|  |  |  |  |
| --- | --- | --- | --- |
| size from this may be judged of by the following examples on railways. | | | |
| **Yards long** | | Ft. high. | Ft. wide. |
|  |  |  |  |
| Liverpool and Manchester Railway tunnels—Wapping to Edge Hill | 2200 | 16 | 22 |
|  |  |  |  |
| Lime Street | 1 mile | 19 | 25 |
| Primrose Hill, London, and Birmingham Railway.... | 1250 | 25 | 22 |
|  |  |  |  |
| Kilsby ditto | 2420 | 27 | 23½ |
| Canterbury and Whitstable | 880 | 12 | 12 |
| Leeds and Selby | 700 | 17 | 22 |
| Whitby and Pickering | 130 | 14 | 10 |
| Leicester and Swannington | 1760 | 13½ | 10¾ |

In the agreement entered into with the contractor, the price of the contract, and a schedule, by which any extra or additional works are to be executed, should be stated; and likewise the mode of payment, and the nature of any reten­tions. The time for completion, and fines for exceeding this time, should be clearly and distinctly laid down ; with the condition that all payments are subject to the engineer’s ap­proval of the work. The contractor should find all tools, machinery, labour, and materials of an approved kind, get­ting out all foundations, excavations, shafts, culverts, drains, roads, &c. ; and he should provide all centrings, coffer-dams, pumping apparatus, scaffolding, fencing, and other requisite materiais of every description, according to the specifications, plans, and drawings, and the instructions which he may from time to time receive from the engineer. In the case of a railway, he should lay the permanent way, the materials being in this case found for him ; and io a canal he should construct all the locks and gates, if there arc any at either end of the tunnel, and form the towing-path. When he does not employ a sufficient number of men on the work, the engineer should have power to engage more, after giv­ing him a week’s notice of his intention. These may be re­tained temporarily or permanently, as may be required, and in all cases using the contractor’s materials, the men’s pay be­ing deducted from the price of his contract. The engineer should also have the power of ordering the discharge of any foreman or workman acting improperly, or doing his work with carelessness ; a power which he should be cau­tious not to use without strong reasons. The ground over the tunnel should be fenced off previously to commencing the work. The contractor should be restricted from enter­ing on any adjoining land without leave ; and if this should be necessary after the leave is obtained, the required land should be immediately fenced in. Temporary roads, for the conveyance of materials from the high roads, when re­quired, should be formed by the contractor ; as also those necessary for conveying away the spoil-earth. If the com­pany who are forming the tunnel are called upon by any of the surrounding occupiers, they should have power to compensate them for any damages, and to place the suras thus paid to the contractor’s account.

The contractor should not be allowed to sublet any portion of the work without permission in writing from the engineer. He should also be bound to take down or otherwise alter any work not approved of by the en­gineer, and to remove all unsound materials. All mate­rials, from the moment they arc brought on the site of the works, become the property of the persons for whom the tunnel is made, and the contractor must not remove them again without permission ; but the company or other per­sons making the tunnel are not to be answerable for the damages which any materials may sustain. These and simi­lar clauses in the agreement, are of course only provided for cases of emergency, and would seldom require to be acted on. The contractor should make all the alterations and ad­ditions which he may be instructed to do by the engineer, and no others. He is to be furnished with copies of the plans, sections, and other drawings, also of the specification, and is himself to see if these are correct ; he is also to do all that may be reasonably implied, although not actually expressed, in the drawings and specification. It is usual to deduct ten per cent. from the payments ; the whole of which is not returned to the contractor till twelve months after the completion of the work, he being bound to keep it in re­pair for that length of time. The payments are in general made monthly, including those for extra and additional works, after being approved by the engineer, who is to cer­tify the same. It is also usual in large works of this kind, when the contractor has more than two millions of bricks on the site of the work, to allow him half or two thirds of their cost.

' When the tunnel is for a railway, the company deliver the permanent-way materials at the nearest convenient place, and the contractor brings them to the works, defray­ing the charge of wharfage, if any. In the event of any dis­putes, the decision of the principal engineer is in all cases to be final.

The drawings should consist of, 1. a general section of the tunnel longitudinally, containing all the measurements to an exact scale ; the positions of any ventilating shafts if such are required ; their length, breadth, thickness of brick­work, &c.

2. Views of the fronts and wings, with plans and sections of the foundations and wing-walls, showing the curves and batters.

3. Plans and sections of the ventilating shafts, and the iron-work connected with them on the working shafts.

4. Transverse sections of the tunnel, with any other de­tails as to drains, and all other necessary information ; and plan and section of fronts.

5. A general plan of the property through which the tunnel passes, showing the width to be fenced in.

6. If for a railway, plans of the rails, blocks, and the mode of laying them. If for a canal, plans of the locks and gates, with all other necessary details.

The specification should define in words the situation and termini of the tunnel, and the number and dimensions of the locks, if for a canal ; and should then enumerate the various works, such as fencing off the ground above, one chain in width, till the tunnel is completed ; sinking ven­tilating and working shafts ; excavating and building the tunnel; building the fronts; laying the drainage; excavating in open cutting at each end, if required; forming and turf­ing the slopes, and fencing and ditching them, and the tops of the fronts ; depositing all the earth in a given place, so as, when soiled, to he fit for agricultural purposes ; ballasting and laying the way, if for a railway ; but if for a canal, mak­ing all the necessary locks and feeders, forming the towing- path, building lock-houses, deviating roads if required, and keeping the whole in repair for one year.

The temporary fencing should be on each side of the tunnel one chain in width, between which all work and ma­terials arc to be comprised. It should be of split oak posts nine feet apart, mortised for the reception of three hori­zontal oak or larch bars ; the posts three and a half feet above ground, and the bars having one intermediate stay or prickpost firmly nailed to each of them. This fencing should be substantially fixed previously to the commence­ment of any other work, so as to exclude sheep and cattle from the intermediate space, and protect the surrounding land from damage. On the outside of the fencing a ditch should be formed, four feet wide at the top, one foot wide at the bottom, and one and a half foot deep, communicating with any existing water-courses or drains, so as effectually to prevent any of the shafts which may be sunk from in­jury by the overflow of water during the progress of the work. The strictest attention should be paid to this stipu-