

upon various circumstances—the amount of work it will be required to do, the quantity of road metal used, the strength of the bridges and culverts over which it must pass.

A steam roller costs much more than a horse roller, but when it can be kept constantly employed does so much better and faster work that it is the more economical. For this reason when several municipalities can join together in the purchase of a steam roller it should be had. A weight of ten tons does satisfactory work, and is not too heavy for the majority of bridges.

Gravel and limestone bind more easily than the better varieties of granite and trap, and a lighter roller may be used with good effect.

If the bridges are old-time wooden structures, if the road mileage on which work is to be done is not very great, if the material used is not trap or similarly hard metal, a horse roller of from five to eight tons may be used.

The work of a horse roller, however, is not so perfect as that of a steam roller. The feet of the horses disturb the metal, and the lesser weight requires that the rolling shall be continued very much longer.

Rolling should commence at the side of the road, approaching the centre gradually. If the roller is first passed over the centre, the loose metal is crowded out and the shape of the crown destroyed. It is best to roll the earth foundation in dry weather, and each succeeding layer up to the top dressing. When the latter is put on, the rolling should be continued in wet weather, or the metal thoroughly soaked with an ordinary watering cart. When finished the road should be thoroughly compact and solid, able to resist without displacement the heaviest load passing over it. Extra labor and expense in the first construction of gravel or macadam roads is more than made up by the decreased cost of maintenance. Bad roads are expensive.

The paving of city streets was referred to in a paper on "Highway Legislation," by Prof. Francis Wayland, of Yale. For cities he advocated compelling the street car corporations to pay for keeping a certain space on each side of, as well as between the tracks, in good order. This is only equitable, because by diminishing the amount of room which can be used by vehicles they add greatly to the wear and tear of the remainder. It was, moreover, suggested that a tax should be levied on vehicles in proportion to the amount of injury which they were capable of doing in their daily use. There seemed to be an injustice in calling on abutters to pay a considerable part of the expense of repairing a street which would have needed almost no repair but for the damage caused by heavy carts. If the amount of this wagon tax were used exclusively for street repairs it would go far toward a reasonable solution of the problem.

### Warming of Public Buildings.

BY B. SCHREINER.

In planning heating systems for public buildings (or private buildings for that matter) we find that each case presents its own peculiarities and requires to be studied separately. In general, however, the scope available for the designing of an efficient service for warming a building depends on whether in making the plans for the building, proper care has been taken to secure ventilation and the best warming device, or whether the building has been planned regardless of warming and ventilation. But as the results desired are the same in either case, and only the ways and means to be applied to secure those results differ, I will view this question of warming public buildings, first as, to the result desired, and second, as to the means to apply to secure those results.

1. The object of warming any building is to protect its occupants, not only against the inclemency of atmospheric disturbances and rigid temperatures, but to insure and maintain such temperatures in any part of the building, as will be required for the well being of the same.

As pure air in passing through the lungs becomes charged with carbonic acid, becomes unsuitable for breathing, it is essential that the vitiated air be quickly removed, and pure air be continually supplied. As the occupation of the people inhabiting those buildings may vary, requiring air of a different degree of temperature, and as some of the rooms are usually more exposed to the outside atmospheric changes than others, means must be provided to maintain at all times such temperature in each room as is conducive to the well being of the occupants.

Warming a building, expressed in other words is, to supply the occupants of a building with pure air, delivered in sufficient quantity, and at such temperature as will create the feeling of comfort and well being.

2. To obtain the best results for the warming of a building is to provide for the same when the plan for such building is under way. The selection of a particular system of heating, whether steam heating direct or indirect; or if hot water plant; or if hot air arrangement is to be selected, may often depend upon the money available, or other local conditions. But whatever system is selected, never forget that a thorough ventilation is an important part of the heating plant.

As I am speaking more particularly of warming public buildings—of building larger size—and when sufficient funds for the installation of the best are available, I would say that experience surely directs to the adoption of the indirect steam heating system as the most serviceable device. In basements sufficient room can always be secured for the placing of the required heating surface, for boilers and diverse necessary heating machinery, for the placing of the required devices for purifying the air supply and exhaust machinery.

The heating surface should be calculated amply to supply any quantity of warmed pure air with low boiler pressure. The cross-section of the hot ducts and exhaust channels, should be calculated large to insure a complete change of air in any room, in the shortest required time, without causing draft or violent moving of the air in the rooms.

The time required for a complete renewal of air must be ascertained from the size of the rooms, and the largest number of people who occupy the room. The volume of pure air, required by a pair of full grown lungs, the required humidity of the air, the proper temperature of air reaching the lungs, etc., is now taught in every common school.

To secure efficient exhaust of foul air, we can use exhaust fans, heated air shafts, or both; or we may elect to force the warmed pure air into the rooms, and thereby force out the vitiated air. Whether to apply the exhaust system or the pressure plan, or both combined, will often depend on local conditions; i. e., on the arrangement of the rooms in the building.

To secure a slow, uniform movement of the air, and a uniform temperature throughout the room, place the warm air inlet near the ceiling, and the exhaust (foul air) opening in the floor near the coolest side of the room. A slow (nearly imperceptible) downward movement to exhaust channels is sufficient.

To secure the health of the occupants of a building, it will always be necessary to provide ample appliances for the purification of the air supply, and for the mixture of the proper degree of humidity. Such appliances should work automatically.

As already stated, it is not so very difficult to design an efficient device for warming (and ventilation) of a building, when done in connection with the designing of the plans for the building. But the construction of a well working heating plant, for building already constructed, without any attention to heating and ventilating, is always extremely difficult, and often impossible without involving extra heavy expenses.

The designing of a satisfactory heating plant requires considerable thought, calculations, and a thoroughly practical knowledge of the subject and its details; and I would advise designers of public buildings, if not themselves fully competent, to employ the services of one who knows, and that even architects and Engineers who are pretty well versed in such work, will do well to consult some engineer, known as a specialist in the line of heating large buildings.

Since the visit of the Provincial Road Commissioner to Galt, in September, that town has purchased a rock-crusher and is advertising for tenders on a steam road-roller.