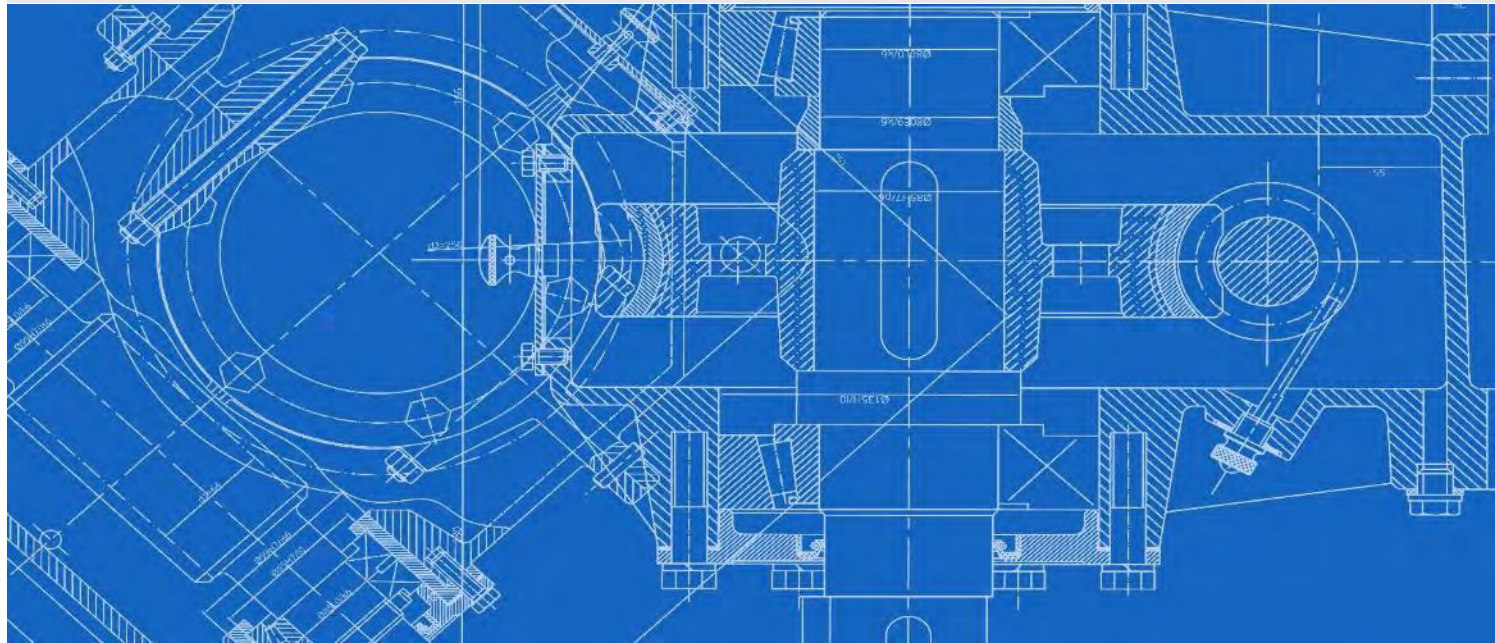


time for complex  
project success

# 4D Planning



**Contemporary Schedule Change Impact  
Visualisation**

# Introducing ourselves

---

- ➔ Celestino Moreno Fernández
- ➔ Ingeniero de Caminos, Canales y Puertos (Civil Engineer)
- ➔ Masters Degree in Management, Purification and treatment of water
- ➔ Consultant Kingsfield Consulting
- ➔ Experience in international engineering and construction projects
- ➔ Areas of particular interest –new technologies applied to project management

# Our aims for this presentation

---

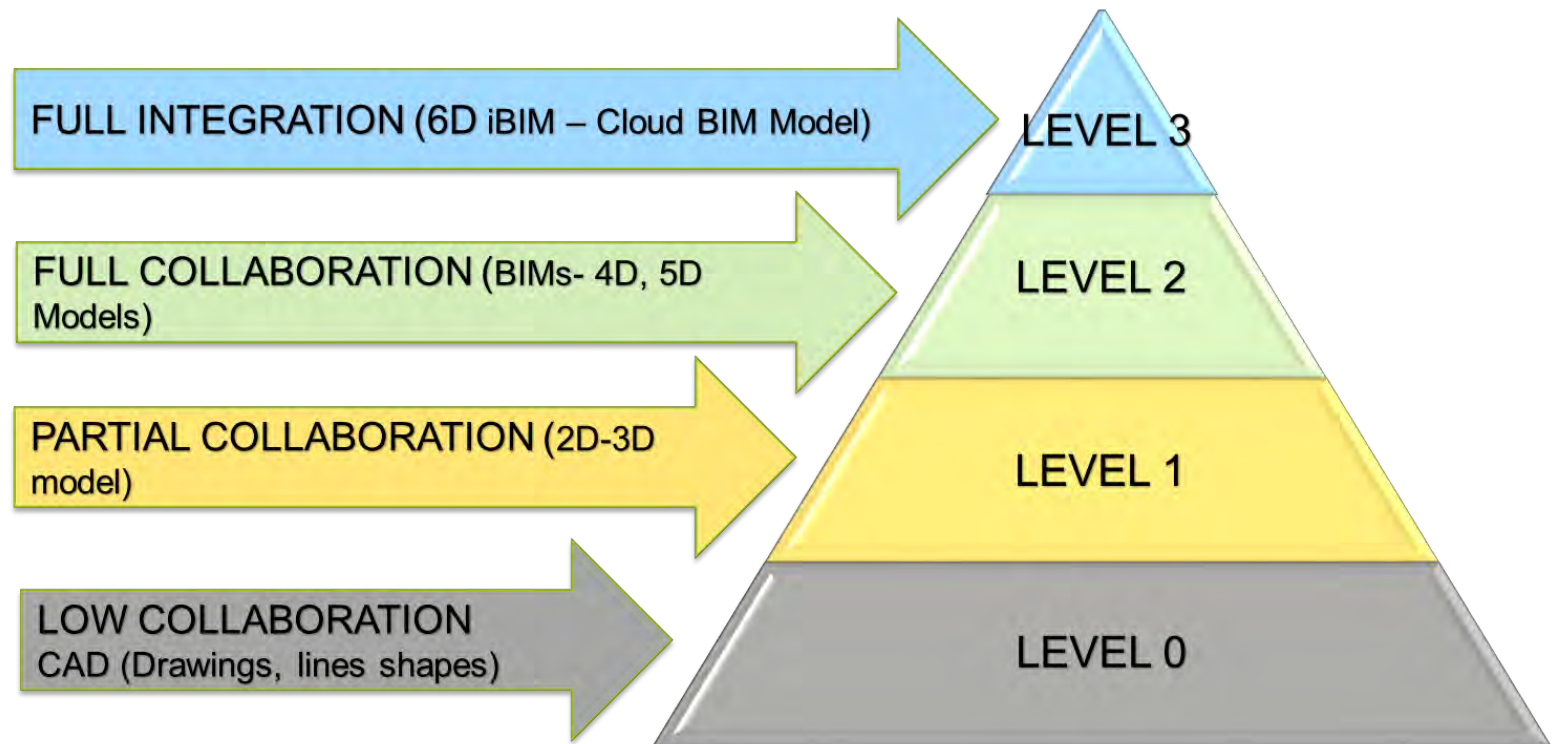
- ➔ How can we visualize our project status? (4D planning)
- ➔ What can 4D do for you?
- ➔ 4D Planning functions
- ➔ 4D Contemporary Change Visualisation
- ➔ 4D Project Controls & Risk Visualisation Reports

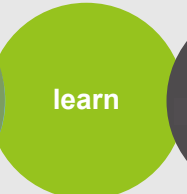




# BIM and its tool to visualise our Project Status

- ➔ BIM is a working Process, a methodology with different levels of collaboration
- ➔ 4D Planning is a software used to implement BIM with a Level 2 collaboration level

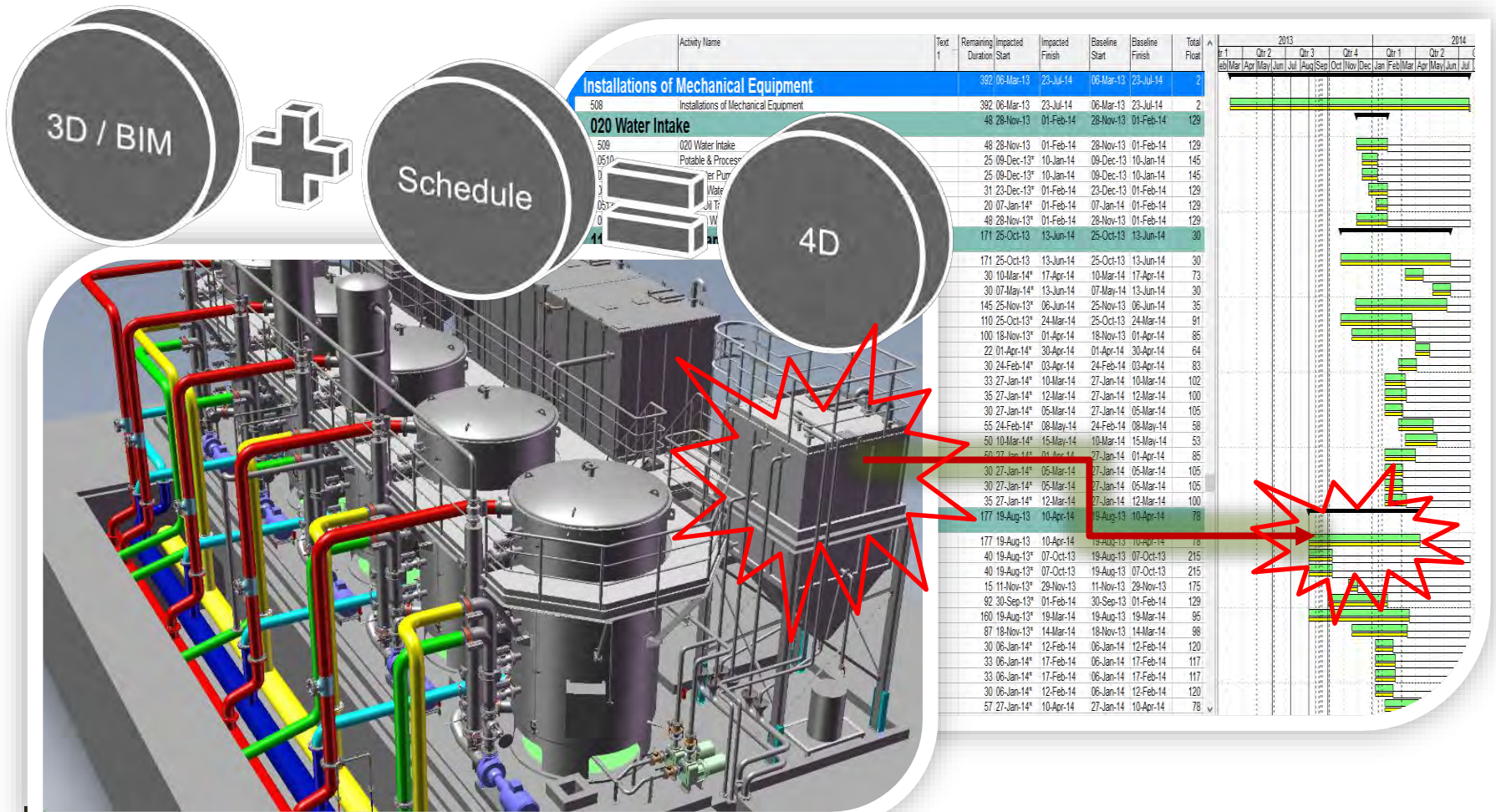




# What is 4D Planning?



# Integration of Schedule with 3D CAD Model



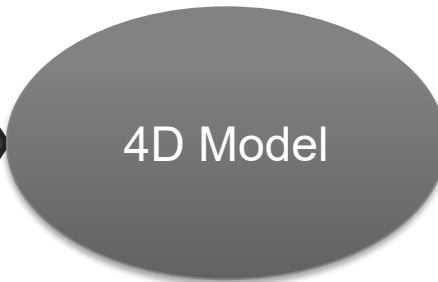
# Integration of Schedule with 3D CAD Model



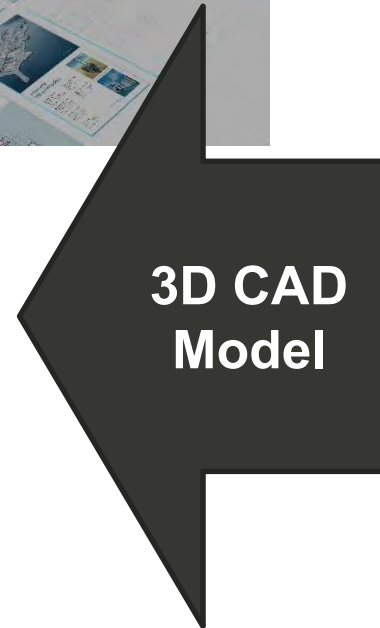
→ Versions  
→ Updates  
→ Progress



**Primavera  
Schedule**



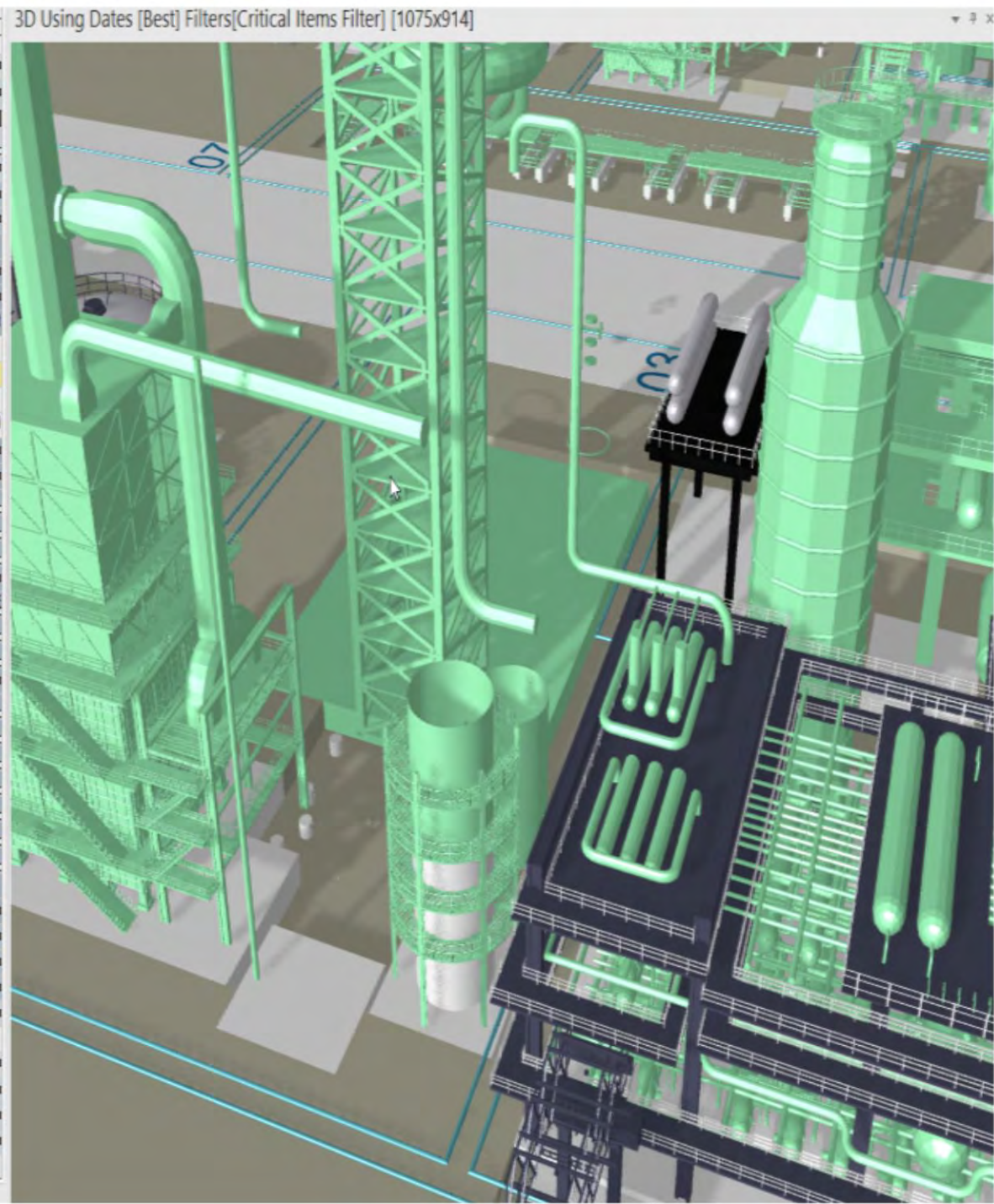
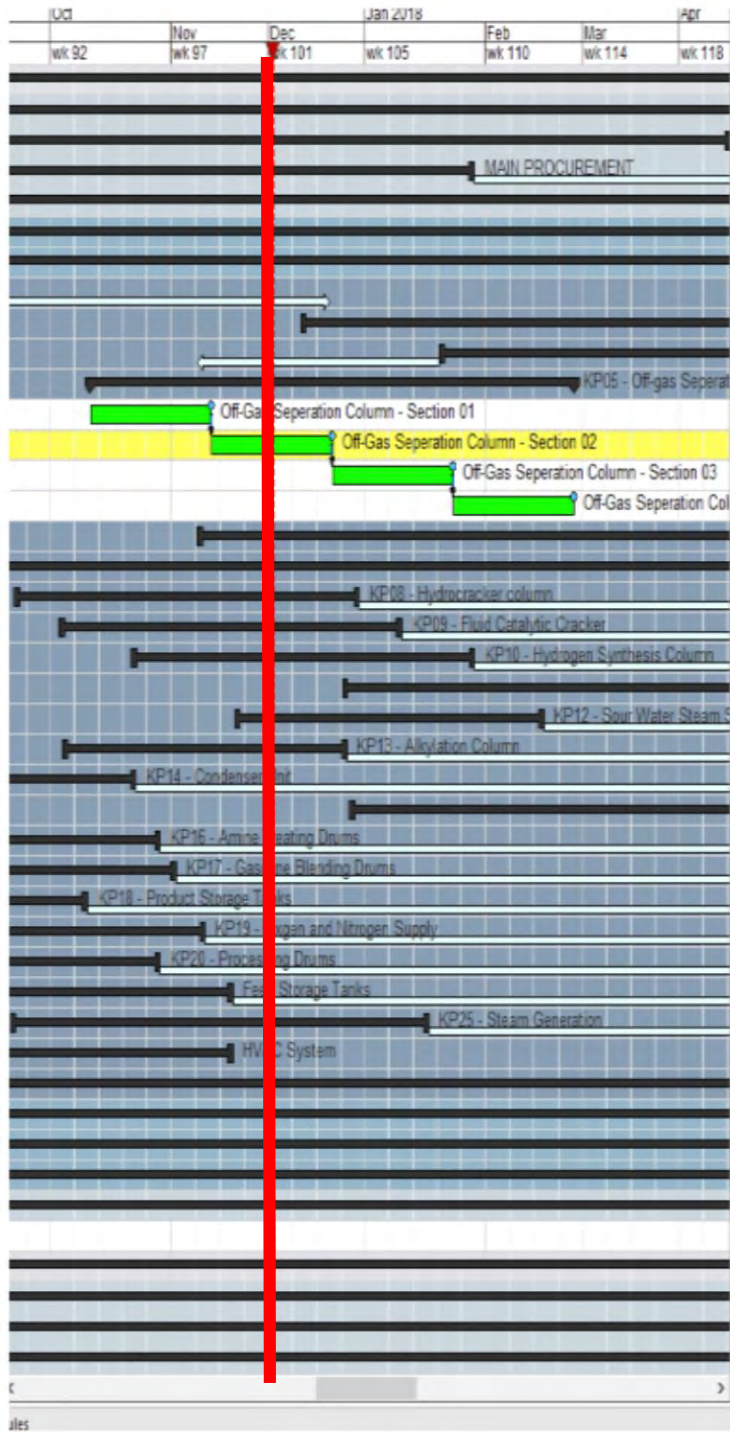
4D Model

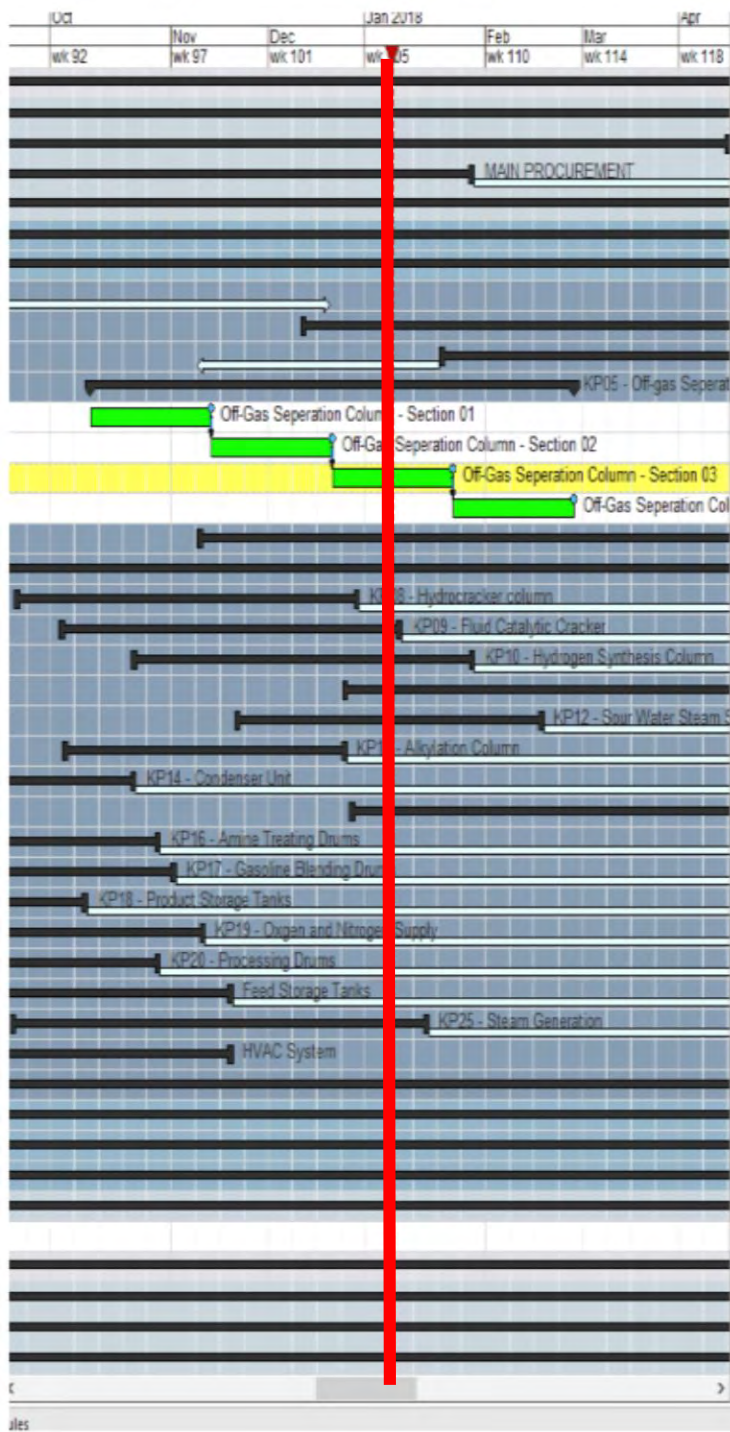


**3D CAD  
Model**

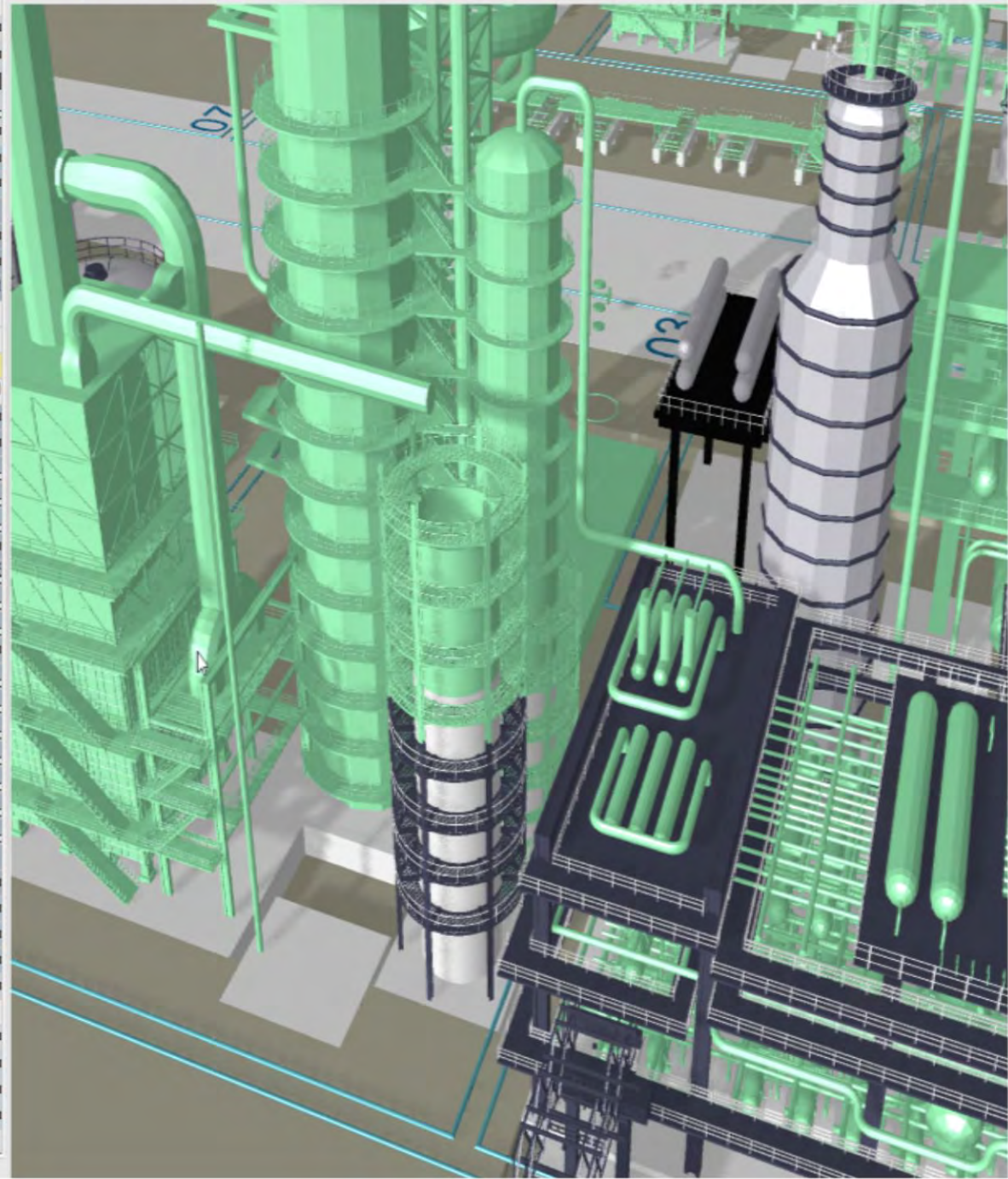
← Versions  
← Updates  
← Additions /  
Deletions

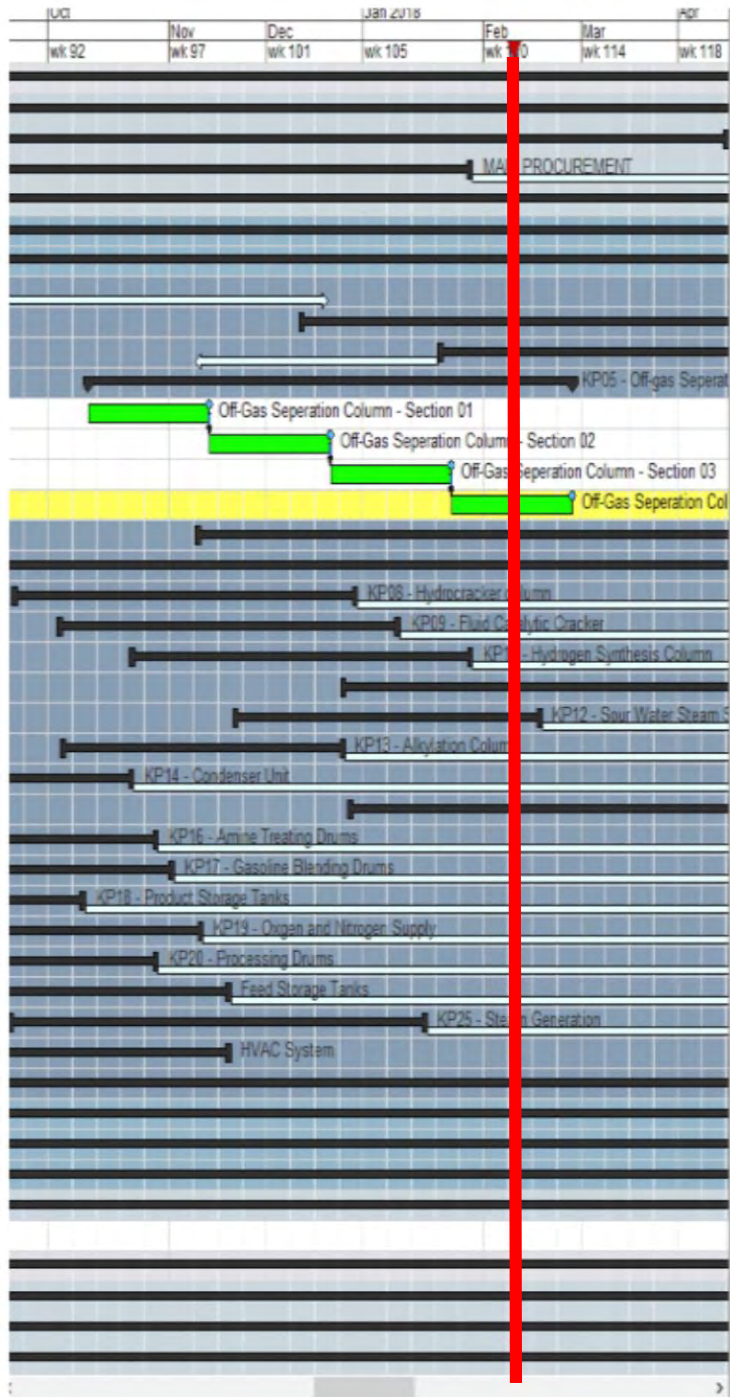




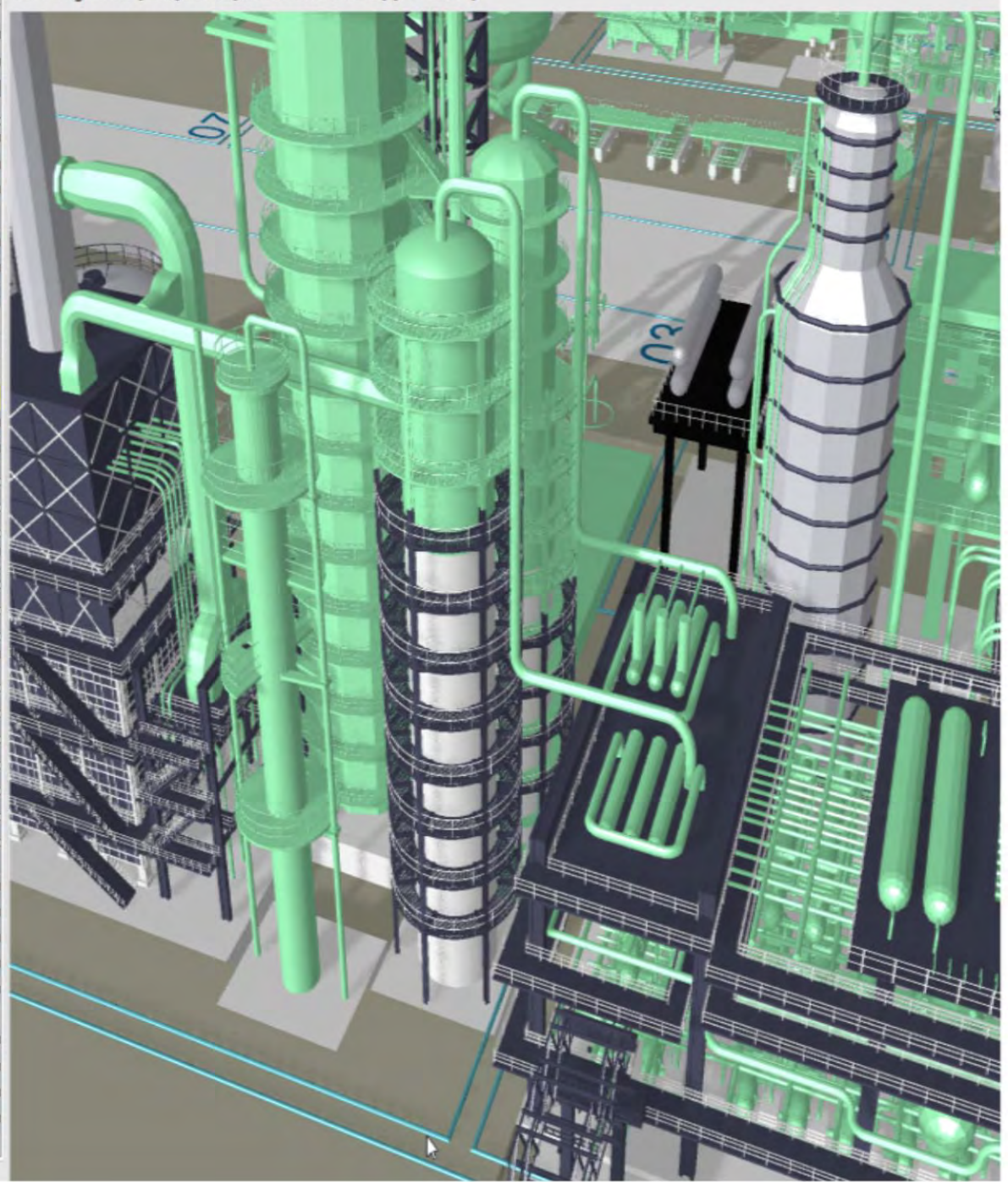


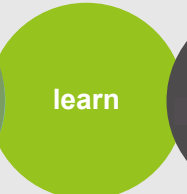
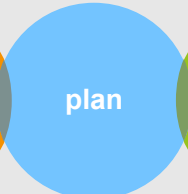
3D Using Dates [Best] Filters[Critical Items Filter] [1075x914]





3D Using Dates [Best] Filters[Critical Items Filter] [1075x914]





# What can 4D do for you?



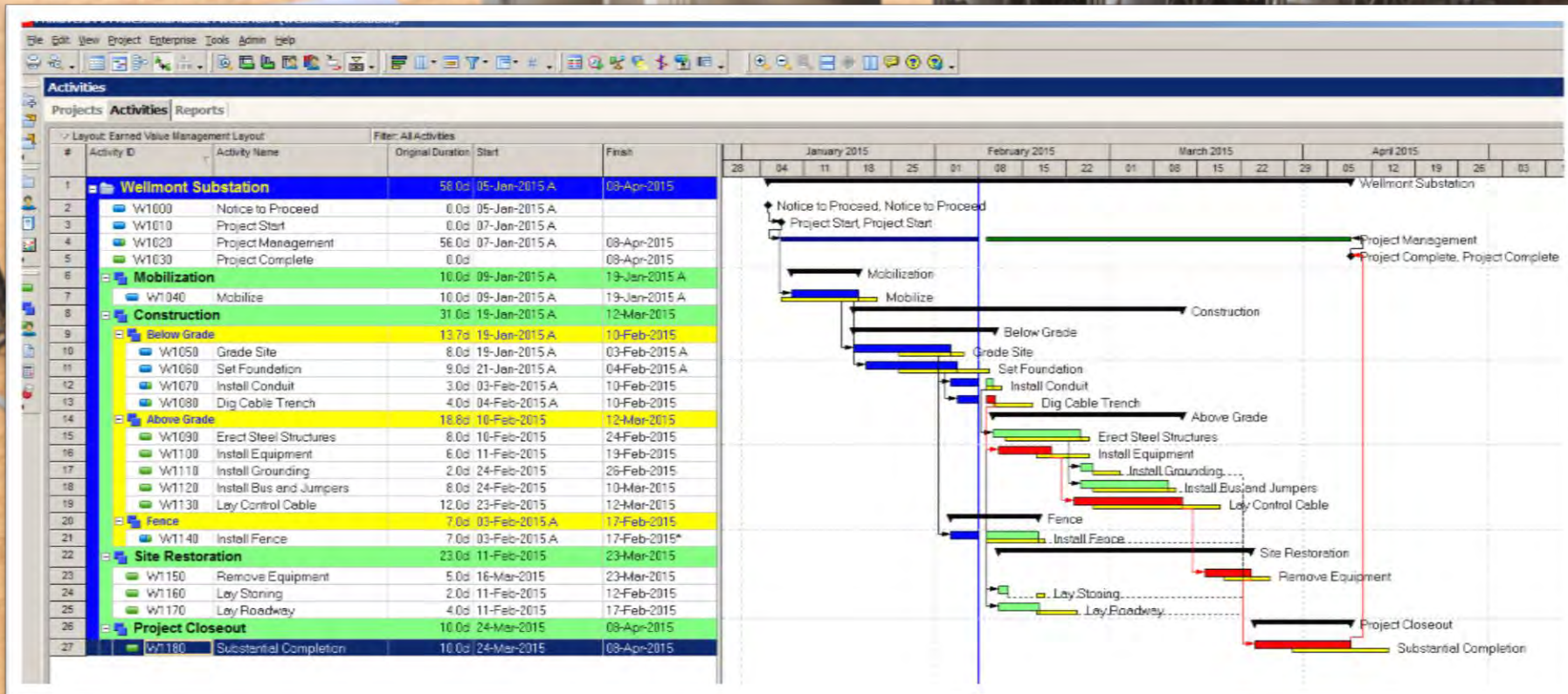
# What can 4D do for you?

---

- Visualise build sequences
- Anticipate interfaces and conflicts of resources and equipment
- Rehearse optimal installation sequences
- Integrated 4D Project Controls
- Visualise the impact of change
- Management of Project Risk and Change Through Advanced Forensic Animation
- Illustrate your claims, reports...

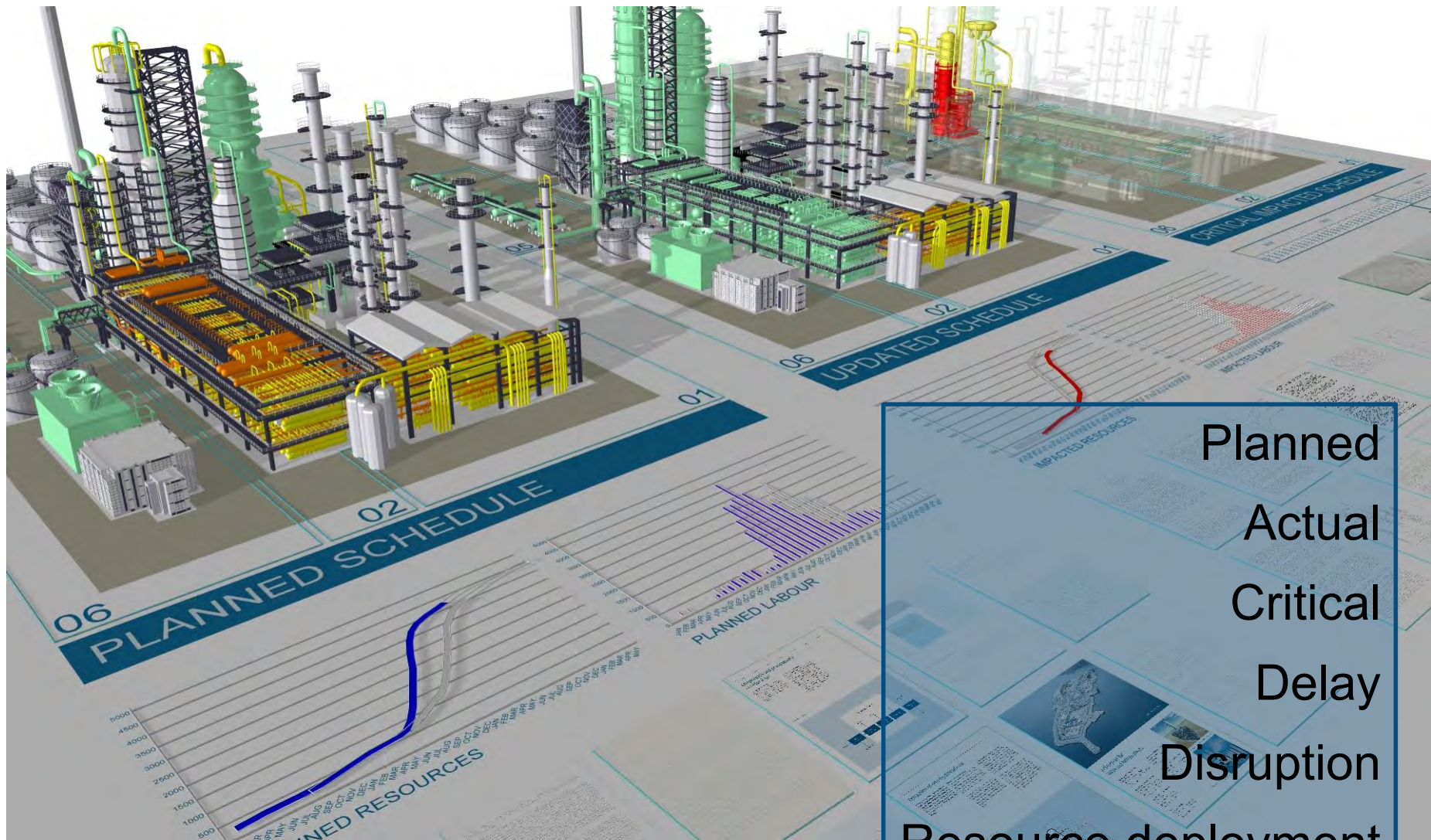
**HOW CAN 4D DO THIS FOR YOU?**

**Bring Your Schedule  
to LIFE...**



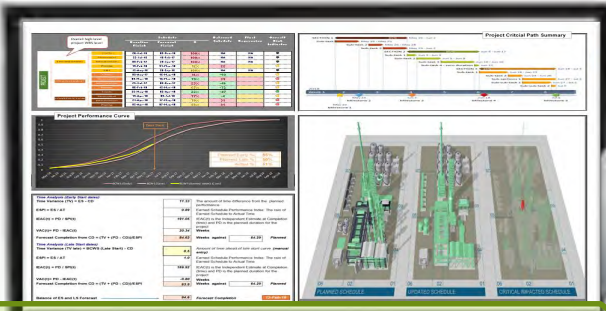
# **Visualise Your Project Schedule Performance**





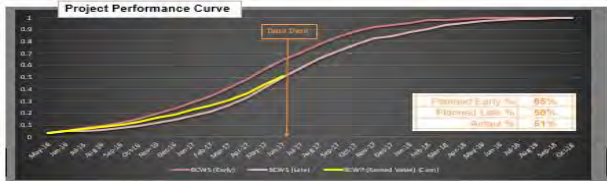
Planned  
 Actual  
 Critical  
 Delay  
 Disruption  
 Resource deployment  
 Risk  
 Opportunity

**Communicate Project  
Schedules Easily to  
Your Project Teams**



**Overall high level project WBS level**

Work Breakdown Structure	Sub-task	Planned Start	Planned End	% Complete	Start	End	Status
SECTION 1	Sub-task 1	28-Oct-18	02-Nov-18	100%	NA	NA	✓
	Sub-task 2	22-Jul-18	18-Feb-19	100%	NA	NA	✓
	Sub-task 3	18-Feb-18	14-Jul-18	100%	NA	NA	✓
	Sub-task 4	15-Aug-18	18-Sep-18	100%	NA	NA	✓
SECTION 2	Sub-task 1	19-Aug-18	16-Nov-18	100%	NA	NA	✓
	Sub-task 2	05-Nov-18	10-Dec-18	75%	29	29	✓
	Sub-task 3	25-Oct-18	02-Nov-18	23%	-46	-46	✓
	Sub-task 4	18-Feb-18	12-Jul-18	100%	NA	NA	✓
SECTION 3	Sub-task 1	25-Nov-18	05-Dec-18	22%	-47	-47	✓
	Sub-task 2	19-Aug-18	09-Jul-18	75%	29	29	✓
	Sub-task 3	24-Sep-18	20-Nov-18	75%	29	29	✓
	Sub-task 4	05-Nov-18	07-Nov-18	83%	21	21	✓



**Time Analysis (Early Start dates)**

Time Variance (TV) = ES - CD

ESPI = ES / AT

IEAC(I) = PD / SPI(I)

VAC(I) = PD - IEAC(I)

Forecast Completion from CD = (TV + (PD - CD)) / ESPI

**Time Analysis (Late Start dates)**

Time Variance (TV late) = BCWS (Late Start) - CD

ESPI = ES / AT

IEAC(I) = PD / SPI(I)

VAC(I) = PD - IEAC(I)

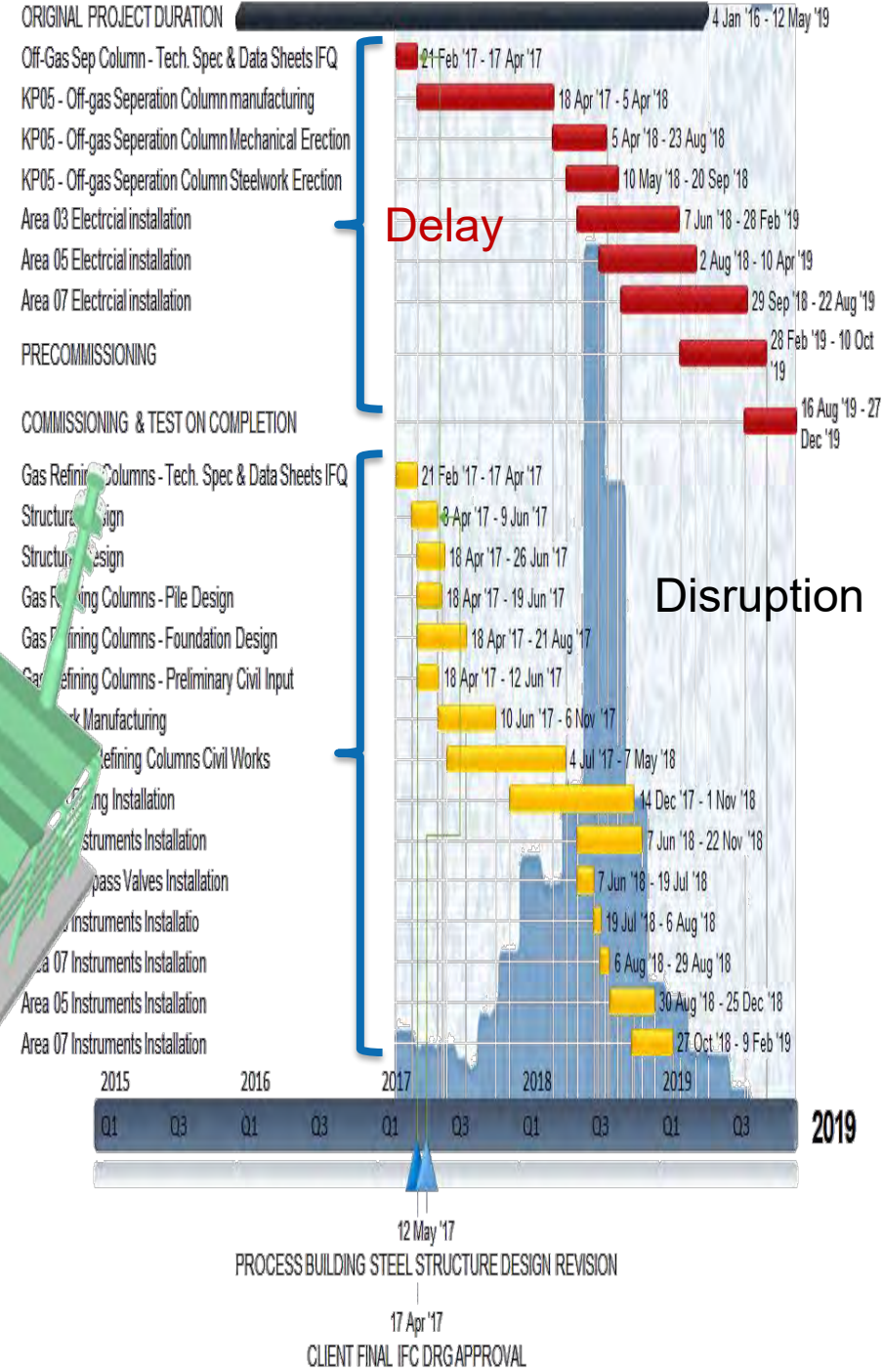
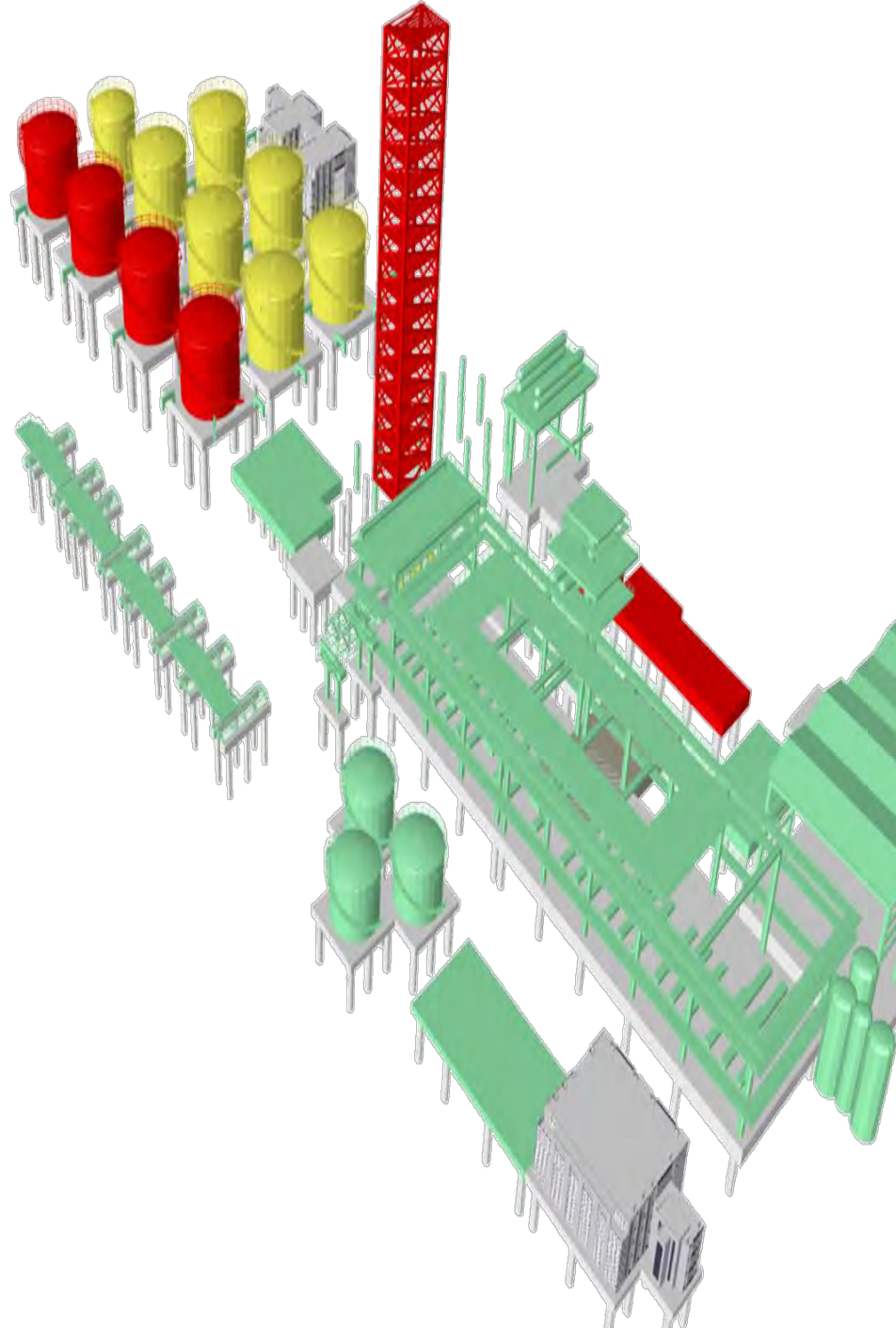
Forecast Completion from CD = (TV + (PD - CD)) / ESPI

Balance of ES and LS Forecast

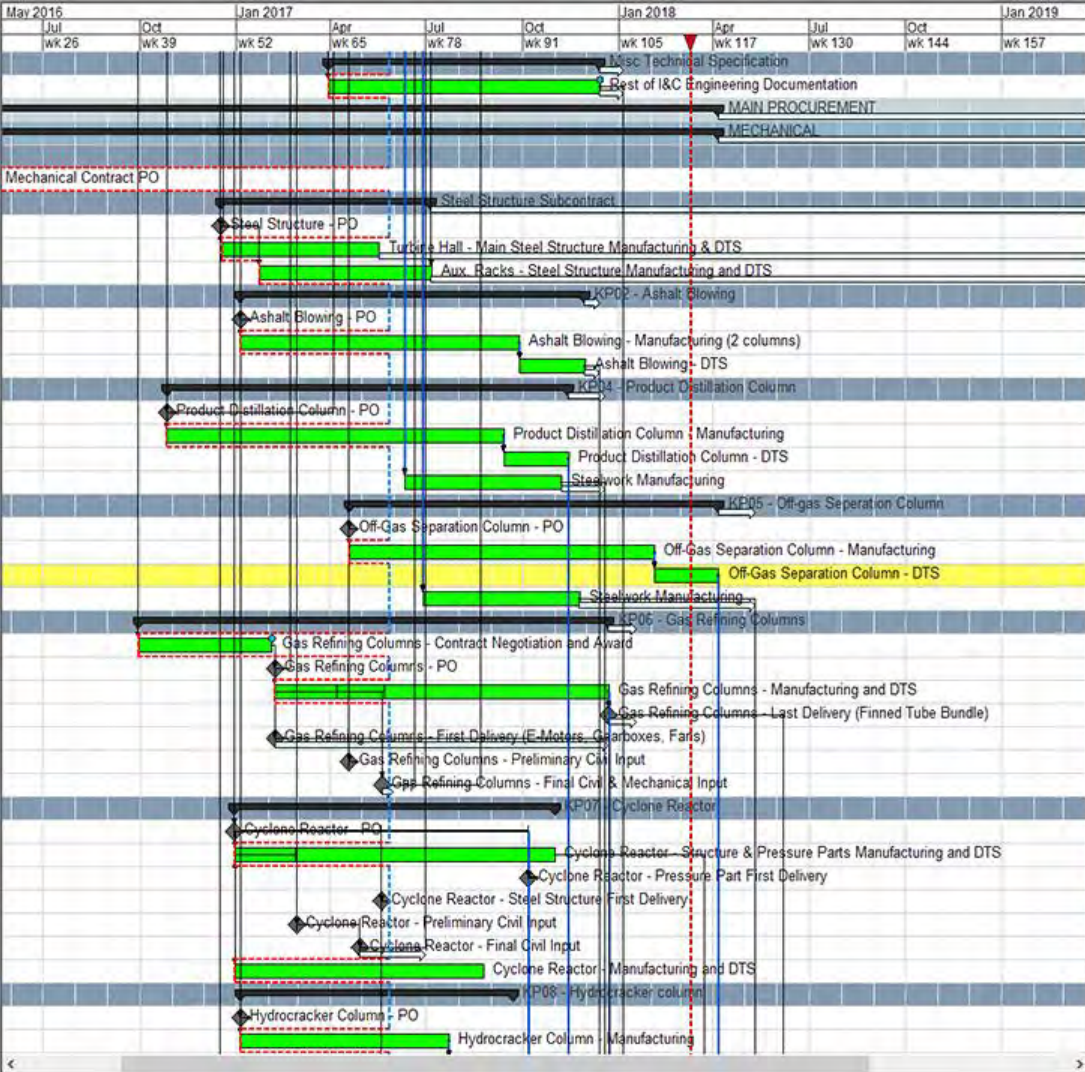
77.23	The amount of time difference from the planned performance:
0.89	Earned Schedule Performance Index: The ratio of Earned Schedule to Actual Time.
197.06	IEAC(I) is the Independent Estimate at Completion (IIEAC) and PD is the planned duration for the project.
20.34	Weeks
84.62	Weeks against 64.29 Planned
0.5	Amount of time ahead of late start curve (manual entry)
1.0	Earned Schedule Performance Index: The ratio of Earned Schedule to Actual Time.
169.92	IEAC(I) is the Independent Estimate at Completion (IIEAC) and PD is the planned duration for the project.
-0.80	Weeks
63.5	Weeks against 64.29 Planned
84.6	Forecast Completion 73-Feb-19



# **Visualise Key Areas of Project Delay and Disruption**



**Align Project Control  
tools to the Schedule  
and Maximise  
Performance**



Budget



Schedule



Productivity



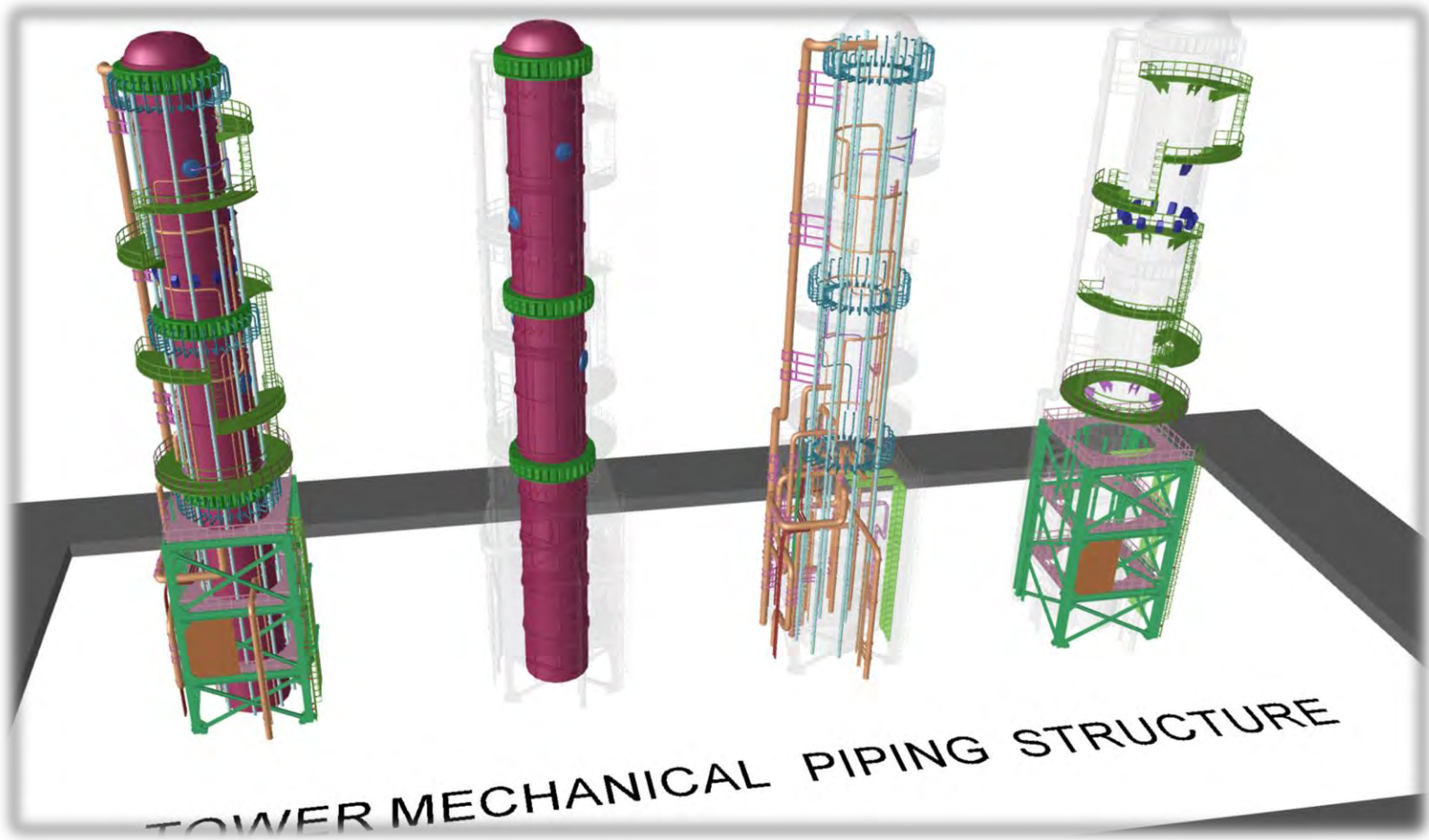
Resources

# 4D Planning Functions

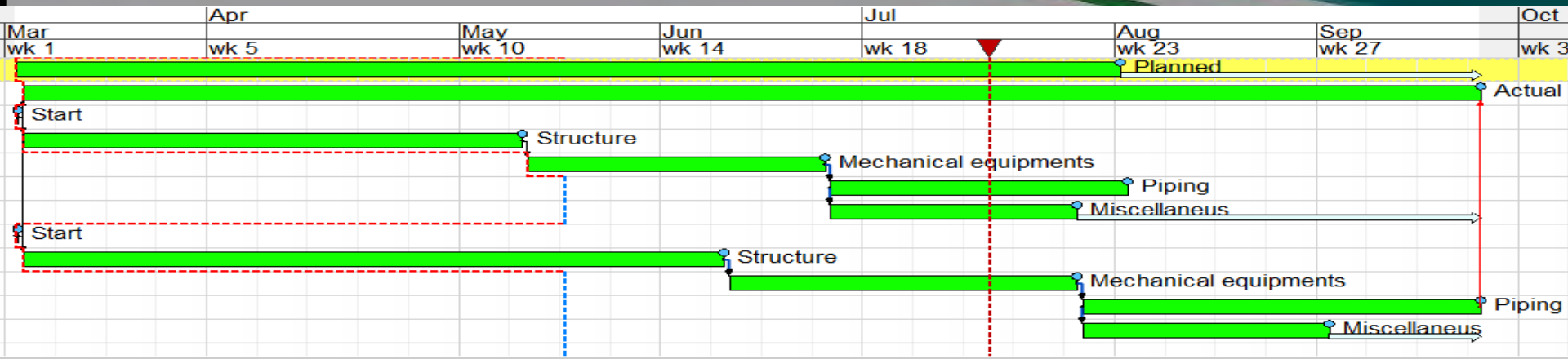
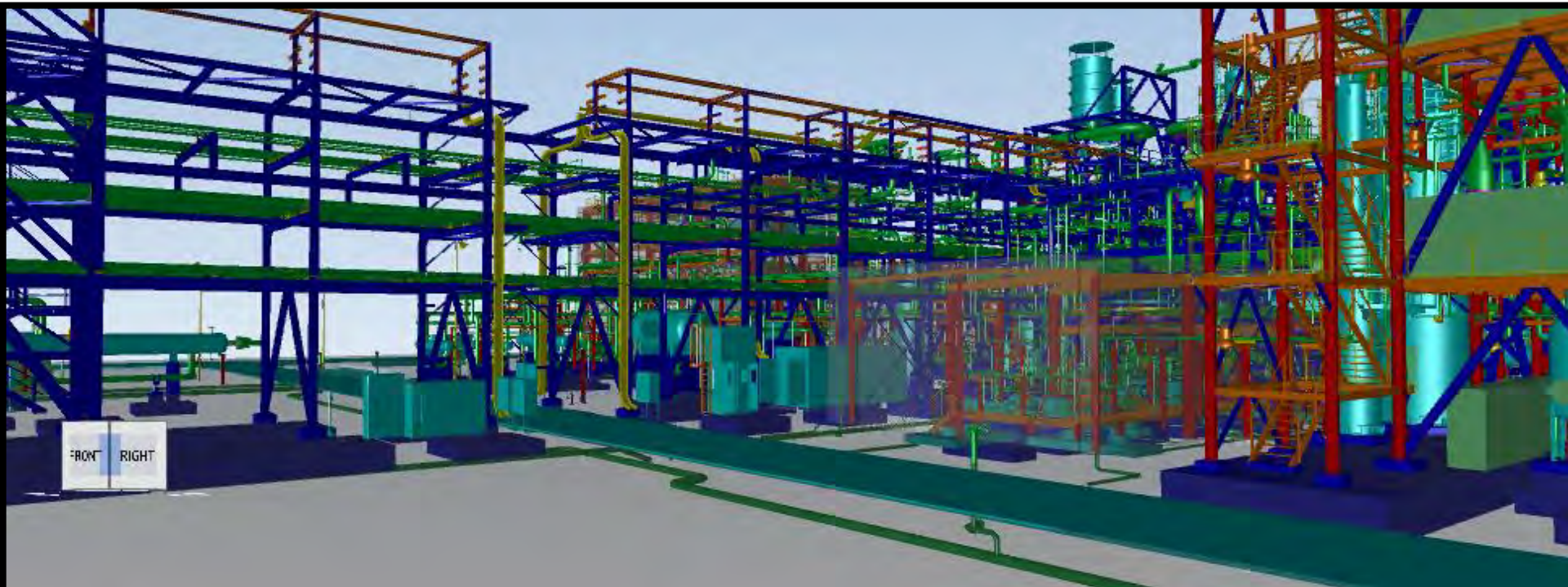




# Isolating Areas of Work



# Navigation & Functionality in the Same Detail as 3D Model



# Select and Locate Activities and 3D Objects

The image displays a software interface for project management and 3D visualization. It is divided into three main sections:

- 3D Objects Panel (Left):** A list of objects with columns for Name, Geometry, Insulation Volume, and Volume. The 'Volume' column for the selected object is highlighted in yellow.
- Table (Middle):** A table with columns: ID, 3D R..., Name, Duration, Start, and Finis. The row for 'Piping Installation...' with ID 'K-01-2610...' and duration '130d' is circled in black.
- Gantt Chart (Right):** A timeline view showing activities from July 2013 to January 2020. The activity 'Piping Installation & Testing' is highlighted in yellow.
- 3D Model (Bottom):** A 3D visualization of a piping installation. A blue arrow points from the circled table entry to the corresponding piping structure in the model. A white circle with 'TOP' and 'RIGHT' labels is visible in the bottom left corner of the 3D view.

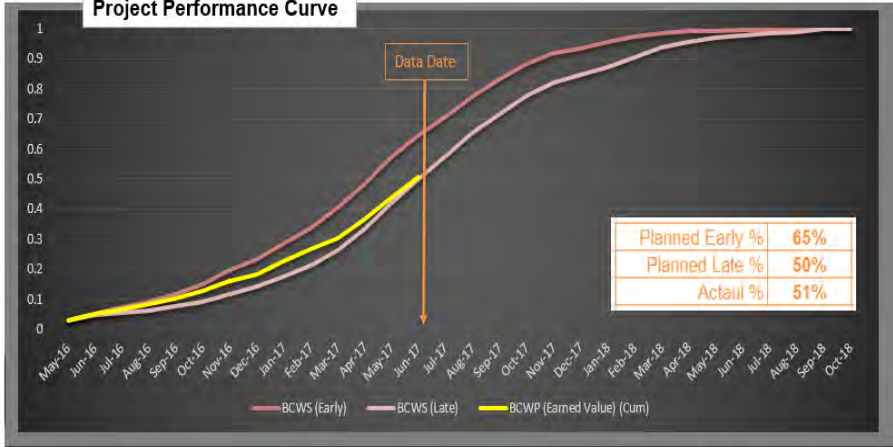
Support Gantt

3D Using Dates [Best] [1264x422]

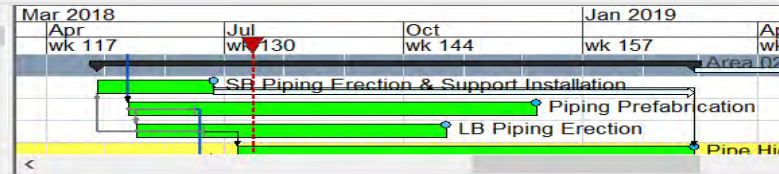
Reso... 3D... Proj... Cor... 3D F... App... View... Reso...

# Planned v Actual Status

Project Performance Curve



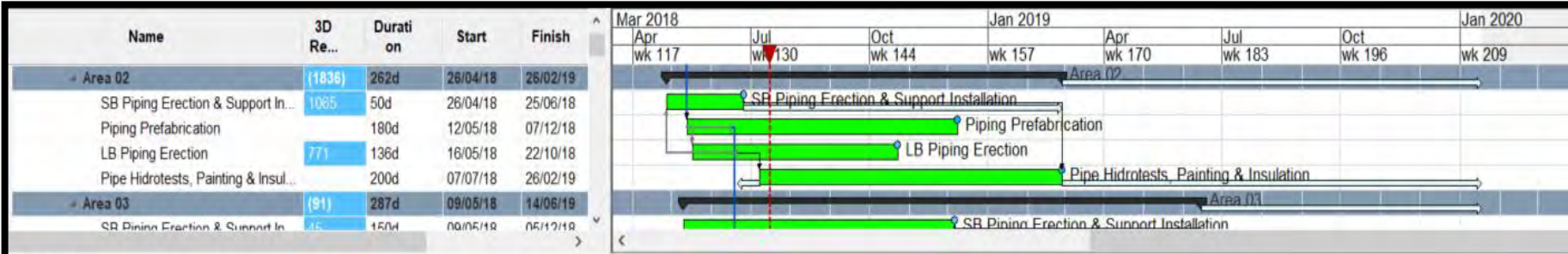
Name	3D Re...	Durati on	Start	Finish
Area 02	(1836)	262d	26/04/18	26/02/19
SB Piping Erection & Support In...	1065	50d	26/04/18	25/06/18
Piping Prefabrication		180d	12/05/18	07/12/18
LB Piping Erection	771	136d	16/05/18	22/10/18
Pipe Hydrotests, Painting & Insul		200d	07/07/18	26/02/19



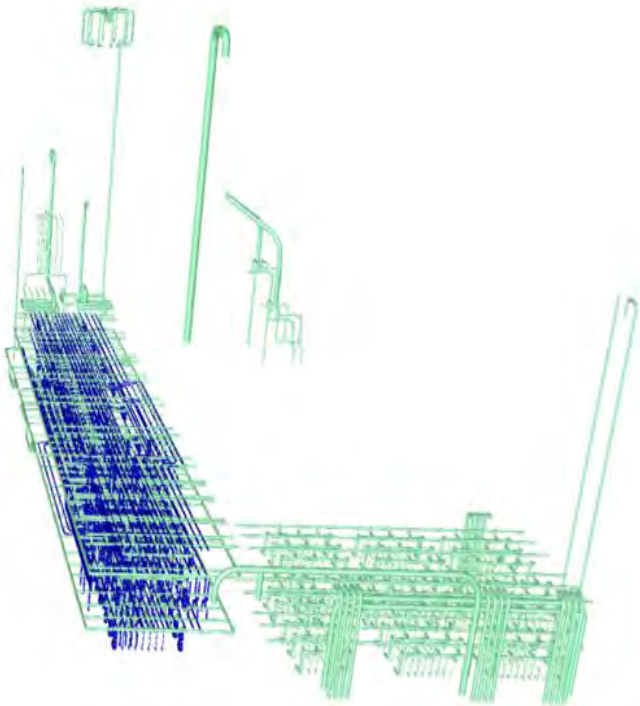
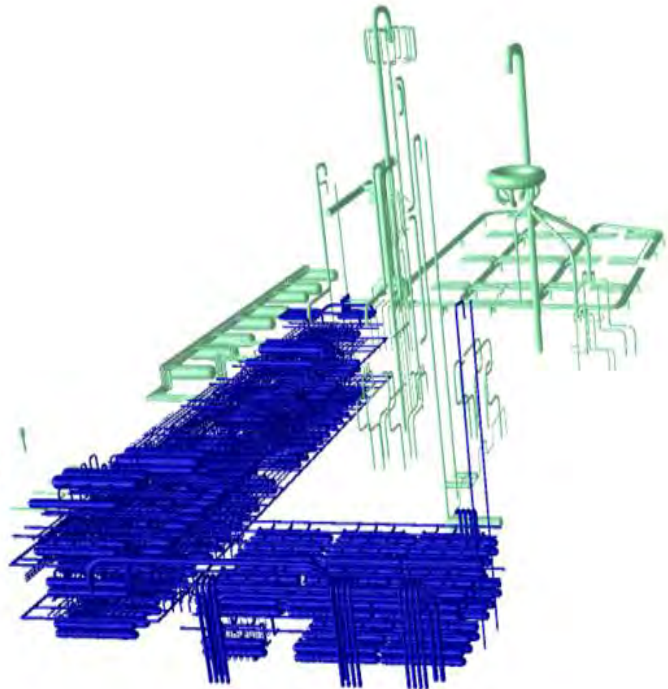
Dates [Best] Filters[3D by Selection [System]] [1346x509]



# Planned v Actual Status (Piping)



Using Dates [Best] Filters[3D by Selection [System]][Pipes Planned vs Actual] [1826x733]



# Critical Areas of Pipework

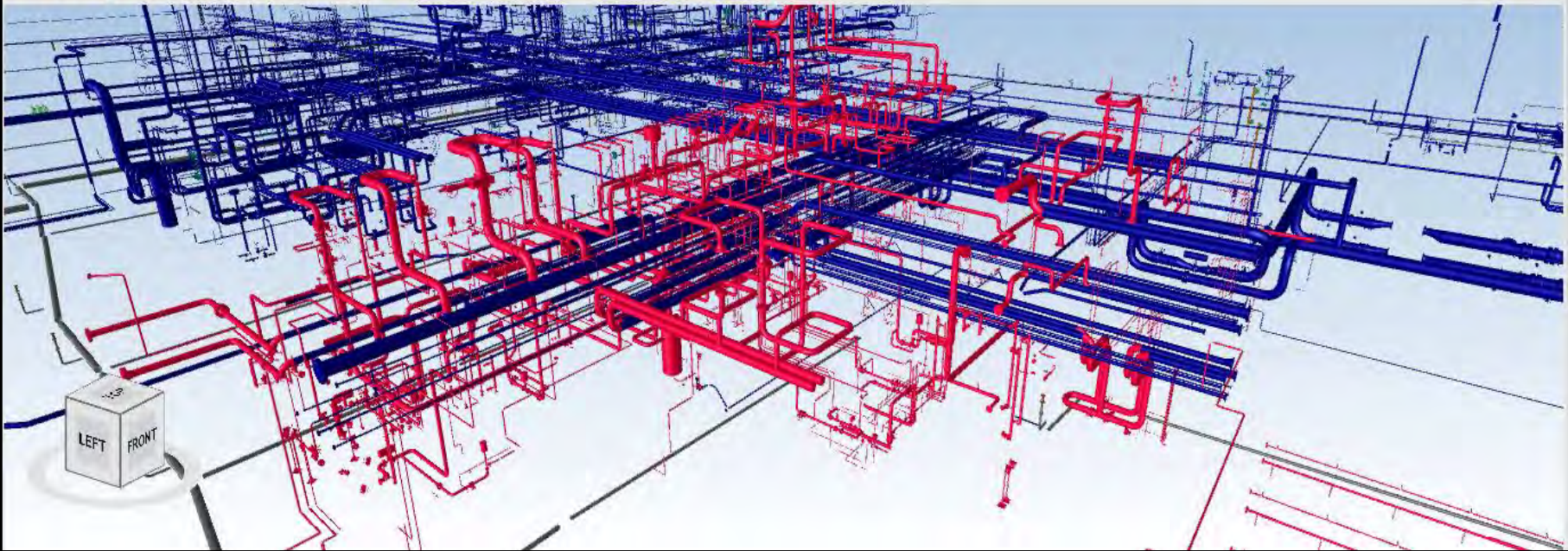
ID	3D R...	Name	Duration	Start	Finish
1	K-01-2610...	General	1076d	16/09/13	30/10/17
43	K-01-2610...	Engineering	940d	16/09/13	21/04/17
1682	K-01-2610...	Procurement & Fabrica...	763d	18/10/13	21/09/16
2553	K-01-2610... (596...	Construction	805d	30/09/14	30/10/17
2554	K-01-2610... (966)	General	424d	02/03/15	01/11/16
2578	K-01-2610... (4969)	Piperacks	551d	30/09/14	08/12/16
2801	K-01-2610... (160...	CA 01	523d	30/09/14	27/10/16
2884	K-01-2610... (7262)	CA 03	524d	30/09/14	28/10/16

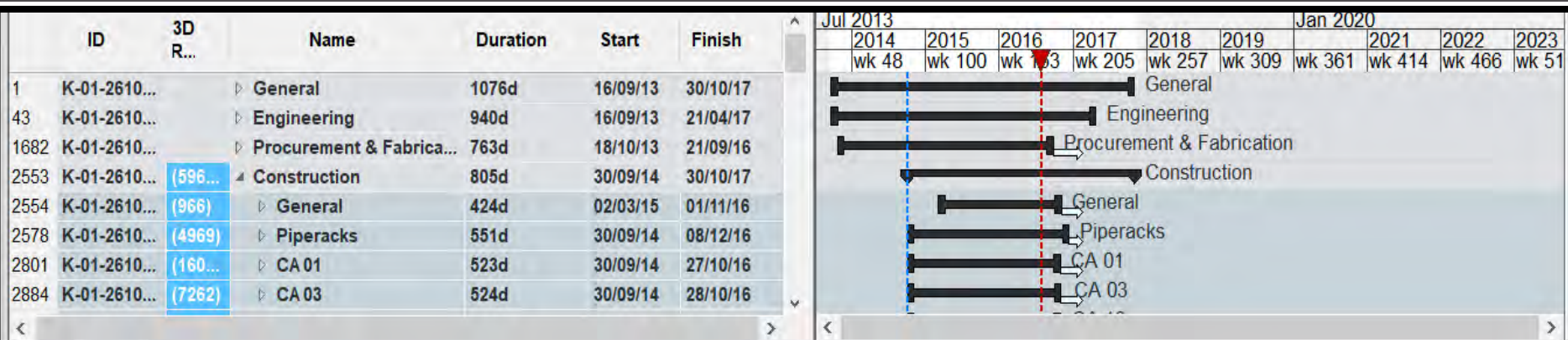
Jul 2013					Jan 2020				
2014	2015	2016	2017	2018	2019	2021	2022	2023	2024
wk 48	wk 100	wk 153	wk 205	wk 257	wk 309	wk 361	wk 414	wk 466	wk 518
General									
Engineering									
Procurement & Fabrication									
Construction									
General									
Piperacks									
CA 01									
CA 03									

Support Gantt

3D Using Dates [Best] Filters[2. Pipes Plan vs Forecast] [1367x425]

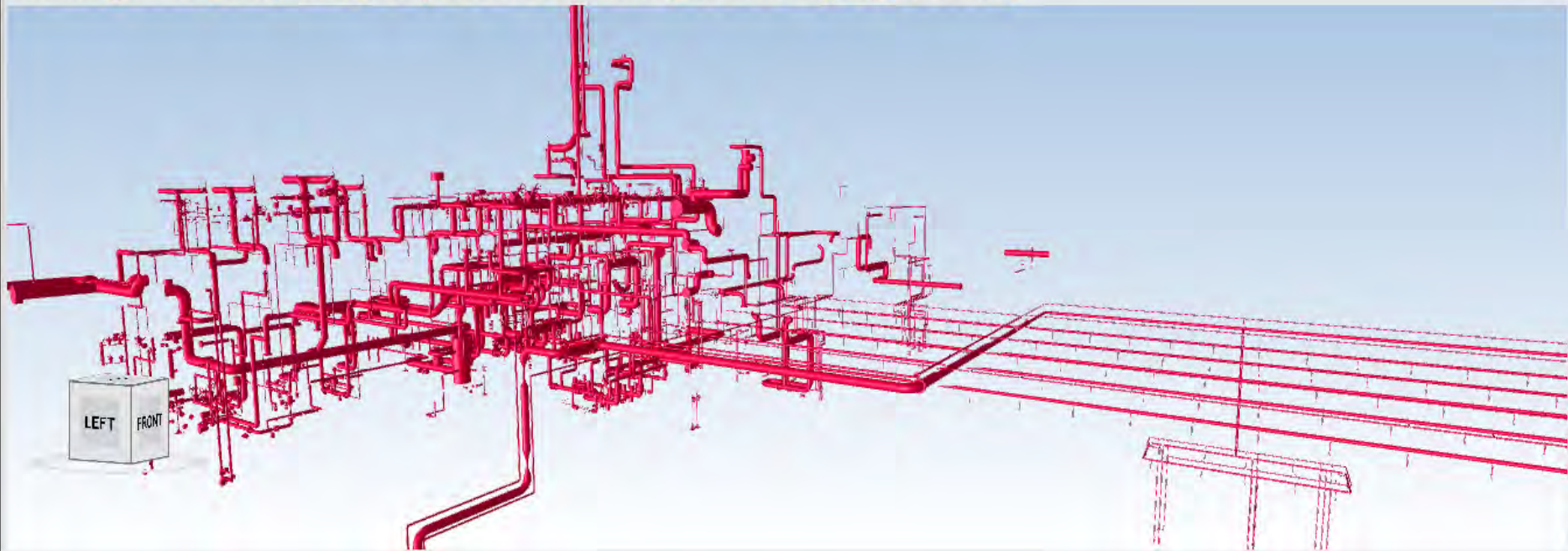


# Critical Areas of Pipework Isolated



Support Gantt

3D Using Dates [Best] Filters[2. Pipes Plan vs Forecast][3. Critical Pipes] [1338x425]

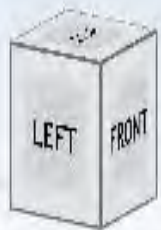


# Actual Progress Indicators

## Resource Statuses

Pipe status

- Released by Engineering
- To release by Engineering
- In Fabrication
- Released for Assembly
- Assembly Scheduled
- Pre-Assembly
- Completed Welding

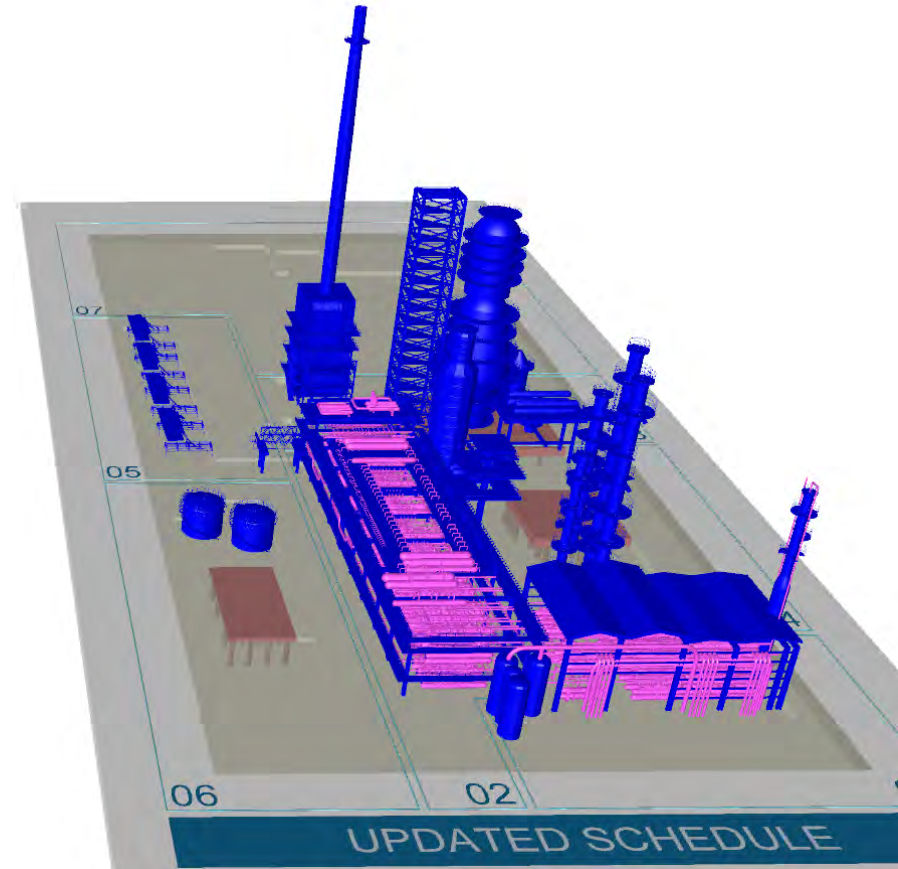
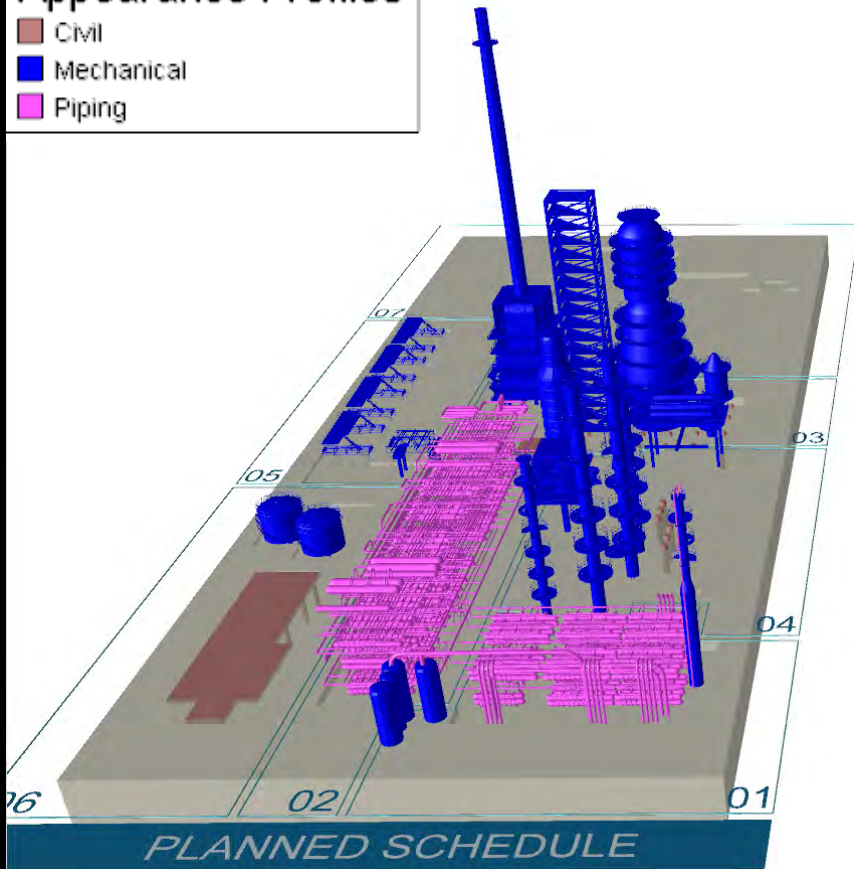




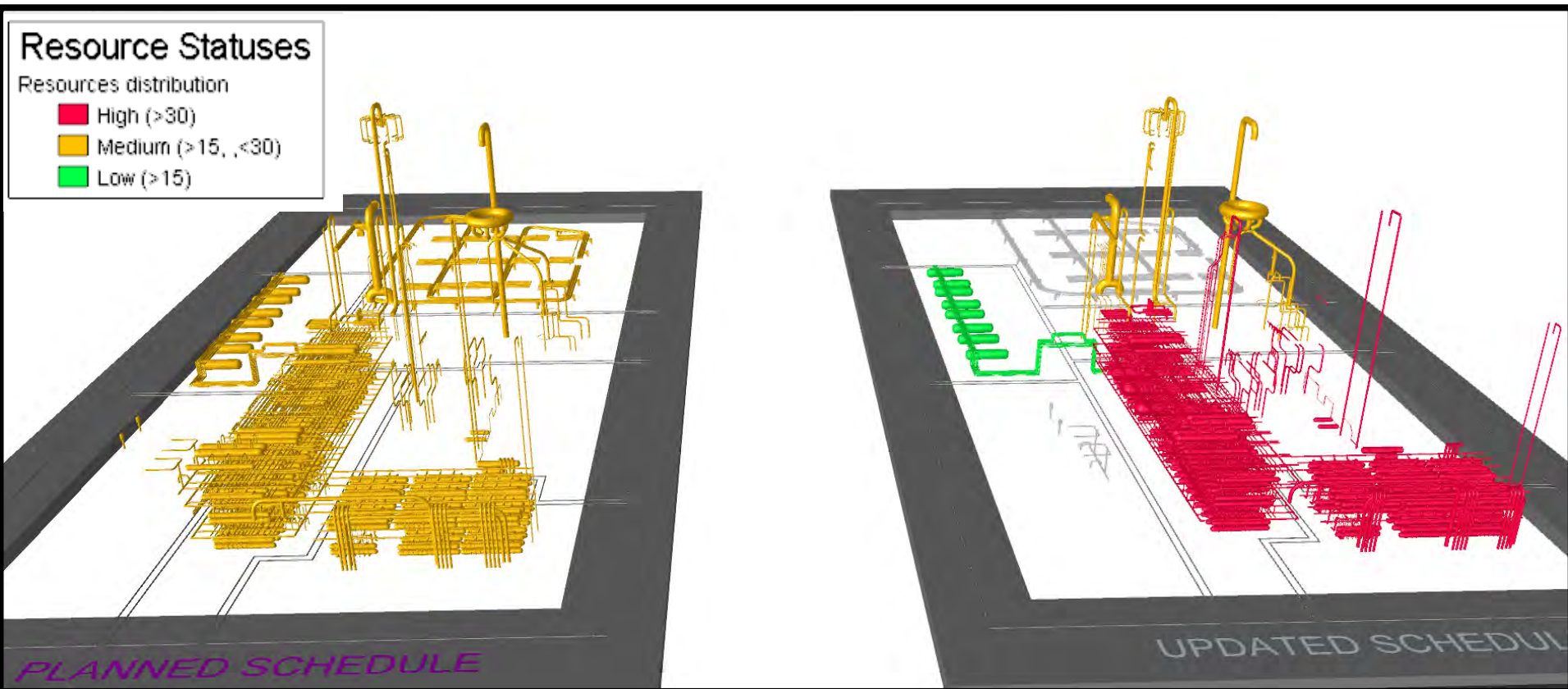
# Heat Map for Resources

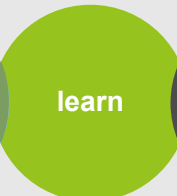
Appearance Profiles

- Civil
- Mechanical
- Piping



# Heat Map for Resources





# 4D Contemporary Change Visualisation



# Change Scenario



- ➔ Delay in subcontractor's civil works
- ➔ Subcontractor alleged delayed delivery of drawings and work stopped during this time
- ➔ Claim for delay and additional costs

# Contractor Alleges Delay Because of Late Foundations Drawings Issue



		START	DRAFT	IFR	IFD	IFC	
Description	Weight	0%	10%	30%	40%	20%	
Civil	100.000%	PPPP	FFFF	AAAA			
General	16.720%	PPP	FFF	AAA			
Preliminary Loads	4.196%	P	2-Mar-16	22-Mar-16	1-Apr-16	1-May-16	1-Jun-16
Piping General Documentation	8.264%	P	28-Mar-16	6-May-16	26-May-16	25-Jul-16	23-Sep-16
Piping Class IFD	4.259%	P	28-Mar-16	17-Apr-16	27-Apr-16	28-May-16	28-Jun-16
LAYOUT	21.615%	PPP	FFF	AAA			
Foundations Arexxx	9.536%	P	28-Mar-16	13-May-16	5-Jun-16	13-Aug-16	21-Oct-16
Foundations Arexxx	0.826%	P	28-Mar-16	31-Mar-16	2-Apr-16	7-Apr-16	13-Apr-16
Foundations Arexxx	11.252%	P	24-Oct-16	17-Dec-16	14-Jan-17	6-Apr-17	27-Jun-17
Foundations Arexxx	0.000%	P	0-Jan-00	30-Dec-25	30-Dec-38	30-Dec-77	30-Dec-16
Foundations Arexxx	0.000%	P	0-Jan-00	24-Feb-26	24-Mar-39	16-Jun-78	8-Sep-17
Foundations Arexxx	0.000%	P	0-Jan-00	30-Mar-26	15-May-39	27-Sep-78	9-Feb-18

**Name**

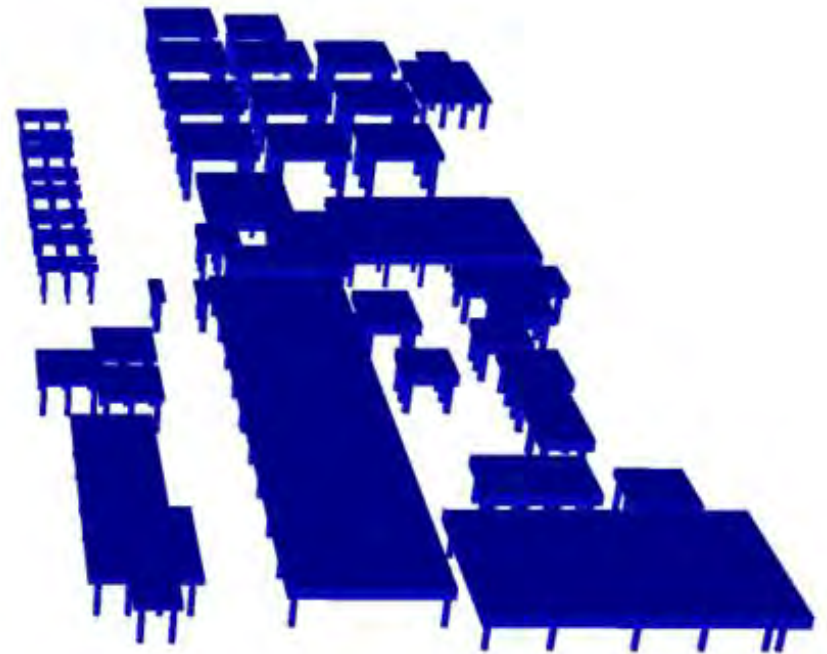
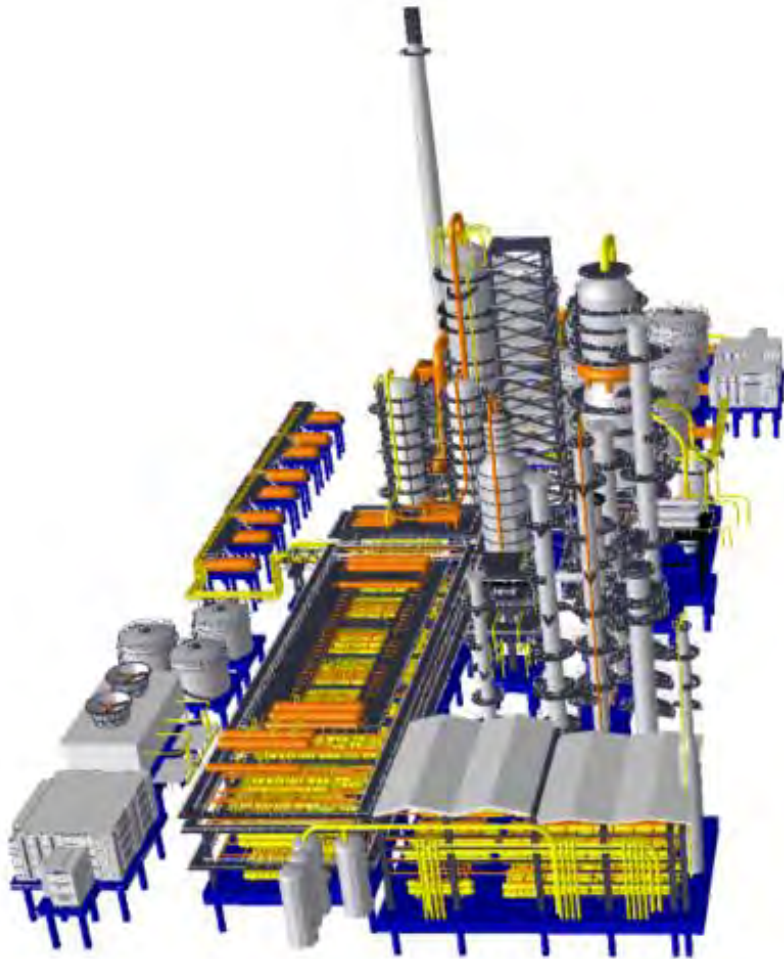
- Structural Steel
  - Install Compressor Shelter Crane
  - Install Compressor Shelter Ventilation
  - Erection Compressor Shelter**
  - Cladding Compressor Shelter
- Equipment Installation
  - Installation Inline Silencer Syngas - 5001N01

**3D Using Dates [Best] [593x448]**

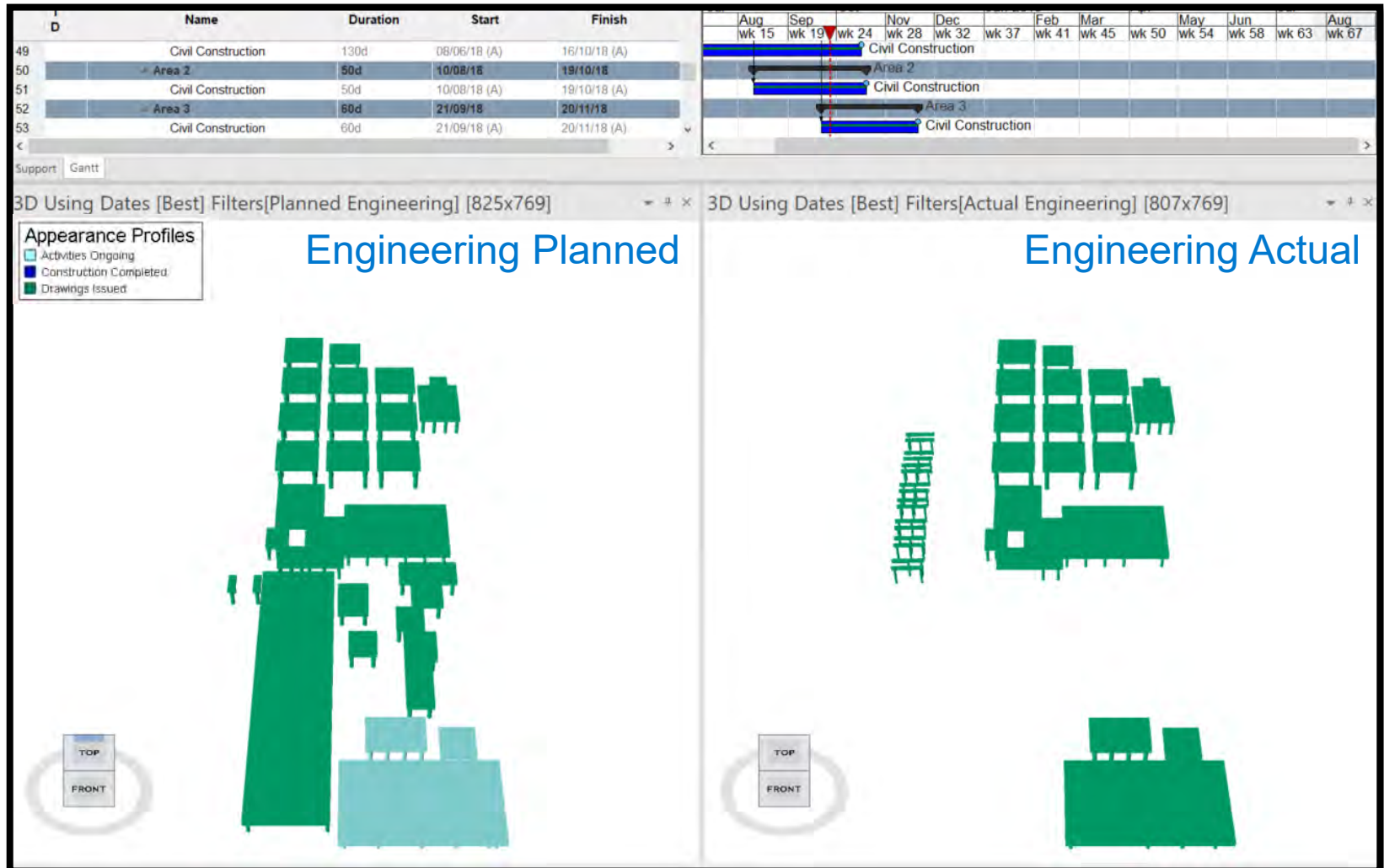
**3D Using Dates [Best] Filters[3D by Selectio...**

**Planned**      **Actual**

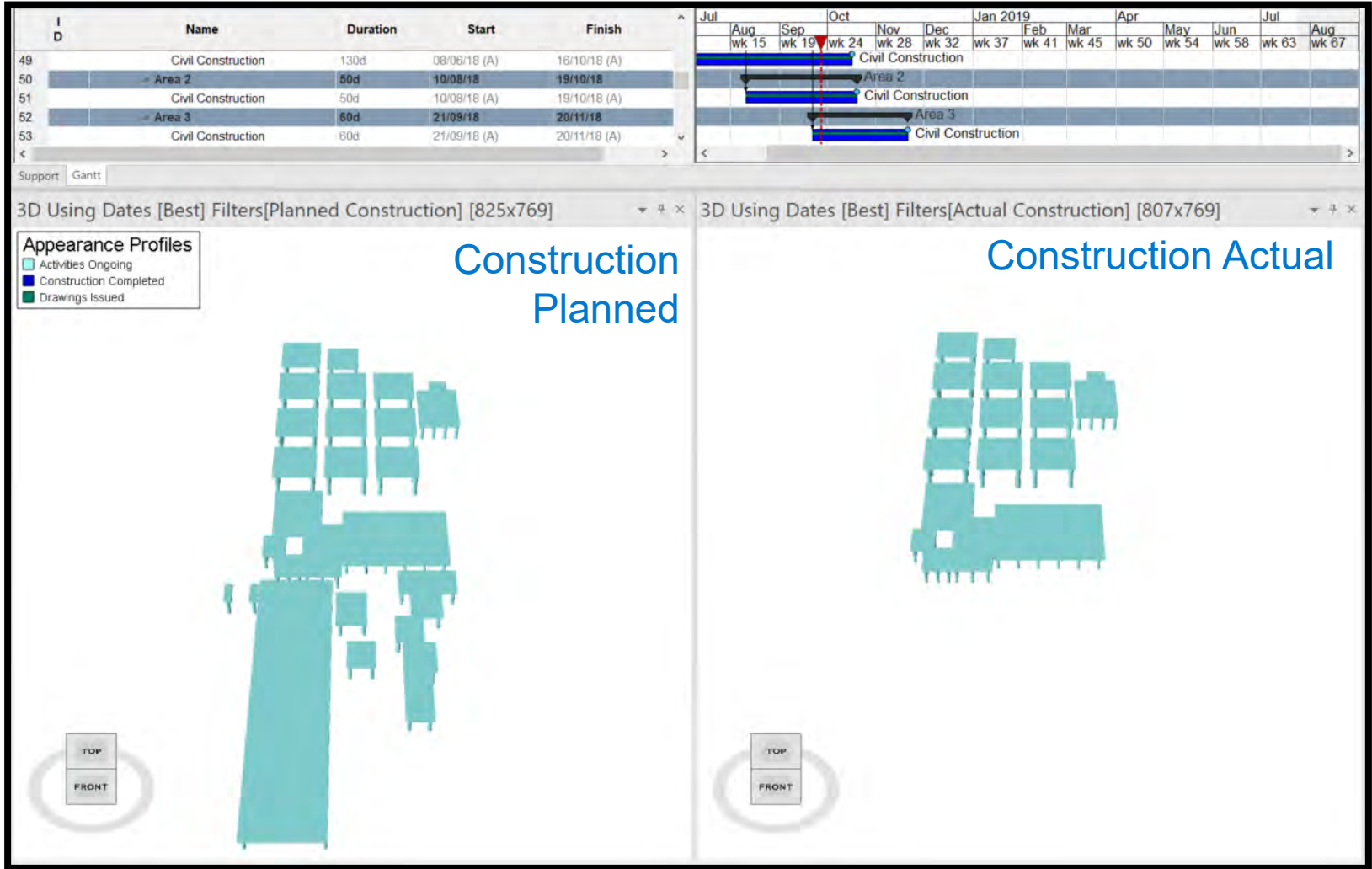
# Foundation Drawings Isolated From the Model



# Engineering Status (Week 20)

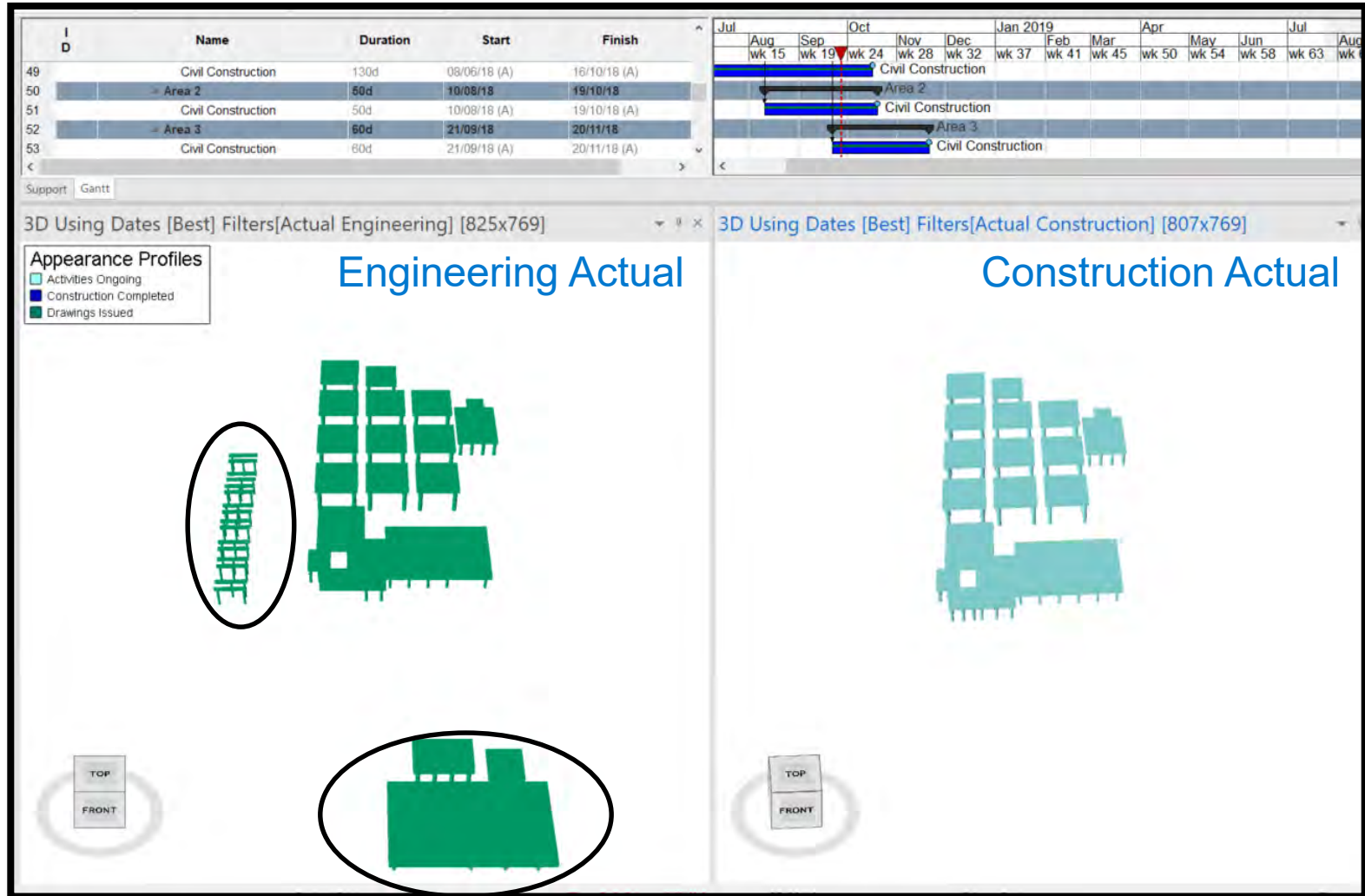


# Construction Status (Week 20)

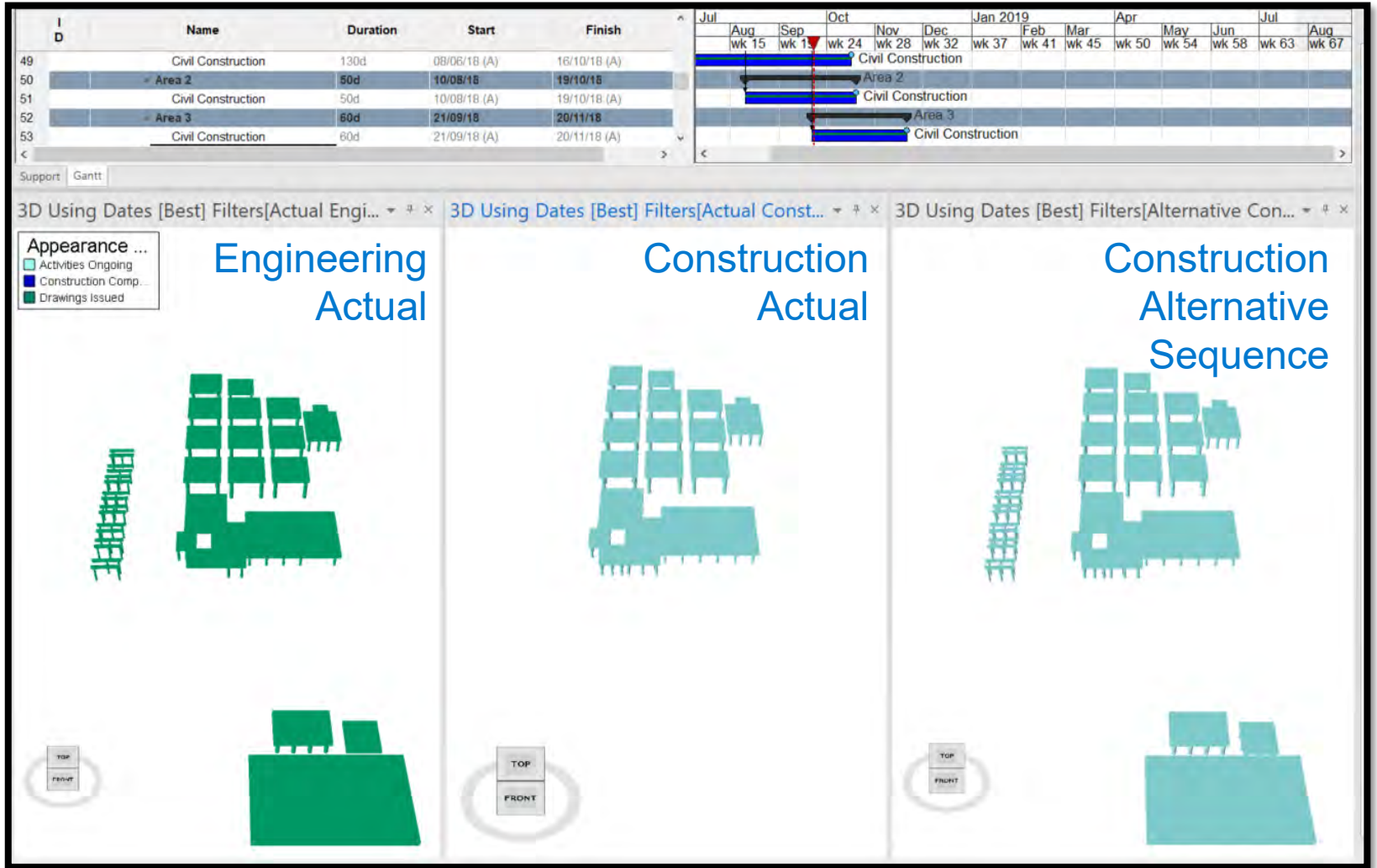




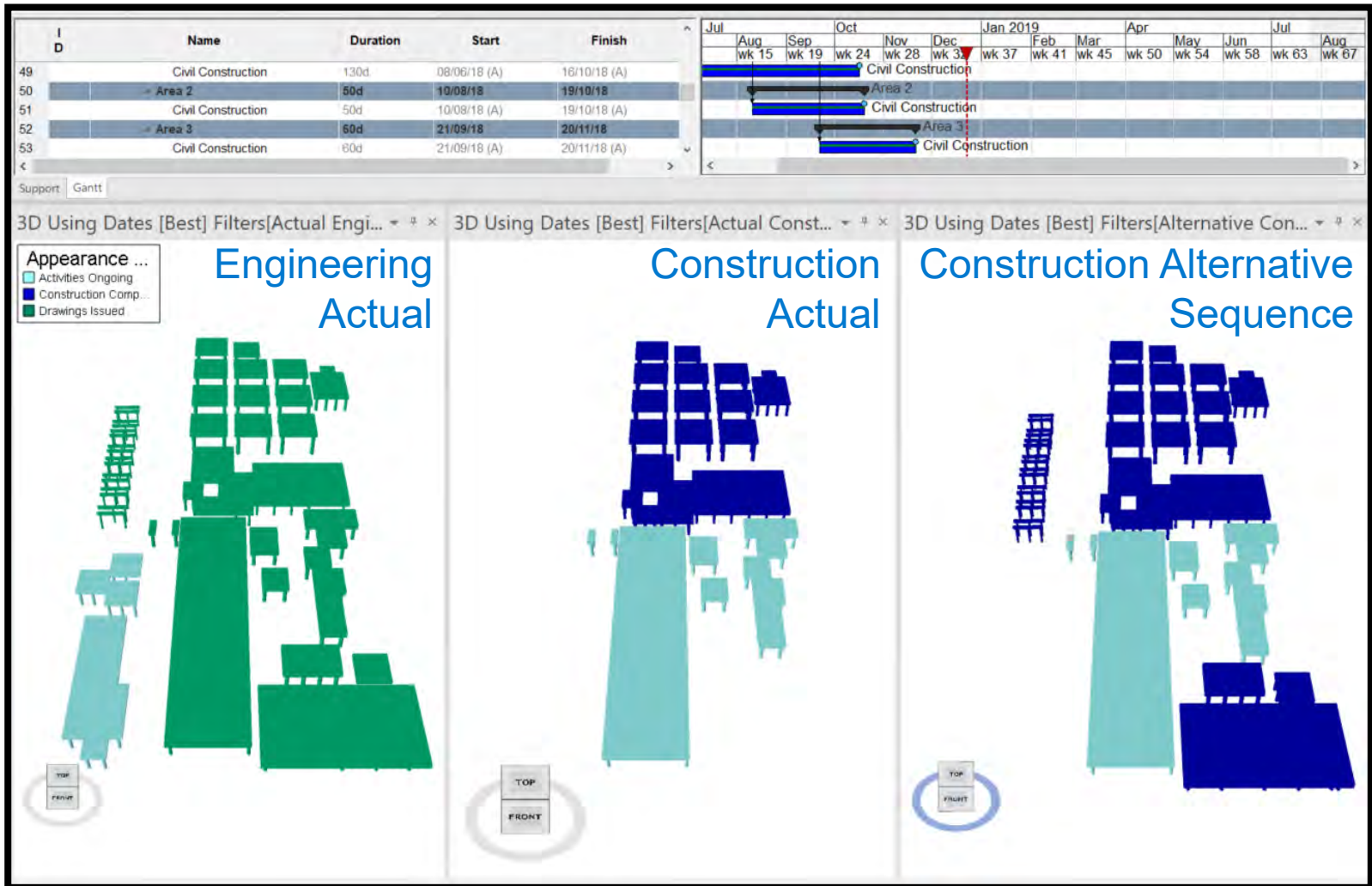
# Eng. vs Const. Actual Status (week 20)



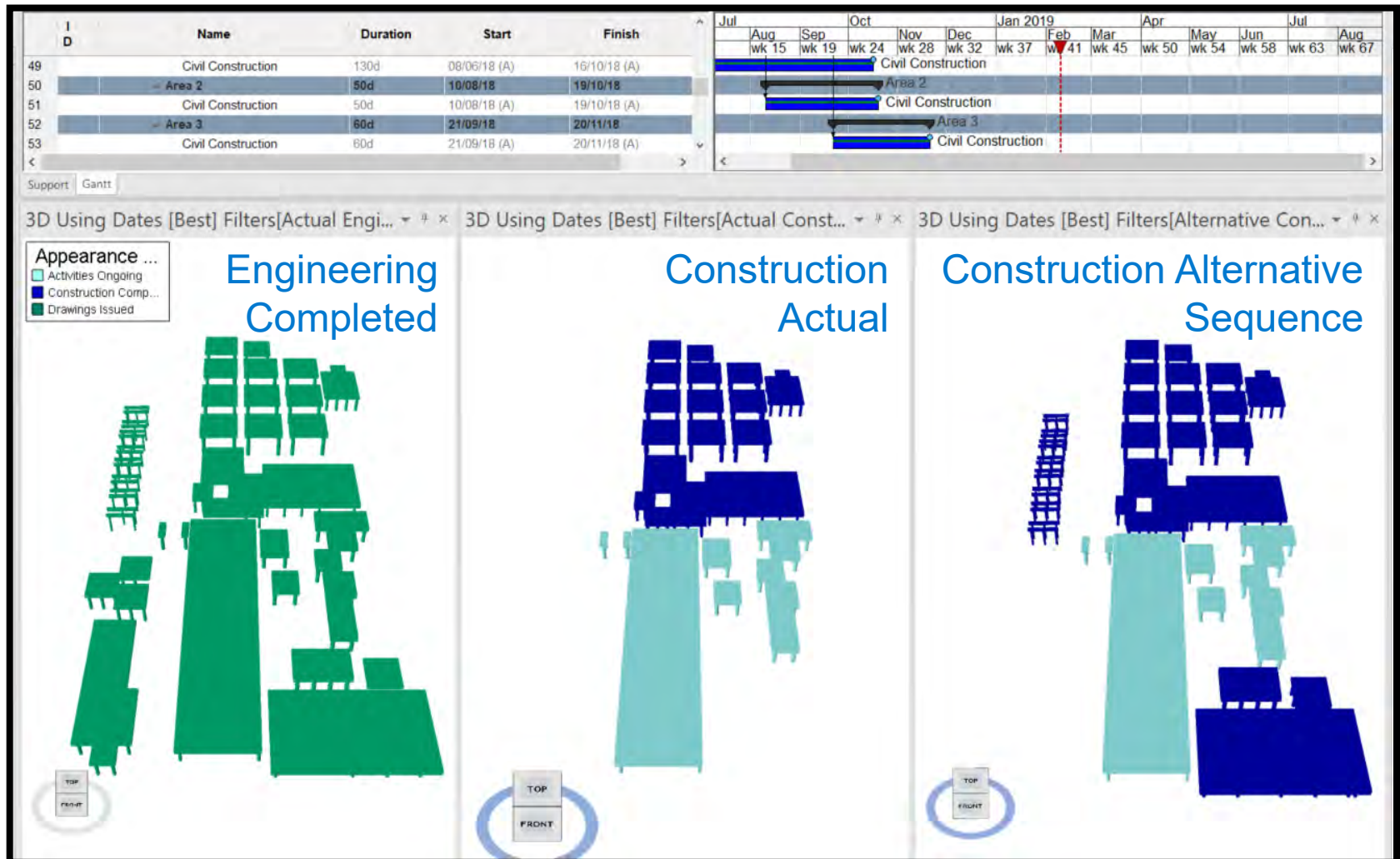
# Change of sequence Status (week 20)



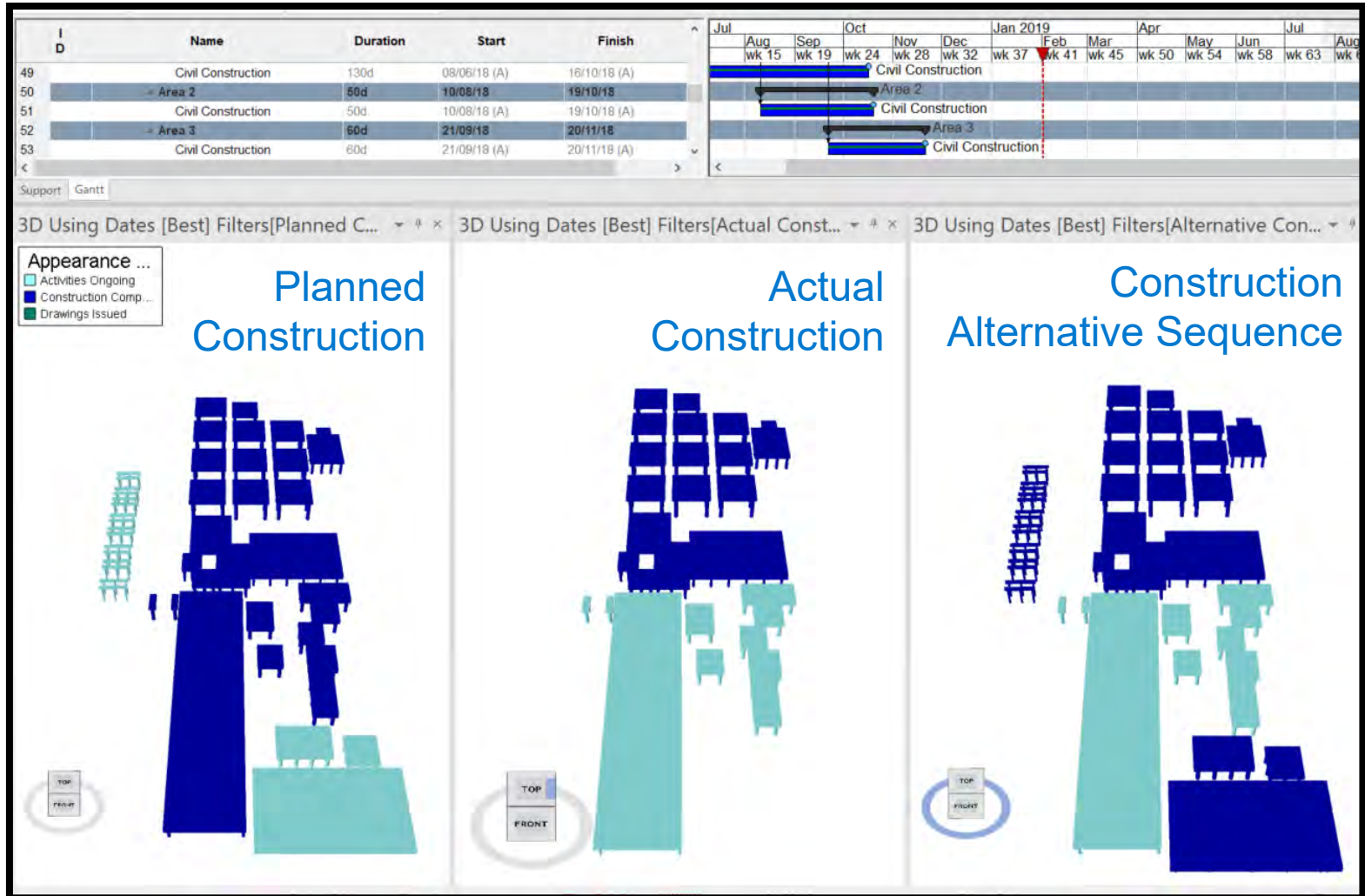
# Change of sequence (week 33)



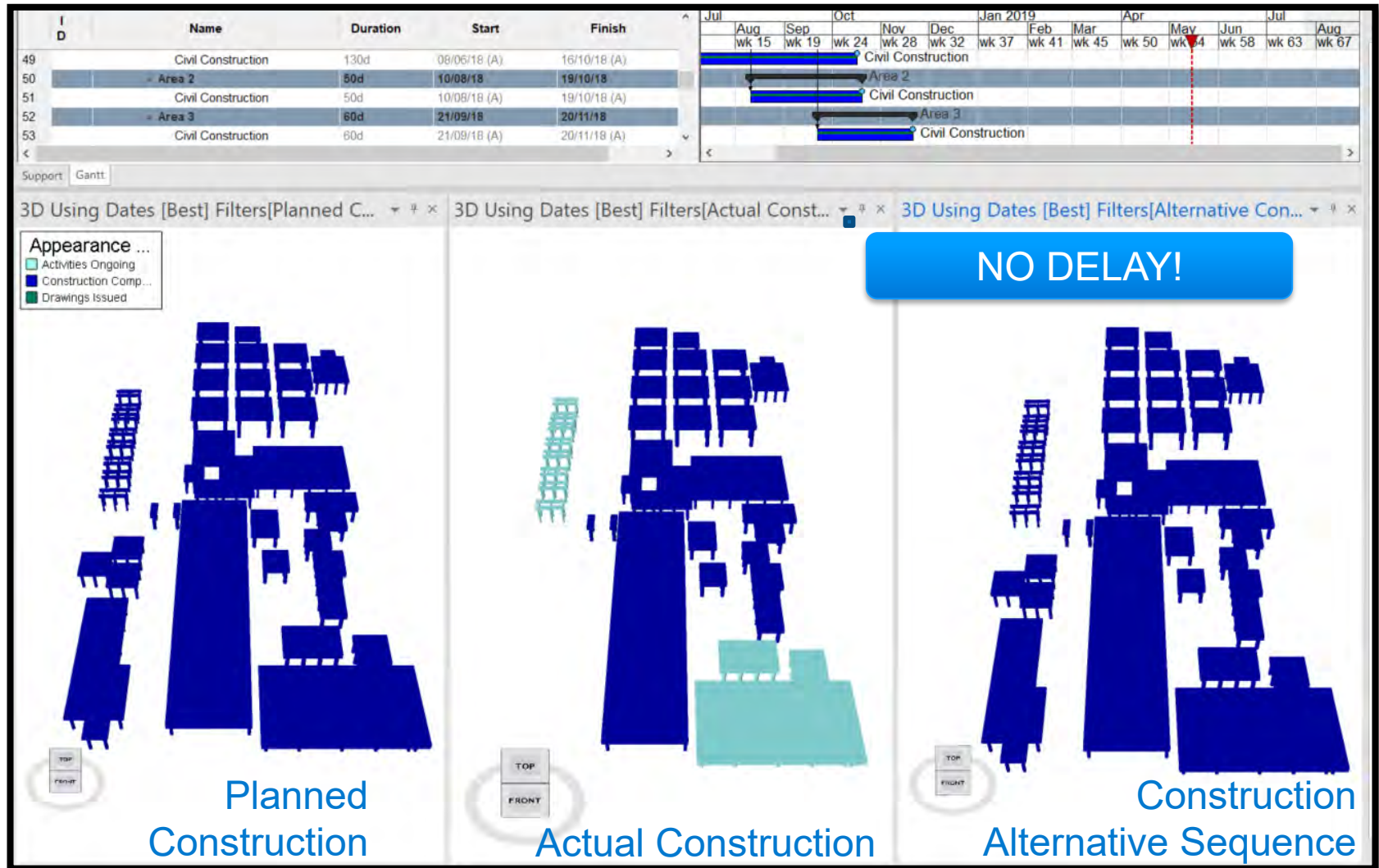
# Change of sequence (week 41)



# Change of sequence (week 41)



# Change of sequence (week 54 – Planned Completion Date)



# 4D Project Controls & Risk Visualisation Reports



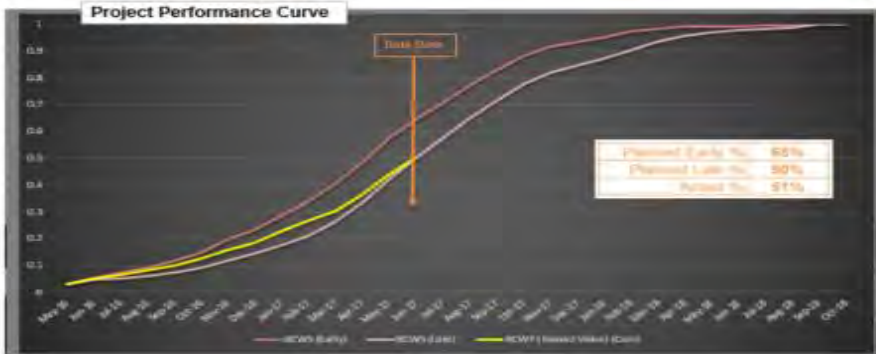
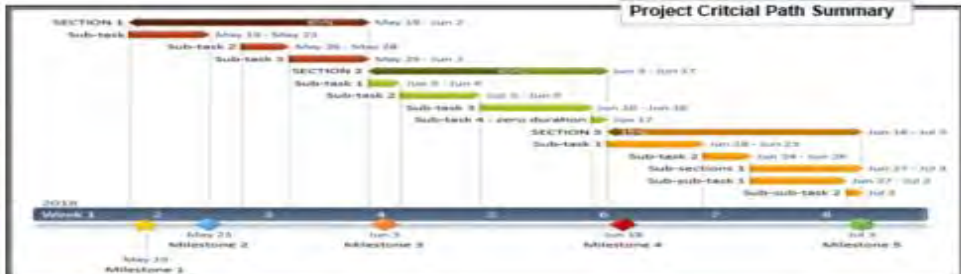
# Project Level Report

**kingsfield planning**  
Project Controls Report  
PROJECT LEVEL REPORT

Contract Time Elapsed/Remaining	293	66	<b>Project Name</b>
ES Forecast Completion	18 Feb 13	115	
Report Date	26 October 2012		
Project Manager	[Name]		
Client	[Name]		

Baseline Contract start	01-Jan-12
Baseline Contract completion	31-Dec-12
Current Forecast Completion	10-Jun-13

Task	Baseline Finish	Schedule Forecast Finish	%	Balance Schedule	Float	Recovery	Overall Risk Indicator
							Indicator
Task 1	20-Oct-16	02-Dec-16	100%	NA	NA	NA	●
Task 2	22-Jul-16	16-Feb-17	100%	NA	NA	NA	●
Task 3	03-Feb-17	23-Jan-17	100%	NA	NA	NA	●
Task 4	19-Feb-10	31-Mar-10	12%	22	NA	NA	●
Task 5	15-Aug-16	26-Sep-16	100%	NA	NA	NA	●
Task 6	03-Aug-17	16-May-10	85%	-39	NA	NA	●
Task 7	03-Mar-10	16-May-10	79%	-39	NA	NA	●
Task 8	25-Oct-17	02-Dec-17	23%	-46	NA	NA	●
Task 9	06-Feb-18	12-Mar-18	67%	-72	NA	NA	●
Task 10	25-May-18	05-Apr-10	22%	-47	NA	NA	●
Task 11	19-Apr-10	09-Jul-10	77%	-4	NA	NA	●
Task 12	21-Apr-10	17-May-10	79%	-31	NA	NA	●
Task 13	05-Apr-10	07-May-10	89%	-81	NA	NA	●



**Time Analysis (Early Start dates)**  
Time Variance (TV) = ES - CD

ESPI = ES / AT  
IEAC(t) = PD / SPI(t)  
VAC(t) = PD - IEAC(t)  
Forecast Completion from CD = (TV + (PD - CD)) / ESPI

**Time Analysis (Late Start dates)**  
Time Variance (TV late) = BCWS (Late Start) - CD

ESPI = ES / AT  
IEAC(t) = PD / SPI(t)  
VAC(t) = PD - IEAC(t)  
Forecast Completion from CD = (TV + (PD - CD)) / ESPI

11.33	The amount of time difference from the planned performance
0.89	Earned Schedule Performance Index: The ratio of Earned Schedule to Actual Time
191.05	IEAC(t) is the Independent Estimate of Completion (time) and PD is the planned duration for the project
20.34	<b>Weeks against</b> 84.29 <b>Planned</b>
84.62	<b>Weeks against</b> 84.29 <b>Planned</b>
0.5	Amount of time ahead of late start curve (manual entry)
7.0	Earned Schedule Performance Index: The ratio of Earned Schedule to Actual Time
169.92	IEAC(t) is the Independent Estimate of Completion (time) and PD is the planned duration for the project
-0.80	<b>Weeks against</b> 84.29 <b>Planned</b>
63.6	<b>Weeks against</b> 84.29 <b>Planned</b>
84.6	<b>Forecast Completion</b> 83-Feb-13





# Summary: From 2D Schedules to 3D Animation



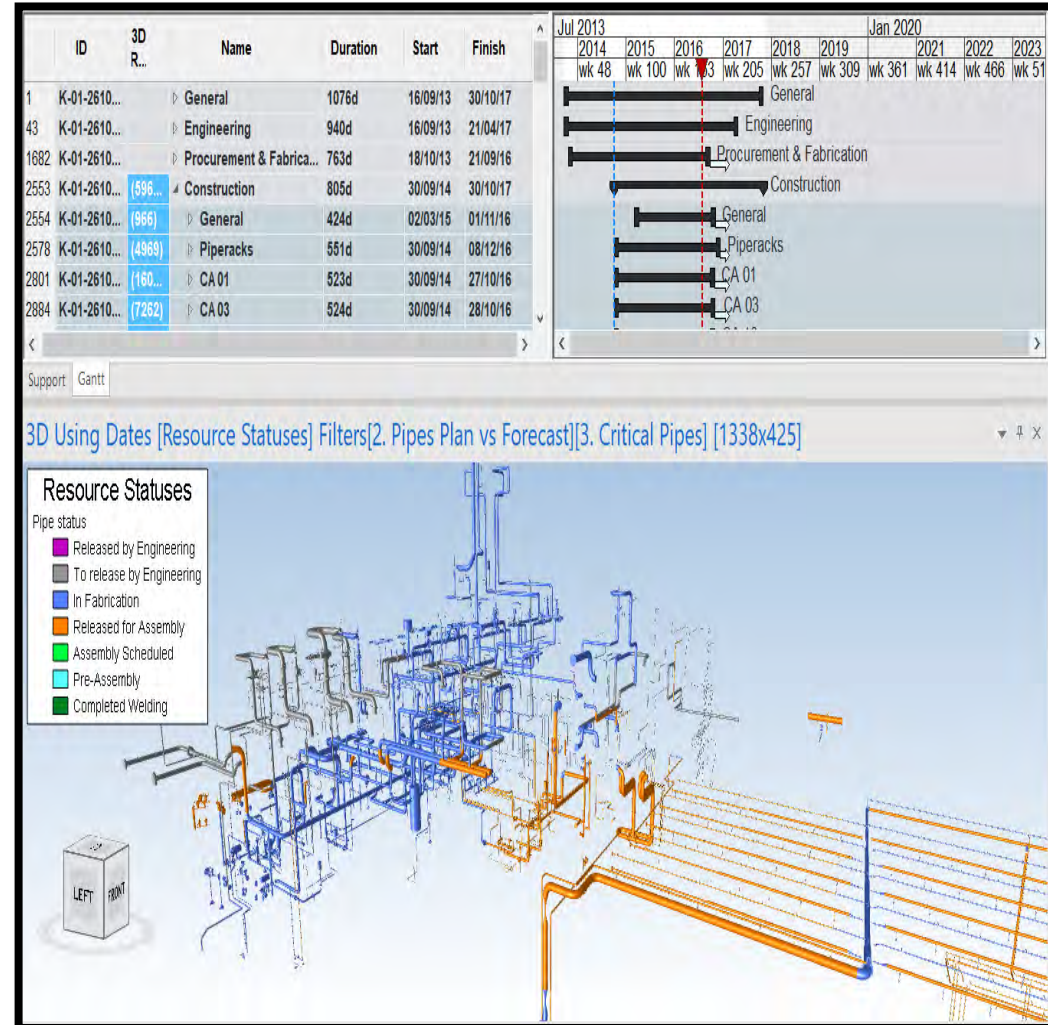
The screenshot displays the Primavera P6 Professional software interface. The main window shows a Gantt chart for the project 'Rock Springs Issue 30.0'. The chart is organized by quarters from Q4 2014 to Q1 2016. A detailed view of the 'Foundation work' activity is shown in a pop-up window, listing tasks such as 'Foundation Work', 'Excavation PSA area', and 'Excavation ASU area' with their respective start and finish dates.

Activity ID	Activity Name	Start	Finish
ATXCH80	Foundation Work	20-Sep-14	30-Sep-15
ATXCH830	Excavation PSA area	20-Sep-14	30-Sep-15
ATXCH1050	Excavation ASU area	01-Oct-14	30-Oct-14
ATXCH800	Foundation Work Equipment/ Equipment Structure	01-Oct-14	30-Oct-14
ATXCH1040	Excavation Reframer area	01-Oct-14	30-Oct-14
ATXCH1000	Excavation PSA area	01-Oct-14	30-Oct-14
ATXCH1010	Excavation Reframer area	01-Oct-14	30-Oct-14
ATXCH1020	Excavation PSA area	01-Oct-14	30-Oct-14
ATXCH1030	Excavation Reframer area	01-Oct-14	30-Oct-14
ATXCH1040	Excavation PSA area	01-Oct-14	30-Oct-14
ATXCH1050	Excavation Reframer area	01-Oct-14	30-Oct-14
ATXCH1060	Excavation PSA area	01-Oct-14	30-Oct-14
ATXCH1070	Excavation Reframer area	01-Oct-14	30-Oct-14
ATXCH1080	Excavation PSA area	01-Oct-14	30-Oct-14
ATXCH1090	Excavation Reframer area	01-Oct-14	30-Oct-14
ATXCH1100	Excavation PSA area	01-Oct-14	30-Oct-14
ATXCH1110	Excavation Reframer area	01-Oct-14	30-Oct-14
ATXCH1120	Excavation PSA area	01-Oct-14	30-Oct-14
ATXCH1130	Excavation Reframer area	01-Oct-14	30-Oct-14
ATXCH1140	Excavation PSA area	01-Oct-14	30-Oct-14
ATXCH1150	Excavation Reframer area	01-Oct-14	30-Oct-14
ATXCH1160	Excavation PSA area	01-Oct-14	30-Oct-14
ATXCH1170	Excavation Reframer area	01-Oct-14	30-Oct-14
ATXCH1180	Excavation PSA area	01-Oct-14	30-Oct-14
ATXCH1190	Excavation Reframer area	01-Oct-14	30-Oct-14
ATXCH1200	Excavation PSA area	01-Oct-14	30-Oct-14

The 3D model on the right shows a tall industrial tower with a pink cylindrical body, green structural steel, and various pipes and ladders. The software interface includes a menu bar, a toolbar, and a status bar at the bottom showing 'Portfolio: All Projects', 'Access Mode: Shared', 'Data Date: 31-May-16', 'Baseline: Current Project', 'User: celestino.moreno', and 'DB: P6 Professional\_1 (Professional)'.

# Summary

- Visualise build sequences
- Anticipate interfaces and conflicts of resources and equipment
- Rehearse optimal installation sequences
- Integrated 4D Project Controls
- Visualise the impact of change
- Management of Project Risk and Change Through Advanced Forensic Animation
- Illustrate your claims, reports...



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