ARTICLE

# What Is the Planned Duration of a Construction Activity?

The planning, programming and scheduling of construction projects relies on the identification of the planned activities, their logic inter-relationships and their durations.

This article reviews and determines how the planned durations of construction activities in programmes and schedules are estimated and established, and the need to consider the appropriate level of accuracy when doing so.

The use of the word 'estimated' as opposed to 'calculated' is deliberate. Although the planned duration of a construction activity may well be the result of a calculation, the various factors used in the calculation are often only estimations.

As an accomplished and experienced construction professional of over 45 years, who has worked exclusively in the field of planning, programming and scheduling, and in the analysis of delay, and in dealing with time related issues on construction projects; typically I would expect the planned duration of a programme construction planned activity to be the result of the following estimated calculation:

$$\frac{\text{Quantity of Work x Production Output Rate}}{\text{Labour Resource Assignment}}$$

As can be seen from the above formula, there are three separate variables which determine the planned duration of any individual construction activity.

First, is the 'Quantity of Work'. This could be, for example, the tonnage of rebar.

In order to establish the quantity of rebar in tonnes associated with the relevant programmed construction activity, the extent or scope of the activity needs to be defined, for example, 'Basement Slab - Area 1'.

However, in the early stages, when the programme is being developed, the Basement rebar bending schedules would probably not be available, and so the exact quantity of rebar for the Basement Slab - Area 1 would not be known.

Therefore, in order to establish the relevant rebar quantities, an approximate take-off of the quantities from the drawings is carried out, or an estimate is made from industry accepted rebar factors, or the quantities in the Bills of Quantities ("BoQ") are used (which might also be approximate and subject to re-measure).[1]

[1] NB. The quantities in the BoQ are only re-measured if the BoQ is an approximate quantities BoQ; however, with a lump sum contract the quantities would not be re-measured.

Second, is the 'Production Output Rate'. This is where standard production output rates (industry standard rates, or in-house company rates, or another source) should relate to the size, diameter and tonnage of the rebar to be fixed in the Basement Slab - Area 1.

However, as noted above, in the early stages, when the programme is being developed, the Basement rebar bending schedules are unlikely to be available, and so the tonnages for each size and diameter of rebar would not be known. Accordingly, an average has to be estimated or assumed, and hence the production output rate is usually an average estimate.

Even if the Basement Slab - Area 1 rebar bending schedules are available, and so the tonnages for each respective rebar size and diameter are known, whilst the rebar quantities will be more certain, the production output rates will still need to be considered and verified.

Careful consideration needs to be given to the applicable production output rates including verifying the source of the rates, whether they are applicable for the type of project under consideration, whether they are suitable for the location/situation, and/or are relevant to the particular site, and in the country in which the project is based. Appropriate adjustments should be made for any variations from the base criteria adopted to reflect the foregoing.

In fact, in addition to the foregoing, there are many other dynamic factors and aspects to be considered when establishing appropriate production output rates, such as the distance from the rebar storage yard to the site, whether the rebar is pre-cut and bent, the depth of the Basement, any site constraints including ingress and egress availability, accessibility of the work front, any limitations as to how many workers can be deployed to work in a particular location and other similar considerations.

Notwithstanding, the most common problem encountered is usually where to obtain source data for a starting base production output rate, before all of the other factors are taken into account, in order to establish the most appropriate production output rate that is as accurate and reliable as possible.

In my experience, most industry standard production output rates, will be in-house company rates derived from a contractor's experience of productivity gained on previous projects, and so are often private and confidential and usually not available to external planning, programming and scheduling practitioners.

Other sources of standard production output rates, include; industry produced pricing and estimating books, which provide construction industry standard production output rates and market prices. Such publications include Spon's, Laxton's, BCIS Wessex, PSA, Hutchins, and other construction pricing and/or estimating books which are widely available in the market.[2]

However, in the writer's experience, these pricing and estimating books tend to be very generous with respect to production output rates, as they include various contingencies, and so, if these rates are used for programming and pricing purposes, without adjustment, they are unlikely to be competitive.

Indeed, as alluded to in the preceding paragraphs, most contractors tend to maintain their own suite of standard production output rates, ranging from general or 'rule of thumb' guidelines to more sophisticated databases, with comprehensive 'detailed' standard production output rates for various construction activities.

Contractors' own production output rates are generally based on past performance, previous experience, prior projects and work-studies in the field. However, the accuracy of such data will be determined by how often the data is tested, maintained and/or updated. Also, it should be remembered that no two construction projects are ever really the same, so adjustments to the rates should be made on a project-by-project basis, but in my experience, often this is not the case.

In the writer's opinion, the keeping and maintaining of an accurate database of detailed standard production output rates, is essential if the contractor wants certainty and confidence, not only in planning, programming and resourcing of the works, but also in the pricing the works for tender bidding purposes.

In my experience, it is generally acknowledged in the construction industry that much of a contractors tender pricing will be based on rates and prices provided by sub-contractors, with a contractor adding a markup for overheads and profit recovery. Accordingly, much of the potential risk associated with the production output rates is dissipated through the supply chain.

[2] Spon's Suite of Price Book compiled by the cost consultancy team at AECOM, Laxton's Suite of Building Price Books by V. B. Johnson, BCIS Wessex Comprehensive Building Estimating Price Book - Major and Minor Works by the RICS, PSA Schedule of Rates for Building Works by Carillion, Hutchins Priced Schedules Price Book by Griffiths and Hutchins.

However, in such circumstances, contractors will be wholly dependent on the accuracy of a sub-contractor's pricing and would therefore be advised to run some cursory checks with the sub-contractor on the basic productivity assumptions adopted by the sub-contractor when pricing the works.

Where a particular sub-contractor has used production output rates in its planning and pricing of its works, that are too low and/or inappropriate, then it will not be long before problems start to manifest, and for the sub-contractor to look to the contractor for financial assistance to overcome the problems that arise from poor productivity estimates.

Returning to the main focus of this article, when a production output rate has been established (optimistic or pessimistic) then the first part of the estimated calculation of the duration of each planned construction activity, multiplies the 'Quantity of Work' by the 'Production Output Rate' the product of which is the number of labour man-hours or man-days estimated or calculated to be required to carry out the relevant planned activity.

In the current example, the rebar to the Basement Slab - Area 1, if the rebar tonnage amounts to 40 tonnes and the production output rate is 24 hours (or 3 man-days) per tonne, this equates to 120 man-days, and so establishes the first part of the estimated calculation of the activity duration.

The third element of the calculation is to establish the 'Labour Resource Assignment' which considers the numbers of labourers/workers to be assigned/allocated to the planned work activity, which will, in turn, determine the duration.

Therefore, in the current example, if six rebar workers are allocated/assigned to carry out the fixing of the rebar to the Basement Slab - Area 1, then the planned duration of this work activity would be 20 working days (i.e., 120/6=20).

Accordingly, if eight rebar workers are allocated/assigned, the duration will reduce to 15 working days, whereas if four rebar workers are allocated/assigned, the duration will increase to 30 working days.

The planner's task would be to objectively review feasibility to establish the optimum level of rebar workers (in our example 4, 6 or 8 or more) that can be allocated to this particular activity, which is likely to be an estimate based on the experience of the planner.

The key message here being, that once the number of man-days to carry out the planned construction activity has been established, the duration of a planned construction activity is thereafter dependent of the number of labour workers that are assigned to the particular work task.

Often the activity time slot is pre-determined, to a certain extent, by the contract. If, in the current example, in order to meet the timeline in the contract, only 15 working days can be spared for this activity, the labour allocation would have to be 8 rebar workers. The deployment of less than 8 rebar workers would mean that the contractor would take longer to complete the work and would not meet this particular completion obligation.

It should also be noted that the activity duration can be affected by a multitude of other factors, such as the tools and equipment used, the working method adopted, the cranage availability, or double handling, or in this example, the use of pre-fabricated rebar cages, which would save time spent on the in-situ rebar fabrication and therefore reduce the on-site activity duration.

The planner might however decide that the optimum level of rebar workers that can be allocated or assigned to the planned activity Basement Slab - Area 1 is 6 (based on the Basement area and size, accessibility, cranage time allocation, no pre-fabrication of rebar) and so the duration of the activity inserted into the programme would be the 15 working days.

In fact, programming software packages have a facility whereby activity durations can only be generated by inputting quantities, production output rates and resources, and so do not allow the planner to insert (guessed!) durations, with only a start and end date.

In my opinion, this facility should be the standard default setting, to force planning practitioners to properly work out the planned durations of programme activities.

As in my experience most activity durations that are inserted into the programming software have no build-up and no resource allocation, and so are of little use to the planner or the analyst.

A further point to consider at this stage, is that the rebar quantity (40 tonnes of rebar), and the production output rate (24 hours (or 3 man-days) per tonne) that has been used to establish the number of man-days in the estimated calculation of the activity duration, should correlate with what included in the BoQ for this work, and the same as (or better than) the production output rate that has been used in the pricing of the tender.

So, where the planner has settled upon a planned duration of 15 working days for the fixing of the rebar to the Basement Slab - Area 1, based on an allocation of 6 rebar fixers, all seems to be good, or is it? It should be remembered that the planner's calculation is still based on:

— a quantity which might not be accurate;

— an average expected production output rate which might not be wholly applicable; and

— a decision with respect to the allocation of the optimum level of workers required which might not be feasible.

It is recognised that, in addition to the various factors and aspects already noted herein, there are many more that may from my experience need to be considered when estimating/calculating the planned duration of an individual construction activity, these include, but are not limited to:

— methods of working / construction methods adopted;

— the location and size of project, and proximity to other buildings

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— environmental considerations, including anticipated weather conditions;

— efficiency, repetition and familiarity with the work;

— complexity, uncertainty, continuity of work;

— material supply, order and sequence of working;

— optimal deployment of plant and equipment;

— skill level and availability of skilled workers;

— quality of supervision and management;

— imposed constraints, hours of daylight;

— economic factors, travel restrictions; and

— motivation of workforce, holidays, absenteeism, influence of unions.

However difficult and complex the task might be, a realistic/accurate estimation/calculation of the planned durations for programme work activities is vitally important, as they are a key element in the formulation of the programme of work on which the contractor's progress will be monitored, delays assessed, and claims formulated.

A further key objective of the construction planner is to establish the expected level of efficiency, productivity and output to take account of all of the potential variables that may occur on any given project. This is where the experience, skill and judgement of the planner is paramount. In order to achieve this objective, the planner will often need significant input and assistance, not only from the project manager, but also from the other key members of the project team.

In summary, the preparation and formulation of a fully resourced and critical path networked baseline programme, which is properly considered and well thought through, is essential if it is to have any chance of working as an effective project management tool.

This is because this baseline of planned intent will be under scrutiny and critique, if actual production/output is lower than that planned or anticipated at tender stage.

However, if the baseline of planned intent has a solid basis, as it accounted for all factors known about at the time of drafting, so confirming that it was feasible from the outset, then claims for disruption, reduced productivity and/or inefficient working, should be a lot easier to prove and evidence.



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