
It is well known that concrete, though an excellent material in compression, has very little strength in tension, while on the other hand steel is of little value in compression as being in this combination light, it would have a tendency to "buckle"; but when used in tension can be relied on with perfect safety. Mr Walmesley, M I C E addressing the Institute at Bradford on the 7th of September of last year, said on the subject of the respective strains to be borne by the two members of the combination: "If the beam be supported at both ends of its length, and loaded between the supports, the upper portion will be in compression and the lower in tension." Following these principles Monier placed his metal in the bottom of the building and his concrete upon it with the resulting development of construction above noticed.

EXPANDED STEEL CONSTRUCTION SHOWING STEELWORK READY TO RECEIVE COVER OF EXPANDED STEEL AND CONCRETE

The combination, however, was found to carry with it two objections. There was an element of uncertainty about the position of the steel in the combination, and the manipulation was tedious, and therefore expensive. It was necessary to use a large number of rods which had to be woven together, or latticed, and secured with wire at the joints. The process was not only slow, but it demanded great accuracy from the workmen, failing which the metal was exceedingly likely to get into the wrong place, i.e. into the wrong line of strain, thus receiving the compression, not the tension strain—doing, in fact the work for which its partner had its place in the combination.

Quite recently John Golding swept these two objections away by the simple expedient of expanding the steel before use. After many trials he constructed a machine which does this part of the work with ease and certainty. Seizing each thin plate, it drags it lengthwise and sideways until it becomes like a square of wire netting being really a sheet of steel expanded into meshes. The sheet when lying on a flat surface touches at only one point in each mesh. Thus, when concrete is applied, it embeds the steel entirely, getting under and over at every part, while the steel remains in the bottom layer, the region of its special tensile strain. There is no difficulty about the jointing for the necessary continuance of the sheet of steel. All the workmen have to do as they lay down the sheets for the combination is to overlap them to whatever extent the architect may order. In general the overlap of a single mesh is considered ample. With this improvement there does not seem much to be desired in the manufacture of armoured concrete. At all events the process is now at the highest point it has ever attained. The metal is sure of its right place in the combination, and, being fully embedded, is preserved indefinitely, suffering absolutely no deterioration whatever.

The engineering verdict applied after long and careful trial as all such verdicts are in England, is that the tension efficiency of a given beam is increased from ten to twelve times, by the use of the expanded metal, the rule being vouched for by such men as Sir B. Baker and Sir J. Fowler. The rule has been subsequently tested by the committee of the Architects' Association at Newcastle, and it was found that the strength was appreciably greater than the rule allotted. It was after that



EXPANDED STEEL CONSTRUCTION SHOWING THE EXPANDED STEEL AND CONCRETE COVER.