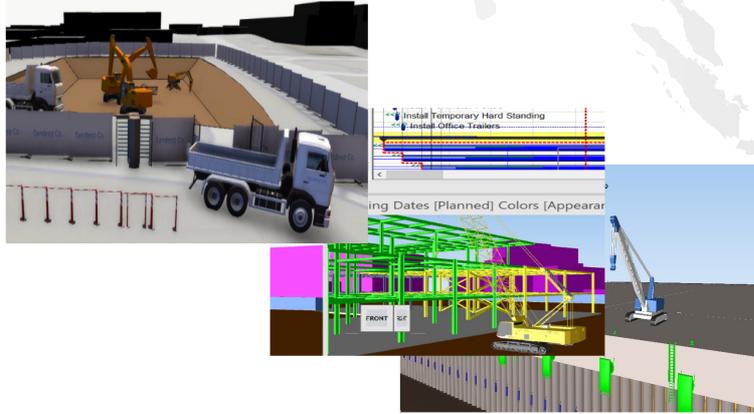


4D PROGRAM – FUTURE OF PROJECT CONTROLS



Welcome to **PGCS Project and Program Management Symposium 2023**

BY
SANDEEP CHINNOBAIAH

Prime Project Control

CONTENT

Prime Project Control

Introduction

- Intro to 4D Planning
- Traditional Planning vs Visual Planning
- Why Future is 4D Project Controls

Sneak Preview

- Site Constraints Using 4D
- Site Utilization Planning
- Comparison Windows
- Visualize Delay Analysis
- Advantages for Tendering
- Model Based Quantity Take off
- Machinery Resource Usage in 4D
- Earned Value Analysis in 4D
- Get it Right Approach

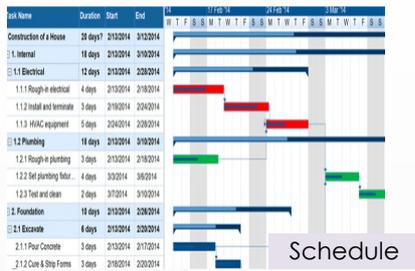
Net Zero Goals

- How 4D will help your Decarbonization Goals

Conclusion & Take Away

INTRO TO 4D PROGRAM

Prime Project Control



The advancement and availability of 3D BIM Models and Scheduling data.

When integrated together and simulated with a schedule timeline, a 4D Schedule sequence is generated.

- 4D Program combines value proposition of both BIM and Schedule Advantages such as -
 - Clash Detection;
 - Simulated Sequence aids in decision making on untested sequence;
 - Similar functions of Critical Path; Custom Filters and additionally has 3D Filters.
 - Simplified Quantity Estimation
 - The cost loaded Schedule, will be used for 5D functions
 - Earned Value Analysis
 - Procurement Planning & Forecasting



Visual Planning brings lot more to the table for stake holders.

TRADITIONAL PLANNING VS VISUAL PLANNING

Prime Project Control

2D Program	4D Program
<ul style="list-style-type: none"> • Gantt Chart Schedule & resource tables. 	<ul style="list-style-type: none"> • Contains both Gantt Chart and activity elements in 3D Model.
<ul style="list-style-type: none"> • Does not allow Visualization <ul style="list-style-type: none"> • Difficult to judge clashes as no visual representation • Resources loaded but doesn't allow the visual representation of the Equipment movement • Construction sequence considered on assumption basis may go wrong 	<ul style="list-style-type: none"> • Allows of Visualization due to integration of 3D Models <ul style="list-style-type: none"> • Better Sequence Simulation • Visualize the Clash • Coordinated Construction Sequence representation. • Timely corrective measures
<ul style="list-style-type: none"> • Difficult for Non- Planners to Understand the program 	<ul style="list-style-type: none"> • Makes it easy to all stake holders to understand the construction methodologies, program and ideas.
<ul style="list-style-type: none"> • Cannot Determine Quantity, as no 3D Model integration. 	<ul style="list-style-type: none"> • Can determine & estimate the quantities with the help of 4D, which aids decision making in various ways
<p>Doesn't have capability to do any Equipment / Machinery Simulation of construction sequence.</p>	<ul style="list-style-type: none"> • Allows Equipment Movement Simulation, Sequence Optimization & Risk Identification.

Visual Planning brings lot more to the table for stake holders.

TYPICAL LAYOUT OF 4D PROGRAM Prime Project Control

ID	Name	Duration	BL Late Finish	BL Early Finish	Start	Finish
ST0... Pre Construction 30d						
ST0...	Notice to Proceed	0d			4/6/2015 (*)	5/15/2015
ST0...	Building Permit	30d	3/27/2015	3/27/2015	4/6/2015 (A)	5/15/2015 (A)
ST0...	Award Subcontractors	5d	3/6/2015	3/6/2015	4/6/2015 (A)	4/10/2015 (A)
ST0...	Install Perimeter Fence	3d	3/11/2015	3/11/2015	4/20/2015 (A)	4/22/2015 (A)
ST0...	Install Temporary Hard Standing	1d	3/12/2015	3/12/2015	4/23/2015 (A)	4/23/2015 (A)
ST0...	Install Office Trailers	2d	3/16/2015	3/16/2015	4/27/2015 (A)	4/28/2015 (A)
ST0... Material Procurement 2235d						
ST0...	Structural Steel	2225d	6/19/2015	6/19/2015	4/13/2015 (A)	10/20/2023
ST0...	Curtain Wall	2220d	6/12/2015	6/12/2015	4/27/2015 (A)	10/27/2023
ST0...	Elevator	2215d	6/5/2015	6/5/2015	5/11/2015 (A)	11/3/2023

WHY FUTURE IS 4D PLANNING Prime Project Control

```

    graph LR
      A[Gantt Chart in 1890s, 1910-1920's] --> B[CPM in 1950's-1960's]
      B --> C[MSP & Primavera In 1983-1984]
      C --> D[4D Planning in Early 2000 - 2020's]
      subgraph Present
      D
      end
      D --> E[4D Planning + AI Guidance Bot]
      subgraph Future
      E
      end
    
```

Transitions / shift in the way we are working is constantly changing

How 4D Planning will embrace AI ??

With the help of Generative AI

- Command / Prompt will Do linking of Schedule ↔ Model
- Command / Prompt will generate Quantities, Predictive Productivity Rates
- **For Example, Link ground floor beam activity to its model elements**
 - Generates Queries and Shows Linkage Log Data

IDENTIFY SITE CONSTRAINTS USING 4D Prime Project Control

Constraints can be in Design Feasibility, Space/ Access Constraint, Procurement challenges, Risk, Safety Constraints and etc.

CONSTRAINTS AT –

CONCEPTION / DESIGN STAGE

- A Digital Twin,
- Simulate Concept / Design in Virtual Environment
- Engage and Coordinate with all Stakeholders
- Aid in Finalizing Design / Concept before hand
- Preview the real site challenges

PRE-CONSTRUCTION STAGE

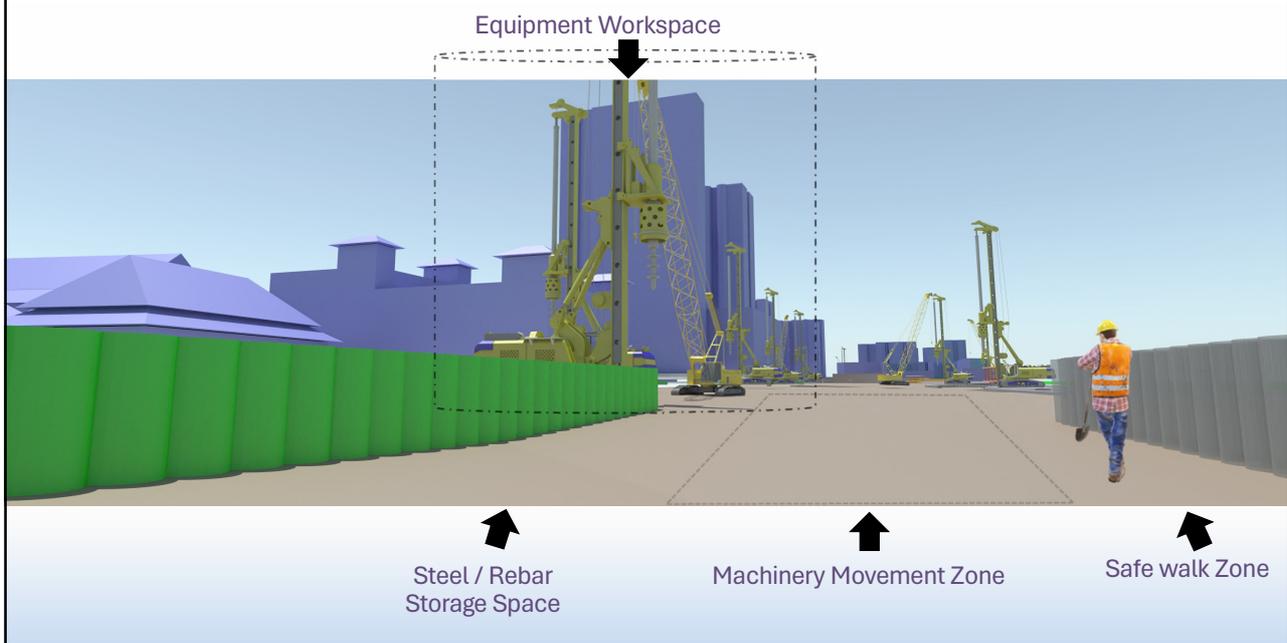
- Procurement monitoring
- Site utilization planning
- Site Risk Identification and Mitigation Planning

CONSTRUCTION STAGE

- Monitor Progress against Plan or Baseline
- Delay Causes / Visual Representation of Area under delay

SITE UTILISATION PLANNING

Prime Project Control



SITE UTILISATION PLANNING

Prime Project Control



COMPARISON WINDOWS

Prime Project Control

Comparison Windows,

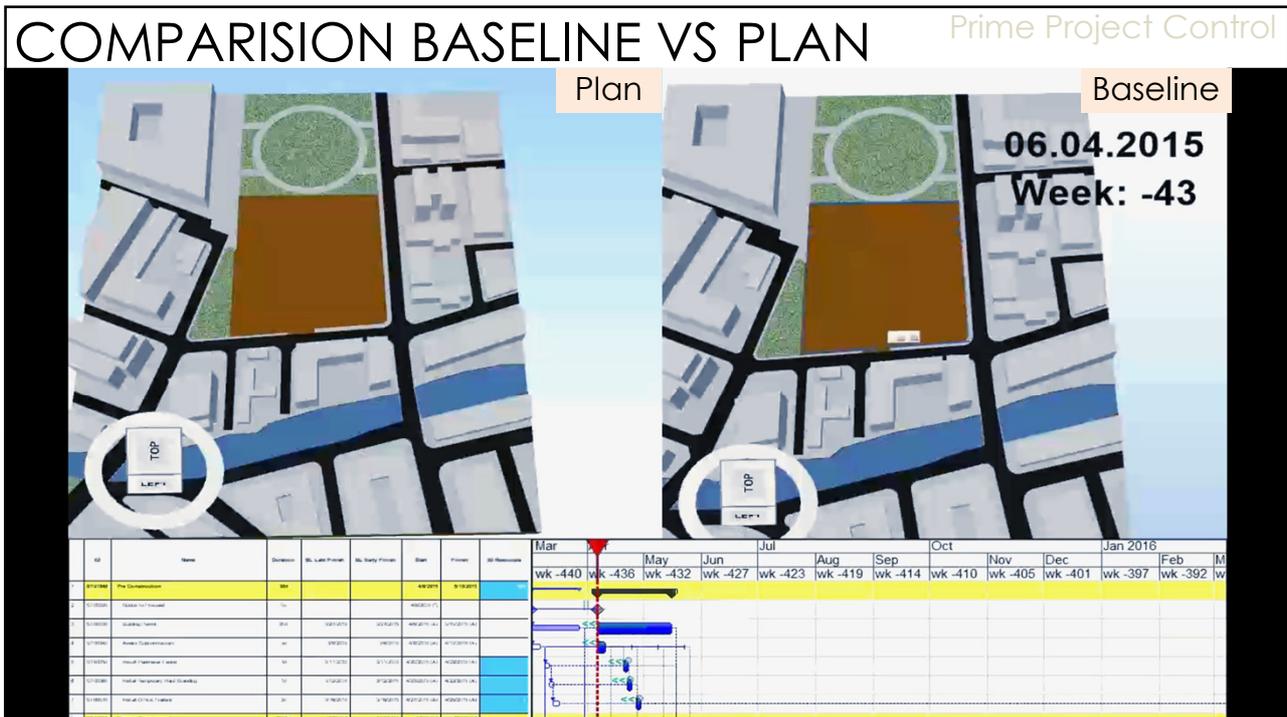
- Comparing Baseline vs Revision Programme / Plan
- Comparing Baseline vs Actual Progress
- Comparing Progress Updated Program vs Delay Analysis Programme

These Comparison windows will provide clear insights & comparison data will enable productive decisions

If the site to be presented is large and it does not fit into single window viewing it can be presented as per Zone Wise views. (For Example, East area, West Area, etc.)

The Visual Presentation of Comparison will aid in Construction Claims arising from delayed Site Progress, Procurement, Unforeseen Site Conditions etc.

It saves your time and effort in convincing the delay analysis



VISUALISE DELAY ANALYSIS

Prime Project Control

Present your Prospective and Retrospective Analysis in 4D Simulation
Cases where it is very effective –

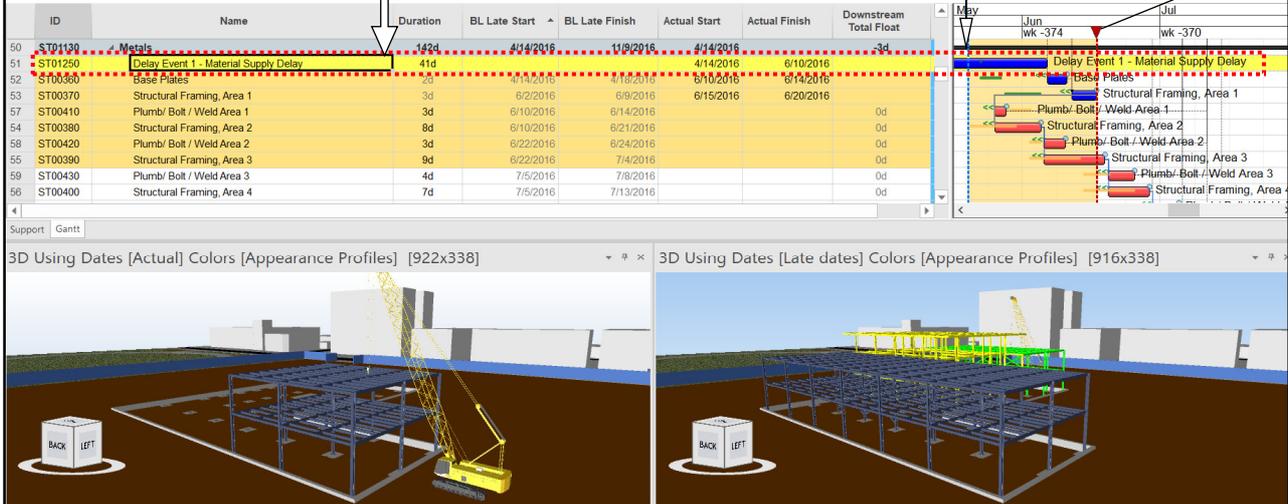
- **Site Access** - Where site access is not granted, visually can represent no activity undertaken at that area.
- **Site Obstructions** - where site is obstructed by an ongoing activity of the Contesting / Interfacing Party
- **Additional Works** - To demonstrate additional works undertaken which are not under the original scope of works.
- **Unforeseen Site / Ground Condition** – Visually demonstrate the unforeseen site conditions by modeling additional elements and comparing against Tender or Original Plan Conditions.

4D – DELAY ANALYSIS VISUAL DEMONSTRATION

Insert Delay Event Details (Duration & Dates)

Schedule on Assessment Date

Move The Focus Time



Notice Delayed Area's on Actual Window by Comparing with Baseline Late dates. Use this as Substantiation Along with Regular Delay Claims to Strengthen your claims

TENDERING ADVANTAGES

Prime Project Control

- *Demonstrate construction sequences effectively with visual representation of works.*
- *Visualize Resource Deployment such as Machinery Placements, Storage Zones, Safe Access Zones and Critical Areas Management can be simulated and presented very logically, which enhances confidence in the ability of the firm and increases winning chances.*
- *Demonstrating about clear construction strategies / sequences :*
 - *Avoid Wrong / Incorrect Assumptions, as visual data gives more clarity.*
 - *Avoid Under / Over planning of resources, with the help of Optimization using Visual Data*
 - *Avoid erroneous technical considerations, review any hidden or unforeseen risks.*
 - *Present Confidently in achieving Project Goals both Financially and Timewise.*
 - *Demonstrate Site Safety Aspects & Measures*

MODEL BASED QUANTITY TAKE-OFF IN 4D

Single Item Qty – 32.4m³ (Take Off Instantly)

Multiple Qty – 414.3 m³ (Take Off Instantly)

Example – If Next Week Activity is to cast 10 Piles as Above Selected,

- Able to check upcoming Qty.
- Cross Verify whether site team has placed order for concrete.
- Post Casting Checks – Wastage against plan volume.

Readily Available Qty, Duration & Resources will be useful in Assessing Productivity Data

MODEL BASED QUANTITY TAKE-OFF IN 4D

Advantages of 4D Based Quantity Take Off

- Helps in Forecasting upcoming Quantities on Daily / Weekly / Monthly
- Streamline Procurements and Supply Chain
- Compare Plan vs Actual Quantity's (easily determine wastage / losses & extra volume)
- Predicting Productivity Rates
- Plan & Arrange required Resources (Manpower requirements)

MACHINERY RESOURCE USAGE MONITORING

Visualize in 4D + Resource Histogram + Resource Utilization Table

ID	Name	Duration	BL Late Finish	BL Early Finish	Start	Finish
1	ST0... Pre Construction	30d			4/6/2015	5/15/2015
2	ST0... Notice to Proceed	0d			4/6/2015 (*)	
3	ST0... Building Permit	30d	3/27/2015	3/27/2015	4/6/2015 (A)	5/15/2015 (A)
4	ST0... Award Subcontractors	5d	3/6/2015	3/6/2015	4/6/2015 (A)	4/10/2015 (A)
5	ST0... Install Perimeter Fence	3d	3/11/2015	3/11/2015	4/20/2015 (A)	4/22/2015 (A)
6	ST0... Install Temporary Hard Standing	1d	3/12/2015	3/12/2015	4/23/2015 (A)	4/23/2015 (A)
7	ST0... Install Office Trailers	2d	3/16/2015	3/16/2015	4/27/2015 (A)	4/28/2015 (A)
8	ST0... Material Procurement	2235d	6/19/2015	6/19/2015	4/13/2015	11/3/2023
9	ST0... Structural Steel	2225d	6/19/2015	6/19/2015	4/13/2015 (A)	10/20/2023
10	ST0... Curtain Wall	2220d	6/12/2015	6/12/2015	4/27/2015 (A)	10/27/2023
11	ST0... Elevator	2215d	6/5/2015	6/5/2015	5/11/2015 (A)	11/3/2023
12	ST0... MEP Equipment	60d	5/29/2015	5/29/2015	5/25/2015	8/14/2015
13	ST0... Construction	238d	12/23/2016	2/2/2016	4/6/2015	3/2/2016
14	ST0... Site Construction	228d	12/9/2016	1/19/2016	4/6/2015	2/17/2016
15	ST0... Foundation Excavation	5d	4/3/2015	4/3/2015	5/18/2015	5/22/2015
16	ST0... Structural Piles	20d	3/23/2016	5/1/2015	4/6/2015	5/1/2015

Planned utilization for all equipment resources

Resource	5/7/2015	5/7/2015
Detailed Crawler Crane.dwf	0.00%	0.00%
Excavator.dwf	0.00%	0.00%
Total:	0.00%	0.00%

3D Using Dates [Planned] Colors [Appearance Profiles] [1846x206]

MACHINERY RESOURCE USAGE MONITORING

- Plan Machinery resource requirement during the project timeline
- Predict & forecast realistic requirement resources at various stages of works
- Planned Utilization and Available Units of resources

ID	Name	Duration	Start	Finish
1	ST0... Pre Construction	30d	4/6/2015	5/15/2015
2	ST0... Notice to Proceed	0d	4/6/2015 (*)	
3	ST0... Building Permit	30d	4/6/2015 (A)	5/15/2015
4	ST0... Award Subcontractors	5d	4/6/2015 (A)	4/10/2015
5	ST0... Install Perimeter Fence	3d	4/20/2015 (A)	4/22/2015
6	ST0... Install Temporary Hard Standing	1d	4/23/2015 (A)	4/23/2015
7	ST0... Install Office Trailers	2d	4/27/2015 (A)	4/28/2015
8	ST0... Material Procurement	2235d	4/13/2015	11/3/2023
9	ST0... Structural Steel	2182d, 4h	4/13/2015 (A)	8/23/2023
10	ST0... Curtain Wall	2220d	4/27/2015 (A)	10/27/2023
11	ST0... Elevator	2215d	5/11/2015 (A)	11/3/2023
12	ST0... MEP Equipment	60d	5/25/2015	8/14/2015
13	ST0... Construction	238d	4/6/2015	3/2/2016
14	ST0... Site Construction	228d	4/6/2015	2/17/2016
15	ST0... Foundation Excavation	5d	5/18/2015	5/22/2015
16	ST0... Structural Piles	20d	4/6/2015	5/1/2015

Planned utilization for all equipment resources

Resource	Units / Time	Resource Count
Detailed Crawler Crane.dwf	5/21/2015	5/21/2015
Excavator.dwf	100.00%	100.00%
Total:	100.00%	100.00%

3D Using Dates [Planned] Colors [Appearance Profiles] [1846x204]

EARNED VALUE ANALYSIS IN 4D

Visualize in 4D + EV Graph + Cost Details

Prime Project Control

ID	Name	Duration	Start	Finish	Planned Value	BL Budget	Earned Value	Actual Cost [ACWP]
3	STO... Building Permit	30d	4/6/2015 (A)	5/15/2015 (A)	\$0.00	\$0.00	\$0.00	\$0.00
4	STO... Award Subcontractors	5d	4/6/2015 (A)	4/10/2015 (A)	\$0.00	\$0.00	\$0.00	\$0.00
5	STO... Install Perimeter Fence	3d	4/20/2015 (A)	4/22/2015 (A)	\$200,000.00	\$0.00	\$200,000.00	\$100,000.00
6	STO... Install Temporary Hard Standing	1d	4/23/2015 (A)	4/23/2015 (A)	\$300,000.00	\$0.00	\$300,000.00	\$260,000.00
7	STO... Install Office Trailers	2d	4/27/2015 (A)	4/28/2015 (A)	\$40,000.00	\$0.00	\$40,000.00	\$37,000.00
8	STO... Material Procurement	2235d	4/13/2015	11/3/2023	\$485,000.00	\$0.00	\$378,214.29	\$247,000.00
9	STO... Structural Steel	2182d, 4h	4/13/2015 (A)	8/23/2023	\$400,000.00	\$0.00	\$360,000.00	\$230,000.00
10	STO... Curtain Wall	2220d	4/27/2015 (A)	10/27/2023	\$85,000.00	\$0.00	\$18,214.29	\$17,000.00
11	STO... Elevator	2215d	5/11/2015 (A)	11/3/2023	\$0.00	\$0.00	\$0.00	\$0.00
12	STO... MEP Equipment	60d	5/25/2015	8/14/2015	\$0.00	\$0.00	\$0.00	\$0.00
13	STO... Construction	238d	4/6/2015	3/2/2016	\$0.00	\$0.00	\$0.00	\$0.00
14	STO... Site Construction	228d	4/6/2015	2/17/2016	\$0.00	\$0.00	\$0.00	\$0.00
15	STO... Foundation Excavation	5d	5/18/2015	5/22/2015	\$0.00	\$0.00	\$0.00	\$0.00
16	STO... Structural Piles	20d	4/6/2015	5/1/2015	\$0.00	\$0.00	\$0.00	\$0.00
17	STO... Piles 1	8d	4/6/2015	4/15/2015	\$0.00	\$0.00	\$0.00	\$0.00
18	STO... Piles 2	8d	4/16/2015	4/27/2015	\$0.00	\$0.00	\$0.00	\$0.00
19	STO... Piles 3	4d	4/28/2015	5/1/2015	\$0.00	\$0.00	\$0.00	\$0.00
20	STO... Site Utilities	30d	5/18/2015	6/26/2015	\$0.00	\$0.00	\$0.00	\$0.00

3D Using Dates [Planned] Colors [Appearance Profiles] [1846x185]

EARNED VALUE ANALYSIS IN 4D

Visualize in 4D + EV Graph + Cost Details

Prime Project Control

EV Graph Legend:

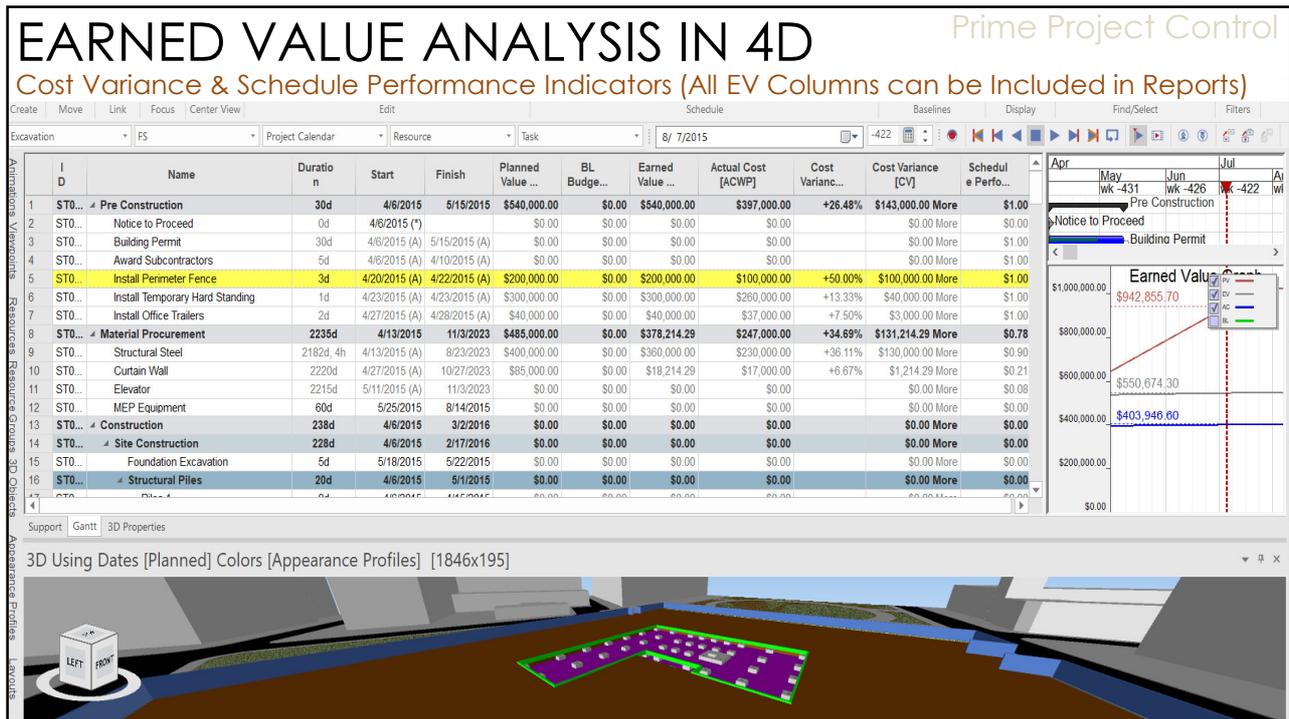
- PV - planned work** (Solid black line)
- AC - what the work actually cost** (Dashed red line)
- EV = actual work accomplished** (Dashed blue line)

Status Date: Indicated by a green arrow pointing to the vertical dashed line at Time 12.

Cost Data:

- Planned Value (PV): \$550,674.30
- Actual Cost (AC): \$942,855.70
- Earned Value (EV): \$403,946.60

3D Using Dates [Planned] Colors [Appearance Profiles] [1846x195]



GET IT RIGHT APPROACH

Prime Project Control

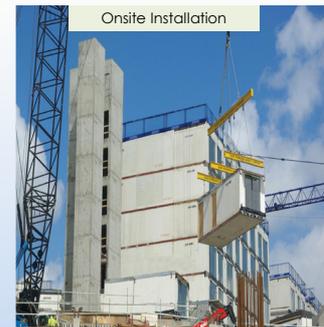
- Don't try to dwell into too much of details
- Avoid Non-Productive Approaches – Like Modelling unnecessary elements, abortive works, frequent change in models.
- Do Feasibility Study for using 4D, not all project's problem are solved using 4D
 - Small, Simple & Straight forward projects may not require extensive resource team of 4D. Remember the cost to benefit is low or negative.
- Use 4D & 5D for not just Visualization or Clash Detection – get to its real strength in functions such as Site Safety Assessment, Spatial Planning, Improve Constructability & Cost Control.
- Establish a Simple Workflow Process
- Set Targeted Benefits and Outcomes
- Use for Supply Chain and Subcontract Monitoring
- Improves Transparency Project Tracking
- Use for Collaborative Working Flow

MEETING NET ZERO GOALS USING 4D Prime Project Control

- 4D will bring Clarity in your Machinery Resource Planning & Space Utilization Planning
 - Avoid multiple Mob / Demob of machinery, longer idling time & unplanned deployments
 - Reduce Construction Losses, due to clarity in resources and constructability
- 4D – 5D; usage will reduce higher dependence Procurement and Quantity Surveyor manpower and their turnaround time;
 - Example – To take-off Quantities & To Plan Procurements – The team could take few days to workout, which can be instantly generated in a better functioning 4D Tool.
- Meet your ESG – Environment Sustainability Goals, by using Digital 4D Program for coordination with all stakeholders. (less printing, less program/ progress update sessions & faster meetings)

4D AND DfMA

- **Cost** – Save Cost due to less onsite manpower
- **Time** – Faster construction cycle
- **Carbon Emission** – Reduced due to less time on Site activity, faster turnaround of works
- **Net Zero Factories** – Sourcing materials From Renewable Energized factories and using 4D tool coordinated on site installation.



CONCLUSION Prime Project Control

- 4D Program has more capability compared to Traditional Program
- 4D/5D Project Controls – Cost, Quantity Take off, EV Analysis will help improve and make it better, faster, efficient approach in Project Controls
- Resources in 4D – Machinery Resources can be planned & monitored more effectively
- Better Coordination among Stake Holders
- Reduction in abortive, non-feasible methodologies in construction
- Improves Site Safety & Risk Control Measures
- Identify constraints and risk at Early Stages
- Yes, Future of Project Controls will be with 4D !!

TAKE AWAY

Prime Project Control

- A Free Udemy Course link of 4D Program is given below (limited to 100 Redemption)



THANK YOU !!

Let's

LinkedIn



Appreciate your valuable feedback

<https://www.youtube.com/c/PrimeProjectControl/>

Prime Project Control