

engineer to cover up his own carelessness or ignorance by requiring the provision of things which could not be read into the contract by any fair-minded person.

Strict adherence to plans and specifications and to the interpretations placed upon them by the engineer should be required in the contract. This is, of course, presupposed in the undertaking of the work by the Contractor, but it is nevertheless not amiss to point out in the general clauses of the specifications that he will be held rigidly to the written requirements and that he should in no case count upon the leniency of the engineer in releasing him from an onerous obligation.

Responsibility for accuracy of plans and specifications lies, in general, with the party who made them. If the work is done in accordance with the detailed instructions of the engineer and these are found to be erroneous, the Contractor is not liable, unless perhaps he had entered into the absurd agreement to guarantee the engineer's plans and specifications. If the Contractor prepares the detail plans, he, in this case, must assume the responsibility. Approval of these plans by the engineer does not release him, and it is generally so stated in the specifications.

The feasibility of a proposed scheme is in effect guaranteed by the party who proposes it. If the engineer requires a cofferdam to be constructed in a certain manner and it fails, his principal, the Owner, must bear the expense of the failure. If, on the other hand, the Contractor had put forward the proposal, even though the engineer had allowed the work to proceed without protest, the Contractor is responsible. Sometimes, also, the engineer accepts an entire scheme proposed by a Contractor, such as the finishing of new or special materials, machinery or devices, and since the Contractor is by reason of his special experience better acquainted than the engineer with the nature and performance of what he proposes to supply, the former may, by the specifications, be required to guarantee the workability of that part of the construction or equipment provided by him.

(4) **Character of Work.**—Apart from the description in the specific clauses of the specification of the kind of work required in each class, it is well to cover the character of all work in a general way, and in addition to establish the conditions which must be instituted and maintained by the Contractor as an essential of good work. He should be required not only to deliver up to the Owner in the completed structure the best materials and workmanship customarily obtainable, but he should be called upon to provide labor, tools and appliances of a character necessary for the performance of work of this class required. It should further be stipulated that all defective work must be removed and made good at the expense of the Contractor before final approval is granted. The possible refusal of the Contractor to do this should be anticipated by a provision that the Owner may remove such work himself and deduct the cost from any moneys due the Contractor.

(5) **Inspection.**—The fullest privileges of inspection must be retained by the Owner if entire confidence is to be placed in the work. To this end the Contractor should be required to furnish to the selection of the inspector samples of cement, sand, gravel, steel, and all other materials requiring laboratory examination. Sometimes, as in the inspection of structural steel at the mills, the contractor is called upon to provide the necessary testing machines as well. In field inspection, the right of opening up work which has been covered should be secured to the Owner, or his engineer, but if investigation shows such work to have been in accordance with the contract,

the Owner should be required to pay for the cost of the opening up. No materials should be allowed in the work which have not had the final approval of the inspector before use. Cement, for example, might be thoroughly satisfactory as tested at the mills or as disclosed by samples taken from the cars, but due to careless handling or storage might be seriously impaired by the time it was incorporated in the work. It is a safe rule to specify, in addition, that all condemned material shall be immediately removed from the site of the work. If allowed to remain, it is surprising how readily it finds its way into the structure.

Many times in the experience of every engineer there arises the embarrassing situation where imperfect work has been approved by an inspector, or while, perhaps, not definitely approved, has been allowed to be put in without protest. In such circumstances the Contractor very naturally takes the position that the work has been done to the satisfaction of the engineer, or to that of his representative, and, therefore, ought not to be replaced. Such an attitude on the part of the Contractor is indefensible, for the reason that conformity with the contract is the standard of acceptance, and if it can be shown at any time before final approval of the work and the taking over of it by the Owner, that the work is not in accordance with the contract, the Owner may require the Contractor to make such alterations as may put it in a condition to satisfy the demands of that instrument. Approval of defective work through oversight or failure to point out faulty construction during its execution does not relieve the Contractor of the responsibility of providing at the close of the work precisely what the Owner called for in the contract.

(6) **Conduct of Work.**—Although, broadly speaking, the engineer is interested only in the character and acceptability of the completed work, he should retain sufficient powers over the Contractor's operations to not only ensure safety, speed and freedom from disputes during construction, but also to require reasonable assurance that the methods of the Contractor will result in ultimate success. At the outset, full protection of the public from accident by means of fences, barriers, covered passageways and lights should be demanded, and if reasonable safeguards for the Contractors own employes are not required, they at least should be required for the employes of other Contractors and for the representatives of the Owner. In addition, the stakes, hubs and marks placed by the engineer or his assistants should be the objects of protection. Work should be allowed to commence only at such places and times as may be mentioned in instructions from the engineer, and the order of prosecution of the work should be under his control. Only in this way would it be possible to have one Contractor conform to the needs of another and to the exigencies of the whole constructional scheme. Direction of the Contractor's forces should be in the hands of a competent and responsible foreman, satisfactory to the engineer. Whatever the character of the foreman may be, however, he should be constituted the official representative of the Contractor in the absence of the latter, and, therefore, qualified to receive instructions from the engineer. Otherwise, an unwilling Contractor might make it exceedingly difficult to deliver disconcerting instructions. In order that completion on time may be facilitated and the engineer's arrangements as a whole safeguarded, he should have the right to order an increase of the Contractor's force if thought necessary, and if the character of the Contractor's employes is objectionable and not suitable for the performance of the class of work required by the contract, the engineer