Introduction to Delay Analysis

Schedule Analysis

- The schedule can be used to identify delays and quantify the impact
  - Time
  - Money
- The validity of a schedule analysis starts with developing an complete and accurate schedule and consistent unbiased updating

Delay

- According to AACEI Recommended Practices 29R-03, Forensic Schedule Analysis:
  - "Delay simply means a state of extended duration of an activity, or a state of an activity not having started or finished on time, relative to its predecessor."
- Activity Delay vs. Project Delay
  - Activities can be delayed without delaying the overall project
  - Activities that are critical to a specific part of the work may not be critical to the overall project

Delay

- The three main questions of a delay
  - Who was at fault?
  - How much delay was experienced?
  - How much did the delay cost?
- All three questions can be answered by keeping accurate project records and performing a objective schedule analysis
- The schedule analysis can be performed contemporaneously or retrospectively (after the fact)

Unavoidable Delays

- Force Majeure Delays
  - Non-contracted work delays
  - Extreme weather delays
  - Labor issues/strikes
  - Unknown conditions
  - Supply shortages
  - Acts of God
  - Wars

Avoidable Delays

- Owner caused delays
  - Change Orders
  - Access to worksite
  - Operation considerations
  - Suspensions of work
  - Delays in owner furnished items
  - Coordination with other Contracts

Avoidable Delays

- Contractor caused delays
  - Late submittals
  - Schedule omissions
  - Mismanagement of resources
  - Quality assurance and rework
  - Insufficient productivity rates
  - Lack of onsite supervision

Avoidable Delays

- Designer caused delays
  - Design errors and omissions
  - Slow reviews of submittals, RFIs, and change order requests
  - Late implementation of change orders
  - Delays in inspections and tests
- Designer caused delays are sometimes difficult to separate from owner caused delays

Delay Classifications

- Excusable, non-compensable delay
  - Not the fault of the contractor nor the owner
  - The contractor is provided extra time (time extension), but no additional compensation
  - Sometimes just called an excusable delay
- Excusable, compensable
  - The fault of the owner or party contracted by the owner
  - The contractor is provided additional time and money (compensation may be limited by the contract)

Delay Classifications

- Non-excusable (inexcusable)
  - The fault of the contractor
  - No additional time or money
  - May result in liquidated damages
- Concurrent delay
  - A combination of compensable and non-excusable delays
  - Both the owner and the contractor cause delays at the same time
  - Additional time is granted, but no additional compensation
  - Pacing

Actual Critical Path

- The actual critical path of a project cannot be determined by any singular schedule
- The actual critical path must be assembled by tracking the critical activities at time that they occur
  - In a perfect scenario it will be the same as the baseline schedule, but this is very rare
- This contemporaneous perspective is the best way of analyzing schedules fairly
- Hindsight is not always 20/20

Schedule Delay Analysis Types

Taxonomy	1	RETROSPECTIVE													
	2	OBSERVATIONAL							MODELED						
	3	Static Logic			Dynamic Logic				Additive				Subtractive		
	4	3.1 Gross	3.2 Periodic		Contemporaneous Updates (3.3 As-Is or 3.4 Split)		3.5 Modified / Reconstructed Updates		3.6 Single Base[2]		3.7 Multi Base[1]		3.8 Single Simulation		3.9 Multi Simulation[1]	
	5		Fixed Periods	Variable Windows	All Periods	Grouped Periods	Fixed Periods	Variable Windows	Global Insertion	Stepped Insertion	Fixed Periods	Variable Windows or Grouped	Global Extraction	Stepped Extraction	Fixed Periods	Stepped Extraction
Common Names		As-Planned vs As-Built	Window Analysis		Contemporaneous Period Analysis, Time Impact Analysis, Window	Contemporaneous Period Analysis, Time Impact Analysis, Window Analysis	Contemporaneous Period Analysis, Time Impact Analysis	Window Analysis, Time Impact Analysis	Impacted As-Planned, What-If	Time Impact Analysis, Impacted As-Planned	Time Impact Analysis	Window Analysis, Impacted As-Planned	Collapsed As-Built	Time Impact Analysis, Collapsed As-Built	Time Impact Analysis, Collapsed As-Built	Time Impact Analysis, Window Analysis, Collapsed As-Built

- AACEI Taxonomy of Forensic Schedule Analysis (RP 29R-03, 2011)
  - As-Planned vs As-Built
  - Time Impact Analysis
  - Windows Analysis
  - Impacted As-Planned
  - Collapsed As-Built

As-Planned vs. As-Built

- Simply a comparison between the As-Planned Schedule and the As-Built Schedule
- Delays in the start and finish of each activity are tracked in addition to the overall project

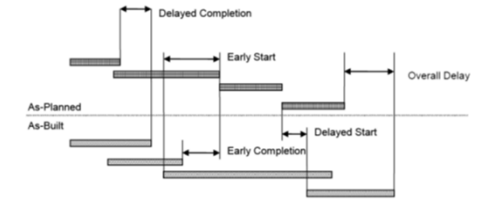

Figure 3 – Observational, Static, Gross Analysis Method Graphic Example

As-Planned vs. As-Built

- AACEI RP 29R-03, MIP 3.1
- Simplest method of schedule analysis
- Can be done using a graphical approach or by tabulating the dates and sequences of the activities
- Does not identify the actual critical path activities
- Should not be used for large or complicated networks
- Apportionment of delay is subjective
- Comparison can also be made in windows

Windows or Time Impact Analysis

- Windows or Time Impact Analysis uses the As-Planned Schedule, periodic updates, and the As-Built Schedule to assemble the actual critical path of the project
- AACEI RP 29R-03, MIP 3.3, 3.4, and 3.5
- Depending on the window this method can take a very long time
- Very accurate and can be completed on a contemporaneous basis with when the delays occur

Windows or Time Impact Analysis

- Basic Steps
  - Progress is added to the baseline schedule on a daily basis (or window) up through the first update
  - Critical activities are tabulated and delay is apportioned
  - After all progress has been entered up through the first update, the process is repeated between all successive updates
  - Delay can be measured by comparing when activities occur between updates or by the total float on the last activity

Windows or Time Impact Analysis

- Advantages
  - Widely accepted
  - Determines actual critical path
  - Uses contemporaneous data
  - Good with large and complicated schedules
- Disadvantages
  - Requires good schedule updates and as-built data
  - Assumes that schedule was used to manage project
  - Requires expert knowledge and a lot of time to prepare

Differences of Methods

- MIP 3.3, 3.4, and 3.5 are completed with the same basic steps
- The only difference between 3.3 and 3.4 is that a “half-step” file is created between revisions
  - It is a progressed schedule without the non-progress revisions
- MIP 3.5 is used when periodic updates are not available
  - Updates are recreated which classifies this method as a retrospective analysis and not a contemporaneous

Impacted As-Planned

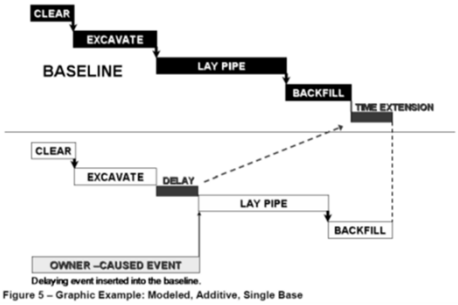

Figure 5 – Graphic Example: Modeled, Additive, Single Base

- The impacted as-planned analysis, MIP 3.6, is a foresight method
- Despite being called a foresight method the impacted as-planned analysis is used retrospectively
- Impact fragnets are inserted in the baseline schedule where they occur in relation to other activities to determine overall project delay

Impacted As-Planned

- Advantages
  - Simple to prepare and understand
  - Relies on the original schedule logic
  - Does not require updates or as-built schedules
  - May be adequate for simple networks if actual progress was similar to planned progress
- Disadvantages
  - Allows the analyst to subjectively select the delays
  - The analysis is hypothetical in that other progress, or lack there of, is not considered
  - This method is not accepted by the courts

Collapsed As-Built

- The collapsed as-built schedule analysis, MIP 3.8, is a hindsight method and is always used retrospectively
- The analysis involves removing impact activities from the As-Built schedule to determine the resulting delay

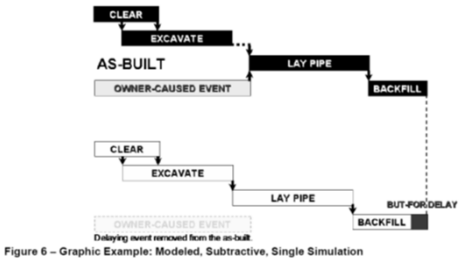

Figure 6 – Graphic Example: Modeled, Subtractive, Single Simulation

Collapsed As-Built

- Advantages
  - Based as-built information
  - Relatively simple to perform and understand
  - May be adequate if all but the impacted activities occurred as-planned
- Disadvantages
  - Allows for subject selection of delay activities
  - Does not determine the actual critical path
  - Does not consider float at the time the delay started
  - Does not use contemporaneous information from schedule updates

Validity of Results

- No two methods will produce the same results
  - The same method executed by different analyst may also produce different results
- To increase accuracy and validity
  - Document everything you do
  - Change as little as possible
  - Use as many sources of information as possible
  - Stay consistent in your preferences
  - If not sure of which path to choose, try both and compare results

Selecting the Right Method

- AACEI does not specify that one method is better than the others
  - RP 29R-03 only provides a common language and standard protocols for performing an analysis
- The scheduler must consider
  - Available information
  - Quality of information
  - Time to complete analysis
  - Complexity of project and schedule
  - Resemblance of As-Built to As-Planned
  - Others

Time Extensions

- Time extensions to the Contract are granted for excusable delays
- Extensions can be for the whole project or specific milestones
- Delay must be on the critical path
- The Contractor cannot be at fault
- The delay could not be reasonably foreseeable at the time the Contract was signed
- The Contractor must have notified the Owner within a reasonable amount of time
- If the Contractor seeks compensation, actual damages must be proven

Acceleration

- When a delay is experienced, both the owner or the contractor may decide to accelerate to avoid damages
- Contractors may accelerate at any time possible if they are responsible for delay
- Directed acceleration
  - Owner directs the Contractor to accelerate for a negotiated cost
- Constructive acceleration
  - Contractor is delayed at no fault of their own (excusable delay)
  - The Contractor notifies the Owner of the delay and requests a time extension.
  - The time extension is rejected by the Owner and the Contractor is thereby required to accelerate to finish the job on-time
  - The Contractor actually accelerates and incurs extra costs

Schedule Disruption

- Types of Disruption
  - Out of sequence work
  - Stacking of trades
  - Impact of individual changes or cumulative impact of multiple changes
  - Inefficiencies caused by different work shifts
- Actual damages must be proven
  - Burden is on the Contractor

Early Completion Schedule

- A Contractor may plan to finish the project earlier than what is required by the Contract
  - May be a cost savings due to reduced fixed costs
- If a Contractor plans to finish early, but is delayed by the Owner, the may be entitled to compensation if:
  - Baseline schedule was reasonable
  - Clearly shown that project was intended to be completed early
  - No exclusions in Contract and Owner was notified of the intent to finish early
  - Delays must be excusable and compensable
  - Owners received timely notification of the delay
  - Schedule was updated and maintained (used for evidence)