Alpha Corporation

Planning for Adverse Weather Conditions in Construction Projects

Chris Carson, PSP, CCM
Corporate Director of Project Controls

Planning for Adverse Weather

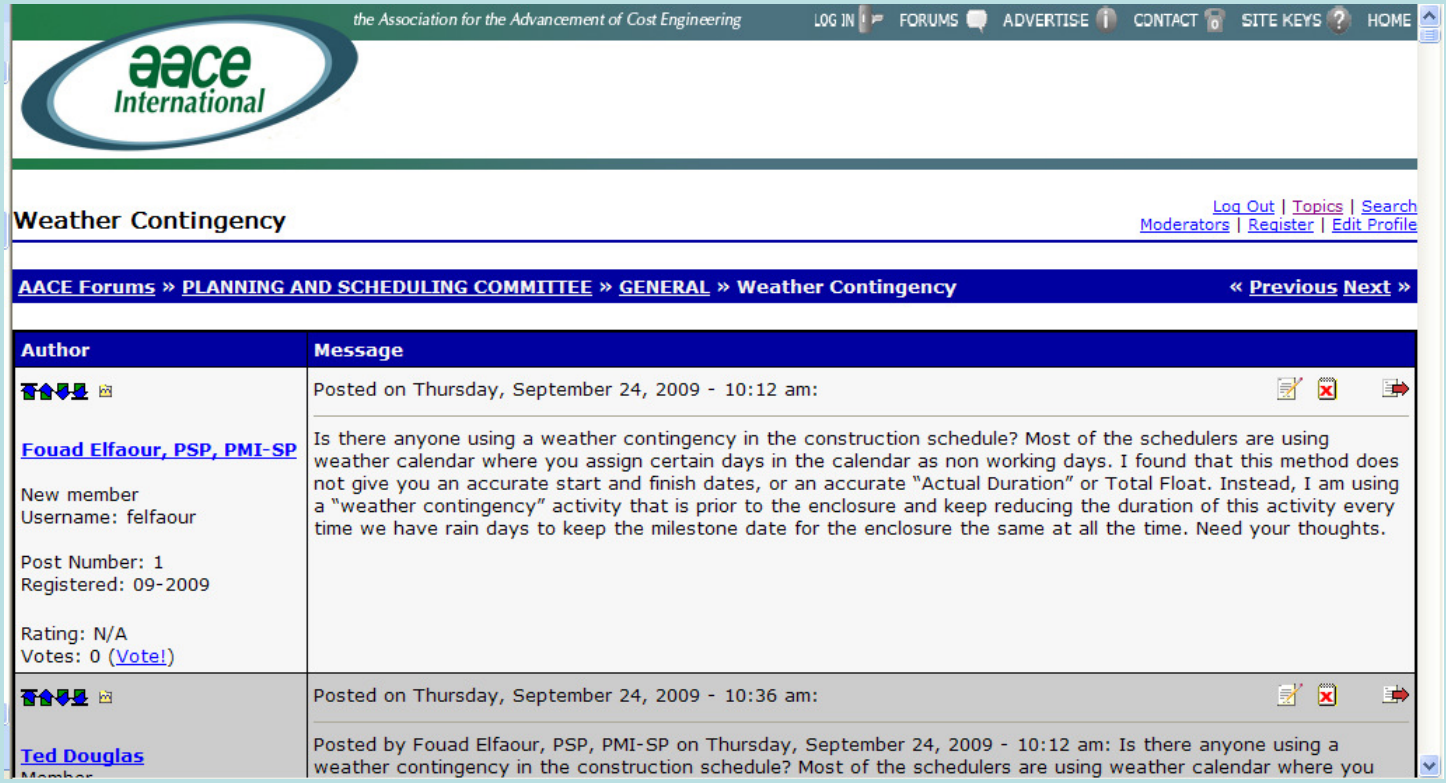
- Chris Carson, PSP, CCM
  - Corporate Director of Project Controls
  - Alpha Corporation
    - Engineering & construction manager/consultant
    - CM firm – 45th Largest U.S. CM firm by ENR
    - Program Manager – 28th Largest U.S. PGM by ENR
    - Provide CM services; scheduling, schedule review, claims analysis, claims defense, all other services
  - Active in PMI College of Scheduling, AACEi, CMAA
    - Managing Director, PMI-CoS SEI (Scheduling Excellence Initiative) Best Practices & Guidelines for Scheduling
    - Author, AACEi, Schedule Recovery Recommended Practice
    - Co-Author, AACEi, Schedule Design & Identifying the Critical Path RPs
    - Editorial Team, CMAA, Revision of Time Management Chapter of CM Standards of Practice
  - 37 years of construction management experience

Planning for Adverse Weather

- Best Practices for Planning for Adverse Weather
  - Developed in conjunction with Patrick Kelly, PSP, Project Controls Manager, Alpha Corporation

Planning for Adverse Weather

- Idea for this Webinar
  - Arose from discussions in the AACEi Forums



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Weather Contingency

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AACE Forums » PLANNING AND SCHEDULING COMMITTEE » GENERAL » Weather Contingency « Previous Next »

Author	Message
Fouad Elfaour, PSP, PMI-SP New member Username: felfaour Post Number: 1 Registered: 09-2009 Rating: N/A Votes: 0 (Vote!)	Posted on Thursday, September 24, 2009 - 10:12 am: Is there anyone using a weather contingency in the construction schedule? Most of the schedulers are using weather calendar where you assign certain days in the calendar as non working days. I found that this method does not give you an accurate start and finish dates, or an accurate "Actual Duration" or Total Float. Instead, I am using a "weather contingency" activity that is prior to the enclosure and keep reducing the duration of this activity every time we have rain days to keep the milestone date for the enclosure the same at all the time. Need your thoughts.
Ted Douglas	Posted on Thursday, September 24, 2009 - 10:36 am: Posted by Fouad Elfaour, PSP, PMI-SP on Thursday, September 24, 2009 - 10:12 am: Is there anyone using a weather contingency in the construction schedule? Most of the schedulers are using weather calendar where you

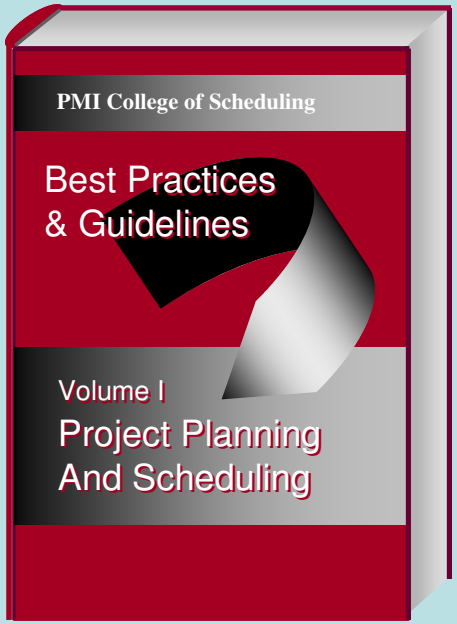
Planning for Adverse Weather

- AACEi participants in discussion
  - Question by Fouad Elfaour on 9/24/2009, ended 10/20/2009
  - Comments by:
    - Ted Douglas
    - Chris Carson
    - Dennis Read Hanks
    - Vera Lovejoy
    - Donald McDonald
    - Ron Winter
    - Hilal Itani
    - Jim Zack, Jr.
    - Jose Noe
    - Zartab Ouraishi
    - Patrick Egger
    - Patrick Burkhead
    - Marc Glasser
  - Go to Webpage http://www.aacei.org/ "Resources, Discussion Forums" for discussions – under P&S Committee,"Weather Contingency"

Planning for Adverse Weather

- PMI College of Scheduling
  - Schedule Excellence Initiative – writing Best Practices and Guidelines for Scheduling
  - Volunteer effort
  - Email Chris to join:
    - chris.carson@alphacorporation.com

7.08.5 Weather Calendars					
		7.8.5 Weather Calendars - Advisories What should be avoided at all cost? Owner dbearden, Started 17/03/2007	1	2	20/06/2009 03:35 pm (Last post 177.3 days ago) > It can be difficult to determi...
		7.8.5 Weather Calendars - Best Practices What is the ideal application method? Owner dbearden, Started 17/03/2007	2	9	16/02/2009 03:07 pm (Last post 301.3 days ago) > FYI Phil April; It Worked! ...
		7.8.5 Weather Calendars - Default Condition Answer the question, under what conditions? Describe the typical context for application. Describe when the practice is typically not applied. Owner dbearden, Started 17/03/2007	0	0	No posts
		7.8.5 Weather Calendars - Definition Define the term. Owner dbearden, Started 17/03/2007	0	0	No posts
		7.8.5 Weather Calendars - Purpose Answer the question, Why? What is the purpose? Owner dbearden, Started 17/03/2007	0	0	No posts
		7.8.5 Weather Calendars - Recommended Practice Answer the question, what is the preferred application method? Owner dbearden, Started 17/03/2007	1	0	20/11/2007 11:57 pm (Last post 754.9 days ago) > Custom calendars are very powe...



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Weather Planning

- The ability of a CPM schedule to provide reasonable predictions of activity starts/finishes and milestone/project completion is based on the completeness of the schedule network
- Modeling is an appropriate method to simulate real-world conditions and one that makes the schedule more “accurate”
- Attempting to plan for future weather requires some level of modeling
- Prospective modeling is an acceptable and preferred method of analyzing changed conditions, so industry has accepted modeling
- Use of modeling does require use of best and/or recommended practices just as is required for good CPM scheduling

Weather Planning

- Weather that is sufficiently harsh to halt work is commonly described as “adverse weather” in order to indicate the unfavorable nature of the weather
- Adverse weather can take many forms:
  - High temperature conditions
  - Low temperature conditions
  - Precipitation in the form of rain, snow, hail, ice
  - High wind conditions
  - High or low humidity conditions
- Secondary effects from adverse weather can include:
  - Mud conditions causing lack of accessibility or inability to pursue earthwork operations
  - Moisture conditions resulting in mold or mildew abatement needs
  - Snow and ice removal needs
  - Inability to work due to temperature – masonry, roofing, etc.
  - Materials stocking on high rise floors due to tower crane restrictions

Weather Planning

- Adverse weather
  - Adverse weather is a factor that is known to impact project performance
  - The extent and severity of adverse weather is unknown
  - The timing of adverse weather, while unknown, is somewhat predictable
  - Modeling of weather requires a system to model the severity as well as the timing
- One way of dealing with this would be from a risk management standpoint

Weather Planning

- Simple adverse weather is rarely included in risk assessment because:
  - It is a normal and expected job condition
  - There is ample available historical data
  - Schedulers use a number of different modeling techniques, not all of which are compatible with risk assessment methodology
  - The modeling is complicated by the need for frequency, severity, and timing in the model
- Specific event impacts, such as hurricanes, ARE routinely modeled in risk assessment; these are not included in the scope of routine weather planning
- Some method must be used to model the ramifications of this “known unknown” potential impact on the schedule

Weather Planning Methods

- Schedulers have used a number of different methods to model the impact of adverse weather
  - Use of weekend non-work days to make up for lost weather days
  - Use of an activity just prior to milestones or project completion to house time
  - Increasing durations for activities that are weather-dependent
  - Use of weather calendars
- Each of these methods has distinct advantages and disadvantages

Weather Planning Methods

- Use of weekend non-work days to make up for lost weather days
  - Advantages:
    - Easy, does not require any effort beyond using a five day workweek
    - Does not extend the project when applied
  - Disadvantages:
    - Owner could take the position that the Contractor planned for 2 days of adverse weather each week
    - Weekends may not allow enough time or time at appropriate periods – too little planning in bad seasons, too much in good
    - Subcontractors may expect overtime for weekend work
    - Contractor supervision will have to work weekends
    - Owner furnished supervision or inspection personnel will have to be available
    - Municipalities may not provide inspectors at all on weekends

Weather Planning Methods

- Use of an activity just prior to a milestone or project completion to house time in a bank
  - **Advantages:**
    - Seems to make sense at first sight
    - Allows Owner to monitor and control use of banked time
    - Completion date, or any milestone date with a predecessor weather activity, does include planning for adverse weather
    - Can be used in Monte Carlo simulations

Weather Planning Methods

- Use of an activity just prior to a milestone or project completion to house time in a bank
  - **Disadvantages:**
    - Applies weather planning to non-weather dependent work
    - Reduces usefulness & accuracy of float values
    - Early dates of activities do not have ANY weather planning included, so only the completion dates after the weather activity include weather planning – cannot count on activity dates
    - Sequesters float inappropriately, risk for accurate delay analysis
    - Requires additional effort and time to monitor & adjust
    - Does not consider the time of year or season use , pushes unusual weather discussions to end of project when activity bank runs out
    - Does not allow schedule to automatically predict delay due to weather-dependent activities shift into worse weather periods
    - Continues to sequester float throughout the project when good weather is encountered; does not return available float to project for other use unless activity is adjusted each update
    - Provides an inappropriate feeling of “contingency” in the project

Weather Planning Methods

- Increasing activity durations to account for adverse weather
  - Advantages:
    - Can be done easily with global tools
    - Doesn't require monitoring
  - Disadvantages:
    - Provides reduced transparency of planning
    - Reduces review benefits since durations are no longer calculated by production rates and quantities
    - Planning is based on the static baseline schedule, so when schedule shifts, weather is planned inappropriately for seasons
    - Contractors using schedule will not know if durations represent actual labor predictions since they may have weather planning built in

Weather Planning Methods

- Use of a weather calendar for historical weather
  - Advantages:
    - No maintenance required, except for actualizing weather calendar (which should be done for historical accuracy)
    - Planning is seasonal, more non-work days in times of historically bad weather
    - CPM network automatically keeps weather planning at appropriate seasons; when activities slip into or out of periods of adverse weather, dates are adjusted
    - Accommodates accurate delay analysis; if a delay will cause a later activity to slip into a period of non-work, the analysis shows the increased delay
    - All dates including milestones and completion date are kept accurate (by the model)

Weather Planning Methods

- Use of a weather calendar for historical weather
  - Disadvantages:
    - Float values are affected by calendars; zero float path may have holes due to calendar changes
    - If non-work days are distributed over a five day week, planning may be over done (historical data is kept on a seven day week)

Weather Planning Methods

- Weather Calendar Best Practices
  - Selection of data source
  - Interpreting historical data
  - Selection of historical data
  - Applying data to calendar
  - Choosing activities to apply
  - Risk management using calendars
  - Maintenance of system
  - Claims and analysis
  - Admonitions & advisories

Weather Planning Methods

- Weather Calendar Best Practices
  - Selection of data source
    - Should be done analytically
    - National Weather Service is safe; industry recognized actual data (certified data comes from National Climatic Data Center - NCDC)
    - Need 3 to 5 years worth of data
    - Army Corps of Engineers analyzes NWS and provides monthly expected non-work time

Month	J	F	M	A	M	J	J	A	S	O	N	D
Adverse Weather Days	9	9	9	6	7	6	7	7	5	6	7	9

Weather Planning Methods

- Weather Calendar Best Practices
  - Interpreting historical data
    - Defining a lost weather day
      - Work ceased for more than half the day
      - Manpower was reduced and unable to work due to weather for more than half the day
      - Site conditions prevented work on site (this may require a secondary calendar for just the affected activities)

Weather Planning Methods

- Weather Calendar Best Practices
  - Selection of historical data
    - Data is difficult to choose (NCDC shown below)
    - Daily precipitation reports require judgment about quantity of precipitation

NOVEMBER 1996
LOCAL CLIMATOLOGICAL DATA
NOAA, National Climatic Data Center

MINNEAPOLIS–ST.PAUL, MN
INTERNATIONAL AIRPC
Lat: 44°52' N Long: 9
Time Zone: CENTRAL

DATE	TEMPERATURE °F MAXIMUM	MINIMUM	AVERAGE	DEP FROM NORMAL	AVERAGE DEW PT	AVERAGE WET BULB	DEG DAYS BASE 65° HEATING	COOLING	WEATHER	SNOW/ICE ON GND(IN) 0600 LST DEPTH	1200 LST WATER EQUIV	PRECIPITATION (INCHES) 2400 LST SNOW-FALL	2400 LST WATER EQUIV	PR (INC AVERAGE
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
01	31	19	25	-16	14	21	40	0	SN	0		T	T	29.
02	35	17	26	-15	16	23	39	0		0		0.0	0.00	29.
03	57*	23	40	0	26	34	25	0		0		0.0	0.00	29.
04	46	34	40	0	38	40	25	0	RA BR	0		0.0	0.33	28.
05	45	41	43	4	41	42	22	0	BR	0		0.0	0.00	29.
06	47	29	38	0	38	40	27	0	RA DZ FG BR	0		0.0	0.04	28.
07	48	29	39	1	30	34	26	0		0		0.0	0.00	28.
08	39	30	35	-2	26	32	30	0	SN	0		T	T	29.
09	34	25	30	-7	19	25	35	0	SN	0		T	T	29.
10	27	23	25	-11	13	22	40	0	SN	0		T	T	29.
11	26	13	20	-16	8	18	45	0	SN	0		T	T	29.
12	25	9	17	-18	8	15	48	0		0		0.0	0.00	29.
13	29	14	22	-13	9	18	43	0		0		0.0	0.00	29.
14	29	12	21	-13	9	18	44	0	SN	0		T	T	29.
15	38	25	32	-1	30	32	33	0	RA DZ FZRA SN PE RASNPE	1		1.7	1.58	29.
16	52	38	45*	12	44	44	20	0	RA DZ BR	1		0.0	1.27	28.
17	49	18	34	2	20	24	31	0	RA FZRA SN PE BR	0		T	0.12	29.
18	24	16	20	-12	12	17	45	0		0		0.0	0.00	29.
19	24	15	20	-11	13	19	45	0		0		0.0	0.00	29.
20	25	22	24	-7	19	23	41	0	SN FG FZFG BR	4		4.4	0.46	29.13

MINNEAPOLIS–ST.PAUL, MN

INTERNATIONAL AIRPORT (MSP)
Lat: 44°52' N Long: 93°13' W Elev (Ground): 834 Feet
Time Zone: CENTRAL WBAN: 14922 ISSN #:0198–2745

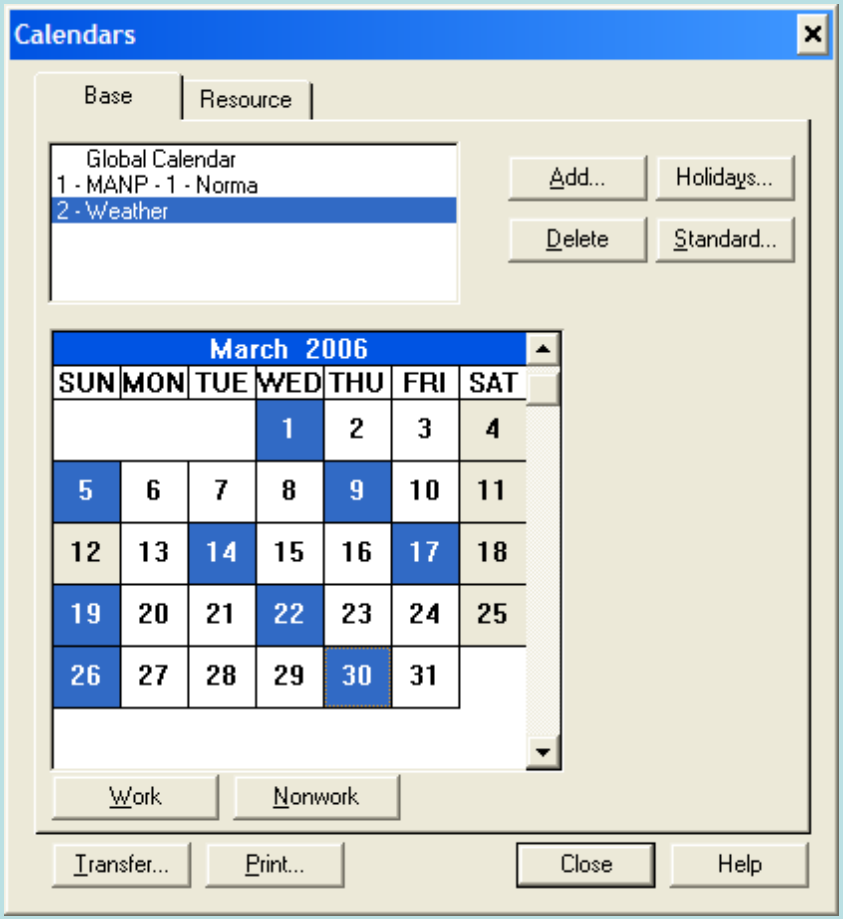
	SNOW/ICE ON GND(IN) 0600 LST DEPTH	1200 LST WATER EQUIV	PRECIPITATION (INCHES) 2400 LST SNOW–FALL	2400 LST WATER EQUIV	PRESSURE (INCHES OF HG) AVERAGE STATION	AVERAGE SEA LEVEL	WIND SPEED = MPH DIR = TENS OF DEGREES RESULTANT SPEED	RES DIR	AVERAGE SPEED	MAXIMUM 5–SEC SPEED	5–SEC DIR	2–MIN SPEED	2–MIN DIR	DATE
	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	0		T	T	29.12	30.05	11.2	31	12.0	26	31	21	32	01
	0		0.0	0.00	29.26	30.20	6.2	29	7.8	20	26	14	29	02
	0		0.0	0.00	29.05	29.97	7.6	18	8.3	18	17	16	18	03
	0		0.0	0.33	28.99	29.90	7.2	14	7.6	16	15	13	14	04

Weather Planning Methods

- Weather Calendar Best Practices
  - Applying data to calendar
    - Make a copy of the default project calendar
    - Ensure the workweek is accurate (usually 5d)
    - Select appropriate month, ex. March = 9 days
    - Review calendar, ex. March – has 5 weeks
    - Turn off 9 days in March
      - Select 1 day for short week
      - Select 2 days per week for the rest
      - Randomly apply across all days, including weekends
    - Continue for all months, include ~20% more months than contractually required to accommodate time extensions

Weather Planning Methods

- Weather Calendar Best Practices
  - Apply data to calendar
    - Note: 1 day in week 1
    - Note: 5th is weekend
    - Note: 19th is weekend
    - Note: 26th is weekend
    - Total 9 days, 3 weekend



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Weather Planning Methods

- Weather Calendar Best Practices
  - Choosing activities to apply
    - Determine if all activities are subject to same weather conditions
      - If so, one calendar should suffice (normal)
      - Code all weather-dependent activities
      - Apply weather calendar to weather-dependent activities
      - Re-calculate schedule
    - If there are multiple weather conditions (precipitation and humidity) create multiple calendars
    - Minimize use of calendars, use only necessary

Weather Planning Methods

- Weather Calendar Best Practices
  - Risk management using calendars
    - For assessing risk due to uncertain adverse weather prediction, Monte Carlo assessment is the best option
      - Monte Carlo runs iterations based on individual estimates
    - If Monte Carlo not available, can use three point estimates in schedule
      - Create three weather calendars; Most likely, Optimistic, Pessimistic
      - Replace each calendar & re-calculate, check the spread
      - This is a rough approach, assumes all activities will suffer one of the three scenarios, so Monte Carlo is much better

Weather Planning Methods

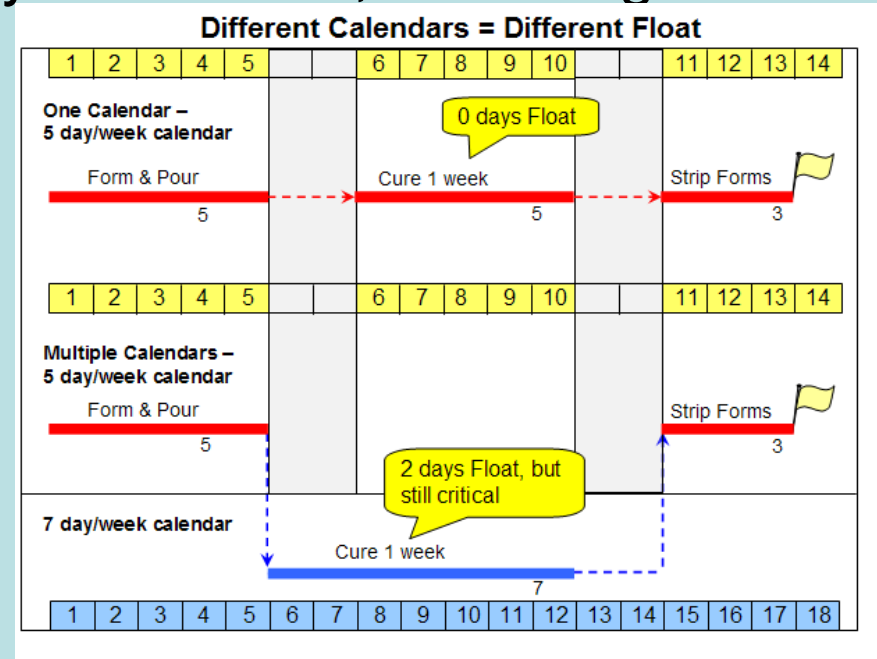
- Weather Calendar Best Practices
  - Maintenance of system
    - Predictions are self-adjusting
      - As activities move from impacted times on weather calendar to un-impacted, the dates will adjust and remain “accurate”
    - Historical data will be inaccurate unless actual non-work dates are tracked
      - Actualizing weather calendar is simple enough
      - With each update, change weather calendar to reflect actual non-work weather days
      - Actual Durations and comparisons with Original Durations will be accurate if calendar is actualized
      - Activity progress bars will neck to indicate actual non-work days
    - If updates show delays, analysis will identify if the delays are due to weather predictions, and form basis for time extension requests

Weather Planning Methods

- Weather Calendar Best Practices
  - Claims & analysis
    - With reasonable planning for weather, delays from excessive adverse weather can be analyzed and submitted – time lost was in excess of historical data to be expected
    - Excessive severe weather claims require:
      - Documentation of non-work (field report support)
      - Activities delayed due to weather must be on Critical Path
      - Analyses are done retrospectively
    - Weather delay is usually excusable, non-compensable

Weather Planning Methods

- Weather Calendar Best Practices
  - Admonitions & advisories
    - Calendar changes affect float paths, if report is organized by Total Float, there might be a hole in the report



Weather Planning Methods

- Discussion about use of methods
  - Dennis Read Hanks, P.E. CCE
    - Weather allowance activity used before substantial completion
    - Use of activity days limited to planned weather days only, so excessive adverse weather would require discussion and time extension negotiated

Weather Planning Methods

- Schedule Risk Assessment - weather
  - Dennis Read Hanks, P.E. CCE

    - Weather calendar - risk ranges
    - Weather Allowance Activity - non-specific
    - Weather module (PRA) – no direct activity impact
    - What is the goal? What are the tools?

Weather Planning Methods

- Discussion about use of methods
  - Fouad Elfaour, PSP, PMI-SP
    - Weather Calendar used for weather-dependent activities
    - Switched to use Weather Contingency activity prior to Milestones
    - Switched back to Weather Calendar with actualizing the weather days

Planning for Adverse Weather in Construction Projects

- Questions?

- Contact:
  - Chris Carson, 757-342-5524
    - Chris.carson@alphacorporation.com