

### Cast Iron and Steel.

Cast iron, wrought iron and steel are now extensively used in the construction of highway bridges, and it may be of interest to municipal councillors to know the true difference between these materials. In order that they may be in a position to judge between them when the merits of the different bridges are being urged by manufacturers and contractors. They differ from one another by reason of the amount of carbon contained in them. The proportion of this ingredient may range from perhaps five per cent. to zero.

Cast iron contains the largest percentage of carbon, say from two to five per cent., which carbon it gets from the fuel. The ore, mixed with coal or charcoal, and with limestone as a flux for the earthy constituents of the ore, is melted in a blast furnace. The ore, fuel and flux are charged in at the top, and the molten iron is drawn off at the bottom, the process being continuous. Although the slag floats on the melted carbon, the cast pig, which has taken up all the carbon it has an affinity for, contains also some slag and other impurities. When broken it is seen to be crystalline in appearance, and it differs in grade from white to grey cast iron, according to the temperature of the furnace and abundance of fuel.

Direct process for making wrought iron or steel from the ore may be employed, but they have generally been wasteful of iron. White pig iron is commonly been melted in a cupola furnace and then run into a bessemer furnace for manipulation which consists principally in its exposure to currents of air to burn out the excess of carbon. Other impurities may at the same time and by the same means be reduced in amount or burned out.

To explain why iron bars are fibrous: in the old-fashioned puddling furnace the surface of the melted pig iron is exposed to a blast rich in oxygen, and is stirred by the puddler to hasten the burning out of the carbon. As the carbon is thus removed the melting point rises and the iron becomes thick or pasty. Cast iron does not take on this intermediate state between fluid and solid, but wrought iron does, and hence can be welded. The semi-fluid iron is collected into a lump by the puddler and withdrawn from the furnace. It is then like a sponge, the particles of wrought iron have adhered to one another, but each particle of iron is more or less coated with a little film of slag and oxide as water is in the pores of a partly dry sponge. The lump of iron is put into a squeezer and the fluid slag and oxide drip out as water does out of a squeezed sponge. But as it is impracticable to squeeze a sponge perfectly dry so it is impracticable to squeeze all the impurities out from among the particles of metallic iron. In the subsequent processes of rolling and rerolling, each globule of iron is elongated but still coated with this film of slag and oxide; so that the

rolled bar consists of a collection of threads of iron. That wrought iron is fibrous is then an accident of the process of manufacture and not a property which is particularly beneficial. If these impurities had not been in the iron when it was rolled it would have been more homogeneous and stronger.

The appearance of fibre in the fracture of a bar which is nicked and bent is not especially indicative of toughness. Soft steel is tough and ductile without being fibrous. If the surface of an iron bar is planed smooth and then etched with acid the metal is dissolved from the surface, and the black lines of oxide are left plainly visible. If the iron is twice cut up into pieces, piled and reheated and rolled, it makes double refined iron, the grade used for good iron bridges, and superior to single refined iron. The tensile strength of the former is about 50,000 pounds, varying with the size of the bars; that is, the more work done in rolling, the stronger the iron. The compressive strength, owing to its ductility, is rather low, from 36,000 pounds to 40,000 pounds.

Latterly the manufacture of what is known as soft steel or homogeneous metal, has been brought to such perfection that steel competes in price with wrought iron. Steel is made from pig iron by several processes—the Bessemer, open hearth and others, all of which have for their main object the burning out of the carbon, either completely or nearly so. Some other substances, which may be classed as impurities, may also be reduced in amount at the same time. The process is a comparatively rapid one, several tons often being acted upon at once, and the heat generated by the union of the carbon with the oxygen of the air is sufficient to keep the mass fluid, although the melting point rises.

If the product, when practically free from carbon, is run into moulds and the resulting ingots are rolled, the material is known as soft or mild steel, ingot iron or homogeneous metal, but it is only iron freed from carbon, purer and stronger than wrought iron.

The common soft steel which is used for tension members of bridges and for pieces exposed to violent use, shocks and vibrations, does not probably contain more than .10 to .12 of one per cent. of carbon. Steel, properly so-called, will harden and temper, and it will not weld, but as the percentage of carbon falls off it loses the property of hardening and tempering and takes on the property of welding.

As to the effect of climate and temperature on soft steel, we might say that hard steels are thought to be effected by cold more than soft steels, but we do not think there is any sensible difference in the resistance of soft steels from change of temperature. Of course the question has been discussed as to the breakage of steel rails in cold weather. We think such

breakages are as much to be ascribed to the rigidity of the frozen ground roadbed as to the action of cold on the steel.

### Wide Tires.—They Should Appeal to the Farmer's Selfishness as Well as His Patriotism.

While the movement for improved highways has not yet accomplished what was expected of it in some sections of the country, the agitation of the question has served to educate the people not only in relation to the value of good roads but also as to the means of preserving serviceable highways when once secured. It is now generally recognized that the use of wagons with wide tires is one of the indispensable aids to the maintenance of permanently good roads, and the near future will undoubtedly witness the practical desertion of the narrow tire for all heavy wagons.

The extent to which the value of wide tires has come to be recognized is shown by the fact that the State of New Jersey has already adopted a law providing for their compulsory adoption and is reaping the benefit in the possession of the best roads in the States. With wide tires in general use, even the present country roads will improve, for wide tires serve as rollers to make the roadbed more compact instead of cutting deep ruts as do heavily-loaded wagons on narrow tires.

One of the strongest objections raised against the proposed change is the loss which it would impose on farmers in compelling them to sacrifice their present narrow tires. Different suggestions have been advanced for the purpose of lightening this burden. In some places it is proposed to have the wide tire law take effect a few years hence, while others are considering the project of allowing to those who use draft wagons with tires not less than three inches in width, a rebate of one-fourth of their highway tax.

While the laws proposed are in some instances commendable as to some of their features, the chances are that this problem will be left to work out its own solution. It is a significant fact that farmers in Vermont are generally buying wide-tire wagons, because they are convinced of the many advantages of the increased width of tire for themselves as well as for the public highways.—Good Roads.

Five things are requisite to a good officer—ability, clean hands, dispatch, patience and impartiality.—Penn.

### Wide Tires In Demand.

The discussion of wide tires for country roads has created demand for such tires, not only for roads but also for farm use and many manufacturers have set about supplying the demand. Owners of lawns in Montrose would be glad of the opportunity to employ a cartman who used a wide tired wagon.—Montrose (Pa.) Democrat.