



فرآیند جامع آنالیز تاخیرات در پروژه

بخش پنجم:
آنالیز زمانی تاخیرات

فرآیند جامع و مدارک و مستندات لازم برای پیش بینی و آنالیز تاخیرات

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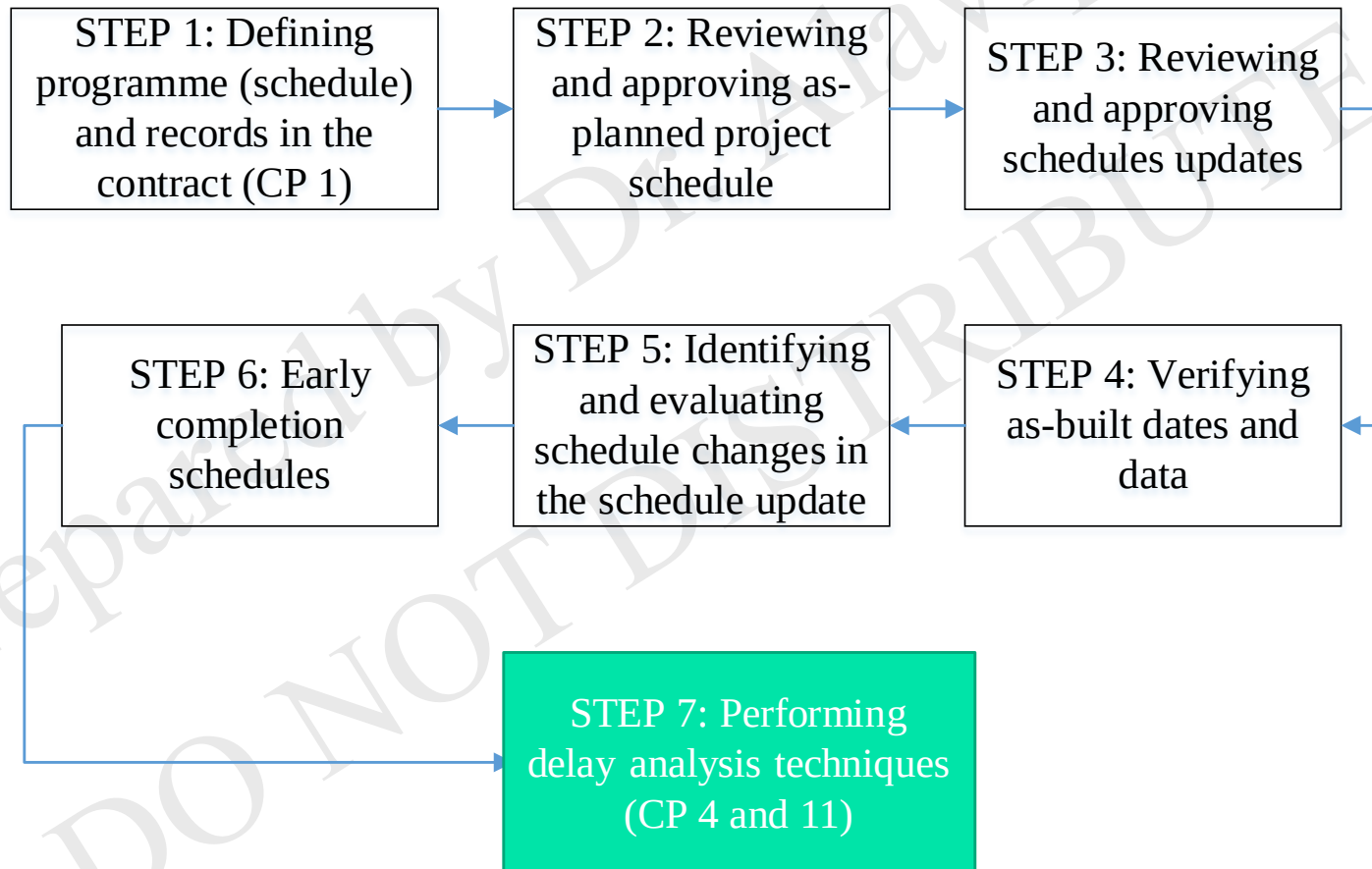
What we will learn?

□ General Procedure for analysis

- ❖ **STEP 1:** Defining programme (schedule) and records in the contract (CP 1)
- ❖ **STEP 2:** Reviewing and approving as-planned project schedule
- ❖ **STEP 3:** Reviewing and approving schedules updates
- ❖ **STEP 4:** Verifying as-built dates and data
- ❖ **STEP 5:** Identifying and evaluating schedule changes in the schedule update
- ❖ **STEP 6:** Early completion schedules
- ❖ **STEP 7:** Performing delay analysis procedure (CPs 4 and 11)

Delay analysis procedure

❑ The following Steps needed to be taken for contemporaneous analysis:



STEP 1: Defining programme (schedule) and records in the contract (CP 1)

1. Programme and records

Contracting parties should reach a clear agreement on the type of records to be kept and allocate the necessary resources to meet that agreement. Further, to assist in managing progress of the works and to reduce the number of disputes relating to delay and disruption, the Contractor should prepare and the CA should accept a properly prepared programme showing the manner and sequence in which the Contractor plans to carry out the works. The programme should be updated to record actual progress, variations, changes of logic, methods and sequences, mitigations or accelerations measures and any EOTs granted. If this is done, then the programme can be more easily used as a tool for managing change and determining EOTs and periods of time for which compensation may be due.

❑ *The guideline presented here describes the typical records needed for effectively managing progress of the works and proving*

1. EOT claim
2. Compensation claim

STEP 1: Defining programme (schedule) and records in the contract (CP 1)

We talked about schedule in the contract in Planning and Scheduling Course

We talked about records in the contract in Document Management Course

However, we will make the link between CP 1 and delay analysis in this course.

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Introduction to records

❑ To reach a **clear** and **documented** agreement on **record keeping**, the parties should **consider**:

- (a) the types of records to be produced and the information to be contained therein;
- (b) who is responsible for both producing and checking those records;
- (c) the frequency with which those records are to be updated or produced;
- (d) the distribution list for those records;
- (e) the format of those records (for example, to ensure compatibility with any project-wide database); and
- (f) the ownership (including any relevant intellectual property rights) and storage of, and access to, those records.

It is recommended that the items mentioned included in the bidding documents.

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Introduction to records

Should owner also keep the records?

STEP 1: Defining programme (schedule) and records in the contract (CP 1) –

Introduction to records

- ☐ The **employer (owner)** should consider **whether it is appropriate** to **produce** and **maintain** its own **independent set of relevant records**.
- ☐ **Why is it helpful?** Such records **assist** to:
 1. Have **better management control**
 2. **Support any claims** the employer or contractor may have **against each other**

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Format and storage of records

❑ Format and storage of records:

❖ **Records** should be produced and stored electronically (at least in PDF format)

✓ Emails, programmes and spreadsheets containing formula should be kept in **their electronic format**.

✓ **Some records** may need to be **shared by other parties** such as contractor.

DO NOT FORGET TO DEFINE ACCESS AT THE OUTSET

✓ **Technology** is quickly **changing**, therefore use **standard document management systems** that are **flexible**.

✓ Regarding the **growing use of building information modeling (BIM)**, the effective use of **BIM requires specific agreement** between the parties regarding:

1. Content of records
2. Use of records
3. Ownership of records

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Records

❑ The **“Records”** recommended here **divided** into the following **six categories**:

1. Programme records
2. Progress records
3. Resource records
4. Costs records
5. Correspondence and administration records
6. Contract and tender documents

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

1. Programme records

- ☐ These records **set out** the **contractor's plan** for **carrying out the works**.
- ☐ Include **three major items**:
 1. Main programmes
 2. Supplemental detailed programmes
 3. Explanatory records

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

1. Programme records

❑ Main programmies include:

1. Tender programmes
2. Contractor's proposed programmes (**submitted for acceptance**)
3. Baseline (as-planned) programme (**accepted programme**)
4. Updated programmes (**the last of which should be an as-built programme**)
5. Revised programmes to take account of
 - ❖ Re-sequencing
 - ❖ Acceleration measures
 - ❖ Mitigation measures
6. Detailed short-term look ahead programmes such as four week look-ahead programmes
7. Contractor's internal target programmes

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

1. Programme records

❑ Supplemental detailed programmes in a suitable format such as CPM, LOB, time location analysis, tabular spreadsheet, or database for:

- (a) design;
- (b) approvals (including the CA's approvals and public authority approvals);
- (c) procurement or manufacturing;
- (d) delivery;
- (e) installation;
- (f) construction of key aspects of the works; and
- (g) testing and commissioning.

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

1. Programme records

❑ Explanatory records that explain in words, graphics, and spreadsheets

❖ This is schedule narrative report

❖ These **records are used** to:

1. Explain **contractor's plan** in detail
2. Explain **activities** in the programmes
3. Explain how the **durations**, **logic**, and **sequences** of **activities** were **determined**

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

1. Programme records

❑ Some examples of explanatory records:

1. Narrative programme for contractor's proposed programme for baseline

- ❖ Set out the **assumptions** at a minimum: key resources, risks, sequencing constraints, and the critical path

2. Narrative programme for updated programme or proposed revised programme

❖ For example:

1. Identification of any delay or disruption events
2. Key changes to the sequence and duration of activities or as-built data from:
 1. Last updated programme
 2. Critical path
 3. Near critical path

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

1. Programme records

□ Some examples of **explanatory records**:

3. Progress curves for:

- ❖ Costs
- ❖ Resources
- ❖ Physical construction

4. Tabular report of milestones

- ❖ Scheduled
- ❖ Forecast
- ❖ Actual

COLOR	DESCRIPTION OF USE
Red	Items to be added to the drawing
Green	Items to be removed from a drawing
Blue	Comments that are not to be added to the drawing
Yellow Highlighter	Used for marked items as completed by the designer

5. As-built database for each activity

6. BIM files where BIM is being used for the activities

7. Marked-up drawings showing the anticipated completion and as-built dates for activities

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

2. Progress records

- ☐ **Identify** the **progress** of the works at a **particular time**.
- ☐ **Contain** as-built data, both (1) On-site and (2) Off-site
- ☐ **Cover** all the activities that **affect completion** of the works (**near critical** or **critical path**)
- ☐ **Progress records** are required to **establish the progress** of the works **at the time of a delay or disruption event**, the **impact of that event**, and **its effect on the works**

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

2. Progress records

❑ Progress records should be connected with

- ❖ As-planned programme
- ❖ Updated programme
- ❖ Costs records

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

2. Progress records

☐ Include **three major items:**

1. Raw data records
2. Compiled records
3. Procurement records

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

2. Progress records

- ❑ Raw data records are those that should be **compiled** on a **regular basis**, normally **daily** which record **how relevant parts of the work are being carried out**.
- ❑ Progress achieved:
 - ❖ Before periods of **delay or disruption**
 - ❖ During periods of **delay or disruption**
 - ❖ After periods of **delay or disruption**

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

2. Progress records

☐ Sample of Raw data records:

1. Reports

- ❖ For each major work area recording weather conditions, manpower, deliveries of key materials, discovery of adverse site conditions, working hours, major plant and equipment used, and work activities underway

2. Health, safety, environmental and/or security issues log

3. Obstruction data

4. Evidence of area handovers between contractors/others

- ❖ Identifying which contractor/other party should perform each work in each area at what time

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

2. Progress records

❑ Sample of Raw data records:

Labor Time Reporting

Daily Labor Time Card											
Project	Highway Bridge		Project No.		200808-05		Weather		Cloudy-windy		
Date	July 20		Prepared by G.A.S.								
Employee Number	Name	Craft	Time Classification	Hourly Rate	Cost Code					Total Hours	Gross Amount
					03157.10.3	03157.20.3					
132	Winnowich, N.	F	ST	34.00		8				8	\$272.00
			OT								
221	Clouten, S.	C	ST	\$31.00		8				8	\$248.00
			OT								
248	Schluder, L.	C	ST	\$31.00		8				8	\$248.00
			OT								
319	Mills, R.	O	ST	\$33.00		2				2	\$66.00
			OT	0							
143	Gibson, E.	L	ST	\$22.00		8				8	\$176.00
			OT								
417	Sears, K.	L	ST	\$22.00		8				8	\$176.00
			OT								
176	Sibanda, M.	L	ST	\$22.00	2	6				8	\$176.00
			OT								
Total Hours					2	48				50	
Total Cost					\$44.00	\$1,318.00					\$1,362.00

Highway bridge, daily labor time card

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

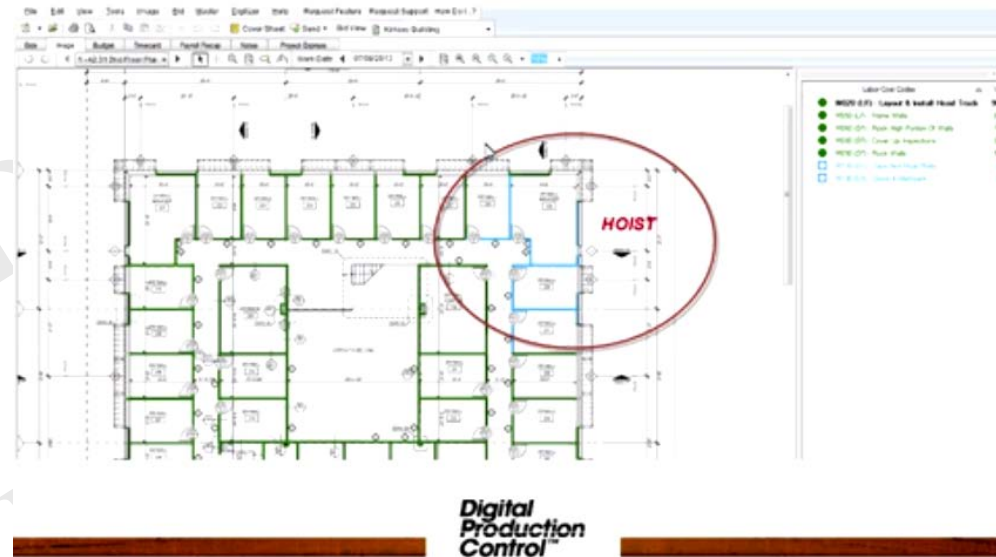
2. Progress records

❑ Sample of Raw data records:

Description	Begin Time	End Time	Quantity (LF)
Excavating Soil	700	913	
Excavating Rock	913	1400	
Excavation Soil	1400	1500	

Quantity 14.5

Duration 8



Description	Begin Time	End Time	Duration	Quantity (LF)	Productivity
Excavating Soil	700	910	2.1	20	9.52
Excavating Rock	910	1400	4.9	10	2.04
Excavation Soil	1400	1500	1	10	10.00

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

2. Progress records

☐ Sample of Raw data records:

4. **Geological mapping** records
5. **Inspection requests/inspection** reports
6. **Site test** records
7. **Testing and commissioning** records (including certificates)
8. **Webcam videos**
9. **Progress photographs**
 - ❖ With **date taken** and if possible **GPS coordinates**

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

2. Progress records

❑ **Compiled records:** These are records **prepared** from the (1) **raw data records** and (2) **programme records**. These include:

1. **Detailed monthly progress** reports

2. **Weekly progress** reports setting out the following:

a) **Overview of progress in the main work areas**

❖ Including design and procurement or manufacturing

b) **Work status in each area of the works**

❖ Covering the relevant programme activities underway

c) **Illustrations of progress achieved**

❖ Such as drawing of pile locations with piles completed, level and section of concrete cast, etc.

d) **Weather reports**

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

2. Progress records

- ❑ **Compiled records:** These are records **prepared** from the (1) **raw data records** and (2) **programme records**. These include:

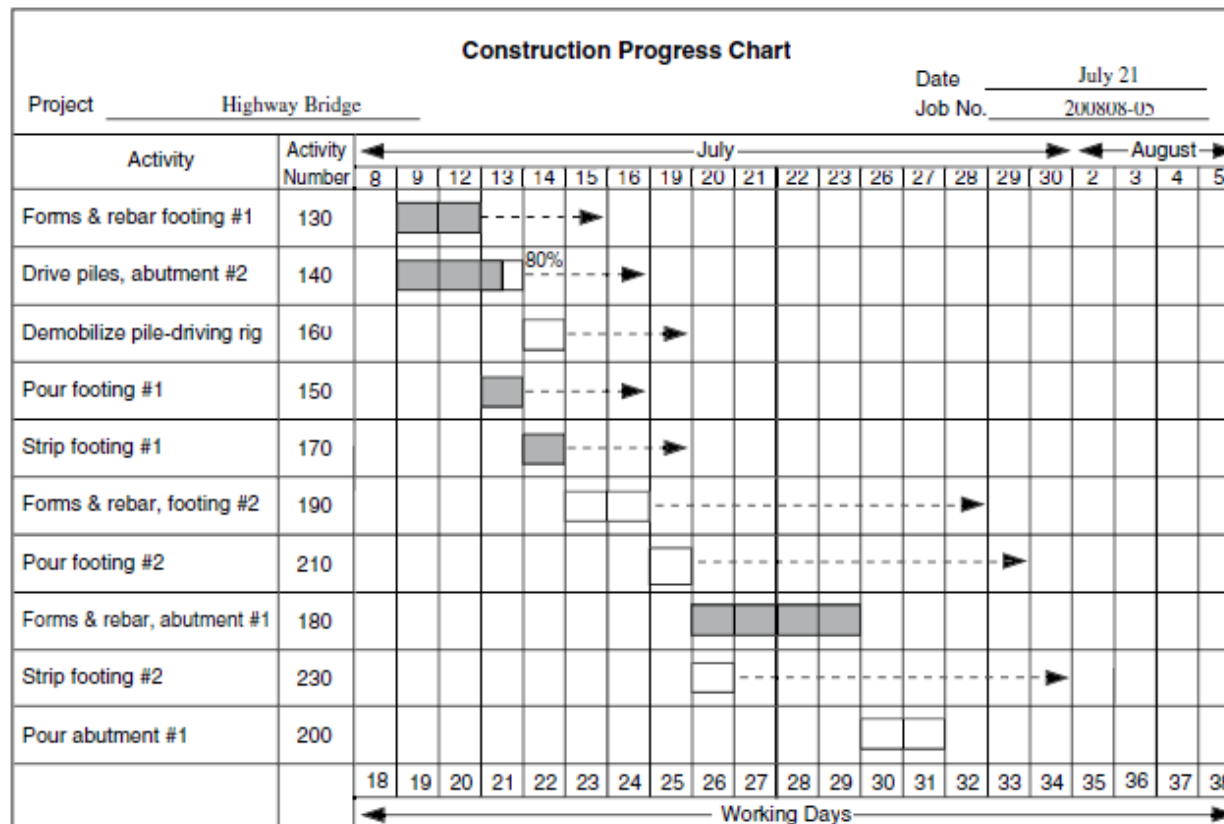
[illegible]

Activity Status Report to Monitor Project Schedule Status.

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

2. Progress records

- ❑ **Compiled records:** These are records prepared from the (1) raw data records and (2) programme records. These include:



STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

2. Progress records

- ❑ **Compiled records:** These are records prepared from the (1) raw data records and (2) programme records. These include:

Weekly Labor Time Card									
Craft <u>C</u>									
Name <u>Clouten, S.</u>					Project <u>Highway Bridge</u>				
Employee No. <u>221</u>					Project No. <u>200808-05</u>				
Week Ending <u>July 21</u>					Prepared by <u>S.K.S.</u>				
Cost Code	Time Classification	Hourly Rate	Thursday	Friday	Monday	Tuesday	Wednesday	Total Hours	Total Cost
03157.10.3	ST	\$31.00	8					8	\$248.00
	OT								
03157.20.3	ST	\$31.00		8	8	8		24	\$744.00
	OT								
03311.10.3	ST	\$31.00					8	8	\$248.00
	OT								
	ST								
	OT								
	ST								
	OT								
Total Hours	ST		8	8	8	8	8	40	
	OT								
Gross Amount			\$248.00	\$248.00	\$248.00	\$248.00	\$248.00		\$1,240.00
Weather			Clear-hot	Clear-hot	Cloudy-gusty	Cloudy-windy	Cloudy-windy		

Highway bridge, weekly labor time card

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

2. Progress records

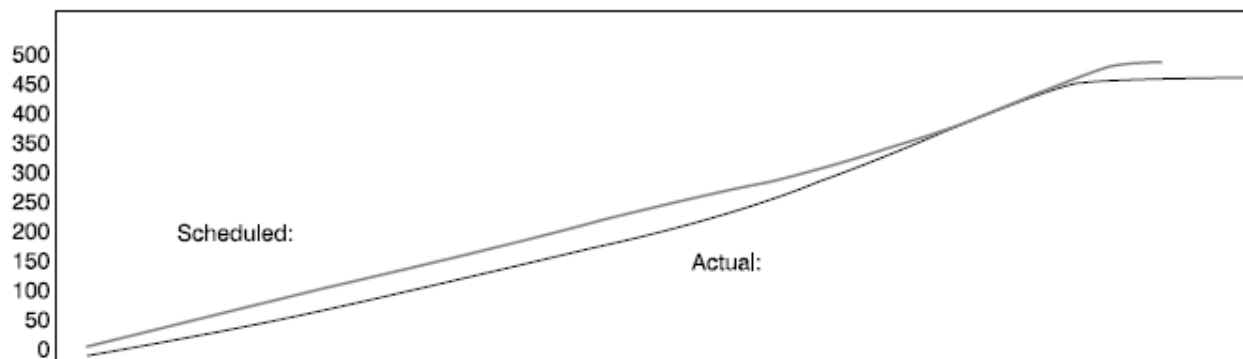
- ☐ **Compiled records:** These are records prepared from the (1) raw data records and (2) programme records. These include:

Project: Olympic Hotel and Resort
System/Area: Doors, Frames, and Hardware

Foreman: Joe Wallace
Date Developed: 11/20/19

Work Days:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Totals:
Estimated Crew Size:	3	3	3	3	3	4	4	4	4	4	4	4	4	4	3	0	0	
Estimated Daily Hours:	24	24	24	24	24	32	32	32	32	32	32	32	32	32	24	0	0	
Accumulated Hours:	24	48	72	96	120	152	184	216	248	280	312	344	376	408	432	432	432	432
Actual Crew Size:	2	2	2	3	3	3	4	4	4	5	5	5	5	2	2	1	1	
Actual Daily Hours:	16	16	16	24	24	24	32	32	32	40	40	40	40	16	16	8	8	
Accumulated Hours:	16	32	48	72	96	120	152	184	216	256	296	336	376	392	408	416	424	424

Manpower Curve:
Hours:



STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

2. Progress records

- ❑ **Compiled records:** These are records prepared from the (1) raw data records and (2) programme records. These include:

Weekly Labor Cost Report																
Project <u>Highway Bridge</u>		Project No. <u>200808-05</u>														
Week ending <u>July 21 (working day 27)</u>		Prepared by <u>S.K.S.</u>														
Cost Code (1)	Work Type (2)	Unit (3)	Quantity			Direct Labor Cost				Labor Unit Cost			To Date		Projected	
			Budget (4)	This Week (5)	To Date (6)	Budget (7)	Budget to Date (8)	This Week (9)	To Date (10)	Budget (11)	This Week (12)	To Date (13)	Savings (14)	Loss (15)	Savings (16)	Loss (17)
31220.10.3	Excavation, unclassified	cy	1,667	0	1,667	\$2,643	\$2,643	\$0	\$2,459	\$1.59	-	\$1.48	\$184		\$184	
31222.10.3	Excavation, structural	cy	120	0	120	\$2,985	\$2,985	\$0	\$3,353	\$24.88	-	\$27.94		\$368		\$368
31350.00.3	Pile-driving rig, mob. & demob.	job	-	-	-	*\$4,374	*\$4,374	\$0	\$4,004	\$4,374	-	\$4,004	\$370		\$370	
31361.10.3	Piling, steel, driving	lf	2,240	560	2,016	\$8,224	\$7,402	\$6,373	\$15,762	\$3.67	\$11.38	\$7.82		\$8,360		**\$9,293
03150.10.3	Footing forms, fabricate	sf	360	0	360	\$936	\$936	\$0	\$963	\$2.60	-	\$2.68		\$27		\$27
03150.20.3	Abutment forms, prefabricate	sf	1,810	0	1,810	\$3,548	\$3,548	\$0	\$2,780	\$1.96	-	\$1.54	\$768		\$768	
03157.10.3	Footing forms, place	sf	720	0	360	\$360	\$180	\$0	\$165	\$0.50	-	\$0.46	\$15		\$30	
03159.10.3	Footing forms, strip	sf	720	360	360	\$158	\$79	\$48	\$48	\$0.22	\$0.13	\$0.13	\$31		\$62	
03157.20.3	Abutment forms, place	sf	3,620	1,810	1,810	\$7,312	\$3,656	\$3,504	\$3,504	\$2.02	\$1.94	\$1.94	\$152		\$304	
03311.10.3	Concrete, footing, place	cy	120	0	60	\$1,200	\$600	\$0	\$554	\$10.00	-	\$9.23	\$46		\$92	
*67% of budget for mobilization											Subtotals		\$1,566	\$8,755	\$1,810	\$9,688
**Based on last week, will probably be \$10,087											Totals		⊕	\$7,189	⊕	\$7,878

Highway bridge, weekly labor cost report (#1)

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

2. Progress records

- ☐ **Procurement records:** These establish the **procurement** of **materials** and **permanent equipment** for the **works** that required to **provided timely**.
- ☐ *Examples include:*
 1. **Quotations** from **sub-contractors** and **suppliers**
 2. **Supplier contracts** including any **amendments**
 3. **Shipment** records
 4. **Delivery** records

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

3. Resource records

❑ Capture the resources used to **deliver the works**, including:

- ❖ Management
- ❖ Labor
- ❖ Equipment
- ❖ Materials
- ❖ Subcontractors

productivity should be considered!

Without **records of planned and utilized resources**, it will be more difficult for the contractor to prove entitlement to **time and costs incurred arising from additions or changes** to the **works** and **other delay or disruption events**

Resource records should be detailed and comprehensive and where possible should be allocated to the as-planned/updated programme activities.

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

4. Cost records

- ❑ Include a **sufficient level of detail** such that **costs** can be **linked to delay or disruption events**.

- ❖ Labor
- ❖ Material
- ❖ Equipment
- ❖ Subcontractors
- ❖ Project overhead
- ❖ **General overhead**

However,
Could you always claim for HOOH?

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

4. Cost records

☐ Regarding subcontractors

1. Subcontract agreements
2. Subcontractor correspondence (communication)
3. Claims made by subcontractors and responses
4. Subcontractor applications for payment
5. Details of all payments made to subcontractors

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

4. Cost records

☐ Regarding suppliers

1. Supply agreements
2. Supplier correspondence (communication)
3. Claims made by suppliers and responses
4. Supplier invoices
5. Details of all payments made to suppliers

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

4. Cost records

- ❑ If the **contractor** wants to **use a formula** for the **assessment** of **lost profits** and **general overheads (unabsorbed overheads)**, it will need to **produce evidence** that the delay caused by owner **avoid contractor** to take a **new project**.

What you need to be able to use a formula?

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

4. Cost records

❑ To prove, you need the following:

1. **Business plans** prior to delay **caused by employer**
2. Contractor's **bidding history**
3. Records of **acceptance** or **rejection of bidding**
4. Records that **support** the **inputs into the formula** used, in particular **contractor's company accounts** for:
 - a) **Periods** immediately **preceding and succeeding** the **employer delay**
 - b) **Period** when the **employer delay** occurred

Let's see more in detail!

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

4. Cost records

☐ Regarding contractor general overhead

1. Financial statements documenting annual general overhead costs and revenue (**Planning and Scheduling course**)
2. Business plans for generating profit (Company Cash flow forecast) (**Planning and Scheduling course**)
3. Records regarding bidding history
4. Records regarding bidding opportunities
5. Internal meeting minutes to review future bidding opportunities and staff availability
6. Short interval schedule and project reporting (**Planning and Scheduling course**)

Copies of all invoices should be kept in an easily retrievable filing system preferably with electronic copies.

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

4. Cost records

- ❑ You may need to disclose some of your confidential information if the case is taken to the court...

a claiming party has to accept some **loss of confidentiality**

How we can avoid this problem?

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

4. Cost records

The **parties** might therefore consider agreeing relevant rates in the **contract**, rather than requiring **proof of actual costs or loss** for certain eventualities

Example?

An agreement regarding **staff rates** to be charged in the event of an employer delay to completion

THIS IS BENEFICIAL TO BOTH PARTIES

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

5. Correspondence and administration records

- ☐ All written communications between the employer, the CA, and third parties relevant to the progress of the works.
- ☐ Written communications should be:
 - ❖ Uniquely **numbered**
 - ❖ Contain a **descriptive** subject line
 - ❖ Dated and issued to the agreed **distribution list**

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

5. Correspondence and administration records

☐ This **includes:**

1. Letters/emails
2. Contract management
3. Technical
4. Milestones
5. Claims

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

5. Correspondence and administration records

☐ Letters/emails covers:

1. **Letters** and **material emails** between **parties involved** in the works
2. **Other emails** (including **internal emails**)

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

5. Correspondence and administration records

- ☐ Email communications should have a **protocol** from the **outset** of each project.
- ☐ Emails communications should be **archived in native format**.
- ☐ Email communications that are **internal** should also **be archived**.
- ☐ Even with the **best system** for managing and achieving emails, **some emails** may be **lost**. To **reduce the adverse effect** of these issues:

1. **Material communications (of whatever nature)** should be:

- a) Prepared in the form of a letter
- b) Uniquely numbered
- c) Carefully retained

2. **Key emails** should be

- a) Kept in a centralized folder
- b) Given unique correspondence number

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

5. Correspondence and administration records

- ☐ **Contract management** covers **all notices** or **documents** issued under the contract, **with the exception** of:
 - a) Letters/emails
 - b) Claims related records

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

5. Correspondence and administration records

❑ Contract management **examples** include:

- a) CA instructions and **confirmation of instructions**
- b) Early warning notices (and their close out)
- c) Variations/change requests or **proposals**
- d) Bonds, insurance documents or **guarantees**
- e) All other documents issued under or required by the contract (**other than claims related records**)

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

5. Correspondence and administration records

- ❑ **Technical records:** these are **technical documentation** submitted **during** the course of the **works**,

along with the **final documentation** submitted by the **contractor**.

❖ Technical documentation is **needed to**

demonstrate compliance by the **contractor** with

1. Contract drawings
2. Specifications

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

5. Correspondence and administration records

❑ Technical records **examples** include:

1. Submission logs, including **date of submission**, **date of response**, **status** and **follow up required** and **underlying documentation** for:

- ✓ Design drawings and calculations
- ✓ Method statements
- ✓ Subcontractor approval requests
- ✓ Material submittals
- ✓ Shop drawings
- ✓ Requests for information and responses

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

5. Correspondence and administration records

❑ Technical records **examples** include:

2. Approvals by the CA

3. Agendas for minutes of meetings, including:

- ❖ Design
- ❖ Construction progress
- ❖ Programme review
- ❖ Management
- ❖ Health & safety, environmental and security
- ❖ Quality

4. Deficiency/non-compliance notices (and their close out)

5. As-built drawings/documents

6. Operations and maintenance manuals

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

5. Correspondence and administration records

❑ Milestones include:

- ❖ Achieving **certificates**
- ❖ **Contractor's request** for a **certificate** that the works are **complete**
 - ✓ And the **CA's response** including a report on any areas of **disagreement**
- ❖ **CA's certificate** that the **works are complete**

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

5. Correspondence and administration records

☐ **Claims records** include:

1. **EOT claims/responses** including the CA's determinations
2. Claims for **additional payment/responses** including the CA's determinations
3. **Notices of dissatisfaction** with **determinations**
4. **Referrals** to further stages of the **dispute resolution procedure**
5. **Documents** produced for the **purposes of further stages of the dispute resolution procedure**

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

6. Contract and tender (bidding) documents

❑ These documents **establish** the contractor's requirements in

1. Carrying out the **works**

2. **Assumed baseline** in terms of time and costs for carrying out the works

❖ A **complete copy** of construction contracts including **any amendments** should be maintained by both parties.

❖ Tender documents include **all correspondence** between the parties regarding the contract negotiations.

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

6. Contract and tender (bidding) documents

❑ Tender documents include:

1. On the part of employer

- (a) Tender **submissions** by all tenders,
- (b) Tender **evaluations**, and
- (c) Employer's calculations of any liquidated damages rates

2. On the part of the contractor

❖ Records **demonstrating**

- 1. Build-up to its **tender price**
- 2. Any amendments to the price
- 3. Assumptions on which the **tender price** is based.

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

6. Contract and tender (bidding) documents

☐ Contract documents:

1. **Contract agreement**
2. **Correspondence** relating to the **contract negotiations**
 - ❖ Including any **letter of intent** and **letter of award**
3. **Conditions of contract**
 - ❖ **General conditions** and **special/particular conditions**
4. **Specifications** and the **employer's requirements**
5. **Drawings**
6. **Schedule of prices** or **bills of quantities**
7. **Contractor's tender submission** and any **clarifications** to that **submission**

STEP 1: Defining programme (schedule) and records in the contract (CP 1) – Categories of records

6. Contract and tender (bidding) documents

❑ **Tender documents**: Documents **produced** or **issued** by both the **employer** and the **contractor** **pre-contract** and include the following:

1. **Instructions** issued by the **employer** to **tenderers**, including a **draft copy** of the **contract**
2. **Any clarifications** issued by the **employer** regarding those **instructions** or the **draft contract**
3. **Submissions** from **all tenderers**
 - ❖ **Technical** and **commercial** **submissions** including **all clarifications** to those **submissions**
4. **Contractor's tender build-up** including **all estimating information**
5. **Employer's tender evaluation**
6. **Employer's calculations** for any **liquidated damages rates** in the contract

STEP 2: Reviewing and approving as-planned project schedule

- ❑ As defined, the **as-planned schedule** is the schedule created either:
 1. **Before construction begins**
 2. **Very early in the first stage of the project**
- ❑ **As-planned** should represent the **Contractor's plan** to construct the project based on the **information** it had at **the time of bid**.
- ❑ It is **erroneous** to use the **Owner's version** as the **as-planned schedule** for the project because the **Contractor** may plan to **construct** the Project in a **different sequence** or **manner**.



STEP 2: Reviewing and approving as-planned project schedule

- ❑ After identifying the schedule, the **analyst** should review that schedule for sequencing and feasibility.

A note of caution:

Often the analyst, or the person assessing the Project for delays, **reviews** the Contractor's schedule and decides that it did not correctly portray:

- (1) Sequencing of the project
- (2) Durations for the activities



STEP 2: Reviewing and approving as-planned project schedule

❑ The **reviewer** of the **as-planned schedule** should **ultimately** be able to **conclude** that the **as-planned schedule**:

1. **Complies** with the **contract requirements**,
2. **Depicts** the **contractor's plan** to complete the project, and
3. **Represents** a plan that is **constructible**, with a **critical path** that **makes sense**



STEP 2: Reviewing and approving as-planned project schedule

❑ Although there is **no single checklist** that defines what constitutes a **“good” Project schedule**, it is recommended that the **reviewer** should take the **following steps** when performing the review of the **Contractor’s as-planned schedule**.

❖ For the purposes of this discussion, it is **assumed** that the **as-planned schedule** is a **Critical Path Method (CPM) schedule**.

1. **Understand** the **contract requirements**
2. **Verify** the **contents** of the **schedule submission**
3. Does the schedule **conform** to the **contract requirements**?
4. Is the schedule **contractible** and are the **durations reasonable**?
5. Do the **critical path** and **near critical paths** make sense?



STEP 2: Reviewing and approving as-planned project schedule

1. Understand the contract requirements

- ☐ Reviewer should have a **thorough understanding** of the **contract documents**
- ☐ The **contract documents** will **provide** the reviewer with **necessary information** including, but **not limited to**:
 1. Project's scope of work
 2. Project's staging or phasing
 3. Contract milestones
 4. Owner review times
 5. Third-party responsibilities
 6. Contract restrictions and constraints



STEP 2: Reviewing and approving as-planned project schedule

2. **Verify** the contents of the schedule submission

- ❑ The **first step** is to determine whether or not the **contractor's schedule submittal** meets the **requirements** of the **contract's scheduling specification**.
- ❑ Most **CPM scheduling specifications** require the contractor to **submit**
 1. A copy of **electronic schedule file**
 2. **Schedule narrative**
 3. Multiple schedule or **tabular reports**

and requires the contractor to **submit** the schedule **within a certain time**.

In the **written review**, the reviewer should **state**:

1. Whether the submission was **submitted on time**
2. **Missing reports**
3. **Deadline to submit missing reports**



STEP 2: Reviewing and approving as-planned project schedule

3. Does the schedule **conform** to the **contract requirements**?

☐ After **reviewing contract documents comprehensively (Step 1)** and after **checking the contents of the schedule submission (Step 2)**,

the reviewer should determine whether the **project schedule conforms** to the **contract documents**.



STEP 2: Reviewing and approving as-planned project schedule

❑ **Sample of items to evaluate** when reviewing the **schedule's conformance** to the **contract requirements**:

1. Does the schedule **conform** to the **contract milestones, phasing, sequencing requirements**, and so forth?
2. Does the **schedule conform to the CPM scheduling & time extension provisions**?
3. Include **all of the tasks** necessary to **complete the scope of work**



STEP 2: Reviewing and approving as-planned project schedule

3. Does the schedule **conform** to the **contract requirements**?
 1. Does the schedule **conform** to the **contract milestones, phasing, sequencing requirements**, and so forth?
 - ❖ **As-planned schedule** should **conform** to the **contract's phasing**.
 - ❖ **As-planned schedule** should **not forecast** project milestone dates **later** than the **contract milestone dates**.

Why **milestones** are important?



STEP 2: Reviewing and approving as-planned project schedule

ASCE Standard ANSI/ASCE/CI 67-17 (Schedule Delay Analysis)

5.4 IF MULTIPLE MILESTONES HAVE DELAY DAMAGES ASSOCIATED WITH THEM, A SEPARATE DELAY ANALYSIS SHOULD BE PERFORMED FOR EACH MILESTONE

☐ **Float values** are affected by **different constraints** in the CPM network.

☐ In instances where the schedule contains **milestone constraints**,

it may be **more accurate** to identify the **critical path** through

1. Subject milestone or
2. Activities

that must be progressed to **keep that milestone on time**.

Why phasing and sequencing **requirements** are important?

STEP 2: Reviewing and approving as-planned project schedule

ASCE Standard ANSI/ASCE/CI 67-17 (Schedule Delay Analysis)

- ❑ **Chronology** of delay is an important part of a **critical path analysis** as the **basis for segregation** of delays to allow related costs and time impacts to be attributed to the parties involved (**apportionment**).
- ❑ **A chronological evaluation** is critical in determining when events occurred, their impact on the contemporaneous project schedules, and the contemporaneous decisions made by the parties, emphasizing the importance of **keeping project records and schedule updates** throughout the project.
- ❑ The **schedule** is **not static and changes continually** on the basis of events as they unfold on a project,
and this **must** be reflected in a proper **evaluation** of project delays.



STEP 2: Reviewing and approving as-planned project schedule

3. Does the schedule **conform** to the **contract requirements**?
2. Does the **schedule conform to the CPM scheduling & time extension provisions**? Some of **contract's scheduling provision**:
 - ❖ **Limit** the **duration of activities**
 - ❖ **Limit** the use of **unnecessary or inappropriate constraints**
 - ❖ **Prohibit activities** with **open ends**
 - ❖ **Prescribe** the use of certain **logic relationships, lags, and leads**
 - ❖ **Establish** the required **level of detail** in the **schedule**

Let's look at them more in detail!



STEP 2: Reviewing and approving as-planned project schedule

❑ Limit the duration of activities

- ❖ As a guide, **no activity or lag** (other than a summary activity) should **exceed 28 days** in duration.
- ❖ Wherever possible, an **activity** should not **encompass more than one trade** or operation.

How about the time when rolling wave planning used?

STEP 2: Reviewing and approving as-planned project schedule

❑ **Limit** the use of **unnecessary** or **inappropriate constraints**

- ❖ **Manually applied constraints** such as 'must start' or 'must finish' fixed dates, 'zero float' and other programming techniques that can have the effect of inhibiting a programme from reacting **dynamically to change** should be **avoided** (or, if unavoidable, properly explained in the programme narrative) (SCL).

How about other hard constraints?



STEP 2: Reviewing and approving as-planned project schedule

ASCE Standard ANSI/ASCE/CI 67-17 (Schedule Delay Analysis)

5.3 EXCESSIVE CONSTRAINTS ON ACTIVITIES THAT INTERFERE WITH A LOGIC-DRIVEN CRITICAL PATH MAY COMPLICATE EVALUATION OF CRITICAL DELAYS AND SHOULD BE CONSIDERED IN A DELAY ANALYSIS

- ☐ Excessive constraints should generally be **avoided**.
- ☐ In a constrained schedule, **total float may be driven** by constrained dates **instead of the project end date**.
- ☐ The **use of constraints complicates** the use of total float as a **time prioritizing tool**.
- ☐ Particularly, the **use of** specified constraints on individual activities or specifying float values on individual activities **may interrupt a logic-driven critical path** and is **not preferred**.



STEP 2: Reviewing and approving as-planned project schedule

❖ Prohibit activities with open ends

- ❖ The **Contractor's proposed programme** (and any revisions) should be prepared with **sufficient detail using logic links** (i.e. each activity is linked to **both a predecessor and successor activity or milestone**)

to provide **proper forward visibility** so that the **effect of delay** and **disruption events** can be **predicted** with as **much accuracy as possible (SCL)**.

Remember **dangling logic** in Planning and Scheduling Course?



STEP 2: Reviewing and approving as-planned project schedule

❑ **Prescribe** the use of certain **logic relationships, lags, and leads**

- ❖ **Lags** may be introduced for **non-work periods** (**such as curing of concrete**) but **better visibility and understanding** is provided if such matters are **shown as activities** in themselves
- ❖ Where utilized, the **Contractor** should provide an **explanation** in the programme narrative as to **why particular leads and lags** have been applied (SCL).
- ❖ **Leads and lags** may result in **incorrect progress tracking** if **delays prevent** the project from being performed as **planned**.
- ❖ A **preferred alternative** to leads and lags is to **break activities up into smaller segments** and use **finish-to- start relationships** (ASCE)



STEP 2: Reviewing and approving as-planned project schedule

3. Does the schedule **conform** to the **contract requirements**?
3. Include **all of the tasks** necessary to **complete the scope of work**
 - ❖ **Tasks** and **activities** to **construct the project**
 - ❖ **Activities** for **preparation** and **submission** of:
 1. **Key submittals,**
 2. **Time** for the **procurement** of **key equipment** and **materials,**
 3. **Adequate time** for **certain owner activities:**
 1. Submittal reviews
 2. Procurement of owner-furnished materials or equipment

STEP 2: Reviewing and approving as-planned project schedule

3. Does the schedule **conform** to the **contract requirements**?

3. Include **all of the tasks** necessary to **complete the scope of work**

❖ **For example**, the **schedule** should include:

- ❖ Time for permitting or third-party/regulatory activities
- ❖ Concrete cure times
- ❖ surcharge durations for settlement
- ❖ Winter shutdown periods
- ❖ Permitting restrictions
- ❖ Work area restrictions
- ❖ Coordination with adjacent projects

STEP 2: Reviewing and approving as-planned project schedule

3. Does the schedule **conform** to the **contract requirements**?

If one of three major items **missed** in the schedule, the **reviewer** asks the contractor to **revise** and **resubmit** the **schedule**.



STEP 2: Reviewing and approving as-planned project schedule

4. Is the schedule **contractible** and are the **durations reasonable**?
- ☐ After **verifying** that the **as-planned schedule** meets the **Contract requirements**, the **next step** involves an evaluation of
1. **Schedule's sequencing** of the **work activities**
 2. **Activity durations**



STEP 2: Reviewing and approving as-planned project schedule

4. Is the schedule **contractible** and are the **durations reasonable**?

1. Schedule's sequencing of the work activities

1. Contractual logic
2. Mandatory logic
3. Discretionary logic
 - ✓ Contractors choice
 - ✓ Most likely to be out-of sequence

Remember that we talked about this in **Planning and Scheduling Course**?



Contractual logic – AACE Definition

- ❑ The **AACE** defines this type of logic as:

*“Clearly **understood** work scope allows one to **define work activities** and logic with precision. The opposite of soft logic.”*

- ❑ But this definition **fails** to **distinguish** between **logic** that is required by the **laws of man (contract)** or the **laws of physics**.

So the better definition of this type of logic is (John C. Livengood):

Logic required by the **contract** and/or **scope of work** that **mandates**
certain of the owners sequence requirements



Mandatory logic – AACE Definition

1. The **AACE** offers the following **definition** for this type of relationship:
“A *dependency inherent in the nature of the work being done, such as a physical limitation. Used in hard logic.*”
2. The **AACE** also offers definitions of **Irrefutable Logic**
“Network logic that is rational and compelling and cannot be disputed on the basis of reason,”

So the better definition of this type of logic is (John C. Livengood):

Logic required by the **physical necessity of the materials and design**



Discretionary logic – AACE Definition

1. The **AACE** has a **definitions** for discretionary logic:

*“Dependency defined by **preference**, rather than necessity. These are typically employed in **preferential** or **soft logic**.”*

2. **Another AACE** definition proposes:

*“**Preferential logic**: contractor’s approach to sequencing work over and above those sequences indicated in or required by contract documents. **Examples** include **equipment restraints**, **crew movements**, **form reuse**, **special logic restraints**, etc., factored into the **progress schedule**.”*



STEP 2: Reviewing and approving as-planned project schedule

4. Is the schedule contractible and are the durations reasonable?

1. Schedule's sequencing of the work activities

1.54 The Contractor (not the CA) controls the method and sequence of the works (and bases its tender price on its ability to do so). Therefore, provided the Contractor complies with the contract and all applicable laws, the Contractor may perform the works in the manner it thinks appropriate. The contract provisions for accepting the Contractor's proposed programme should reflect that fact, subject to any Employer constraints identified in the contract.



STEP 2: Reviewing and approving as-planned project schedule

4. Is the schedule contractible and are the durations reasonable?

1. Schedule's sequencing of the work activities

If the schedule **contains instances** that show the Project work occurring in a sequence that violates the project's contractual and mandatory logic,

Then the **reviewer** should ask the **contractor** to revise and resubmit the schedule **correcting the logics**.



STEP 2: Reviewing and approving as-planned project schedule

4. Is the schedule **contractible** and are the **durations reasonable**?

2. Activity durations

❖ The reviewer **must** also evaluate the **reasonableness of the activity durations**, which is perhaps the **most subjective part** of a schedule review.

1. An activity's duration can vary based on productivity.

○ In most cases, the reviewer does **not have access** to this information and has to **rely on his or her own experience**, which in most cases is **sufficient** to **identify overly optimistic** or **exaggerated durations**.

2. Material procurement durations with long lead times

○ If a **material procurement** activity has a **duration greater** than the **maximum activity duration** specified in the **Contract**,

and if it seems **reasonable**,

then the reviewer should **accept the new duration**.

STEP 2: Reviewing and approving as-planned project schedule

4. Is the schedule contractible and are the durations reasonable?

2. Activity durations

If the **reviewer feels** that he is **not qualified** to evaluate the reasonableness of activity durations,

then it is **recommended** that the reviewer rely on a **colleague** or **co-worker** who has **more experience** with those kinds of operations.



STEP 2: Reviewing and approving as-planned project schedule

4. Is the schedule **contractible** and are the **durations reasonable**?

❑ The **reviewer** should also be aware that the **manipulation** of logic relationships and **inflation** of activity **durations**

are **methods** that a Contractor can use to take **advantage of float**.

❖ Doing so may provide the **Contractor with a sense of security**, but this is **false** and may result in **claims in the future**.

❖ It is **very difficult** to identify instances when the **Contractor is attempting** to take **advantage of float** in activity durations **without the knowledge** of the **Contractor's planned resources**, and this has led

many Owners to **request** **resource-loaded schedules**.



STEP 2: Reviewing and approving as-planned project schedule

4. Is the schedule contractible and are the durations reasonable?

If logic relationships or activity durations do not appear **correct** or **reasonable**, then the **reviewer must ask the Contractor** to further **explain** or **address** the item(s) in question.

Opening a line of communication between reviewer and the Contractor will assist the parties in **developing a culture of cooperation, transparency**, and **trust** early in the Project.



STEP 2: Reviewing and approving as-planned project schedule

5. Do the critical path and near critical paths make sense?

- ☐ With a **thorough understanding** of the scope of work, the reviewer should be able to recognize if the Project's critical path and near critical paths are **reasonable**.

Due to the **importance of the critical path** to the overall schedule, if there are **questions** related to the **reliability of the critical path**, these provide sufficient justification to **ask the Contractor** for clarification or to revise and resubmit the schedule.

STEP 2: Reviewing and approving as-planned project schedule

1. It is far **wiser** to perform a **detailed review**,
2. Provide **feedback** to the **Contractor**,
3. Jointly resolve any problems or questions, and
4. Ultimately accept the **initial schedule** and **move on**

How about the **duration** to respond the contractor to review and approve the as-planned schedule?

STEP 2: Reviewing and approving as-planned project schedule

- 1.55 Also, to avoid uncertainty, the contract should contain wording to the effect that if the CA does not respond to the Contractor regarding the proposed programme within a specified time, it is deemed accepted and becomes the 'Accepted Programme'. The parties should consider at the outset whether to incorporate a provision into the contract which incentivises the Contractor to submit a proposed programme that complies with the contractual requirements (such as a portion of the contract sum being withheld pending the submission of a compliant programme). Otherwise, if the Contractor fails to meet its contractual obligations with respect to programming, the CA may consider invoking the contract provisions for dealing with general defaults by the Contractor. In this situation, the CA should also (to the extent possible) maintain and update a programme with actual progress based on its own knowledge.

ماده ۴۶- موارد فسخ پیمان

۴۶-الف-۲)

تأخیر در ارائه برنامه زمانی تفصیلی به مدت بیش از نصف مهلت تعیین شده برای تسلیم آن.

STEP 2: Reviewing and approving as-planned project schedule

سلام

◆ یکسوال در خصوص تمدید مدت پیمان داشتم:

اگر در ابتدای پروژه به دلیل مشکلات نقشه ای از جانب کارفرما تاخیر چند ماهه در کار پیش بیاد و برنامه زمانبندی هم هنوز تایید نهایی نشده باشه (در حال رفت و برگشت اصلاحی)

? آیا میشه از کارفرما درخواست اضافه کردن مدت پیمان کرد؟ اساسا در این مورد دستوالعملی چیزی وجود داره یا اینکه باید صبر کرد تا مدت اولیه پیمان تموم بشه و جز لایحه تاخیرات اوردش؟

- 1.53 The proposed programme should not encompass any changes or delays that have occurred since the contract commencement date. Any such post-commencement changes or delays should be dealt with in accordance with the EOT procedure in the guidance to Core Principle 5 in Part B after the proposed programme has been accepted.

STEP 2: Reviewing and approving as-planned project schedule

- 1.56 The Protocol regards the agreement of the Accepted Programme as being very important both for managing progress of the works and assessing any EOT applications. Disagreements over what constitutes the Accepted Programme should be resolved straight away and not be allowed to continue through the works. An unaccepted Contractor's proposed programme or update can become the source for disputes. Accordingly, the CA should specify what contractual requirements are not met before determining that a proposed programme or an update is inadequate.

What if we could **not resolve** this at the outset?

STEP 2: Reviewing and approving as-planned project schedule

1.57 Acceptance by the CA constitutes an **acknowledgement** that the Accepted Programme represents a **reasonable, realistic** and **achievable** depiction of the sequence and timing for carrying out the works. Acceptance **does not** turn Contractor's proposed programme into a **contract document**, or **mandate** that the works should be constructed **exactly as set** out in the Accepted Programme. **Nor does** it amount to a **warranty** by the **CA to the Contractor** or the **Employer** that the Accepted Programme can be **achieved**.

STEP 2: Reviewing and approving as-planned project schedule

Who is **responsible** for erroneous in the schedule?

Should the **analyst** change the schedule?



STEP 2: Reviewing and approving as-planned project schedule

- ❑ The analyst **might** then **change** the schedule to reflect his **judgment** about the errors.

The analyst should avoid this practice at all costs!

- ✓ The **decision** as to **whether or not** the **Contractor's** schedule was practicable is a **highly subjective one**.
 - Therefore, it is **far better** to give the **Contractor** the **benefit** of the **doubt** than to **disallow**, **ignore**, or **even change** the schedule.
 - If there are **minor errors** or **inconsistencies** in the **Contractor's as-planned schedule**, contractor will be **accounted** for **during the analysis of the delays**.

You should answer many questions here!

STEP 2: Reviewing and approving as-planned project schedule

1. To **what extent** the **CM** can **interfere** in contractor's schedule?
2. Could CM make suggestions **not required** by the contract?
3. Could the CM consider means and methods of **contractor** while **approving** the baseline?
4. **Where** CM could find this information?
5. So, how the **review comments** should be worded?
6. **What if** contractors take unreasonable positions on reasonable review comments?
7. What **factors** should CM consider while reviewing and accepting the **baseline**?
8. Should **subcontractors** sign off on the schedule?

There is a Time Management Standard published by CMAA that we taught in advanced level of Scheduling course!



STEP 3: Reviewing and approving schedules updates

- ❑ **Reviewing** and **approving** **schedule updates** submitted by the Contractor follows the **same process** as the **review** and **approval** of an **as-planned schedule**.
- ❑ However, there are **two additional items** that the reviewer should consider when reviewing a **schedule update**:
 1. **Verification** of the **as-built data**
 2. **Identification** and **evaluation** of the **schedule changes** made in the **new schedule update**

No longer than one month

All documents are consistent in this rule.

Do you know why?



STEP 4: Verifying as-built dates and data

- ❑ The **reviewer** should find a way to track and verify the **actual performance** of activities **during the update period**.
- ❑ While it is always important to **ensure** that the **as-built information is correct**, this is **even more important** for **cost-loaded schedules being used by**
 1. **Contractor** to forecast monthly cash flow projections
 2. **Owner** to pay the Contractor based on the monthly progress **reported** in the schedule



STEP 4: Verifying as-built dates and data

- ❑ One of the **best places** to find as-built information is in the **Project schedule updates**, because the **periodic updates** typically **record** the **dates** that specific **activities start** and **finish**.
- ❑ Even if the **updates** contain the **Project's as-built information**, it is **always** wise to verify information in the **updates**, using as **many independent sources** as possible.
 - ❖ For example, the **analyst** might **review** the Project daily reports to **verify** that **specific activities started** and **finished** on the dates **indicated in the updates**.

Retained and Override Logic?

STEP 4: Verifying as-built dates and data

- 1.59 The Updated Programmes should be archived as separate electronic files and the saved versions should be copied electronically to the CA (again, in native format, not as a PDF), along with a report describing revisions made to activity durations or logic as compared to the Accepted Programme (or a previous Updated Programme) and the reasons for the revisions. The purpose of saving Updated Programmes is to provide a contemporaneous record of revisions to the Contractor's intended work sequences and activities. No version of any programme should be overwritten – all versions need to be saved separately.

What if the CA disagrees with the progress the contractor considers it has achieved!



STEP 4: Verifying as-built dates and data

1.60 If the CA disagrees with the progress the Contractor considers it has achieved, it should notify the Contractor, and the CA and Contractor should then attempt to reach agreement. If they do not agree, the CA's view should prevail (unless and until it is reviewed and replaced under the contract dispute resolution procedures), and the CA's view on progress should be reflected in the Updated Programmes. The Contractor's position on the areas of disagreement should be recorded and submitted with the Updated Programmes.

What if the updates do not provide the information required or do not exist



STEP 4: Verifying as-built dates and data

What if the updates do not provide the information required or do not exist

- ☐ The analyst has **no alternative** but to **prepare his own as-built diagram**, using the contemporaneous project documents.



STEP 4: Verifying as-built dates and data

- ❑ Note that in the **creation** of an **as-built diagram**, the **analyst** should **document** **every day** that work is **recorded** for **each activity**.
 - ❖ It is **not enough** to **merely record** the **start date** and then the **finish date**.
 - ✓ **While** the **start and finish** dates are **extremely important**, the **determination** of **whether work** was **continuous** or **interrupted** may also be **significant**.

*An **as-built** is **not truly** a **schedule** but rather a **history** of **when specific work** is **performed**.*

STEP 5: Identifying and evaluating schedule changes in the schedule update

- 1.62 Specifically, the Contractor should attempt to reasonably revise its planned logic, sequence, and activity durations for the remainder of the works whenever there is or may be Contractor Delay to Completion or variations so as to ensure the contract completion date will be achieved. The contract should contain provisions allowing the CA to require the Contractor to produce a proposed revised programme in such circumstances. These revisions should be made to the most recent Updated Programme (or the Accepted Programme if no Updated Programme has yet been produced).

What should be done before?

STEP 5: Identifying and evaluating schedule changes in the schedule update

- ❑ If the **Contractor** makes any schedule **changes** that **affect** the **critical path**, **near critical paths**, or **Project milestones**, the reviewer should **require the Contractor** to:

*Provide an **explanation** of:*

1. **Why** the schedule was **altered**
2. **Explain** its **effect**

Best practice is to require that the contractor explain all logic changes.

Do we need to notify the CA or CM?

STEP 5: Identifying and evaluating schedule changes in the schedule update

- 1.63 The Contractor should notify the CA of any proposed revisions and provide an electronic copy of the proposed revised programme, together with any consequential revision to the Contractor's method statements and a programme narrative that reflects the proposed revised programme. The CA should review and if appropriate accept the proposed revised programme. Once a revised programme is accepted by the CA it replaces the former Accepted Programme as the tool for monitoring actual progress.

STEP 5: Identifying and evaluating schedule changes in the schedule update

Like the review of the **as-planned schedule**, once the reviewer has **completed** his review of the **Contractor's schedule update**, he should **approve** the update.

The **reviewer's goal** should be to always **have a current version** of the Project schedule that provides an **accurate representation** of the Contractor's current plan to complete the Project.



STEP 6: Early completion schedules

- ❑ Most construction contracts specify the maximum time allowed for the Contractor to perform the work.
- ❑ Few, if any, contracts specify a minimum duration.
- ❑ However, a Contractor has both the **right** and the **financial incentive** to finish a **Project early**, if possible.

Thus, it is important for **Owners** and **Contractors** alike to deal with early completion schedules fairly and effectively.



STEP 6: Early completion schedules

ASCE Standard ANSI/ASCE/CI 67-17 (Schedule Delay Analysis)

- ❑ Generally, the **contractor has the right** to finish early.
- ❑ The **owner gains the benefit** of early project use, and the **contractor gets offsite** and **no longer incurs general conditions costs**.
- ❑ The additional contractor **cost savings** of early completion also are reflected in a **lower bid price** anticipating early completion.
 - ❖ Although the **owner should not have** to spend **additional costs** to meet a **contractor's early completion schedule**,
the **owner should not interfere** with the **contractor's ability** to finish early.



STEP 6: Early completion schedules

ASCE Standard ANSI/ASCE/CI 67-17 (Schedule Delay Analysis)

6.1 A PLAN TO FINISH EARLY SHOULD BE REASONABLE

- ☐ Parties should **address early completion as early** in the project as possible.
- ☐ It is good practice for the **contractor to inform the owner** that the contractor plans on **finishing early**.
- ☐ An **owner** should review and validate the **potential** of the contractor to finish early.
- ☐ If an owner takes exception,
owner should **inform and discuss** this with the contractor
before making a decision to acknowledge the contractor's intent.



STEP 6: Early completion schedules

❑ If **early Project completion** is intended by the **Contractor**, it needs **two** **requirements**:

1. **Early finish date** should be **shown** on the **official project schedule**
2. **Multiple schedules** should **always be avoided**

The **Contractor** **benefits** from these practices because it is **extremely difficult** for a **Contractor** to convince an **Owner** or the **courts** that he planned to **finish early** when the **schedule did not reflect this plan**.

❑ **Owners** and **Contractors** are sometimes **resistant to these practices**.

❖ **Owners** are resistant because some **Contractors will claim** for damages if they believe the **Owner prevented** them from **finishing early**.



STEP 6: Early completion schedules – Example

❑ Some Owners will not accept schedules that show a duration less than the Contract duration.

❖ Usually, **there is no contractual basis** for the **Owner's insistence** on this requirement.

What is the solution?



STEP 6: Early completion schedules

1. In this situation, the **Contractor** should **ask the Owner** to **show where** in the Contract the **minimum time is specified**.

❖ **If** the **Owner still insists** on a schedule using all the Contract time **even though** **no minimum time is specified**,

then:



STEP 6: Early completion schedules

2. Contractor should submit the same early completion schedule with one additional activity at the end making up the difference between the planned early finish date and the Contract's duration.
 - ❖ This activity could be called “Contractor contingency.”
- ✓ The schedule should be accompanied by a letter that clearly explains that the Contractor plans to finish early and has added the contingency activity only to get the schedule approved.
- ✓ The letter should also state that the Contractor expects to receive compensation if it is prevented from finishing early because of the Owner's actions.



STEP 6: Early completion schedules

- ❑ The Owner (or Owner's representative) **must review** an **early completion schedule** carefully to ensure that
 1. It is complete
 2. Logic is correct
 3. Durations are reasonable given the contractor's resources
- ❑ **Resources** and **productivity** should be checked and tracked carefully!

If an **early completion** schedule is **accepted**, the **Owner's representative** **must closely monitor** the work on the **Project** and **note any deviations** between **planned** and **actual durations** as they occur.



STEP 6: Early completion schedules

What if the contractor is unable to finish the project early, should he/she pay the compensation?



STEP 6: Early completion schedules

Even if the Contractor exceeds the early completion duration through its own actions, it faces no greater exposure to damages from the Owner.

- ❖ Contract's duration is **300 calendar days** but that the **Contractor** plans to complete **the work in 200 calendar days**. If a **Liquidated Damages** clause is included in the Contract, the damages will **not** become **effective until day 301**.

☐ Event Analysis Sheet

☐ CVIs (confirmation of
verbal instructions)

☐ PCEs (potential
compensation events)

☐ A list of potential
delay events should
then be created.

☐ For each potential
delay event, an “**event
analysis sheet**” should
be prepared.

EVENT ANALYSIS SHEET

EAS REFERENCE: 001

REFERENCE DOCUMENTS

Location: _____
CVI: _____
RFI: _____
PCE.CE: _____

JOB REF: 1009.004

Hotel and Casino Projects
Client: Steel Company Inc.

EVENT DESCRIPTION:

EAS 001 [EVENT DESCRIPTION HERE]
CPM Activity: [Activity ID & Description here]

	Plan* (a)	Actual (b)	Variance (b) - (a)
Start			
Finish			
Duration			
Total float			

*planned dates in current "windows" schedule

WINDOWS REF: _____

ERECTION SEQUENCE: _____

PAY APP LINE ITEM REF: _____

TOTAL FLOAT LOSS IN WINDOW: _____

Time Analysis:

Relevant Facts:

Measurement of Delay:

Key Dates: - - -

SCHEDULE IMPACT : (ACTIVITIES ADDED/DELETED/REVISED)

ACTIVITY DESCRIPTION	ACTIVITY ID	DURATION	PRED	SUCC	LOGIC	CONSTR

COMMENTS / ASSUMPTIONS / ACTIONS :

STEP 7: Performing delay analysis procedure (CPs 4 and 11)

۱۰	نامۀ کارفرما - ابلاغ صورت جلسات	۱۳۹۹/۰۲/۱۹	۱۳۹۹/۰۲/۱۰
۱۱	ابلاغ صورت مجلس ۲۱۶: اجرای اولیه و تخریب حوضچه های زمین فوتبال	پیوست نامه	۲۱۶
۱۲	ابلاغ صورت مجلس ۲۱۷: ساخت و نصب حوضچه و دریاچه فیزی شیر فلکه ها و شیرهای برداشت زمین فوتبال	پیوست نامه	۲۱۷
		۱۳۹۹/۰۲/۱۰	۱۳۹۹/۰۲/۱۰

تأثیر بر برنامه زمان بندی مصوب

ردیف	عنوان	ID	نوع	مدت زمان	پیش نیازها	پس نیازها
۱	ساخت گاتر و حوضچه زهکشی	football05	فعالیت	۴۵ روز	Football03	Football00
۲	ابلاغ تسمیات جدید زیرسازی پیست تارتان جهت اصلاح شیب و افزایش ارتفاع گاترها	football05-delay08	مورد منجر به تاخیر	۱۱ روز	M-delay-field042	football05-11
۳	ابلاغ دستور کار تخریب و اجرای مجدد حوضچه های شستشو و شیرفلکه ها	football05-delay09	مورد منجر به تاخیر	۱۱ روز	M-delay-field043	football05-12
۴	اجرای گاترها و کانال آب	football05-11	فعالیت	۴۰ روز	football05-delay01	football05 FF
۵	اجرای حوضچه شیر فلکه شستشوی چمن	football05-12	فعالیت	۱۰ روز	football05-delay01, football05-delay07	football05 FF

عملیات تکمیل باقیمانده کاسه استادیوم	کارفرما	مشاور	پیمانکار
سریداران سبزوار - اولویت اول بهره برداری			
قرارداد	تاریخ	۱۳۹۳/۰۲/۲۴	

شناسنامه موارد منجر به تاخیر

عنوان	تغییر زیرسازی پیست تارتان و جابه جایی حوضچه های شیرفلکه
شماره ردیف	۲۲
کد در برنامه زمان بندی تحلیل تاخیر	football05-11, football05-12
فعالیت تأثیر پذیرفته	ساخت گاتر و حوضچه زهکشی
روى مسیر بحرانی	شناوری کل
نحوه اتصال در برنامه	۱۱ fragnet
تاریخ شروع	۱۳۹۸/۰۹/۲۷
تاریخ خاتمه	۱۳۹۸/۱۰/۰۸

شرح

به دلیل تغییر شیب عرضی پیست تارتان، ارتفاع دیواره گاتر بتنی کنار پیست در یک سمت افزایش یافت. با توجه به اینکه لایه بیس براساس نقشه های اولیه اجرا شده بود، عملیات اضافه نمودن ارتفاع که شامل همه مراحل ساخت ابنیه بتن مسلح است، به ناچار از ابتدا شروع شد. همچنین به دلیل تغییر جنس روسازی بخش شمالی و جنوبی زمین فوتبال (فضای ID)، کلیه حوضچه های برداشت آب نیز تخریب و تعمیر محل داده شدند. از آنجا که عملیات بخش لایه زهکشی برای روسازی قبلی انجام شده بود، ناگزیر کلیه عملیات از نو تجدید گردید.

مستندات

ردیف	موضوع	تاریخ	شماره
۱	نامۀ مشاور - پیشنهاد دستور کار اصلاح زیرسازی پیست تارتان	۱۳۹۸/۰۹/۱۹	۹۸-۰۸۰۸۱
۲	نامۀ مشاور - ابلاغ دستور کار اصلاح شیب زیرسازی پیست تارتان و جابه جایی حوضچه های شیر فلکه، ابلاغ دستور کارهای ۱۰۲۶ و ۱۰۲۵	۱۳۹۸/۰۹/۲۷	۹۸-۰۸۲۵۰
۳	دستور کار ۱۰۲۵: اجرا و تخریب حوضچه های شیر فلکه های زمین فوتبال و اجرای لوله پلی اتیلن	پیوست نامه	۱۰۲۵
۴	دستور کار ۱۰۲۶: جزئیات افزایش ارتفاع دیواره کانال های پیست تارتان	پیوست نامه	۱۰۲۶
۵	نامۀ پیمانکار - پیشنهاد تغییر روش اجرای زیرسازی پیست تارتان	۱۳۹۸/۱۰/۰۳	۹۸/۲۳۰۸/۸۵۹۸
۶	نامۀ مشاور - جزئیات زیرسازی پیست تارتان	۱۳۹۸/۱۰/۰۸	۹۸-۰۸۷۰۸
۷	نامۀ مشاور - ارسال دستور کار ۱۰۲۵: اجرا و تخریب حوضچه های شیر فلکه و اجرای لوله پلی اتیلن	۱۳۹۸/۱۱/۱۶	۹۸-۱۰۱۴۴
۸	نامۀ کارفرما - ابلاغ دستور کار ۱۰۲۵: تخریب و اجرای حوضچه های شیر فلکه و اجرای لوله پلی اتیلن	۱۳۹۸/۱۲/۰۷	۹۸/۹۸/۶۴۴۶
۹	نامۀ مشاور - ارسال صورت جلسات	۱۳۹۹/۰۲/۲۰	۹۹-۰۰۹۳۲

STEP 7: Performing delay analysis procedure (CPs 4 and 11)

- ☐ **Details of all the delay issues** identified should be recorded in a **delay register** (below table).
- ☐ This table should capture **all delays**.
- ☐ This table could be more complex.

Ref no.	Cause and effect of delay or disruption	Delay to section or part of works	Delay to competition date	Contract clause relevant to delay	Date of delay notice and particulars
1.	Under-slab drainage Additional works arising out of discovery of ground beam clash	16 days	4 days	25 Relevant event 25.4.5.1	Contractor's letters: November 23 2005



STEP 7: Performing delay analysis procedure (CPs 4 and 11)

- ❑ These projects are more likely to **avoid long-term disputes** due to the **transparency** of these emerging events, allowing issues to be **resolved in the first instance**, on the ground level.
- ❑ If prepared **forensically**, a **register of events** should remain a **working document** throughout the **forensic fact finding research phase** and be added to or **amended accordingly**.

What forensic fact finding research could include?

STEP 7: Performing delay analysis procedure (CPs 4 and 11)

❑ Once the initial list of

1. Delay issue files and event analysis sheets has been **prepared**, and

2. Delay register is up and **running**,

main phase of **forensic research** can be undertaken.

❑ This essentially comprises a **review** of

❖ All job-specific documentation,

❖ Media and records

demonstrating what actually happened.

In the course of this exercise, the delay analyst will require access to a wide range of records

Let's see **samples**!

STEP 7: Performing delay analysis procedure (CPs 4 and 11)

- ❑ This is **just an overview** of the likely **sources of data**
- ❑ During this process, the delay register and event analysis sheets should be developed, revisited and continually refined.

What should be done next?

Tender documents:

- Tender programmes
- Drawings issued for construction

Contract documents:

- Contract form(s)
- Specifications
- Employer's requirements
- Contractor's proposals
- Bills of quantities
- Drawings issued for construction

Construction programmes:

- Construction programme
- Subcontractor programmes
- Short-term programmes
- Revised programmes
- Updated 'as-built' programmes
- Information required by

Project and site records:

- Programmes
- Project meeting minutes
- Contractors' progress reports
- Subcontractors' reports
- Photographs and videos
- Site diaries or logs
- Job correspondence
- Requests for information (RFI)
- Labour returns
- Drawing issue registers
- Plant hire registers
- Certificates (time and money)
- Confirmation of verbal instructions (CVI)

Project documents:

- Drawing revisions
- Document/drawing transmittal sheets
- Instructions
- Design change orders
- Project staff list and attendance record
- Computer discs and hard-drives

Claim related records:

- Computer-aided 3D simulations
- Delay notices
- Failure to release information notices
- Claim specific files/documents (e.g. previous claim submissions, time extension awards)
- BIM data



STEP 7: Performing delay analysis procedure (CPs 4 and 11)

- ❑ Once the documentation and records have been **compiled**, the next stage is to **marshal this information** into a format in which it can be used effectively, regardless of **which delay analysis technique** is being pursued.

Let's look at **techniques** first!



Delay analysis using common methods

❑ Two major sources:

1. Recommended Practice No. 29R-03 (2011)

- ❖ American Association of Cost Engineering (AACE) International

2. SCL Delay Protocol (2nd Edition published in Feb 2017)

- ❖ Society of Construction Law Delay and Disruption Protocol



Common methods of analyzing delays

- ❑ **SCL** says **six** methods
- ❑ **AACE** says **nine** methodologies
- ❑ **Others** say **seventeen or more**
- ❑ **An argument** could be made for a **near infinite number**

- ❑ We will discuss **major types**
 - ❖ **All others** are simply **variations** of **these types**

Delay analysis – Key terms: Contemporaneous vs. Forensic

■ Contemporaneous [of the time]

Schedules prepared
and used during the
project to manage the
work

■ After-the-Fact

Schedules created
after the project has
been completed

- ❑ All too often, **analysts** will **create a schedule** well **after** the **Project is completed** or, alternatively, will **modify** the **Project schedule**, asserting there **were errors** that needed **correction**.

limited adjustments to a schedule may be **appropriate**, but

- Making significant changes or
- Creating a new schedule is

very subjective and **not an accepted practice** for an **analysis of delays** to a Project.



Delay analysis – Key terms: Prospective vs. Retrospective

❑ **Delay impact** is determined in **one** of **two** different ways:

1. **Prospective** delay analysis

- ❖ It identifies the **likely impact** of **historical progress** or **delay events** on a **completion date**.
- ❖ The **conclusion** of this analysis **may not match** the **as-built schedule** because *the contractor's actual performance may well have been influenced by the effects of attempted acceleration, re-sequencing or redeployment of resources in order to **try to avoid liability** for liquidated damages or due to other Employer and Contractor Risk Events.*

2. **Retrospective** delay analysis

- ❖ It identifies the **actual impact** of the **delay events** on the **identified actual** or **as-built critical path**





Delay analysis – Key terms: Cause and effect vs. Effect and cause

❑ **Six methods** mentioned in **SCL protocol**.

How these methods work?

1. Cause and effect type analysis

❖ Start with the **identification** and **description** of a **cause** and then its **impact**

2. Effect and cause type analysis

❖ **Identifying** critical delay (an effect) and then what might **have caused** that **delay**

Delay analysis – Key terms: Cause and effect vs. Effect and cause

1. For Contemporaneous analysis

❖ Cause and effect methods are recommended

✓ Time impact analysis

1. For After-the-fact analysis

❖ Effect and cause methods are **generally** more reliable

Because consider **all causes** of the **delay incurred**.

Delay analysis – Key terms: Importance of the critical path

❑ **Criticality** is determined in **one** of **three different ways**:

1. Purely **prospective** critical path assessments

- ❖ It adopts the **perspective evident** at the **outset** of the project **only** and **take no account** of **progress achieved**.

2. **Contemporaneous** critical path assessments

- ❖ It adopts an **evolving perspective** over the **course of the works** and **take account** of the **effect** that **both historical progress** and **changes** in the strategy for the **future prosecution** of the works have on **predicted criticality**.

3. **Retrospective** critical path assessments

- ❖ It adopts the **perspective evident** at the **end** of the project.

Delay analysis – Key terms: Importance of the critical path

The **analyst** should never assume that the **critical path** is static and remains unchanged throughout the Project.

Experience teaches us that the **reverse** is more often true.

Changes in the **critical path** are normal and should be expected.



Delay analysis – Key terms: Importance of the critical path

ASCE Standard ANSI/ASCE/CI 67-17 (Schedule Delay Analysis)

7.1 **Delays** should be evaluated as they occur in **chronological sequence**

7.2 A **schedule delay analysis** should reflect an analysis of prior entitlement so as to reflect a **current adjusted completion** date **prior to evaluating delay**.

7.3 **Consideration** should be included as to **how delays were evaluated** by the participants during the project.

7.4 **Evaluation** of **delay chronology** should be documented and supported with **contemporaneous records**

ASCE Standard ANSI/ASCE/CI 67-17 (Schedule Delay Analysis)

7.1 DELAYS SHOULD BE EVALUATED AS THEY OCCUR IN CHRONOLOGICAL SEQUENCE

- ☐ Generally, **delays** should be evaluated **chronologically** and **cumulatively** in the order in which they occur on the project.
- ☐ The **delay recognized** to have **started first** in time that affects the schedule will be **fully evaluated** until that **delay is resolved**.
- ☐ This **may have no impact** on the critical path or directly affect or **change the critical path**.
- ☐ It **may absorb float** on one or more paths and/or create float on others.
 - ❖ Likewise, **changes to the work** through change orders should be **incorporated** into the schedules **as they occur**, **whether** they have a direct overall schedule impact to the critical path or they only reflect the absorption of float.

Delay analysis – Key terms: SCL Methods

Method of Analysis	Analysis Type	Critical Path Determined	Delay Impact Determined	Requires
Impacted As-Planned Analysis	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.

Delay analysis – Key terms: SCL Methods

Method of Analysis	Analysis Type	Critical Path Determined	Delay Impact Determined	Requires
As-Planned versus As-Built Windows Analysis	Effect & Cause	Contemporaneously	Retrospectively	- Baseline programme. - As-built data.
Retrospective Longest Path Analysis	Effect & Cause	Retrospectively	Retrospectively	- Baseline Programme. - As-built programme.
Collapsed As-Built Analysis	Cause & Effect	Retrospectively	Retrospectively	- Logic linked as-built programme. - A selection of delay events to be modelled.

Delay analysis – Key terms: AACE Methods

Observational	As-Planned As-Built	Gross	As-Planned vs. As-Built (MIP 3.1)
		Periodic	As-Planned vs. As-Built (MIP 3.2)
	Contemporaneous Period Analysis (Windows)	Contemporaneous As-Is	Contemporaneous Period Analysis (MIP 3.3)
		Bifurcated Contemporaneous	Bifurcated CPA (MIP 3.4)
		Recreated / Modified	Recreated CPA (MIP 3.5)
Modeled	Time Impact Analysis	Single Base	Impacted As-Planned (MIP 3.6)
		Multiple Base	Retrospective TIA (MIP 3.7)
	Collapsed As-Built	Single Simulation	Collapsed As-Built (Single) (MIP 3.8)
		Multiple Simulation	Collapsed As-Built (Multiple) (MIP 3.9)



Delay analysis – Key terms: SCL vs. AACE methods

Which one is the best?

*We will see comparison between methods at the end
when you learned techniques*

موسسه مهندسی و مدیریت ساخت علوی پور (ACEMI)

دفتر آموزش



تهران، بلوار فردوس شرق، مجتمع آبگینه، طبقه سوم اداری، واحد C42



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