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The Valuation of a Variation

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Most forms of contract provide a mechanism whereby the employer, via the engineer or architect, may issue variations during the progress of the works. Those same forms of contract generally also provide guidance as to how such a variation should be valued. Notwithstanding such guidance, I find it surprising that such valuations often neglect to consider the application of anything other than Bill of Quantity rates. Therefore, putting to one side the effect of such variations upon the ability of the contractor to complete by the original Date for Completion, the following text considers the valuation of the measured work content of a variation.

By way of example I consider the changes that could occur to a simple underground pedestrian walkway. The Tender Drawings showed the elevation of the walkway as follows:-

During excavation a bank of uncharted services was found. The Engineer / Architect decided that in order to minimize the impact upon the Date for Completion, the profile of the underground pedestrian walkway would be revised to that shown below:-

Assuming that the quantities have been correctly re-measured, the question is, what matters should be considered when applying the rates to this variation.

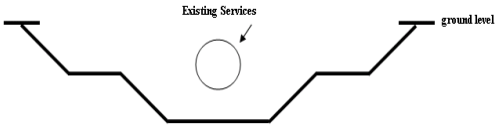
The changes affect the following elements of work:- Earthworks, Formwork, Steel Reinforcement and Concrete.

Therefore, giving consideration to each of these elements I make the following observations :-

Earthworks :

It is clear that the excavation now extends deeper than originally planned and this will affect the depth range within which the maximum depth falls and, hence, should be measured. As the Bill of Quantities already provided a rate for excavating at this greater depth range, the engineer elected to apply that rate. However, the contractor may also wish to bring the following matters to the engineer's attention as they all affected the valuation of the work:-

1. It was originally intended that the volume of excavation displaced by the structure, which was not required for backfilling, would be loaded into transport and immediately removed from the site to a tip. The excavated material, which was required for backfilling, was intended to be stored in spoil heaps adjacent to the excavation thereby avoiding the need for multiple handling. However, limited space was available adjacent to the excavation and, accordingly, the additional volume of material required for backfilling



could not be stored in the intended manner. Instead, it had to be loaded into dump trucks and transported a distance of 100metres to where space was available for storage. In preparation for this activity, the surface of the storage area had to be stripped of vegetation and prepared for use. Tarpaulin sheets were required to protect the material whilst stored and, thereafter, further excavation and transportation was required to load and return the material for backfilling. The storage area then had to be returned to its original condition after use.

2. Whilst the Bill of Quantities contained a rate for excavating at this greater depth, the structure to which that rate applied was of considerable dimensions on plan. Hence, the allowance for earthwork support per m3 of excavation was relatively small in comparison with the structure now being considered.
3. Further, the condition of the subsoil in the area to be excavated was of lesser integrity than that of the larger structure, hence, the integrity of the earthwork support had to be increased proportionally and, in some areas, steel trench sheeting had to be used with crossbracing.
4. The increase in excavation depth dictated that the last 500mm was to be excavated below the water table level and gave rise to considerable dewatering. In comparison, the larger structure was located in a comparatively dry area of the site where excavation was unaffected by groundwater.
5. Being saturated with water, the material excavated from below the water table was heavier than the material originally intended to be excavated, hence, less volume could be loaded into each tripper truck as each truck had a defined weight restriction. Less volume per truck requires consideration for a greater rate per volume.
6. Further, the wet material could not be taken to the intended tip and, although an alternative tip was located, it was an additional 10km away. Hence, the transportation costs per m3 increased as did the tipping fee for what was considered to be deleterious or unsuitable, material.
7. Great care, including an amount of hand excavation, had to be implemented when excavating in the location of the existing services. In comparison, no existing services were in evidence at the location of the larger structure.
8. Temporary support to the existing services had to be provided whilst work in that area was undertaken.

9. Preparation of the excavated surface below the water table required a different process to that originally intended for preparation of surfaces above the water table.

10. Ground bearing pressure tests were now required to be undertaken to both the upper and lower levels of the excavated surfaces .

Formwork :

1. The change in profile dictated far greater setting out than that originally required and, hence, increased the surveying costs.

2. The number of uses of the formwork panels was now reduced and, hence, the unit rate per m2 should be proportionally increased.

3. Additional formwork panels were required to accommodate the downward step in the walkway profile. These had limited uses, far less than had been anticipated from the Tender Drawings of the original scheme.

4. Working conditions in the lower part of the excavation (i.e. that part below the water table), even with dewatering, were difficult and, coupled with the greater time required to provide materials to the workface and the less repetitive nature of the work, reduced productivity.

5. The revised profile and crossbracing increased the number of construction joints.

Reinforcement :

1. The original scheme required bent bars to be provided to accommodate two changes in direction only. The revised scheme required four changes of direction which required a larger percentage of bent bars. This affected not only the cost of material provision but also the productivity of steelfixing.

2. Reinforcement was stored in racks on the Site. The increased quantity of reinforcement dictated that an increased quantity of storage racks had to be purchased. This, in turn, dictated that the area designated as a bending yard had to be increased in size, which also increased the length of the temporary perimeter fence to the bending yard. The site area had to be prepared and later returned to its original condition.

3. In order to secure a more competitive steel price, the contractor had placed a bulk order with its steel reinforcement supplier at an early date for all the steel on the project. The instruction to change the profile of the pedestrial walkway was not issued until several months into the project. Due to the global increase in steel prices the additional steel reinforcement could not be purchased for the same unit rate per tonne.

Concrete

1. The increase in depth of the structure dictated that the concrete agitator trucks could no longer reach the point of placement for the concrete to the lower levels. Hence, different methods had to be considered such as pumping the concrete or placing by crane and skip.

2. The number of construction joints increased and, because the lower levels were below the water table, the Contractor had to incorporate waterbar at these locations.

Implications

In summary, there are many ways that a simple variation can impact upon a contractor's costs. From my experience, few of these are ever properly recognized by engineers and/or quantity surveyors. It is not just a simple exercise to value the works at rates in the Bill of Quantities as, more innovation is required if the contractor is to recover its proper entitlements.