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Elements Of A Robust Delay Analysis

by

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Edmund Wan: Everyone, can we take a seat, please.

Just a couple of housekeeping matters before I introduce Wendy.

Future events: on 20 September, we have a talk to be given by Julian Cohen on third party funding. We also have one in October, the date is yet to be confirmed.

The one day conference, the annual one day conference will be held on Friday, 3 November. A flyer will go out shortly for that and, as usual, we will host the conference cocktails, the pre conference cocktails, on Wednesday, 1 November. That will be at the China Club.

The one day conference this year, because of renovations at the football club, we will be hosting that at the Harbour Grand Hotel in North Point and then, on 6 December, we will be hosting the Christmas cocktails. So, that's our future events.

Today we welcome Wendy MacLaughlin who will be giving us a seminar on "Elements of a Robust Delay Analysis".

Wendy is a chartered civil engineer with 25 years of experience in design construction and project planning specifically in the construction of power stations and large infrastructure projects. This combination of skills constitutes a sound basis for her primary role as a Programming Expert on over 50 expert appointments, and has given oral evidence 11 times.

Wendy specialises in delay analysis and is known for her pragmatic and proportionate approach to her analyses, and her keen eye for detail.

She has undertaken delay analyses on engineering construction projects including power plants, process facilities and infrastructure projects. She has worked on projects around the world including power stations in the Philippines, Malaysia, West Africa, the Middle East, Northern Europe and South America, the UK, Saudi Arabia, Egypt, Africa, Australia, on rail, and road projects in Romania, UK, East Africa, the Middle East and Australia.

She has experience as a party and Tribunal appointed expert, and has given evidence to arbitral tribunals on numerous occasions in London, Dubai, Australia, Bucharest, Santiago, Johannesburg and Stockholm. She is cited in the 2016 Who's Who as an "intellectually rigorous authority", and in 2017 as "everything you would expect from an expert."

So, on that note, I welcome Wendy who is truly a global expert.

Wendy MacLaughlin: Thanks so much. Never believe anything you read or hear.

Okay. So, on the flyer, this is what it said on the tin about what I was going to talk about tonight.

A robust delay analysis, irrespective of methodology, whatever methodology you do, it needs to demonstrate that a delay to progress occurred because of an event.

Often that fundamental requirement gets lost in the terminology bandied about by forensic and others. This talk tonight is going to focus on that essential element which is delay to progress,

using mostly some real examples that I've done over the years, and focus on the importance of records and the use of progress data.

The assessment checklist that we typically use for elements of robust delay claims is a 10 point list. Tonight's talk focuses on 4 and 5, so the event actually causes a delay to progress and that delay is evidenced in the project records and quantified. The key of tonight is going to be examples of how you quantify those events.

The sixth one, the critical path is affected, we're not really going to talk about tonight because that comes back to methodology and how you apply these facts and how that fits in with the contract clause, but the facts are the facts, they're the same.

So whether you are impacting a baseline program or doing your time impact analysis, or collapsing out an event in a collapsed as built, you still have to identify what that period is.

So, why are we not talking about methodology?

Because the delay caused by a claimed issue is what's trying to be demonstrated in any method, and the amount of delays are what those contract clauses are usually expressly asking for. Now, that amount of delay is either that which is expected or anticipated to occur, as you see in any sweep of contracts, or it is the extent to which the contractor was actually delayed or is actually delayed, but the word "actually" is that key word there. And also talking about methodology makes me feel like this ... because it's caught up in terminology like "observational methods", "modelled methods", "prospective methods", "retrospective methods", "dynamic methods", "static methods", and all of that, and you end up in situations like, only in America, could they make delay analysis methods look like this ...

There are 16 on the bottom there. Now, this slide, I am actually going to talk to this slide because it's from the Association of Cost Engineers International. They've got a small life on international in this document, but it divides these two.

There are two interesting categories here: observational and modelled. So if you ever see this chart, there is a very easy way to understand what it means which is this one. This slide, "Observational", means I'm not mucking around with the programs. I'm just going to look at them as they are. This slide means, "I'm really mucking around with the programs. I'm going to create a set of programs that has stuff added into it", or "I'm going to create my own as built program and take stuff out of it."

Now, that's a way, that's my way, of looking at this chart, but we're not talking about that tonight.

The second condition of the protocol has, I think, a better way of classifying the various methodologies, but it does introduce three concepts.

One is this analysis type in the column headed "Analysis Types", so that's cause and effect. That is: am I asking a program to predict the effect of this cause or am I collapsing it out? So that is a way of thinking about the modelled side, the mucking around program side. Or am I identifying an effect from programs or progress data and looking at records to establish the reasons why. Now, that's the other side. That's the observational side.

The other two "prospective" and "retrospective" is not for tonight.

But in any of those methods, whether you are mucking around with a program, creating a model, collapsing something out in this first section, or, if you're doing something observational where you're looking at what the program and progress data is telling you, they all need a delay to progress caused by the event. That is the fundamental requirement of any analysis.

So, what does that mean? What is a delay to progress? Well, it's a change in progress rate that

occurs or will occur if it has to be assessed on a forecast basis as a consequence of the event.

To demonstrate that causal link, you need to have the activity affected identified on the program.

Now, that may be your first problem, it may not be there, which is a common problem, and you need to quantify the extent of that delay to progress.

So, first thing, look at the program. Is it sufficiently detailed to assess the event? Well, if not, which, in my experience, is usually the case, what else is available? What else can you use? Physical progress data, S curves, progress measurement. How is a contractor measuring his progress? What's your metric? The metrics are the key point on the next slide. And what documents do you need to demonstrate that this issue has an actual effect on your progress?

The key principle that I use when I am looking at what are claimed issues and how am I going to analyse it is I get in my head as close to the person undertaking the physical work: "What do they need?", "What do they need to be signing off on a day to day basis as these works are actually being built?" You can often go to the contract at the back in the appendices, the audit rights, and look at the quality requirements whole points, project controls requirements, to see what documents should be being kept. You usually get behind a green bar on a program.

I have put up here some delay to progress metrics for establishing delay to progress of all the works. The last three are for productivity metrics. They have an input and an output. The rest of them are just production, and they range for a variety of trades. So "tonnes per day" is fixing of rebar or "joints per day" is, like, welding on a pipeline, "chainage per day" is general welding measured on process plants. Pipe rates, cubic metres of concrete, metres per day of like cables pulled. "Terminations" is probably one of the better ones for cabling.

As you get towards the end of the job it changes and often "works to go" list or "completions" or "punch items" are a better measure of the effective issues on the works, and these last ones for disruption. I've got examples on progress measurement and I've got an example on disruption. There we have "man hours per tonne" for reinforcement, "man hours per tonne" over each of the welding or "machine hours per cubic metre" for earthworks or fuel.

The example I have tonight is fuel. Fuel input to earthmoving equipment and paving equipment per output of metre cubed or square metre or millimetre, because that's what we had.

So, if your expert is program rather than progress data driven, these are the risks that I see. Often the schedules are treated as the sole source of truth, "The program says this."

In my view the schedule is just another secondary source of progress information. It's not the primary data. It is a view of one way of completing the remaining work might be done at a particular point in time, and the work or dependencies not in the program will be missed.

I see that quite often for a variety of reasons but often the subject that I'm analysing is not there in the program, and the real story is behind these green bars in the records.

The other thing is that the bar from the program won't show you the rate of progress, and it's all about rate. So a delay is a change to rate of progress.

You also need to understand the basis of the planned durations in those programs. Nowadays "basis of schedule documents" are common across projects. You can fairly easily assess with a reasonable witness the allowed duration. It's made up of three things: resources, quantity and production rate because part of our reason for a delay may be an underestimation of the production rate that could be achieved, fewer resources are planned, or less efficient resources are planned. It is important to understand that planned benchmark.

Then you've got to assemble the progress data. That depends on the subject matter being analysed.

If it's engineering it will be transmittals and deliverables and drawings and rate of production of those. If it's something physical, it will be those physical metrics: concrete progress, steel progress, welding progress or cabling progress.

You can pull them together in a plan, an actual rate datagram, and we will show some of those as we continue, in Excel.

Then you can interpret it. You will have a planned slope and you will have an actual slope and that will give you a snapshot of the entire plan of actual duration of that activity and your event that you're trying to prove caused the particular delay to progress will fit somewhere in that picture.

Then you've got to go to the project documents to understand the reasons for the variances in between planned and actual rate. Often the claimed issue a given issue might be claimed to have caused delay and then when you get into it, you know, there are other factors. There's machine breakdowns. There's weather impacts. There's just downtime, unscheduled downtime; maintenance. Insufficiency of resources. It could be any other reasons for a delay to progress than that being the subject of the claim.

This is typically what people think the delay analyst is looking at, the bars on the program.

The one highlighted is a welding one. This is a pipeline. It's 300 kilometres, this pipeline, so this bar is three months of welding along a particular section. That section will be comprised of a number of segments of the pipeline, all of which have to be welded.

Now, this particular claimed issue was additional travel time, but there's no way you can tell from that program, or any updates of that program, as works along that green bar are progressed, if additional travel time caused any delay to progress whatsoever, so you've got to go to the records: supervisors' reports, welding, day chart, which is there and readily available and, I think, quite easy and inexpensive to interpret and analyse.

So, this was the effect of weld repair crews on additional travel time. They were supposed to stay at this camp ... but they ended up staying at this camp ... and they had additional time to travel each day.

The contractor's claim says, "I've got an additional two hours. I'm losing an additional two hours. I'm losing 20 per cent. Give me 20 per cent of this activity. It's the critical path." There's no disagreement about the critical path. The amount of delay will be the issue it caused.

We went to the production data and said, "Well, how real is this 20 per cent?" Now, this particular project, we were working for the owner in an advisory capacity. These claims would come in and we were part of an assessment team. We compiled our welding data quite easily and the blue so this is weld per day here ... and this is the time that was the subject of the additional travel time, this time here ... So we compiled it either side of that to look at welds per day, on average, in these periods.

We have seven here ... and six here ... So, from that, we said, "Well, actually, it's a 30 per cent reduction, it's not 20". This took us sort of a number of days. So they went back to the contractor, the variations agreed, and everything's sorted. Never looked at the program at all.

This other one is dredging. I had a look at the program and then I kind of put it to one side; you'll see why.

This was a claim for increased quantities of fresh material. I was appointed by the contractor to look at this who had increased quantities to dredge. There was an allowance in the contract of 42,000 cubic metres and they triggered over 200,000, but you just couldn't tell from the program. They had claimed that it delayed all three separable portions of the work. The claim contained

extracts from the program, but the treatment was one bar, 150 days long, just kind of sitting there. Sometimes it would be 150, sometimes it would be 30, then it would be back to 150, then it'd be 120, then it'd be 90, so it was all over the place, but you couldn't identify planned or additional material being treated from that program. But a 10 minute conversation with the guys, this treated material goes on trucks through a treatment train, every truck is logged. They knew every truck that went in, where it came from, when it went into the treatment train and when it came out of the treatment train, so I said, "Well, I'll have that, thank you very much."

So, that came, and it was quite simple to identify and the red here is this 42,000 planned amount of treatment. So anything in red, just on these records again this is simple. I think I worked on this for probably three weeks in total. Anything in red was part of the planned. Anything in blue was not. You can see there's quite a substantial amount of additional material here, but it's not part of the whole picture.

There was a forecast completion date here ... and there was a forecast completion date here ... and when you looked at the work that they were actually doing, this was critical at the time. So we looked at completion here ... and completion here ... but the only way we were able to get that line and where the planned amount had been treated was from the data.

They wanted 59 days on three separable portions. One separable portion wasn't affected at all, so I sort of went back in feeling quite nervous and said, "Well, I don't think this one is affected at all", and they went, "Yeah, we know that", and I'm like, "Oh, okay." I said, "But I think your other two are", but I said, "I don't get 59 days, I get 42", and they went, "Oh, that's great." So off they went to mediation, a 42 day claim, and it all settled. Again not programs, data, delay to progress.

So this ... is just saying what we did, but this ... is saying what we didn't do. We didn't do a program heavy analysis. I didn't go back and reconstruct the program and try to update it with how much material they had treated and reschedule and try to put everything back into Primavera. I'm only putting back the primary data that I've already analysed. So, didn't impact the baseline; didn't update anything because it just wasn't needed.

The employer on the other side just needed to understand the actual impact of the increases in quantities. There was no argument over an increase in quantity. Again, it was only over the effect of it on the work.

This next one is a shallow pipe lay offshore. We were advising the employer here on this one. We were looking at the effects of several change orders.

Again, very good progress data. Anything to do with pipes, you'll have very good progress data.

The blue is the actual production of the pipe lay. It's on a barge and the materials get brought to the barge. So, again, it's kind of a production line supply chain situation.

The claimed amount for loss of production, the total claimed amount, is a difference between the light blue and the sky blue. So that's the claim, that's the claim that came in.

We went through the daily logs and daily reports and said, well, the maximum that it could be, based on what you actually did and based on what the issue is, is the salmon pink. That's the maximum it could be because that's your actual loss of production and, again, this whole exercise took about four weeks, I think, from brief to report. Again, this went off and was settled between the contractor and the owner.

So we've got the pink up the top. That's the maximum it can be. Then we went down to the daily records and the logs and said, well, of these issues we've got other things that are the reason for this, not the issue that you say. The issue they said was supply of the pipes from the barges. Sometimes the barges were broken down. Sometimes there was scheduled maintenance periods. We shaded all them out and we're left with the pink. So the pink is the actual impact

of the claimed issue on the progress of the work. So, again, all the data was there. We didn't use the programs, we didn't have to on this particular one because, again, massive log bars on the program. One bar for the pipe lay, and the critical path wasn't controversial. It was quite a long project. It was obvious the laying of the pipe was the critical path.

I think some people lose sight of that sometimes. Sometimes the critical path is fairly obvious when things have to be built in a certain sequence. Buildings, when you do internals and M&E works not so much. Hospitals, difficult. Process plants and pipelines, reasonably, I think, straightforward.

So the critical path wasn't controversial. The fact that there was a supply issue of the pipes wasn't controversial. It was only the extent to which the issues claimed was affected, so what's the actual delay, "What's my actual delay to progress?"

This is a road construction example. This claimed issue was that there was a latent condition affecting all works. This was quite an interesting one for me. It was roads, so I'm going to show you some earthworks progress on here, but the latent condition was interesting because this one did go to hearing; I said, well, the thing with the latent condition is if I'm looking at the records, the records have got a latent condition in it, like, it's there. It's embedded in it.

So what we did was we separated the delays into two categories because it rained a hell of a lot and the contractor claimed EOT for rain because that was uncontroversial. They then remembered when they got to the end of the contract they didn't get any money for rain, so they had more EOT than they needed, but the rain, hence, the latent condition.

We took the view that I wasn't there, I didn't see the records. I could do the analysis from the records. I can tell you what was a delayed rain, but I can't separate out really a latent condition, so we separated them into two categories: "Weather" and "Other", but then we still had to find the critical path. We still had to understand what the difference between planned and actual progress was. We also had six months of the year when we couldn't do any sealing because it was too wet and, believe me, it was really, really wet.

So, we constructed the S curves and here you can see the planned you can follow this, even. So this green line here is the planned curve for earthworks in a particular component of the road. We've got four components, two carriageways, which switches from one to the other from the program. This is metres cubed per day planned here ... in the green. Early dates. So this had flow. The red is the late days. The latest that this earthworks could be done, without affecting completion, is this red curve here ... and then the blue and the yellow are the as built.

Now, the reason that there's two curves for the as built is this. The blue is from daily truck counts. They went through all their earthworks records and categorised the truck count data.

The yellow is from the monthly survey volumes that were done for payment purposes. You can see that there is actually quite a good alignment here on this one of the daily truck counts and the monthly survey models. It wasn't the case on all the components, I'm not showing you the best graph yet. What you can see is the actual progress here ... and you can also see that when this actual curve crosses the late curve, this is the point where there's no more flow, like, everything's gone here. This was important here ... because this meant that we couldn't finish before our non sealing period. As soon as we got to this point ... there wasn't enough time for us to finish the earthworks, do the pavements and seal the road, so that's flipped. It's a six month delay because you can't make this ... and all the while it was dealing with a difficult issue of latent conditions which they did so very, very successfully.

The next example is again a road but it is records on disruption. I know it's a delay to progress talk, but I thought I'd touch on disruption because then you need records on both sides of the equation. You need production, which is all what we have been doing up until now, and the input.

Our input on this road is fill. I think I was acting for the owner on this one and there was a disruption analysis put forward. Of course, everything was our fault.

Again, we had to go back and say, "What's the issue being claimed and did it actually affect your productivity?" This was done at a very granular level and this did go to hearing. The amount of detail is a bit scary, but we'll walk through it.

It was a Japanese contractor with brilliant, brilliant records. Where the machines were, how much fuel went into them, their registration plates, what type of work they did on every day? The analysis period we're talking about was probably a year, 12 months, with a few suspensions within the 12 months.

So what data did we have? The monthly progress report had tables like this ... That gives you dates. You can see down the right hand side that there's data on every day. So they're compiled, so this is secondary information, but it means the primary information is there. So you go back and ask, "Well, where does this information come from?"

Now, on the as works, they had internally reporting by chainage and I think these are 100 metres apart. No, they're a kilometre apart, about 120 kilometres of road, and what was the progress of the cart and fill and the G7 and G15 layers which is the subgrade layer, the top of the earthworks layer, before the pavements go on. So that information was there on a monthly basis and then, again, put into the monthly progress report.

Now, this is pavements. You can see this in the month. One of the first things you get is monthly progress reports, so I go straight to the back and look at the information they've got there and then go straight back to the client and say, "How did they compile that? That's what I want."

The paving information is calculated from progress records which were kept by the contractor which tells you each day of the week how much progress they made up the road.

That can all be compiled into date, pavement, time and quantities, so that's your production. That's outward.

We did that for earthworks, for pavements, for the subgrade layer and for the black top. We put it all in a triangular location chart so that you get an as planned as built picture but with rates and progress as well. It looks a little odd, but the sequence of the works was in the order of a rainbow, so: red, orange, yellow.

Red is estimation. Filling is orange and yellow, the subgrade layer is green and the pavement layers are blue and purple and black, so the black top is black.

What you can see is this is how it was supposed to go, this is the planned line. So time is up here ... and the location is along here ... So flat is fast and steep is slow. So the flatter it is, the better it is.

So what you can see here is earthworks and pavements. Earthworks was supposed to be well, well ahead of pavement and what you can see here ... so yellow was supposed to be quite far away from blue and, as you can see here, yellow and green are very, very close to green and blue. So it means that the earthworks aren't keeping up with the pavements. You can see down here earthworks are controlling, and then you get a little bit of breathing space here for the pavements, and then the pavements kind of take over and the delay event here is "We ran out of cement", a national cement shortage, which the tribunal decided wasn't an arrangement, it was a reason for delay. But, again, back to delay to progress, that was quantified, these are the days it didn't have cement and then you look at the actual production on these days and there's complete agreement between the experts on the delay to progress.

There is another little bit of suspension. As you can see up here, it's a great big mess, everything is converging up here. Like they said, "We're not doing this anymore", and walked off.

So, just to touch on the input side of things so this is output for production. The input side we have the skilled. I have to say I've never seen this on any other project, but these were fantastic Japanese. So, on every day was a daily report, and you can see that there are items of plant here. These are all individual graders, rollers, excavators, type of excavators, here, where they are, what they're doing and at what chainage they're at.

Those vehicle numbers are on the field supply records, so you can cross reference the vehicle number, vehicle ID, to the fuel it got, and that is a signed off record by the driver. That was tracked by the contractor and also you can see the contractor, there's a column called "Work", and that's a type of work that this equipment was doing. That was all coded and then you've got a complete data set of fuel in and production out.

What you also have with earthworks and pavements is that mix of plant. We're coming on to a measured mile period. A measured mile period had a particular mix of plant, so you could compare the mix of plant in other periods that were different from the measured mile period and you say, "Well, you've used more fuel because you've doubled the number of rollers and you haven't changed anything else." That is your reason for the loss of productivity rather than, you know, you're not being paid or there's no cement. It was clear when there was no cement, there was no production.

We can look at that plant mix over time and then do the loss of productivity calculations and then it was just a long hard slog to compare measured mile periods back to other periods, but the time/location diagrams are quite useful.

So, just visually, that was the measured mile period diagrams.

Do you remember the solid blue lines on the other sheet? They were nice and parallel and it was pretty good, but then some of them are clearly not working in one direction, going back and forth, back and forth, and kind of all over the place. The same with here as well. And when you look at the records, these bits are going back and filling over culverts and drainage structures. In those periods, these here ... as well and here ... and here ... anything like that, you can go back, have a look, and unless you've gone along, they're meant to be out and they come back and filled over done the pavement over the culvert. So again as well, it's just visually: time/location charts, progress and production data, for anything that is giving a good instantaneous picture, a planned and as built.

The next slide I am going to show you is just about conveying this information in an effective way or a clear way to a tribunal.

I am going to show you a project where, I think, both parties were equally responsible for the delay.

It was a very, very strange arrangement. It was a state owned company that had contracted with an EPC, which is not an EPC, to a German company, but the state owned entity had said, "Well, we're actually going to do the construction, so you don't have any risk on construction, and we think we'll do the engineering as well, so you don't have any risk on that." So, of course, the claim back was all related to their scope.

It was a really odd claim to understand. I read it three times going, "I don't even know what this is about, the power station, I don't know power stations". This was odd. This was also a prototype but they didn't know if it was going to work, so LDs on plant commissioning were off so all you had to do was finish the cold commissioning. When you started to look at it, part of the power station was conventional. So I said, "Well, I'm going to take a punt on this part that's critical because that's what the information seems to be suggesting." Who's who? I can't remember who's who. Yes. They are doing engineering. So engineering is light, here ... so that by the time we get the shop drawings, it's already 150 days late. We then recover all this time, lose a bit in

the construction phase, lose a bit more. We're pretty much in the same position we were when we got that information.

Then there's an argument over when cold commissioning ends, is it here or is it this system or is it this system, but you can see from that why there's an argument over who is responsible for the delay because pretty much both are. And then, again, we gave that as part of the report and they went off and did their deal.

Finally I haven't mentioned photographs as a progress record source but everyone knows they're important, so why don't I show you some from my house.

This is what we funnily called the wall of pain or the relief from elders. My other half decided to put LDs in our building, in our house contract, at which point I said, "If you think I am going to be analysing this house, you've got another thing coming, I am not doing this, no way", plus the builder was my friend from uni, "You are not putting LDs on him."

Then I had this brilliant idea that we should put the Ebomina (?) beach pavement on as a feature on the back wall and then my other half decided that he was going to do this tiling. He started this tiling and the photograph on the left was his progress of the tiling probably two weeks before the planned completion date and I said, "You keep going like that, you are going to be here for a year." "Oh, but the builders are going to finish it, they've got to seal it". I said, "They'll be long gone, you'll have to call them back." "I do this for a living, I'm extrapolating your rate of progress, you are the critical path", at which point he went, "I don't think I want to be the critical path." He goes, "No, no, no, they're going slow inside, I'm okay". So then we introduced prefabrication Friday when he would cut up the tiles and then production Saturday and Sunday.

I don't have dates on these, but if I did plot the S curve it would go like this ... by which time the internals did go very slowly, he was probably never on the critical path, but it was fun to take these pictures and tell him he was.

I'm nearly finished but, again photos are, I think, invaluable, as long as they're dated and as long as they're of the same thing over a period of time.

We've talked a lot about records, but I do just want to caution that the analysis of them has to go somewhere and it's not just about churning through data for data's sake. You've got to know what you're asking for, know what you're analysing, know what you're looking for and make sure it's meaningful.

I chose to do this topic tonight because it's relevant to the Security of Payment legislation because preparation is key there. Preparation is absolutely key, especially if you are the recipient of an adjudication claim. If you are properly prepared and you know where to go for your records I just done one last week. I was very tired last week. It was a piling thing but, again, piling, good records. Barge records, piling records, everything. Pull it altogether and could actually get to the actual effect of all these claimed variations in a short period of time because, of course, we only had a short period of time.

By doing this, if you are familiar with the progress data and the production data, then you can easily spot what I call, you know, our delay event war stories.

So this is one. One of my favourites is that we got a time impact analysis to have a look at and there's, you know, 10 milestones and progress printouts like this and I'm going, "Oh my God, it's so boring, what are they really saying here", and you read it and there's like this tale of woe, pages and pages long of a chronology about this issue that's ongoing and ongoing. I'm looking at it and thinking, "This is off the critical path for this milestone all the time, what is it, it must be really major", and then you read it and you realise when you go to the record it was one day of work to a helipad to turn a lights orientation around. It was a one day worksheet. There was a

lulled chronology but there was a one day worksheet, but it had been modelled in a program to show that it was on the critical path all the time.

In the same analysis there was also a delay to another milestone for a critical path running through deleted scope which we didn't understand.

Also in methods like these when you've got programs, contemporaneous programs of the time, there may be changes made so it's important to understand why those changes are there. Sometimes they might be 100 per cent valid, you know, this is what it should have looked like, this was a mistake, it wasn't there. If it had been there the program would have looked like this.

Other times there's just, as I saw in this one, clearly incorrect activities added by the consultants and then you have a real critical path for a project that isn't even in the program. You look at the document and you think, "Everyone is going on about this HE remake", I can't even see that, and that's all the areas of concern. It's not in the program. It's never going to be on the critical path in the program if it's not there. So, again, it's back to documents.

Also at the end of the job the program is often less meaningful than other progress data, especially in commissioning. Commissioning, I would never use a program, I will always go to a log always.

On the other hand, during the work, program is one of the tools you have to assess the affected change. The programs often exist alongside other ad hoc schedules that people prepare, but it is a thing that should be used to assess the effects of owner or employer or company delays. I mean, that's at the heart of ABC contracts: use the program to show the effect of these delays. If that's done properly then you can you know, I do quite a lot of ABC work for projects that are ongoing and quite a lot of work on projects that have used the spirit of ABC that you are supposed to model these and put them in the program and if you do it properly, it does work, but, again, it's underlined by those progress records.

Finally, I haven't said anything about notice requirements because they're all there. Number one of the 10 point checklist.

Hopefully tonight the takeaway is about the use of records to just demonstrate this delay to progress and the application of consents as well. Don't go record crazy or analysis crazy because you will probably burn a lot of money and no one will thank you for it.

And the final one is my favourite quote from In Cold Blood, Truman Capote, nothing to do with delay analysis but I think it resonates. "It's like the case will settle themselves by fancy theories ..." and by that I mean fancy delay analysis methodology talk. He put his faith in facts, sweated for and sworn to. So that's it.

Got any questions?

Edmund Wan: Thank you.

Audience Member: The common sense approach talks about my question really is whether you have to look at the reason, as you said, in construction law protocol and whether you see your common sense approach in the law reform?

Wendy MacLaughlin: I think the words "common sense" are in there. They do say that whatever method you choose I'm pretty sure that we're talking about

--

Audience Member: No, actually, I'm talking of your approach, your common sense approach.

Wendy MacLaughlin: Oh, okay, but it is actually in the protocols as well because David Barry, who is one of the

drafters of the protocols, is a very strong advocate that whatever you do, it has to make sense. It has to make sense. It has to be robust. It has to be credible. It has to be something that did delay to progress and it did have an impact on completion.

I like the protocols update because it has the as planned versus as built in Windows method in there, and that one, to do that properly, you have to apply common sense because you have to understand the whole project and how the various parts of it are. You can't start with a bunch of event and claimed issues. You've got to have your wider view, and then work out your critical path, often sometimes using the programs, sometimes not.

I think it is a step forward. I think the table that categorises the methods and the cause and effect, affected cause classification, is a good update.

Audience Member: Yes. But they're all program based.

Wendy MacLaughlin: The as planned as built isn't necessary and collapse as built, you can I've done a collapsed as built in Excel on commissioning because it's linear. You can agree that any delay to commissioning is going to affect the end date which is usually once you're past a certain point in the project. These are power station projects and your commissioning period, if it's a delayed project, instead of being three months it could be six or eight, but I think it's definitely an improvement on the first protocol.

Audience Member: Thanks.

Wendy MacLaughlin: Yes?

Audience Member: Wendy, more of an observation. I've worked for a Japanese contractor for 19 years and that was the first time I've really seen time change to programming being used. Certainly in respect of that particular contractor it was their very much preferred method of working.

One of the things that you've indicated is actually a Gantt chart is very often not the most appropriate way of programming the job. On a time change issue on any job that's either vertical or linear is by far the better methodology.

Wendy MacLaughlin: I think so. I mean, definitely definitely on the linear and I've talked to people who work with Japanese contractors on the vertical as well.

Audience Member: It works just as well on the vertical if not even better.

Wendy MacLaughlin: Yes, yes, so I understand. I'm a big fan of time change because you get to see the rate of progress which you don't on a Gantt. A Gantt can be hundreds of pages long in a level of detail that to get that instantaneous picture of how you're tracking, it's just not there. The line of balance of time change there, they're there instantaneously. And it's in the phone com (?), it's mentioned, but it's mentioned as a method. I don't see it as a method of analysis. I see it as a planning method. I don't think it's a separate method. I think it's part of, if anything, as planned, as built.

Audience Member: I think when you were talking about the power stations or you were talking about pipe works and things which are fairly straightforward to a certain degree with commissioning, it's okay your methodology can work, but once you get into complicated residential project or office buildings, or something that is non linear, with verticality, different towers, different things, it's quite hard to adopt a sort of measured mile approach or something like that, or even get the records sufficient that you can actually plot something along the lines such as you're suggesting.

Wendy MacLaughlin: It's more difficult in buildings but it's not impossible and you've got different measuring points. If you've got multiple if I've got something to look at that's multiple buildings, I will have to look at every block, but I can look at every block relatively simply.

I did some seven resi blocks in London earlier this year and very, very quickly, for the developer, just to get an idea, "How exposed am I? The contractor is throwing all these things, how exposed am I?", just where are the delays. It was very, very quick, as planned, as built, key measuring points for the structure. So substructure, up to foundations, through the structure, through the envelope and then into the fit out and commissioning.

Commissioning in the building is the same, I think. You can get that granularity that you have. The most difficult part, I think, in buildings is after it's weather tight before commissioning, it's very difficult. I haven't figured out an easy one for that one yet.

Hospitals are the same, I think. At least on a hospital you can usually find a couple of floors that are M&E heavy, but I think residential buildings are probably the hardest to analyse.

Audience Member: I think sometimes with hospitals you also get complications because you can finish the job, and then you get end users coming in, "I don't like this, I don't like that", and then you start having to make all these changes and basically you can't get anything more out of that, I mean the job just drags on and drags on and drags on until some point in time sufficient --

Wendy MacLaughlin: Yes, all those room sign off sheets, but if they are making changes, then, they weren't fun.

Audience Member: I know. It's not like you are talking about a critical path, how it causes this and how it causes that and a change here affects so many days work, they don't understand that.

Wendy MacLaughlin: I think that's a lesson learned in keeping the records.

Audience Member: That's your 165 day page to explain why the one day occurs.

Edmund Wan: We know we have reached the end of the session because the air conditioning has switched off.

Can we please thank Wendy in the usual manner, please.

Wendy MacLaughlin

The views expressed in this paper are those of the authors alone, and do not necessarily represent the views of the Society of Construction Law Hong Kong.

The discussion set out above is a general one and should not be relied upon in place of legal advice specific to the facts of any case. The author accepts no liability for any such reliance.

ELEMENTS OF A ROBUST DELAY ANALYSIS

Records, Metrics, Tips and Essential Elements, and a 10 point checklist

Wendy MacLaughlin (MSc BE (Civil) HONS I CEng MICE)
Partner, Global Lead Expert Services, HKA
16 August 2017

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WHAT IT SAID ON THE TIN…

- A robust delay analysis, irrespective of the methodology, needs to demonstrate that a delay to progress occurred because of an event.
- Often, this fundamental requirement is lost in the terminology of forensic analysts. This talk will focus on that essential element of a delay analysis, using real examples where the importance of records and use of progress data will be conveyed.

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ASSESSMENT CHECKLIST

1. Occurrence of Delay Event
2. Notice requirements
3. Owner/Company is liable for the Event
4. Event actually causes a delay to progress
5. Delay is evidenced in project records and quantified
6. Critical path is affected
7. Contractor is not in concurrent delay
8. Contractor's mitigation obligations are discharged
9. Indirect cost claims are for compensable time related costs
10. Direct cost claims are for compensable task related costs

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INTRODUCTION

- Purpose
- Categorisations
- Advantages/Disadvantages
- How to decide on a methodology
- Demonstrating a delay to progress

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WHY IRRESPECTIVE OF METHODOLOGY??

Because the delay caused by a claimed issue is what is trying to be demonstrated in any method

– The amount of delay is what the contract clauses are usually expressly asking for:
  - either that expected or anticipated (NEC3, NEC4), or
  - the extent to which the contractor was actually delayed

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AND BECAUSE TALKING ABOUT METHODOLOGY….

Makes me feel like that….

Terminology

– "Observational"/ "Modelled"
– Prospective/ Retrospective
– Dynamic / Static

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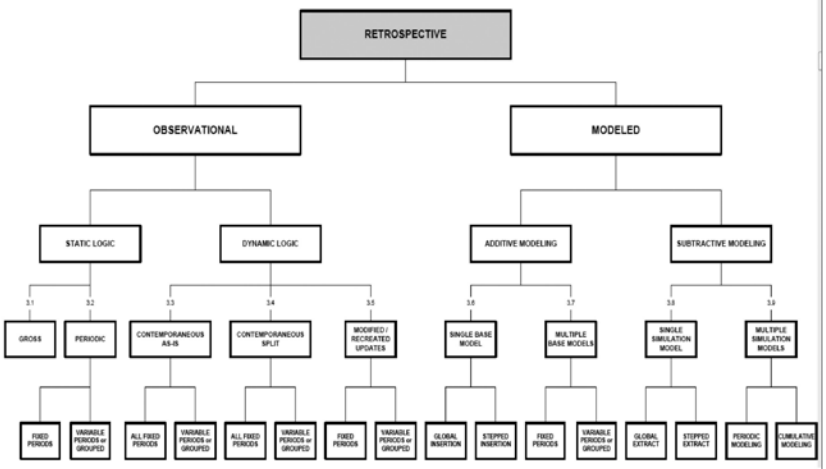
ONLY IN AMERICA



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SCL PROTOCOL FEB 2017 2ND EDITION

Method of Analysis	Analysis Type	Critical Path Determined	Delay Impact Determined	Required
Impacted As-Planned	Cause & Effect	Prospectively	Prospectively	Logic linked baseline programme A selection of delay events to be modelled
Time Impact Analysis	Cause & Effect	Contemporaneously	Prospectively	Logic linked baseline programme Update programmes or progress information with which to update the baseline programme A selection of delay events to be modelled
Time Slice Windows Analysis	Effect & Cause	Contemporaneously	Retrospectively	Logic linked baseline programme Update programmes or progress information with which to update the baseline programme
As Planned v As Built Windows Analysis	Effect & Cause	Contemporaneously	Retrospectively	Baseline programme As Built data
Longest Path Analysis	Effect & Cause	Retrospectively	Retrospectively	Baseline programme As Built data
Collapsed As Built	Cause & Effect	Retrospectively	Retrospectively	Logic linked as built programme A selection of delay events to be modelled

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METHODS – ALL NEED DELAY TO PROGRESS CAUSED BY THE EVENT

Modelled

– Impacted As Planned
– Time Impact Analysis
– Collapsed As Built/As Built But For

Observational

– As Planned v As Built in Windows
– Time slice

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DELAY TO PROGRESS – ANY METHOD

Causal link

- A change in progress rate occurs, or will occur, as a consequence
- Contractor needs to
  - Identify activity affected on the programme Contractor is working to
  - Quantify the extent of the delay to progress
- Programme
  - Is it sufficiently detailed to assess event?
  - If not, what else is available (s-curves, physical progress data)
- Progress measurement
  - How is Contractor measuring progress? (welds, pours, metres, no. of, t, "to-go", dia-in)
  - What documents are required for a robust claim?
  - Key principles:
    - As close to the person undertaking the physical work
    - Often required under EPC Contract or Contractor's sub-contracts (QA, KPIs, project controls)
    - "behind the green bar"

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DELAY TO PROGRESS – ANY METHOD

Delay to Progress

- Evidenced by Records (QA)
- Identify the metric to be used and understand production and productivity
  - t/day
  - joints/day
  - dia-in/day
  - Piles/day
  - m3/day
  - m/day
  - no. of (terminations)/day
  - "to-go" lists
  - Completions/punchlist items
  - mh/t
  - mh/dia-in
  - machine hours/m3

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DELAY TO PROGRESS – ANY METHOD

Delay to Progress

- If your expert is program rather than progress data driven, there is a risk of:
  - Treating the schedule as the sole source of truth
  - It is just another secondary source of progress information
  - It is a view, of one way the remaining work might be done, at a particular point in time
  - Work or dependencies not in the program will be missed
  - The real story is behind the green bars in the records
  - Green bars don't show <u>rates</u> of progress

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DELAY TO PROGRESS – ANY METHOD

Delay to Progress

- Contractor should have the basis of its planned production rate
- Assess for reasonableness (Execution Plan, actual resources, AFC quantities, production rate)
- Assemble the progress data
  - Deliverables / transmittals / drawing data
  - S-curve – planned and actual
  - Excel
  - Time period of analysis
- Interpret the progress data
  - Reasons for delays (other factors, downtime, weather, breakdown, resource insufficiency, progress less than planned in any event)
  - Assess/prepare the claim in that light
- Consider if other issues affected progress when
  - The event had not occurred
  - Was no longer affecting the work

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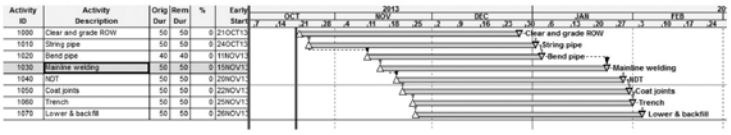
DELAY TO PROGRESS – ANY METHOD

Delay to Progress



Activity ID	Activity Description	Orig Dur	Rem Dur	%	Early Start
1000	Clear and grade ROW	50	50	0	21OCT13
1010	String pipe	50	50	0	24OCT13
1020	Bend pipe	40	40	0	11NOV13
1030	Mainline welding	50	50	0	15NOV13
1040	NDT	50	50	0	20NOV13
1050	Coat joints	50	50	0	22NOV13
1060	Trench	50	50	0	25NOV13
1070	Lower & backfill	50	50	0	26NOV13

- Long green bars
- How did the works progress?
- How can you establish if a particular issue caused a production loss?
- Behind the green bars => Supervisors reports, welding and NDT data

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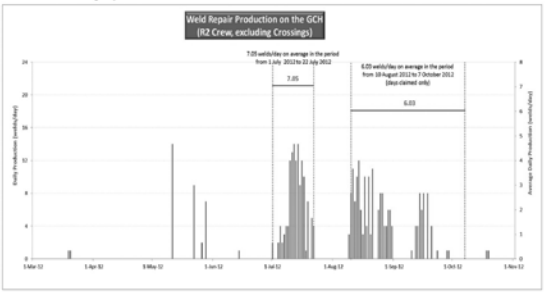
DELAY TO PROGRESS – ANY METHOD

Delay to Progress

- Effect on weld repair crews of additional travel time
- Asserted by Contractor
- Demonstrated by production data



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DELAY TO PROGRESS – ANY METHOD

Treatment of contaminated material - example

- Increased quantities of dredged material had to be treated
- Delayed 3 Separable Portions of the work
- Contractor's claim contained programme extracts
- Treatment shown as 1 bar, over 150 days long
- Cannot identify planned and additional material from the programme
- But => behind the green bars….

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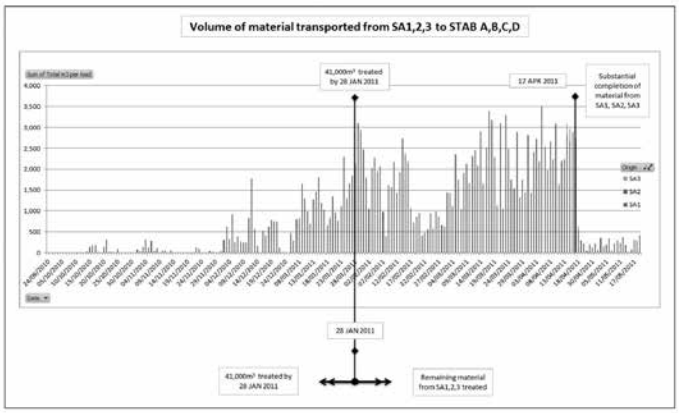
DELAY TO PROGRESS – ANY METHOD

Treatment of contaminated material – truck count analysis



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ANALYSIS TO RESOLVE DISPUTE

Effect of delay to progress on completion

- Establish status of project when "planned" amount of treatment completed
- Used the same progress records, and the statussed programme
- Establish status of project when additional material treated
- Identified from actual data when this became critical
- Was consistent with reported areas of concern
- Resolved in mediation

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ANALYSIS TO RESOLVE DISPUTE

What we didn't do

- Extensive programme heavy analysis
- Re-construct a model of the project and use planning software to spit out the answer
  - Baseline impacted with event => impacted as-planned
  - Updated schedule impacted with event => time impact analysis
- Why not?
- Wasn't needed to resolve the dispute
- Employer needed to understand the actual impact of the increased quantity of treated materials

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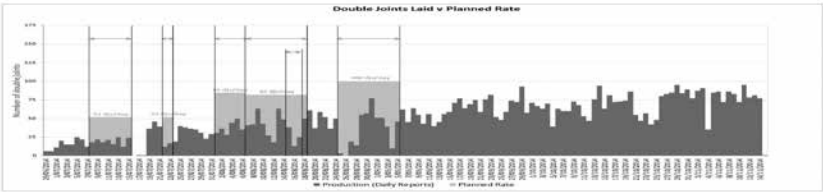
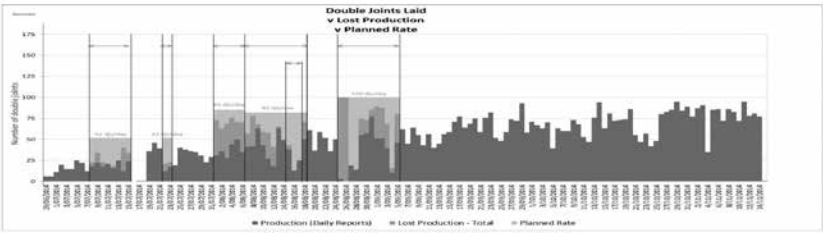
DELAY TO PROGRESS – ANY METHOD





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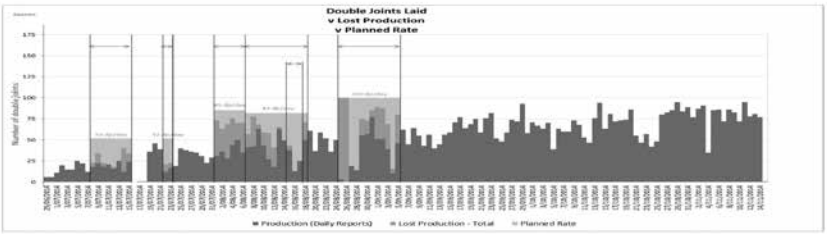
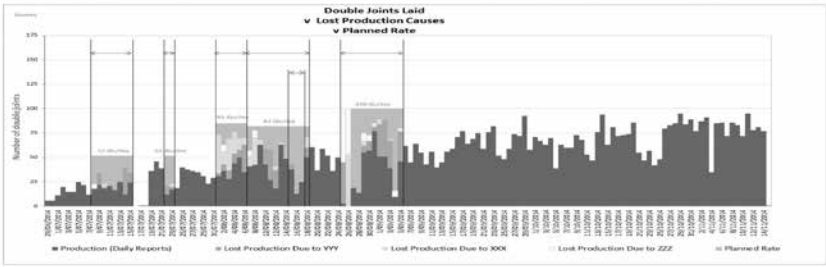
DELAY TO PROGRESS – ANY METHOD





ANALYSIS TO RESOLVE DISPUTE

What we didn't do

– Re-construct a model of the project and use planning software to spit out the answer
  - Long bars on the programme only reflected this underlying data
  - Critical path was not controversial
  - Only the extent to which the issues claimed affected it

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DELAY TO PROGRESS – ANY METHOD

Road construction- example

– Latent condition affecting all works
– Plus a lot of rain
– Delay separated into weather and other
– Earthworks and pavement records uses to compile s-curves to work out which component was critical

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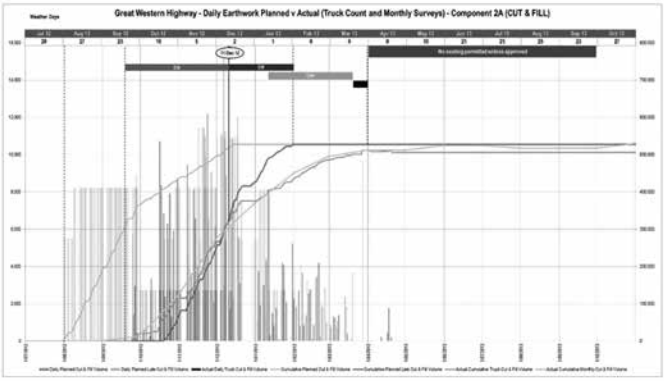
DELAY TO PROGRESS – ANY METHOD

Road construction- example



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ROAD PAVEMENT DISRUPTION

- Cause and effect needs to be demonstrated
- Find your metric from the records available
- Measured mile can usually be found
- Reasons why productivity differed from a measured mile period are key => detailed causal analysis
- Example
  - Production documents (output)
  - Fuel and plant documents (input)
  - Analysis

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MPR DATA

EARTHWORKS, PAVEMENTS AND DBST SUMMARY OF WORKS - JULY 2008

S/No.	Activity	Chainage From	Chainage To	Depth Below Formation Level (mm)	Total Length (m)	Remarks/Completed
	Top Stripping	110+320	112+700	Varies	2380	Completed
1.00	Total Length (m)				2380	
	Cutting and Rock Excavation	116+740	117+000	Varies	260	On going
		117+110	118+200	Varies	1090	On going
2.00	Total Length (m)				1350	
3.00	Road Bed Preparations	109+420	109+430	Varies	10	01-Jul-08
		108+200	108+260	Varies	60	03-Jul-08
		109+430	109+620	Varies	190	05-Jul-08
		109+620	109+730	Varies	110	06-Jul-08
		109+730	109+840	Varies	110	08-Jul-08
		106+740	106+820	Varies	80	09-Jul-08
		109+840	110+000	Varies	160	10-Jul-08
		102+300	102+360	Varies	60	12-Jul-08
		110+000	110+190	Varies	190	14-Jul-08
		110+190	110+280	Varies	90	14-Jul-08
		102+940	103+040	Varies	100	16-Jul-08
		108+460	108+480	Varies	20	16-Jul-08
		105+760	105+880	Varies	120	18-Jul-08
		110+280	110+400	Varies	120	19-Jul-08
		104+900	104+980	Varies	80	19-Jul-08
		110+400	110+550	Varies	150	20-Jul-08
		110+550	110+770	Varies	220	23-Jul-08
		110+770	111+040	Varies	270	26-Jul-08
	Total Length (m)				2140	
4.00	Embankment	100350	100400	Varies	50	02-Jul-08
4.10		109+100	109+200	Varies	100	02-Jul-08
		109+200	109+320	Varies	120	03-Jul-08
		104+680	104+870	Varies	190	03-Jul-08
		109+320	109+430	Varies	110	05-Jul-08
		109+260	109+350	Varies	90	[illegible]

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CONTRACTOR INTERNAL REPORTING

EARTH WORK PROGRESS SUMMARY

Sta.	Fill Vol (m3)	Cut Vol (m3)	JULY '08 Fill Progress (G3 , G7 , G15) Monthly	Fill Progress Cum.	Fill Progress %	Fill Remain	Cut Progress Monthly	Cut Progress Cum.	Cut Progress %	Cut Remain	G7 (m) Monthly	G7 (m) Cum.	G15 (m) Monthly	G15 (m) Cum.
0+000 ~ 1+000	3,823	11,075	0	3,823	100.0%	0	0	11,075	100.0%	0		1,000		1,000
1+000 ~ 2+000	3,449	5,073	0	3,449	100.0%	0	0	5,073	100.0%	0		1,000		1,000
2+000 ~ 3+000	6,466	3,304	0	6,466	100.0%	0	0	3,304	100.0%	0		1,000		1,000
3+000 ~ 4+000	21,969	358	0	21,969	100.0%	0	0	358	100.0%	0		1,000		1,000
4+000 ~ 5+000	9,180	21,097	0	9,180	100.0%	0	0	21,097	100.0%	0		1,000		1,000
5+000 ~ 6+000	20,634	12,932	0	20,634	100.0%	0	0	12,932	100.0%	0		1,000		1,000
6+000 ~ 7+000	13,554	1,206	0	13,554	100.0%	0	0	1,206	100.0%	0		1,000		1,000
7+000 ~ 8+000	13,401	2,074	0	13,401	100.0%	0	0	2,074	100.0%	0		1,000		1,000
8+000 ~ 9+000	12,720	3,542	0	12,720	100.0%	0	0	3,542	100.0%	0		1,000		1,000
9+000 ~ 10+000	6,888	14,292	0	6,888	100.0%	0	0	14,292	100.0%	0		1,000		1,000
10+000 ~ 11+000	12,489	12,099	0	12,489	100.0%	0	0	12,099	100.0%	0		1,000		1,000
11+000 ~ 12+000	14,620	2,326	0	14,620	100.0%	0	0	2,326	100.0%	0		1,000		1,000
12+000 ~ 13+000	17,454	1,077	0	17,454	100.0%	0	0	1,077	100.0%	0		1,000		1,000
13+000 ~ 14+000	12,737	3,408	0	12,737	100.0%	0	0	3,408	100.0%	0		1,000		1,000
14+000 ~ 15+000	6,115	15,063	0	6,115	100.0%	0	0	15,063	100.0%	0		1,000		1,000
15+000 ~ 16+000	6,450	20,672	0	6,450	100.0%	0	0	20,672	100.0%	0		1,000		1,000
16+000 ~ 17+000	16,590	6,571	0	16,590	100.0%	0	0	6,571	100.0%	0		1,000		1,000
17+000 ~ 18+000	7,924	12,939	0	7,924	100.0%	0	0	12,939	100.0%	0		1,000		1,000
18+000 ~ 19+000	5,803	6,462	0	5,803	100.0%	0	0	6,462	100.0%	0		1,000		1,000
19+000 ~ 20+000	8,914	6,714	0	8,914	100.0%	0	0	6,714	100.0%	0		1,000		1,000
20+000 ~ 21+000	36,087	326	0	36,087	100.0%	0	0	326	100.0%	0		1,000		1,000
21+000 ~ 22+000	13,927	14,584	0	13,927	100.0%	0	0	14,584	100.0%	0		1,000		1,000
22+000 ~ 23+000	11,179	16,162	0	11,179	100.0%	0	0	16,162	100.0%	0		1,000		1,000
23+000 ~ 24+000	29,061	6,111	0	29,061	100.0%	0	0	6,111	100.0%	0		1,000		1,000
24+000 ~ 25+000	12,669	6,881	0	12,669	100.0%	0	0	6,881	100.0%	0		1,000		1,000
25+000 ~ 26+000	37,018	8,377	0	37,018	100.0%	0	0	8,377	100.0%	0		1,000		1,000

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MPR DATA

S/No.	Activity	Chainage		Depth Below Formation Level (mm)	Total Length (m)	Remarks/Completed
		From	To			
6.20	C2	95+896	95+682	200	214	01-Jul-08
		95+682	95+590	200	92	01-Jul-08
		95+950	95+360	200	590	02-Jul-08
		95+360	95+194	200	166	02-Jul-08
		95+194	95+014	200	180	03-Jul-08
		95+014	94+828	200	186	04-Jul-08
		94+828	94+620	200	208	05-Jul-08
		94+620	94+513	200	107	05-Jul-08
		94+513	94+303	200	210	06-Jul-08
		94+302	94+141	200	161	07-Jul-08
		98+480	98+680	200	200	16-Jul-08
		98+680	99+062	200	382	17-Jul-08
		99+062	99+383	200	321	18-Jul-08
		96+800	96+970	200	170	23-Jul-08
		97+150	97+320	200	170	23-Jul-08
		97+610	97+790	200	180	24-Jul-08
		96+970	97+072	200	102	29-Jul-08
		97+320	97+610	200	290	29-Jul-08
		100+720	100+970	200	250	30-Jul-08
		100+970	101+380	200	410	31-Jul-08
	Total Length (m)				4589	

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CONTRACTOR'S RECORDS – MEASUREMENT

Progress for subbase C2 — May 2007

date		progress	amount	Sta.1			Sta.2			remarks
		m	m							mothly schedule : 2,100m(150.00m/day)
1	Tue	0.0	0.0							off-day
2	Wed	0.0	0.0							
3	Thu	0.0	0.0							
4	Fri	0.0	0.0							
5	Sat	0.0	0.0							
6	Sun	166.0	166.0	69+390.	~	69+556.				
7	Mon	391.1	557.1	68+502.4	~	68+893.5				
8	Tue	351.5	908.6	68+893.5	~	69+245.				
9	Wed	315.0	1,223.6	69+245.	~	69+390.	69+740.	~	69+910.	
10	Thu	349.0	1,572.6	69+910.	~	70+259.				
11	Fri	0.0	1,572.6							
12	Sat	198.4	1,771.0	70+259.	~	70+457.4				
13	Sun	0.0	1,771.0							off-day

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COMPILE PRODUCTION DATA

Date	SheetNam	Mont	Orig Ch F	Orig Ch T	Adj Ch Fr	Adj Ch Ti	Sectic	Lengtl
16-Apr-07	C1	200704	69+080.00	69+270.00	69+080.00	69+270.00	2a	190.00
18-Apr-07	C1	200704	69+270.00	69+640.00	69+270.00	69+640.00	2a	370.00
19-Apr-07	C1	200704	68+712.90	68+780.00	68+713.60	68+780.00	2a	66.40
19-Apr-07	C1	200704	69+700.00	69+880.00	69+700.00	69+880.00	2a	180.00
20-Apr-07	C1	200704	69+880.00	70+268.00	69+880.00	70+268.00	2a	388.00
21-Apr-07	C1	200704	70+268.00	70+388.00	70+268.00	70+388.00	2a	120.00
23-Apr-07	C1	200704	70+388.00	70+793.00	70+388.00	70+793.00	2a	405.00
24-Apr-07	C1	200704	70+793.00	71+110.00	70+793.00	71+110.00	2a	317.00
25-Apr-07	C1	200704	71+110.00	71+507.00	71+110.00	71+507.00	2a	397.00
26-Apr-07	C1	200704	69+640.00	69+700.00	69+640.00	69+700.00	2a	60.00
26-Apr-07	C1	200704	71+507.00	71+686.40	71+507.00	71+686.40	2a	179.40
6-May-07	C2	200705	69+390.00	69+556.00	69+390.00	69+556.00	2a	166.00
7-May-07	C2	200705	68+502.40	68+893.50	68+502.40	68+893.50	2a	391.10
8-May-07	C2	200705	68+893.50	69+245.00	68+893.50	69+245.00	2a	351.50
9-May-07	C2	200705	69+245.00	69+390.00	69+245.00	69+390.00	2a	145.00
9-May-07	C2	200705	69+740.00	69+910.00	69+740.00	69+910.00	2a	170.00
10-May-07	C2	200705	69+910.00	70+259.00	69+910.00	70+259.00	2a	349.00
12-May-07	C2	200705	70+259.00	70+457.40	70+259.00	70+457.40	2a	198.40
14-May-07	C2	200705	69+636.30	69+740.00	69+636.30	69+740.00	2a	103.70
14-May-07	C2	200705	70+457.40	70+670.00	70+457.40	70+670.00	2a	212.60
15-May-07	C2	200705	70+670.00	71+021.45	70+670.00	71+021.45	2a	351.45
16-May-07	C2	200705	71+021.45	71+370.00	71+021.45	71+370.00	2a	348.55
17-May-07	C2	200705	71+370.44	71+670.00	71+370.00	71+670.00	2a	300.00
18-May-07	C2	200705	69+556.00	69+636.30	69+556.00	69+636.30	2a	80.30

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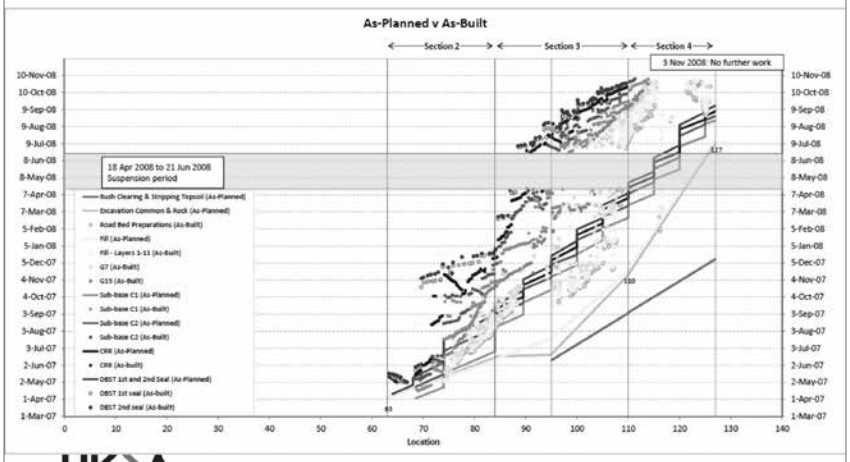
TIME LOCATION CHART



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DAILY REPORT

SITE WORK DAILY SCHEDULE 25th April' 2007

WORK DESCRIPTION	STATION No	EQUIPMENTS	INSPECTIONS	REMARKS
		Earth Works		
Road Maintenance	83km - 85km	GD611A(4), SV512D(8), 5D/T		
Base Camp Preparation	[redacted] Base Camp	GD611A(2), D5H LGP, SD115D(2), 325B(7), 10D/T		
Borrow Pits	74km RHS (Sub-base)	JS330(E), D65EX(1), D85EX(2).		
	76km LHS	PC300(1).		
	94km LHS	EX350(E), D155(1)		
		Pavement Works		
Cement Stabilization - C1	71+108 - 71+500	RM250, GD611A(8), SV510TF(4), SV512D(2), SV512D(3), SV512D(4), TS200(3).	F.D.D.T	
Preparation	71+500 - 71+ 700 (C1)	GD611A(5), 10D/T.	71+108 - 71+500 (C1)	
	69+270 - 69+540 (C2)			
Curing - C1	69+270 - 71+108	5W/B.		
DBST - 1st Seal	67+510 - 66+800	CORINSA(H), CP221, Chipspreader, 2 Distributors, 4D/T		
CRR Brooming	66+250 - 66+030	FK617K (Distributor)		
CRR Laying & Compaction	66+000 - 65+500	GD611A(6), GD611A(7), TS200(2), SV512D(6), SV512D(7), D7H(2)		
Stockpile	61km (DBST)	WA180, 1D/Trailer		
	66km (CRR)	924G, 2D/Trailer		

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DAILY REPORT

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FUEL SUPPLY RECORDS

[redacted] FUEL SUPPLY SHEET (MACHINES)

STATION DIESEL TANK [redacted] Fuel Station

UP DATED 28/March/'07 DATE: 01 / Apr / 07 (SUN)

MACHINE	REQUEST (Lts)	REQUEST BY	REQUEST No.	SUPPLY (Lts)	SUPPLY Time	Dosing(cm) Before	Dosing(cm) After	Dosing(cm) EV	MEAGE	OPE/DREV NAME	OPE/DREV SIGN	LOCATION
TIRE EXCAVATOR												
PW100-1					:							
PW100-2					:							
PW150					:							
EX125WD-1					:							
EX125WD-2					:							
WHEEL LOADER												
950F					:							
966F					:							
85ZA-1					:							
85ZA-2					:							
85ZA-3					:							
65ZA-1					:							
65ZA-2					:							
924G-1	40	ASHDA	51367	40	8:00					Atthchmd	Amnt:	B/CAMP ✓
924G-2					:							
LX70-1					:							
LX70-2					:							
LX110-1					:							
LX110-2					:							
MOTOR GRADER												

FUEL TRACKED BY CONTRACTOR

[redacted] ROAD PROJECT FUEL SUPPLY RECORD
[redacted] STATION

OPENING BALANCE	24,066.6 lts
RECEIVE FROM [redacted]	0.0 lts
RECEIVE FROM OTHER STATION	0.0 lts
DELIVERY TO OTHER STATION	0.0 lts
SUPPLY TO EQUIPMENT	2,771.3 lts
CLOSING BALANCE	23,295.3 lts

DATE: 01/Apr/2007 (Sun)

NAME	ID No	REG. No	TYPE	CLASS	PROPERTY	SUPPLY	WORK	WORK DETAIL	CHARGE	REMARK
D7H-4			BULLDOZER	23t	[redacted]	130	SG		[redacted]	
D85EX-1			BULLDOZER	28t	[redacted]	200	RM		[redacted]	
D85EX-2			BULLDOZER	28t	[redacted]	130	SG		[redacted]	
PC300-1			EXCAVATOR	1.2m3	[redacted]	40	RM		[redacted]	
325B-6			EXCAVATOR	1.2m3	[redacted]	80	RM		[redacted]	
JS330(ES)			EXCAVATOR	1.8m3	[redacted]	80	RM		[redacted]	
924G-1			WHEEL LOADER	2.3m3	[redacted]	40	STR		[redacted]	
GD611A-4			MOTOR GRADER	4.0m	[redacted]	50	RM		[redacted]	
GD611A-6			MOTOR GRADER	4.0m	[redacted]	80	RM		[redacted]	
D/TRUCK	E3	T777ACY	DUMP TRUCK	15t	[redacted]	150	RM		[redacted]	
D/TRUCK	E5	T885ACY	DUMP TRUCK	15t	[redacted]	70	RM		[redacted]	
D/TRUCK	E10	T832AAD	DUMP TRUCK	15t	[redacted]	145	RM		[redacted]	
D/TRUCK	E11	T855AAS	DUMP TRUCK	15t	[redacted]	90	RM		[redacted]	
D/TRUCK	E14	T957ADP	DUMP TRUCK	15t	[redacted]	95.1	RM		[redacted]	
D/TRUCK	E24		DUMP TRUCK	15t	[redacted]	85	RM		[redacted]	
D/TRUCK	V5		DUMP TRUCK	15t	[redacted]	140.1	RM		[redacted]	
D/TRUCK	V7		DUMP TRUCK	15t	[redacted]	84	RM		[redacted]	
D/TRUCK	V9		DUMP TRUCK	15t	[redacted]	85	RM		[redacted]	
D/TRUCK	V11		DUMP TRUCK	15t	[redacted]	85	RM		[redacted]	
T/MIXER	No.5	T881ABT	TRUCK MIXER	4.5m3	[redacted]	60	STR		[redacted]	
T/MIXER	No.6	T882ABT	TRUCK MIXER	4.5m3	[redacted]	40	STR		[redacted]	
2t UNIC		T595AJX	UNIC	2t	[redacted]	40	WS		[redacted]	
DIESEL TANK	K3	TZR9016	DIESEL TANK	10,000 Lts	[redacted]	35	DS		[redacted]	
FORK LIFT-2						30	STR		[redacted]	
DCA400			GENERATOR		[redacted]	120	BCP		[redacted]	
DCA220			GENERATOR		[redacted]	160.1	BCP		[redacted]	
BORE HOLE 2			GENERATOR		[redacted]	40	WT		[redacted]	
KYC C/PLANT			CRUSHER PLANT		[redacted]	20	MQ		[redacted]	SERVICE
		T147ABX	SITE VEHICLE		[redacted]	52	SV		[redacted]	
		T361AJY	SITE VEHICLE		[redacted]	40	SV		[redacted]	

CODED WORK BREAKDOWN

Fuel Work Code	Fuel Descriptions
EW-BC	E/W - BUSH CLEARING
EW-CTF	E/W - CUT TO FILL
EW-CTS	E/W - CUT TO SPOIL
EW-CUT	E/W – CUTTING
EW-REX	E/W - ROCK EXCAVATION
EW-SLS	E/W - SLOPE SHAPING
EW-BP	E/W - BORROW PIT
EW-BTF	E/W - BORROW TO FILL
EW-EBM	E/W - EMBANKMENT (MACHINE)
EW-EBW	E/W - EMBANKMENT (W/B)
SB	SUB BASE
CRR	CRR CONSTRUCT
TCRR	CRR TRANSPORT
AS	ASPHALT
DBST	DBST CONSTRUCT
TDBST	DBST TRANSPORT
WTS	WATER SUPPLY (BORE HOLE)

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FUEL AND PLANT DATA COMPILED

Date	Category	TYPE	NAME	VUID	I.D N	REG. N	CLAS	QUANTITY	WORK
14/04/2007	Small Vehicles	SITE VEHICLE	PICK UP	SV-T948AHN		T948AHN		52	SV
14/04/2007	Small Vehicles	SITE VEHICLE	PAJERO	SV-T431AHL		T431AHL		30	SV
14/04/2007	Small Vehicles	SITE VEHICLE	PICK UP	SV-T696ADU		T696ADU		30	SV
14/04/2007	Small Vehicles	SITE VEHICLE	PICK UP	SV-T911ACM		T911ACM		20	SV
14/04/2007	Trucks	UNIC	4t UNIC	T-4T-UNIC-T453AHL		T453AHL	4T	40	SV
14/04/2007	Trucks	TRUCK	4t TRUCK	T-4T-T451AHL		T451AHL	4t	40	SV
14/04/2007	Trucks	TRUCK	4t UNIC	T-4T-UNIC-T754AAG		T754AAG	4t	30	SV
14/04/2007	General	WORK SHOP	WORK SHOP	WORK SHOP				20	WS
15/04/2007	Machines	BULLDOZER	D65E-2	BD-D65E(2)			18t	100.1	SQ
15/04/2007	Machines	BULLDOZER	D85EX-1	BD-D85EX(1)			28t	220	SB
15/04/2007	Machines	BULLDOZER	D85EX-2	BD-D85EX(2)			28t	220.04	SQ
15/04/2007	Machines	BULLDOZER	D155AX-1	BD-D155AX(1)			38t	180	OT
15/04/2007	Machines	BULLDOZER	D155AX-2	BD-D155AX(2)			38t	160	RM
15/04/2007	Machines	EXCAVATOR	PC300-1	EX-PC300(1)			1.2m3	80	RM
15/04/2007	Machines	EXCAVATOR	CAT325B-5	EX-325(5)			1.2m3	90	MQ
15/04/2007	Machines	EXCAVATOR	CAT325B-8	EX-325B(8)			1.2m3	80	SQ
15/04/2007	Machines	EXCAVATOR	EX350	EX-EX350			1.8m3	20	OT
15/04/2007	Machines	EXCAVATOR	JS330(E5)	EX-JCB330(1)			1.8m3	120	RM
15/04/2007	Machines	WHEEL LOADER	950F	WL-950F-KON			3.1m3	100	MQ
15/04/2007	Machines	WHEEL LOADER	924G-1	WL-924GZ(1)			2.3m3	40	STR
15/04/2007	Machines	WHEEL LOADER	LX110-1	WL-LX110(1)			1.8m3	50	CRR
15/04/2007	Machines	WHEEL LOADER	950F(KE)	WL-950F-KER(B)			3.1m3	100	MQ
15/04/2007	Machines	MOTOR GRADER	GD611A-5	MG-GD611A(5)			4.0m	100	RM
15/04/2007	Machines	MOTOR GRADER	GD611A-6	MG-GD611A(6)			4.0m	120	CRR
15/04/2007	Machines	MOTOR GRADER	GD611A-7	MG-GD611A(7)			4.0m	100	CRR
15/04/2007	Machines	MOTOR GRADER	GD611A-8	MG-GD611A(8)			4.0m	90	SB
15/04/2007	Machines	VIBRATION ROLLER	SV510TF-4	VR-SV510TF(4)			10t	40	SB
15/04/2007	Machines	VIBRATION ROLLER	SV512D-3	VR-SV512D(3)			11t	30	SB
15/04/2007	Machines	VIBRATION ROLLER	SV512D-4	VR-SV512D(4)			11t	40	SB
15/04/2007	Machines	VIBRATION ROLLER	SV512D-6	VR-SV512D(6)			11t	40	CRR
15/04/2007	Machines	VIBRATION ROLLER	SV512D-7	VR-SV512D(7)			11t	30	CRR
15/04/2007	Machines	VIBRATION ROLLER	SV512D-8	VR-SV512D(8)			11t	20	RM
15/04/2007	Machines	TYRE ROLLER	TS200-3	TR-TS200(3)			15t	30	CRR
15/04/2007	Machines	TYRE ROLLER	CORINSA(H/L)	TR-CORINSA			30t	50	CRR
15/04/2007	Machines	CRAWLER DRILL	TCD915	CD-TCD915				40	SQ
15/04/2007	Trucks	DUMP TRUCK	D/TRUCK	DT-K10	K10	T689ABT	10t	25	MQ

ANALYSIS OF PLANT MIX - MM

Count of Fuelled Vehicles:	Date																									
PLANT TYPE / WORK CODE	1/04/2007	2/04/2007	3/04/2007	4/04/2007	5/04/2007	6/04/2007	7/04/2007	8/04/2007	9/04/2007	10/04/2007	11/04/2007	12/04/2007	13/04/2007	14/04/2007	15/04/2007	16/04/2007	17/04/2007	18/04/2007	19/04/2007	20/04/2007	21/04/2007	22/04/2007	23/04/2007	24/04/2007	25/04/2007
⊞ BULLDOZER	7	7	5	8	3					7	6	6	6	8	9	11	10	12	11	11	9		11	10	10
⊞ EXCAVATOR	11	12	12	11	4				1	13	13	13	15	12	12	11	11	13	11	13	10		14	13	13
⊞ MOTOR GRADER	2	2	3	2	3					3	2	3	3	2	4	4	5	5	6	5	2		6	5	5
⊞ ROAD STABILIZER																2		1	1	1			1	1	1
⊞ TYRE ROLLER		1										1	2	2	2	3	1	2	1	3			1	3	3
⊞ VIBRATION ROLLER	1	2	1	2	1					1	2	4	2	2	7	9	5	8	8	8	2		10	10	9
⊞ WHEEL LOADER	4	6	4	5	2					8	5	6	6	6	6	7	6	5	4	6	6		9	7	6
AS																									
AW	2	2	2	2						3	2	2		2	2	2	2	2	2	2	2		2	2	
CMP																1									
CRR												1	1	1	1	1	1			1			1	1	
DBST										1				1					1		1		2		1
DS																									
EW-BC																									
EW-BP																									
EW-CUT																									
EW-EBM																									
EW-EOT																									
EW-REX																									
EW-SLS																									
MQ	1	2	2	2	2					3	2	2	2	2	2	2	3	2		2	2		3	2	2
OT		1																							
RM																									
SB																									
SHR																									
SOD																									
SQ																									
STR	1	1		1						1	1	1	3		1	1		1	1	1	1		1	2	3
TCRR																									
TDBST																									

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LOSS OF PRODUCTIVITY CALCULATION

Loss of Productivity Assessment - C1&C2

Measured Mile	3.92

Week Ending	Length (m)	Fuel (Litres)	Productivity (l/m)	Loss of Productivity	Disruption Factor	Delta to Measured Mile
8-Apr-07		-			0%	
15-Apr-07		420			100%	
22-Apr-07	1,314	5,550	4.22	8%	7%	0.31
29-Apr-07	1,358	6,008	4.42	13%	11%	0.51
6-May-07	166	5,831	35.13	797%	89%	31.21
13-May-07	1,605	5,771	3.60	0%	0%	-0.32
20-May-07	1,397	6,589	4.72	20%	17%	0.80
27-May-07	1,407	5,095	3.62	0%	0%	-0.30
3-Jun-07	526	6,274	11.93	205%	67%	8.01
10-Jun-07	956	7,890	8.25	111%	53%	4.34
17-Jun-07	1,236	7,582	6.13	57%	36%	2.22
24-Jun-07	510	3,811	7.47	91%	48%	3.56

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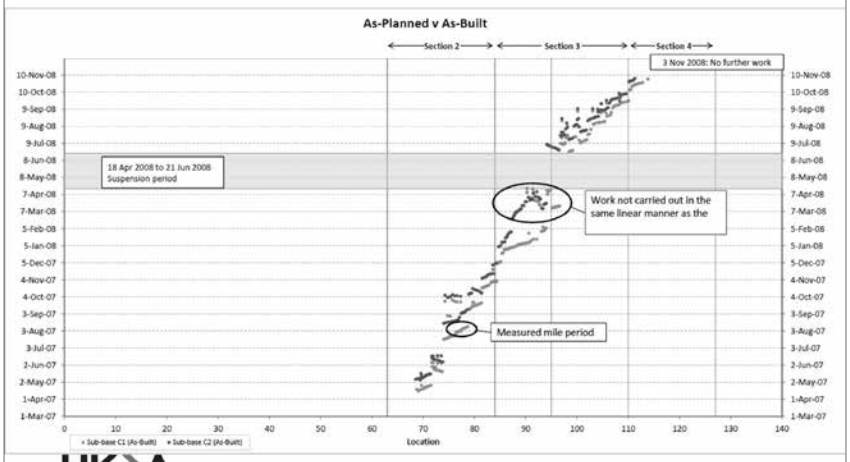
PAVEMENTS



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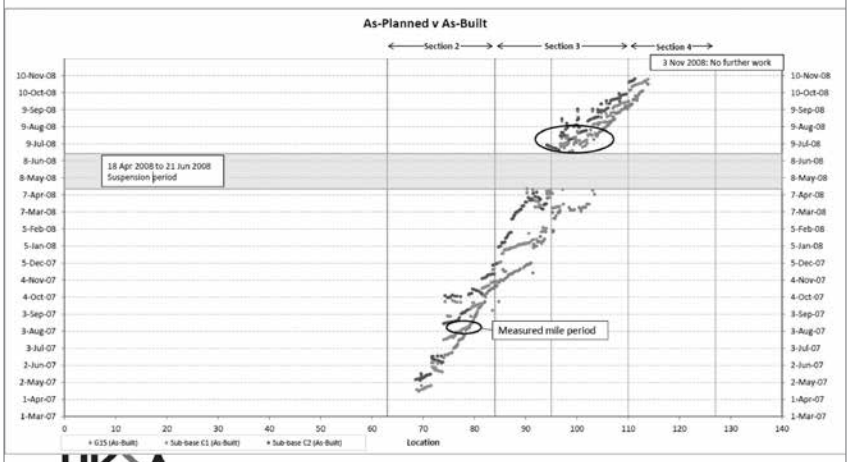
PAVEMENTS



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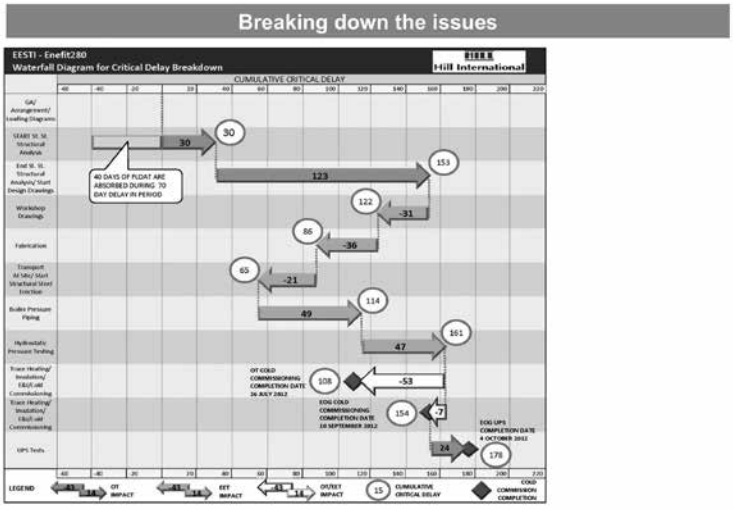
CLARITY



DELAY TO PROGRESS – ANY METHOD

My House – the Wall of Pain/relief from LDs

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DELAY TO PROGRESS – ANY METHOD

My House – the Wall of Pain/relief from LDs

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RECORDS RECORDS RECORDS….

– But…..
- The analysis of them has to go somewhere
- Not data for data's sake

– Security of Payment Legislation
- Preparation is key – for both parties to an adjudication

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TIPS

Prospective method issues

Our "event" war stories:

- 165 day delay to completion for 1 day of work to a helipad
- 64 day delay to completion from a critical path running through deleted scope (camp)
- Changed logic in Time Impact Analysis programmes that differed from contemporaneous programmes (Compare)
- Factually incorrect activities added by consultants
- HV ring main – a real driver to completion – delays not shown in programme
- At the end of the job, programme is less meaningful than other progress data (system completions, "to-go", s-curves

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TIPS

During the works v after the event

On the other hand:

- Programme is a time and change management tool
- Often exists alongside other ad-hoc schedules
- Should be used to assess the effects of Owner/Employer/Company delays
  - Based on the schedule Contractor is actually working to
  - And robust analysis of underlying physical progress
- Effective time management can resolve time related disputes as the project proceeds

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FINALLY

- Notice requirements
- Records to demonstrate delay to progress
- Common sense

- And my favourite quote from Truman Capote's "In Cold Blood""

' *case was seldom solved by "fancy theories"; he put his faith in facts "sweated for and sworn to*'

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QUESTIONS?
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