PREFACE

Construction raises complex issues of the rights, obligations and remedies of parties in relation to the progress of the construction project in which they are engaged. The complexity of the issue arises from

a) the need to interpret the terms of the governing legal relationship between the parties, in order to fix the incidence of liability and to determine the measure of compensation if any,

b) the multitude of participants and events in a construction project, and

c) the difficulty of the principles of causation in law.

The Construction Enterprise

There are numerous discrete events that can affect the progress of a construction enterprise.

The overall enterprise is usually divided and scaled down into separate projects and phases and into manageable work packages carried out by subcontractors and suppliers. The division increases the number of participants and increases the possibilities of actions or inactions that affect progress. The possibility of organisational and communication problems between participants is accentuated by the frequent interdependence, both physically and in time, of each operation and process in the overall enterprise. Inevitably, the long overall enterprise period means that there are changes in personnel adding further to the possibilities.

The physical environment in which the construction enterprise is carried out will determine the incidence of events that will affect progress. Not all the events can be predicted or predicted with any accuracy. For instance, the geographic location of each project will determine the incidence of wind, wave, current, temperature or earthquake events. The site itself will comprise pre-existing physical conditions measured for instance by the nature and properties of ground strata, the existence of ground water and susceptibility to flooding, faults, swallow holes, the presence of capped reservoirs of methane and the presence of toxic materials in existing structures.

Other events relate to legal requirements such as import and export of machinery or health and safety or control of pollution or nuisance that may affect progress of each project.

The incidence and extent of liability for events is dependent not only on the nature and timing of the event but also on the allocation of risk between the parties. That may depend not only on express and implied terms of a contract in relation to the event itself, but also on the reactive obligations and on concepts of foreseeability, probability and remoteness in law.

Inevitably, in view of the complexity of construction enterprises each construction case needs to be considered on its own facts. Nonetheless, it is possible to identify legal principles that will apply.

The Principles of Causation in Construction Law

The modern developments in construction law which has affected causation issues have been the better understanding of risks in construction and the development and availability of powerful computers and programmes to analyse complex construction projects.

The question of causation in construction law raises difficult issues sufficiently frequently for it to have created a specialist area inhabited by experts using increasingly sophisticated programme analysis. Such opinion evidence is frequently unhelpful in resolving the issues.

In this Book I have attempted to explain the law of causation as I understand it applies to construction law and to identify the principles that need to be applied. I have set out the practical steps to be taking in the consideration of the incidence of liability.

In doing so, I have drawn from cases not only in construction but also in other areas of law. There is a risk in transposing considerations in one area of law to another, particularly where the decisions are heavily influenced by policy considerations and the need to administer justice. Nonetheless the concepts and general principles of causation and concepts of risk, loss of chance and apportionment developed in such cases provide a better understanding of causation in construction law.

Definition of Terms

I have attempted to use the common meaning of terms wherever possible and in particular as defined in BS 6079-2: 2000 Project Management Vocabulary.

The term “project” is used to define the particular part of the human endeavour such as the design by a firm of consultants, the manufacture of equipment by the manufacturer or the construction of a contractor and is the summation of discrete activities.

The term “activities” is an operation or process which usually will have a duration as well as consuming resources. The term is often used in practice to describe any line item in a programme. In that case the activity may be the individuals making up the design team, or the drawings and calculations, the parts of the equipment to be manufactured instead of the operations to be carried out to complete the construction and in that case may not consume any resource.

The term “events” is used to define an incidence that may have an effect on progress and the term includes the incidence of natural forces as well as human intervention by action or inaction.

The term “construction contract” refers to any binding contract for a project that involves the design and/or construction of buildings or any engineering works intended to be fixed to land.

The phrase “Employer” is used to describe the contracting party engaging the Contractor to carry out the project. Phrases such as “purchaser” or “owner” are also commonly adopted for the same relationship and in subcontracting arrangements the “Employer” under the subcontract will be the “Contractor” under the main contract.

The phrase “Contractor” is used to describe the contracting party engaged to carry out the project.

The Meaning of "Delay"

I have not attempted a definition of the term "delay" although it is used throughout this Book and in many decided cases. The term is understood in common usage to be a comparative measure of the difference in a measure of time between two situations from which the "delay" is inferred. The measure of time may be by date such as a completion date or a start dat, or by a period such as the duration of an activity.

That flexible meaning of the term "delay" is used in this book and its precise meaning is to be taken from the context in which it is used.

Examples and Illustrations

I have used examples to illustrate the operation of the legal principles together with graphic illustration using the linked bar chart presentation.

I have also used a simple project to explain the different methods of analysis. This theoretical project has been designed to illustrate the common difficulties and inherent inaccuracies that need to be considered in any analysis.

Daniel Atkinson September 2007

TABLE OF CONTENTS

TABLE OF CASES

1.33 Causation is a matter of inference and in construction is based on expert reports, but over-elaborate analysis should be avoided *John Doyle Construction Limited v Laing Management (Scotland) Limited* [2004] 1BLR 295 Inner House the Inner House.

1.34 It appears then that English law does not easily accept the results of scientific analysis. The concern is justified in relation to programme analysis in construction. The analyses are frequently flawed and there can be little confidence in the methods adopted. The facts are many, varied, and disputed. The experts usually admit that the different methods will give different results. In some cases, the experts adopt incorrect logic and ignore the evidence.

1.35 It is not surprising that reference is frequently made to the everyday understanding of causation, which is referred to as "common sense".

1.36 The problem with the concept of common sense is that without further definition it is a test that is not easy to apply to practical problems that occur in construction.

1.3. DOMINANT OR EFFECTIVE CAUSE

1.37 The terms "*effective cause*", "*proximate cause*" or "*dominant cause*" are often used to classify the operative cause of damage. The classification is used to distinguish one event as the cause of the damage, from a number of other events that are simply part of the circumstances in which the damage occurred. The classification also distinguishes situations where there is a break in the causal connection making the initial event simply part of the circumstances in which the damage occurred[1].

1.38 Although often used interchangeably, the terms do not have the same meaning. An "effective cause" does not necessarily exclude other events being "effective" or being a "material cause". The term "dominant cause" is intended to classify the event as ruling or prevailing over other events.

1.39 In some circumstances, there may well be no "dominant cause" and more than one cause of equal efficacy. The use of the classification in English Law does not mean that liability is precluded if there is more than one cause of equal efficacy. It is not necessary that one cause should be "dominant". Liability in contract will depend upon the terms of the contract and the intention of the parties.

1.40 When the classification is used, there is no guidance on how the "dominant cause" is to be ascertained. It does not provide a method of legal analysis.

1.41 In *Leyland Shipping Company Ltd v Norwich Union Fire Insurance Society Ltd,* [1918]HL AC 350 a ship was torpedoed by a German submarine and taken into the harbour of le Havre. When a gale sprang up, she was moved to a berth inside the outer breakwater, where she took the ground at each ebb tide. Ultimately, her bulkheads gave way and she sank. She was insured against perils of the sea, but excluding the

---

[1] The dominant cause approach may in some cases use the concept of new intervening act to establish whether or not the initial event is still effective.

consequences of hostilities. It was held that the "*proximate cause*" of the loss was the damage inflicted by the torpedo, which fell within the exclusion.

1.41.1 The principle is that although the subsequent event played a part, the identification of the hostile act as the "proximate cause" means that it is treated in law as the operative cause of the loss.

1.41.2 The overriding principle in contract is to look at the contract as a whole and to ascertain what the parties had in mind when they identified the particular cause. The "effective cause" is not necessarily the cause that is most proximate in time.

1.41.3 Lord Shaw of Dunfermline observed that causes were often referred to as if they were as distinct from one another as beads in a row or links in a chain. Although the term "chain of causation" was a handy expression it was inadequate since causation was not a chain but a net. He considered that the cause which was truly proximate was that which was proximate in efficiency[2].

1.42 There is little guidance on the identification of the "dominant cause", except for the application of commonsense as understood by the ordinary man taking a broad view *Yorkshire Dale Steamship Co v Minister of War Transport (The Coxwold)* [1942] AC 691.

1.42.1 Lord Wright considered that the choice of the real or efficient cause from out of the whole complex of the facts had to be made by applying commonsense standards.

1.42.2 Causation was as understood by the man in the street, and not as understood by the scientist or the metaphysician.

1.42.3 Cause in the case before him was what a business or seafaring man would take to be the cause without too microscopic analysis but on a broad view.

1.43 In *Monarch Steamship Co Ltd v Karlshamns Oljefabriker* [1949]HL AC196 the ship boilers were defective and delayed leaving Port Said, at the north end of the Suez Canal, until 24 September l939. By that date, the Second World War had broken out and the British Admiralty prohibited the ship from proceeding to Sweden as intended and ordered her to proceed to, and discharge at, Glasgow. The cargo was eventually trans-shipped in neutral ships and delivered to Sweden at extra cost.

1.43.1 Lord Wright adopted the classification of "dominant cause" and chose unseaworthiness as the cause of the loss.

1.43.2 He considered that unseaworthiness caused the Admiralty order diverting the vessel.

---

[2] The facts of the case can be analysed using the principles of new intervening act. It could be said that the moving of the ship to a safe harbour was the natural consequence of being torpedoed and not sunk immediately. The break up followed naturally from the incidence of normal weather.

2.16.1 The fact that the defendant's conduct was found to be a cause when applying the "but for" test was not conclusive as to whether he should be held responsible in law.

2.16.2 The function of the casual enquiry in law was to determine which causes were effective for the purpose of attributing legal responsibility. That was the reason for the defendant's breach to have made a material contribution even if it was not the sole, or even the main cause of the claimant's damage.

Application of the "But-For" Test to Construction Problems

2.17 The application of the "but for" test to construction problems is demonstrated below by three examples from decided cases. The three examples are also used to demonstrate the application of the two concepts of New Intervening Event and the Principled Approach in the next Chapters to show that a different answer to causation may result.

Example 1: Concurrent Events – Shortage of Labour & Inclement Weather

2.18 The central facts are that work is available to be carried out but that no work is carried out on the site for one week and during that period, the contractor does not provide labour on site because of a shortage of labour[8]. The effect of no work during that week is that the contractor is likely to complete the works one week later than the date for completion stated in the contract. In this single event situation, the second expression of the "but for" test leads to the conclusion that the shortage of labour caused one week delay. If there was no shortage of labour then the contractor would not have been delayed, so the shortage is the cause of the delay.

2.19 If a concurrent event is introduced, then the limits of the first part of the "but for" test become apparent.

2.20 During the same week, there is exceptionally adverse inclement weather that would have prevented the contractor carrying out any work even if he had labour. In that situation the "but for" test leads to the conclusion that neither event causes delay. The removal of either event from the circumstances leads to the conclusion that the damage would still have occurred.

2.20.1 If the shortage of labour is removed from the circumstances the delay would still have occurred, since the adverse inclement weather prevents any work being carried out in that week. The shortage of labour is not therefore the caused of the delay using the "but-for" test.

2.20.2 Similarly, if instead the exceptionally inclement weather is removed from the circumstances the delay would still have occurred, since the shortage of labour prevents any work being carried out that week. The exceptional inclement weather is also not the cause of delay using the "but-for" test.

---

8 The first simple example was used by Dyson J in *Henry Boot Construction (UK) Limited v Malmaison Hotel (Manchester) Ltd* [1999]70ConLR32.

2.21 If the effect of each event was sequential, then the damage could be divided between each event. The difficulty is the indivisibility of the damage, which in the example is the additional one week required to complete. Both events independently have caused the same damage, the extra week to complete.

2.22 In the example, both the Contractor and the Employer may have competing claims for damages. The general rule is that the burden of proof lies with the Claimant. If the responsibility for both events lies with the Defendant, then the indivisibility of damage does not prevent the Claimant proving that the Defendant caused the damage, in the example an extra week to complete. This logic is the basis of the total or global claim.

2.23 If one event entitles the Claimant to compensation for the damage and the other does not, then the indivisibility of damage causes the Claimant difficulty in proving causation using only the "but-for" test. The test provides no mechanism for consideration of the purpose and intention of the entitlement to compensation, the rule of law in issue. The "but for" test is inadequate as a test for establishing causation in the case of indivisible damage, something more is required.

Example 2: Event During Culpable Delay

2.24 The central facts are that the contractor fails to progress the work as planned. The contractor is responsible for the failure. During the prolonged period arising from his failure, a period of culpable delay, an event occurs which further interrupts progress of the works[9]. Three different scenarios are examined.

2.25 Example 2.1. The contractor's failure affects the critical path and leads to a prolonged period after the planned completion date. The period of culpable delay is after planned completion. The event is a storm, which floods the site. The storm and therefore the flooding would have been avoided altogether if the contractor had not overrun the completion date.

2.25.1 The "but for" test leads to the conclusion that the event causing the culpable delay caused the damage. The storm would not have had a further effect on progress if the contractor had completed by the contract completion date.

2.26 Example 2.2. Suppose in the second scenario that the prolonged period is within the contract period. The contractor has been delayed on planned programme on part of the works for matters for which he is responsible. That part is not on the critical path to completion so that the contractor is still on course to complete by the contract completion date. The storm occurs during the contract period. If the part had not been delayed, it would have reached a stage of construction that would have prevented the flooding of the site by the storm. The delay caused by the flooding is greater than the "float" on that part and changes the critical path resulting in delay to completion.

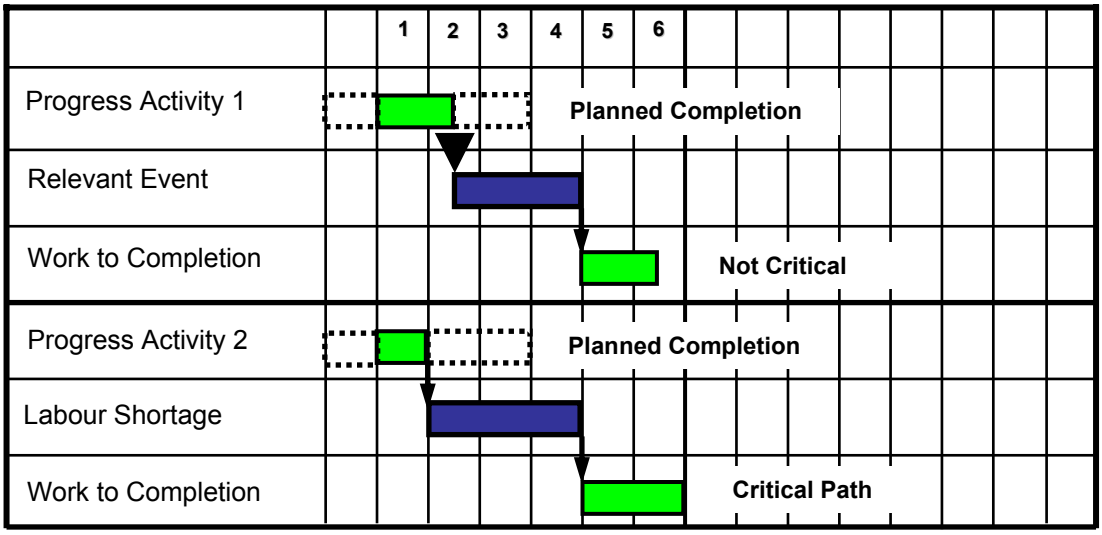
---

[9] The second example (slightly modified) was used by Colman J in *Balfour Beatty Building Ltd v Chestermount Properties Ltd* [1993]62BLR1 QBD.

the critical path then the initial conclusion is that the Relevant Event did not affect completion.

3.53 This is shown below diagrammatically in Figure 2, which shows two activities one of which is on the critical path and the other is not.

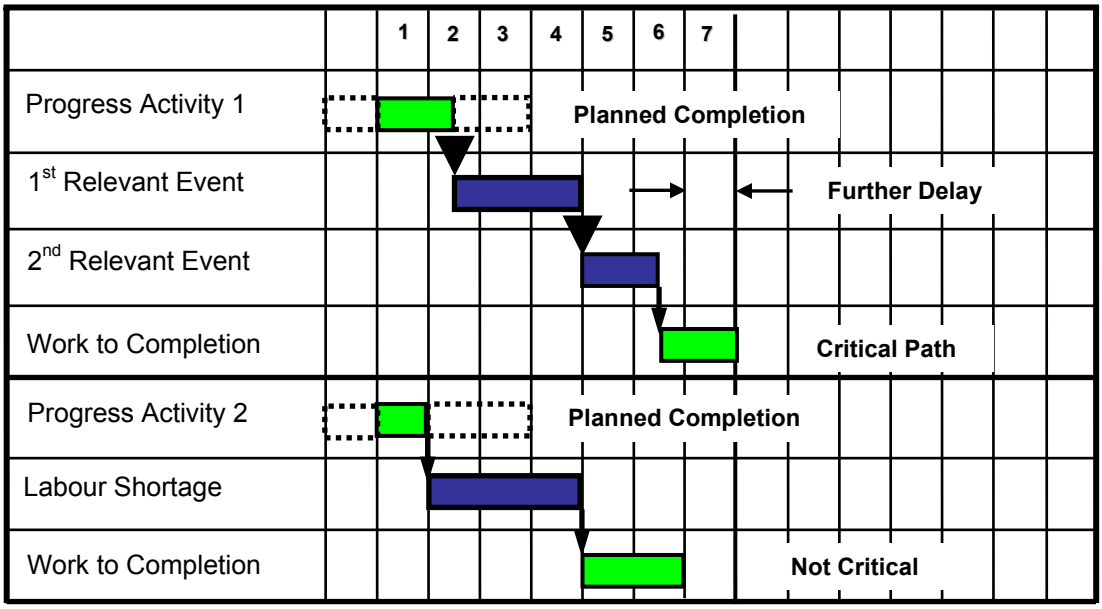
Figure 2 - Separate Events Affecting Different Activities at Date of Activity



3.54 The initial conclusion needs to be verified by examination of actual progress to completion. The initial conclusion is only correct if the critical path does not change during the progress of the works. If viewed retrospectively progress is such that the activity affected by the Relevant Event is on the critical path and the event affected by shortage of labour is not, then the timing difference is not sufficient to draw the conclusion that the Relevant Event occurred in the context of the shortage of labour.

3.55 This is shown below diagrammatically in Figure 3.

Figure 3 - Separate Events Affecting Different Activities at Completion



3.56 Figure 3 above shows that a Relevant Event, which was not on the critical path to completion when it occurred, is on the actual critical path at completion due to the incidence of a subsequent Relevant Event.

3.57 In the above case, it cannot be said that the timing difference of the two events of the first Relevant Event and shortage of labour shows that the first Relevant Event could not have affected the completion date. This remains the case even if both events are on separate critical paths or "near" critical paths. In those cases, the proper conclusion is that the condition for causation is satisfied and that the issue of causation in law must then be considered.

Example 1 – Employer's Claim for Damages for Delay

3.58 If the initial condition is satisfied, the approach to be applied when there are concurrent events and the damage claimed is the Employer's time related loss was established by Colman J in *Balfour Beatty Building Ltd v Chestermount Properties Ltd* [1993]62BLR1 QBD.

3.59 The approach was common ground in *Henry Boot Construction (UK) Limited v Malmaison Hotel (Manchester) Ltd* [1999]**.**

3.59.1 Mr Justice Dyson accepted the approach as a statement of law without adverse comment.

3.59.2 It was agreed that if there are two concurrent causes of delay, one of which is a Relevant Event, and the other is not, then the contractor was entitled to an extension of time for the period of delay caused by the Relevant Event notwithstanding the concurrent effect of the other event.

3.59.3 The approach was demonstrated by an example, which has been examined above as Example 1 in which the two events were the Relevant Event under the JCT Form of exceptionally inclement weather and the event of shortage of labour the fault of the contractor.

3.59.4 In the example, the Architect was required to grant an extension of time of one week, if the failure to work during that week was likely to delay the Works beyond the Completion Date by one week and if it was fair and reasonable to do so.

3.59.5 The Architect could not refuse to grant an extension of time on the grounds that the delay would have occurred in any event by reason of the shortage of labour.

3.60 Example 1 is shown diagrammatically below in Figure 4. The two events are shown as being co-extensive in time and both causing the same indivisible damage of delay to completion.

Productivity will be reduced because of the effect of extended day on the workforce. There will also be a change in the earned income/cost ratio due to premium payment for overtime.

4.27.9 The third point of the analysis by Hicks J identified the assumption that the activity of concrete pour on the project was divisible. The evidence showed to the contrary that a concrete pour had to be started and completed on the same day. It could not be delayed by part of a day. It was either not delayed at all and started and completed on the day as planned, albeit by late working, or its was postponed and a day was lost.

4.27.10 Hicks J therefore derived no assistance from the Expert. Instead, he was left to his own analysis. He decided that it was inherently likely that despite late working there was some delay and proceeded to award a reduced extension of time.

4.4 DELAY ANALYSIS AS EVIDENCE

4.28 Commercially available software allows many activities to be recorded and analysed, in the form of readily understood programmes. The software creates a mathematical model in which activities are represented by durations and the dependence on other activities represented by time constrained links. The assumptions in the model and the inherent limitations on the way the links represent construction logic must not affect the validity of the model, particularly when events cause methods of construction to be changed, otherwise the model will be inaccurate. Available software also allows the modelling of the constraints of available resources and optimisation for efficient working, but this is not easily represented on a programme analysis.

4.29 There are many methods of analysis of delay. The choice of the appropriate analysis depends upon the evidence available, the existing programme evidence and the particular circumstances. The analysis must be based on the facts and the evidence as demonstrated in *Great Eastern Hotel Company Ltd v John Laing Construction Ltd* [2005] EWHC 181 (TCC)**.**

4.29.1 The experts used different approaches to the analysis of delays and the identification of the critical path. Great Eastern's expert used an impacted as-planned programme analysis by which the project was analysed on a monthly basis to measure the impact of events as the project proceeded. The experts agreed that original programme demonstrated Laing's programme intentions at the time it was drawn and at the time the periods allocated to the activities were reasonable. Laing's expert in the main part proceeded retrospectively from an as-built programme to determine the critical path and respective periods of delay and causes. The principal critical path determined by each expert was broadly similar. The total extent of delay periods found by each expert broadly coincided.

4.29.2 The vital differences between the experts related to the route of the critical path and the causes of delay advanced by each expert.

4.29.3 Laing's was a broad-brush case that none of the delays was caused by Laing's and that such delays that may be proved was the consequence of concurrent causes such as the default of the design team to produce timely design information and the performance of the Trade Contractors.

4.29.4 HH Judge David Wilcox considered that the research and analyses of Eastern's expert were impressive and comprehensive. They were based upon the contemporary primary documentation that included computer records and timed site photographs depicting the actual progress of the demolition preparation and construction on site and the inter-relation of these activities. This data was objectively evaluated.

4.29.5 Wilcox J was less impressed by Laing's expert. Wilcox J considered that he demonstrated himself to be lacking in thoroughness in his research and unreliable by reason of his uncritical acceptance of the favourable accounts put forward by Laing. Laing's expert had no concept of his duty to the court as an independent expert. Despite seeing the photographs and material contained in Eastern expert's two reports received and read by him, totalling undermining credit and accuracy of a witnesses' account upon which he relied, Laing's expert chose not to revisit his earlier expressed views in accordance with his clear duty to the Court.

4.29.6 As to Eastern's analysis, Laing argued that the retrospective delay analysis carried out on the planned construction programme by Eastern's expert entirely ignored any and all existing concurrent causes of delay and/or other factors affecting other activities which might have caused delay to completion if, hypothetically, each of the identified critical activities had in fact been completed within the originally programmed period. Wilcox J considered this was not correct and that Eastern's expert did in fact separately and comprehensively carry out such an analysis and concluded that none was in fact critical.

4.29.7 Wilcox J found based on the evidence that there were no causes of critical delay other than those caused by Laing.

4.30 In *John Barker Construction Ltd v London Portman Hotel Ltd* [1996]83BLR31 Mr Recorder Toulson QC was required to consider the approach to be taken in analysing the entitlement to extension of time under a contract which incorporated the JCT Standard Form of Building Contract with Quantities, 1980 Edition, also incorporating the sectional completion supplement.

4.30.1 Toulson emphasised the need for logical analysis of the effect of events on planned progress shown by the programme established at the date of an acceleration agreement.

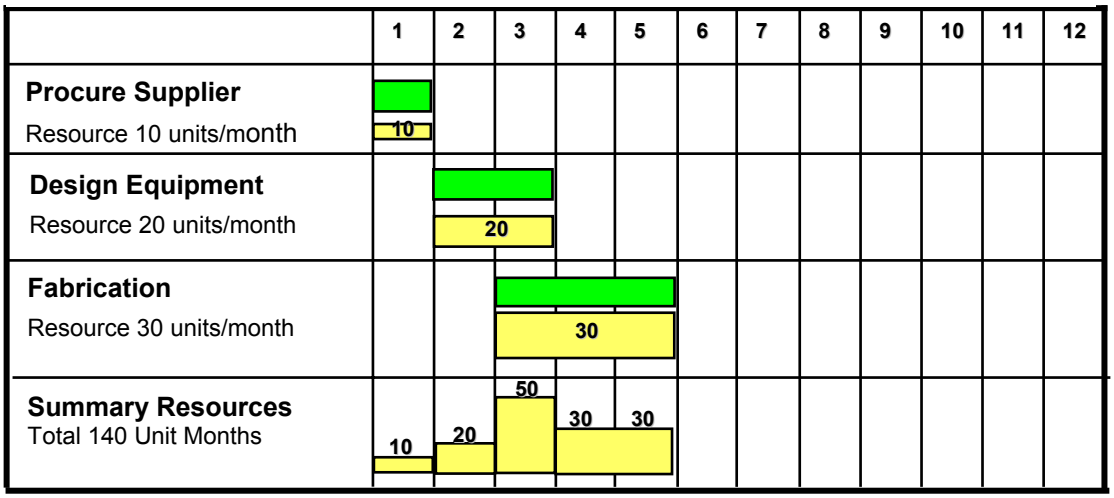
4.30.2 He held that the Architect's assessment of extension of time was fundamentally flawed because he did not carry out a logical analysis in a methodical way of the impact that the relevant matters had or were likely to have on the plaintiffs' planned programme. Instead, he made an

activity. Plant may also be recorded in the same way, but usually the timescale is a day which records the allocation of plant to the particular site. The plant allocation sheets may unusually record when plant is working and therefore using fuel and other consumables and when it is standing. The differences in timescale are taken into account by factoring the hourly or daily costs to arrive at a unit cost for the timescale used on the grid.

5.38 The resource may be defined in terms of overall resource, or separated by type of resource such as design and site or separated by trade. Most often resource is shown in terms of expenditure, which allows different resources with different costs and different timescales to be accumulated to provide a single measure of overall effort.

5.39 An example of a Resource Histogram is shown below in Figure 13 using the first three activities in the Figure 12 Bar Chart.

Figure 13 – Resource Histogram



5.40 The resources for each of the above three activities are different, but are shown on the histogram in terms of the universal units of cost per month. In that way the overall cashflow can be represented. The histogram therefore includes allocations of working hours per labour per month and the working days for plant per month which may not be accurately represented by the continuous unbroken bar for the timescale.

5.3. THE PLANNED PROGRAMME

5.41 The use of the "Planned Programme" as the starting point for delay analysis has the following advantages:

5.41.1 The planned programme is evidence of the expectations of the Contractor and possibly the Employer at the commencement of the project.

5.41.2 The planned programme is evidence of the context in which decisions were made, particularly in relation to mitigation.

5.41.3 The planned programme is likely to have been used and referred to during the project and therefore allows better understanding of other evidence.

5.41.4 The comparison of planned programme and actual events allows an initial estimate of possible delays to activities.

5.42 An essential part of the planned programme is the record of the estimates on which durations and timing are based, if it is to be effective in delay analysis.

5.43 It is not always easy to identify the appropriate "Planned Programme" for delay analysis.

5.44 The Contractor's agreement with an Employer to carry out a project is usually based on a view of how the work will be carried out. The plan may not be set out in the agreement as a programme, but may be part of a tender or produced during negotiations. Frequently a programme is prepared at commencement of the project either as part of the contractor's obligations or simply to assist the contractor to manage the project. All such programmes are evidence of how the Contractor planned to carry out the project at that time. The plan is an express statement and demonstrates the understanding of the workscope and of the Contractor's obligations and the decisions he has made.

5.44.1 The plan may demonstrate the decision on the method of procurement, whether by direct labour or by subcontract.

5.44.2 The plan may demonstrate the construction logic, expressly or by inference, for the chosen method of construction through the timing of activities.

5.44.3 The plan may demonstrate the deployment of resources through the durations of the activities.

5.45 The issued tender programme is a high level programme produced to demonstrate to the Employer that the tenderer has understood the workscope and to describe to the Employer the proposed method of working. The main purpose of the issued tender programme is to allow the Employer to make comparisons with proposals by other tenderers and to assist in selection. Frequently the tender programme is prepared in a very short and intensive period where the emphasis is more on showing compliance and achieving a competitive price, rather than an accurate time analysis of the project.

5.46 The programme prepared at commencement of the project is more carefully considered than the tender programme and usually more detailed. Such a programme may for the first time include the views of those responsible for carrying out the project rather than the estimators at tender stage. As the project progresses revised programmes may be issued. Frequently short duration programmes are issued for immediate tasks as one week or two week "look-ahead" programmes. The look-ahead programmes are likely to be very detailed but limited to the immediate activities.

5.47 The initial planned programme is only one model of the way in which the works could proceed. The initial plan may be incorrect, either under- or over-estimating productivity or durations or the effects of risk events. Some changes to the planned progress will not be the result of external factors but of the inaccuracies inherent in the planned programme. Whenever one assumption in the planned programme is shown to be inaccurate by actual events, other similar assumptions may need to be revised.

6.13 The example shows that there has been an overall delay to planned completion of the project. The change in the timing and duration of the activities are not in any discernable pattern and does not allow the assumption to be made that the planned construction logic was actually followed. The method does not allow a sufficiently detailed analysis and additional evidence would be required.

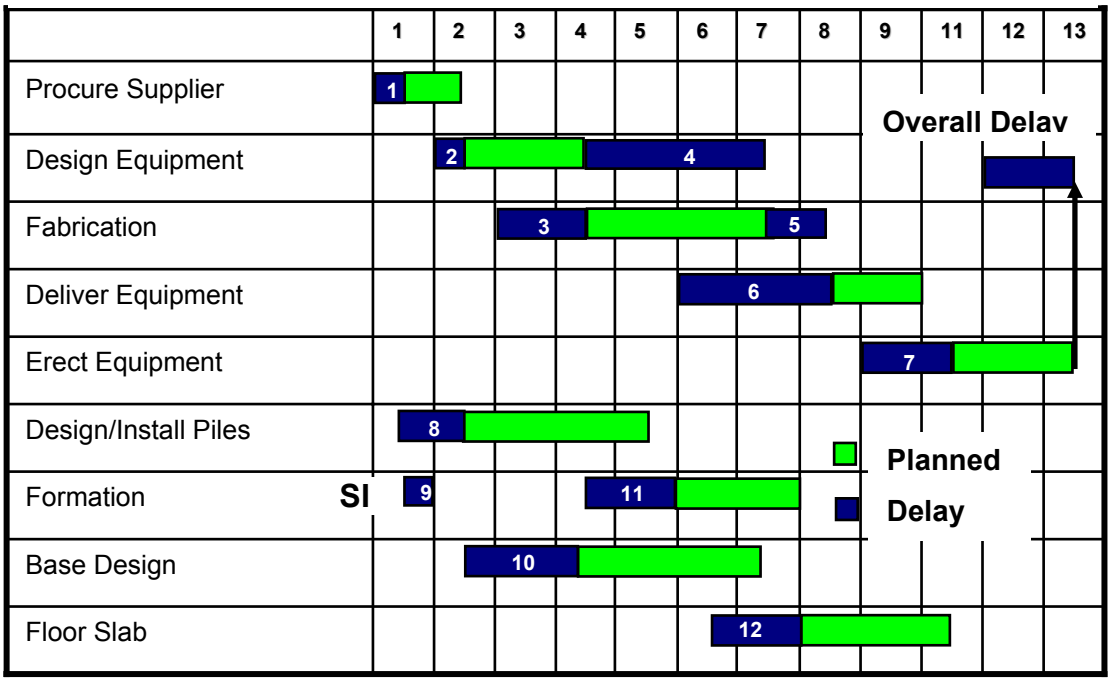
6.14 The method identifies two types of changes in the example.

6.14.1 Changes in the timing or planned commencement of each activity, and

6.14.2 Changes in planned duration of each activity.

6.15 The analysis of the example is shown more clearly below in Figure 15. The delays to each activity are represented as bars together with the planned duration of the activity. The delay in timing or commencement of the activity is shown first, followed by the planned duration and then followed by the additional duration or prolongation to that planned.

Figure 15 - Example - Delays to Planned Programme



6.16 Some of the timing delays are the same, but it is a logical fallacy to infer from that fact alone that those delays were caused by the same causative event. Indeed the fact that the timing delays are not the same for all activities suggests that there is more than one causative event that has contributed to the overall delay. In addition, the overall delay cannot be calculated by the addition of all the individual activity delays leading to the conclusion that the consequences of the causative events require a more sophisticated analysis than the comparison method.

6.17 The Delay 1 is different to other delays since it is a delay to the first planned activity. The Delay 9 is also different since it is a delay to a milestone. In both cases, it is

likely that an investigation of the activity and the milestone will identify the causative event, without investigation of other activities.

6.18 Delays 4 and 5 are also different to other delays, since they are prolongation of the planned duration rather than a delayed commencement. In this case, it may be necessary to investigate other activities and it will be necessary to investigate the work content of the activity and the method of working to identify any change from the plan.

6.19 All other delays will require investigation of the relationship of the activity with others. The comparative method does not however provide a mechanism to do so.

6.20 When the method is used to compare planned and as-built resources, it allows identification of those activities that have involved different resources than planned. The method identifies three types of changes

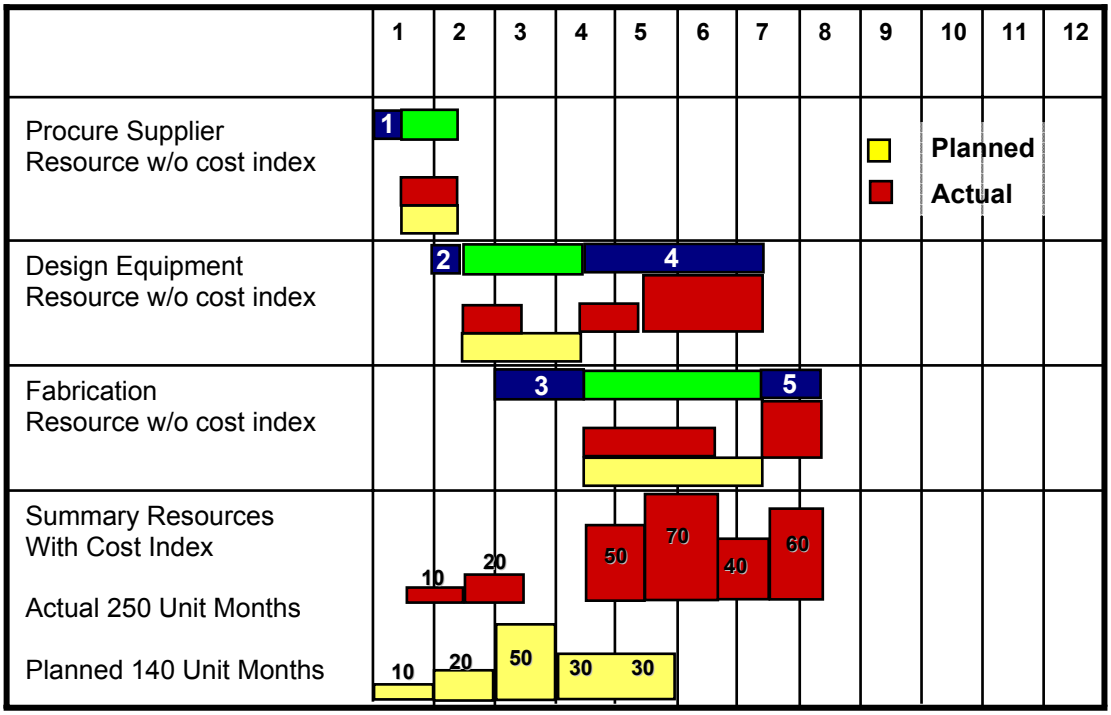
6.20.1 Changes in level of resources for the planned activity duration, and

6.20.2 Changes in period of planned level of resources, and

6.20.3 Changes in the planned type of resources.

6.21 The first three activities in the example in Figure 15, Delays 1 -5, are shown below in Figure 16 together with the planned and actual resources. The planned resources are shown over the planned duration, but with a time lapse to allow for the delayed start. This allows the planned and actual resource profile for each activity to be compared. Although not shown in the example, it is possible for resources to be allocated to an activity in anticipation of the planned start, so that because of the delay the actual resource profile may commence before actual start of the activity.

Figure 16 - Example – Comparison of Resources – Planned v Actual



INDEX

References are to paragraph numbers