enough to hold as many forty-foot cars as the company will need to load and unload in any one day. In isolated places, where the cars are not set as often as that, the sidetrack must be long enough to allow for all the unloading and loading which must be done between each setting by the switch engine. Sidetracks for loading and unloading should in general be level. The rules of the railroad in question, of the state and interstate railway commissions and the state labor laws are the determining factors in the amount of room required for sidetracks.

Building Plans.—After the exact location of the site is determined, then the plans of the buildings may be prepared. It is a mistake to make the final plans of any building before its definite location is settled. The natural grades of the land itself, the streets, the points of the compass and the condition of the subsoil almost invariably change the plans to such an extent that they must be revised or redrawn. All of these conditions should be determined by an exact survey before work on the plans commences.

As before stated, the basis for the design of the factory building should be a complete understanding of the processes to be carried on in the building. Too many factories are built first and the machinery just put in, one piece at a time, after the building is completed. This usually results in the uneconomical use of the floor space, unused spaces occur in some parts and a congested condition results in other parts.

The first plans to be prepared should be complete machinery plans. A study should be made of the progress of the materials through the shop. In general, the manufacturing processes should be so arranged that there will be no lost motion. The various materials which go to make the finished product should all travel through the source of the through the various parts of the factory in such a way that they will arrive at the assembling-room without having travelled any greater distance and without having been transferred more times than is absolutely necessary. Leaving the assembling-room, the materials should go by the shortest possible route to the storage and shipping-rooms. This part of the work is, of course, best planned with the prospective superintendent of the shop. It is sometimes difficult to get the benefit of this man's detailed knowledge and experience without letting his narrowness of viewpoint blind the designer to the broader phase of the question.

As a rule, a good factory superintendent has spent the larger part of his life in some one factory. He probably has made that factory a success. That leads him to think that he knows all there is to know about that business. At least he thinks he knows more than any engineer whom the owners can hire. That is generally true, but his difficulty is that he is so close to his job that his perspective is warped. For instance, if ten years ago he tried a belt-conveyor in his factory which he bought and installed improperly himself, and then afterward abandoned because it did not do the work required, he is convinced that he does not want a belt conveyor in his new factory. The fact that belt-conveyors have been improved since he tried them and that there are thousands of them working satisfactorily under similar conditions will impress him only if you can overcome his prejudices. If you can make him feel that he and the engineer are working together to get the best possible design and that you realize the value of his suggestions, then, generally, it is possible to get him to listen to

The building should be built to suit the machinery. The columns and beams, the height of stories, the location of heating and plumbing pipes, the sprinkler system, the natural and artificial lighting should all be arranged to suit the machinery.

The economical arrangement of the structural parts of the building should also be taken into consideration in the arrangement of the machinery. If possible, the columns should not be spaced to suit special machines unless there is some very decided advantage in doing so. It must be remembered that the life of a building is several times the life of the machinery installed, and that the machinery of the future may be entirely different.

Types of Factory Buildings.—There are two types of factory buildings which are here considered separately. The first is the ordinary one-story building with a hiproof, which may or may not be surmounted by a monitor. It usually has large, unobstructed floor space to provide for the movement of cranes and other large machinery. The second type is the warehouse type of one or more stories in height. Industries which require a clear floor space of more than twenty-five feet in either direction are usually housed in one-story buildings, because it is expensive to carry the weight of upper floors on long spans. Where the materials manufactured are of such size that columns spaced from sixteen feet to twenty-five feet on centres are not objectionable the building of several stories is usually more economical.

A one-story building costs the most per sq. ft. of floor area. This cost per sq. ft. of floor area decreases somewhat with the number of floors built, up to four stories. Above that height the cost per sq. ft. gradually increases. There is comparatively little difference in the cost per sq. ft. of the floor area between a three and an eight-story building.

If basement floor space is suitable it is the cheapest which can be obtained, except where the loads to be carried on the first floor are extremely heavy. A one-story shop building in fireproof construction will cost from from \$1.25 to \$2.00 per ft. of floor space area, depending upon the height of the story, depth of footings, length of spans and kind of exterior finish used. Fireproof buildings of more than one story may be built for as little as fifty cents per square foot of floor area. These approximate figures do not contemplate any sort of plaster or interior finish except whitewash. They do include a properly finished cement floor. The cost per sq. ft., of course, decreases as the size of the ground plan increases. It is more for a long, narrow building than for a square building. However, a factory building should not be made too wide on account of the difficulty in properly lighting the interior. For ordinary factory work from 40 to 50 ft. is the best width. A building of this width can be lighted with a story height of from 12 to 14 ft. If the width of the building be made from 75 to 100 ft., then the story height should be increased to from 14 to 16 ft., the windows being placed as high as possible.

One-story shop buildings are usually built of what may be termed semi-fireproof construction. They are usually built of materials which will not burn, but cannot be said to be entirely fireproof, because the steel trusses are usually left unprotected, so that they might be damaged in case of fire occurring in the contents of the building. As before stated, the one-story plan is usually adopted where large, unobstructed floor spaces are required. This results in long-span steel trusses supporting the roof.

The most common type of roof is the "A"-shaped roof. This roof has many advantages. It is easy to keep watertight, it clears itself of snow easily, and with monitors or ventilators at the peak provides good ventilation for the factory. If these monitors are made wide enough