

BENEFITS OF 4D MODELLING FOR MAJOR POSSESSION WORKS

ABOUT



DEAN BOOTH

Associate Director at Faithful+Gould. Experienced Project Controls/Planning Manager with 30+ years expertise in the rail and construction industry, working on several large multi-disciplined projects within the UK.



MARTIN PAYNE

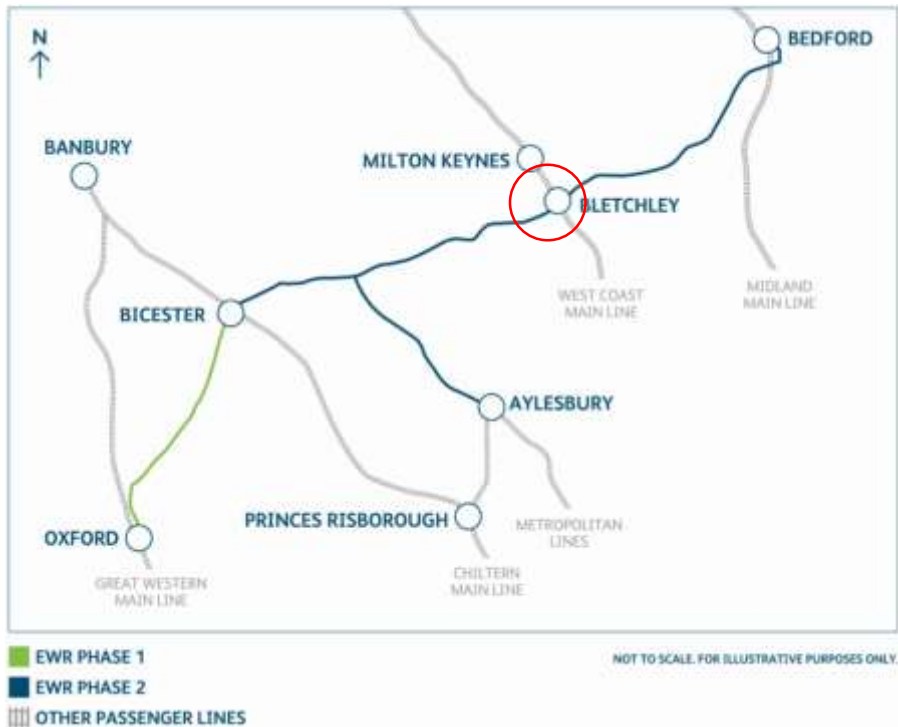
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Special mention to Ehsan Ghasemi, BIM Manager – Volkerlaser



EAST WEST RAIL PHASE 2

The East West Rail Phase 2 Project is currently constructing a rail line and service between Bicester/Aylesbury and Bedford and is made up of an Alliance including Atkins (F+G), VolkerRail, Laing O'Rourke and Network Rail. This is part of the wider East West Rail Project designed to connect Oxford and Cambridge.



INTRODUCTION

A critical element for the project was the construction of a new flyover at Bletchley (over the existing WCML) in a 74-hour possession in May 2021 to allow access for track laying.

This presentation explains how the use of 4D modelling aligned with the P6 Primavera programme facilitated the successful completion of the possession and the installation of 103 'Y' beams across the West Coast Mainline.



OVERVIEW

The Bletchley Flyover was originally a reinforced concrete railway viaduct that carried the former Varsity line between Oxford and Cambridge over the West Coast Main Line (WCML) just south of Bletchley railway station in Milton Keynes. It was retained but largely unused when the line closed in 1968.



ORIGINAL REFURB OPTION CHANGED TO RECONSTRUCTION

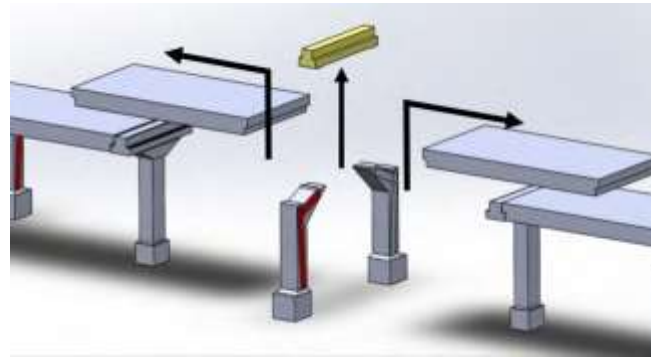
TECHNICAL SOLUTION

- › Alliance courageous in a change of technical solution in 2019
- › Provided asset owner significant improvement
- › Resulted in c£20m in cost savings and more reliable and predictable construction method

DELIVERY IN RAILWAY CLOSURES

- › Also de-risked the impact to the railway and reduced railway closures
- › Part of client putting-passenger-first mandate
- › Close engagement with asset owner NR to manage rail possessions to utilise overruns if necessary
- › Technical Solution enabled shorter closures later if needed.

RE-FURBISHMENT OPTION



RE-CONSTRUCTION



PRE-CURSOR WORKS

Dismantling works of the existing flyover were undertaken in 2020 using a Gottwald AK680 1200te crane (in the picture to the right) and 1000te & 750te cranes and 3D modelling was utilised to understand logistics and crane movements in a tight site environment.

This led the way for using 4D modelling for the re-build of the Bletchley Flyover in 2021.



BFO FLY THROUGH DURING THE DISMANTLING PHASE



DISMANTLING WORKS

(IN PICTURES)



RE-BUILD WEST COAST MAINLINE BOX

The re-construction of the flyover over the WCML was focused on using the 2021 May bank holiday disruptive possession (74 hours) to complete the following works:

- › Installation of 103 'Y' beams (They varied between 31-61 tonnes and averaging 26 metres in length)
- › Removal of 6no Overhead Line Electrification (OLE) structures

- › Re-registration of OLE for both slow and fast lines onto the newly installed 'Y' beams

Due to the complexity of the works, the logistics involved and the critical nature of the works, the project decided to use 4D modelling aligned with the traditional P6 primavera programme.



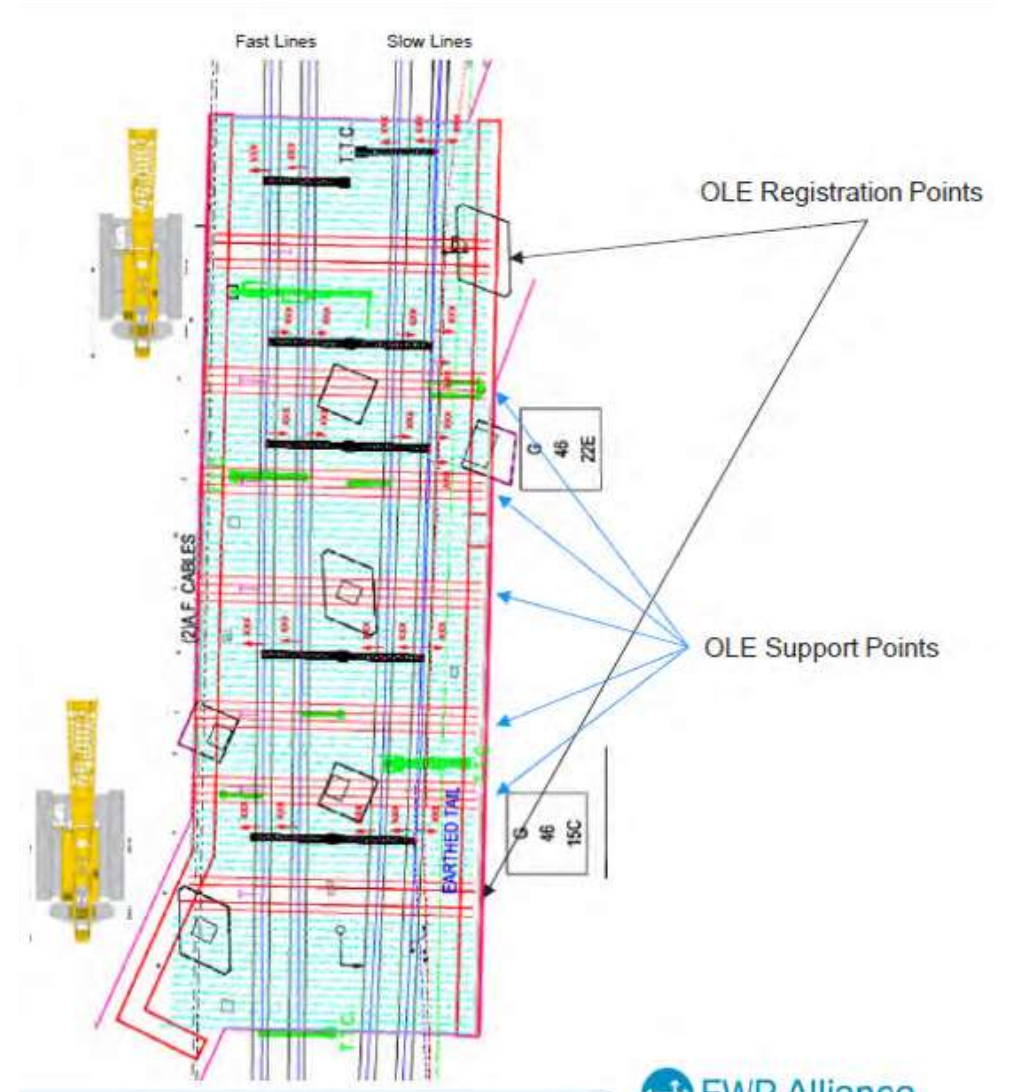
3D VIEW OF THE COMPLETED SCHEME

PLANNING & PREPARATION

The process commenced with a study of the relevant Civil & OLE design drawings and an establishment of a simplified beam numbering system.

The beams were numbered 1-103 from South to North and the 14 beams that support the OLE were identified.

A series of meetings was undertaken to identify key constraints with regard to OLE twin Track Cantilever removals (TTC's) and the sequence required for removals in relation to reinstatement of the OLE under the new beams.



PLANNING & PREPARATION

An initial programme was developed looking at the use of one crane to lift all 103 beams and remove 6 OLE TTC structures.

The programme quickly proved that there was insufficient time in the possession to use only one crane.

A two crane option was then developed which confirmed that the beam installation could be achieved, however the sequence of integration with OLE then had to be incorporated.

Cranes used in the installation of Beams

2x Lr1600-2 Crawler cranes (600ton)



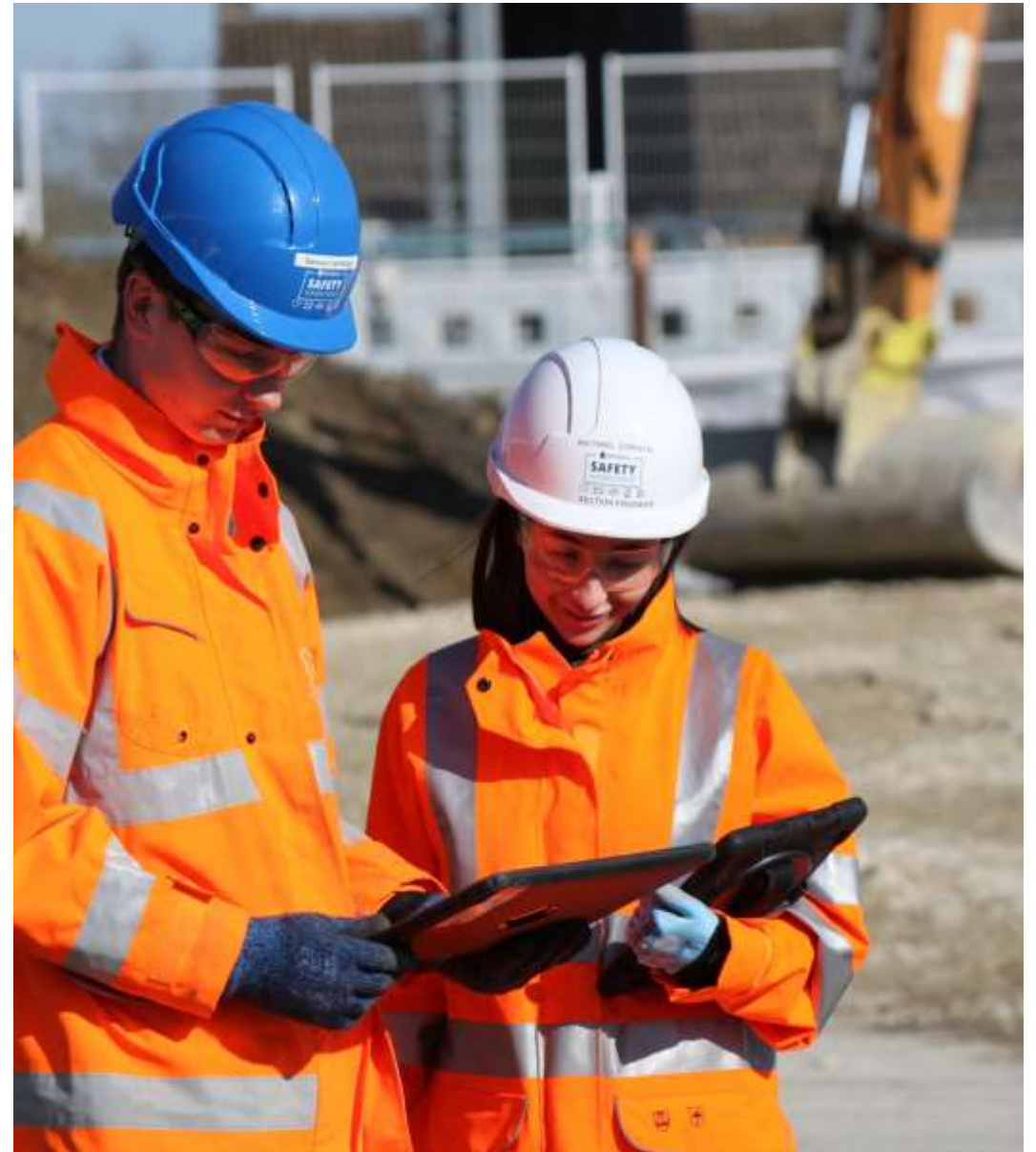
PLANNING & PREPARATION OVERVIEW

It was determined that there were two OLE registration points (4 beams in total) that had to be in place before the existing OLE TTC's could be removed

Different scenarios were tested for the sequencing of the beams to ensure the works were achieved on time and within the possession parameters (including the Network Rail required contingency levels).

Safety constraints were also considered early in the programme development process, an example being that the OLE team working under the installed beams could not be any closer than 6 beams behind the point where beams were being installed/lifted into place.

The programme allied to the 4D allowed visual proof that the co-ordination worked.



COLLABORATION BETWEEN TEAMS ON SITE

LIFTING TEAM



OLE TEAM



PLANNING TEAM

Activity Name	Duration	Start Date	End Date
Site Preparation	10:00	10/01/2017	10/01/2017
Excavation	10:00	10/02/2017	10/02/2017
Foundation	10:00	10/03/2017	10/03/2017
Structural Steel	10:00	10/04/2017	10/04/2017
Roofing	10:00	10/05/2017	10/05/2017
Interior Fit-out	10:00	10/06/2017	10/06/2017
Final Inspection	10:00	10/07/2017	10/07/2017

Working closely with the 4D Modeller the programme activities could be quickly downloaded via an XML file into Fuzor, the 4D software, and once the activities had been assigned to the model elements, different programme scenarios/options could be quickly modelled and reviewed by the team to see where issues/potential clashes needed to be resolved.

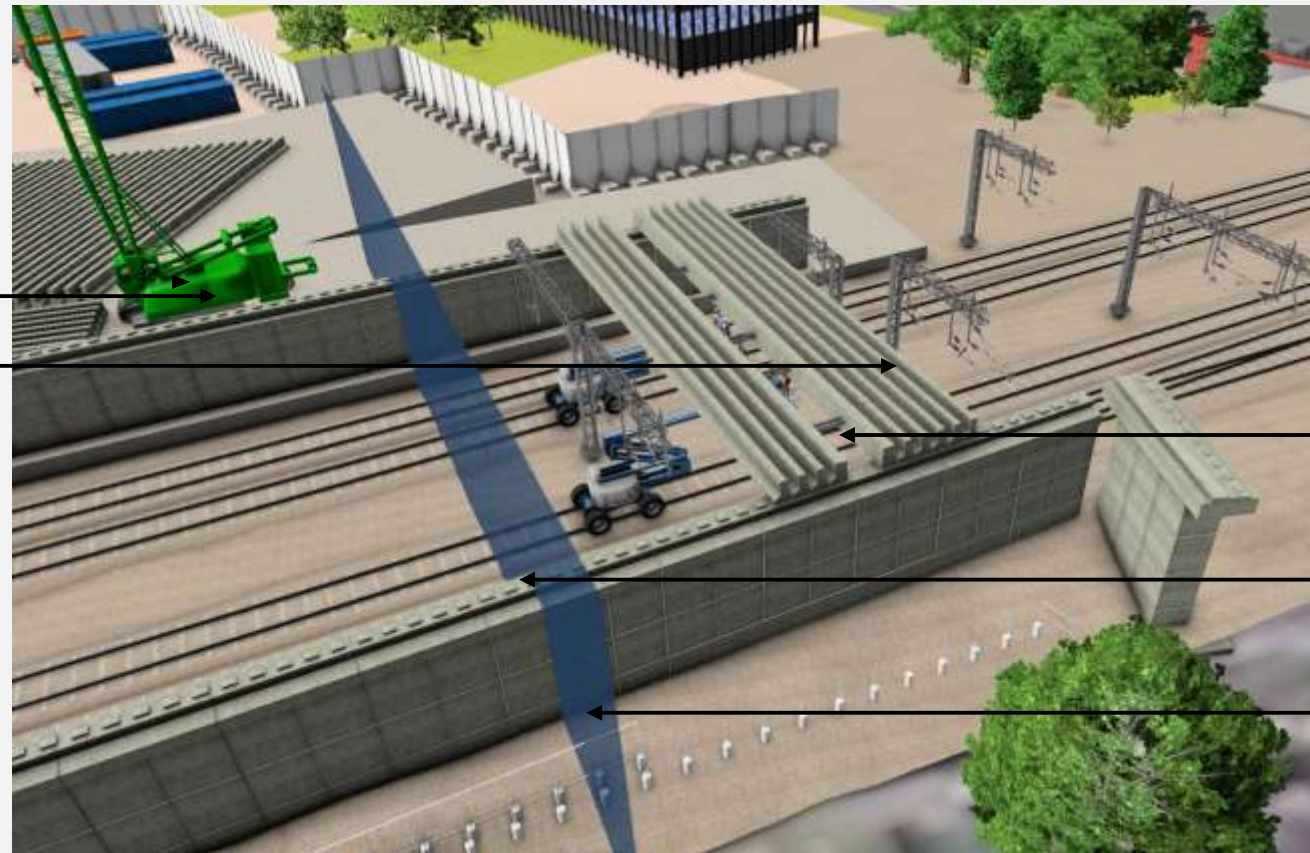
CRANE MOVEMENT LOGISTICS SIMULATION



BLETCHLEY FLYOVER, WEST COAST MAIN LINE, REBUILD

NORTHERN CRANE IS LIFTING BEAMS WHILE INSTALLING NORTHERN OLE REGISTRATION

Northern crane
position 2
Beam 96



Northern OLE
registration

Beam 75
location

Boundry between
OLE team and
lifting team

BLETCHLEY FLYOVER, WEST COAST MAIN LINE, REBUILD

SOUTHERN CRANE IS LIFTING BEAM-8 WHILE INSTALLING OLE SOUTHERN REGISTRATION

Southern crane lift
boundry position 2

Southern crane
position 2

Beam 8



Beam 9

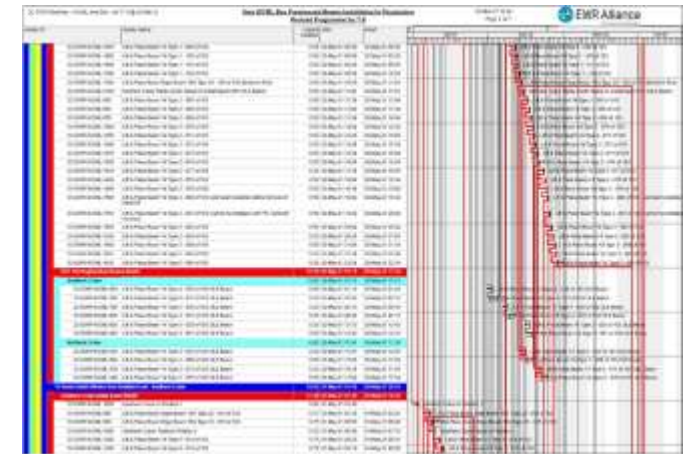
Southern OLE registration

Boundry between OLE
team and lifting team

BLETCHLEY FLYOVER, WEST COAST MAIN LINE, REBUILD

ALL ACTIVITIES FOR WEEK 5 POSSESSION

P6 Programme is Ready for 4D Model

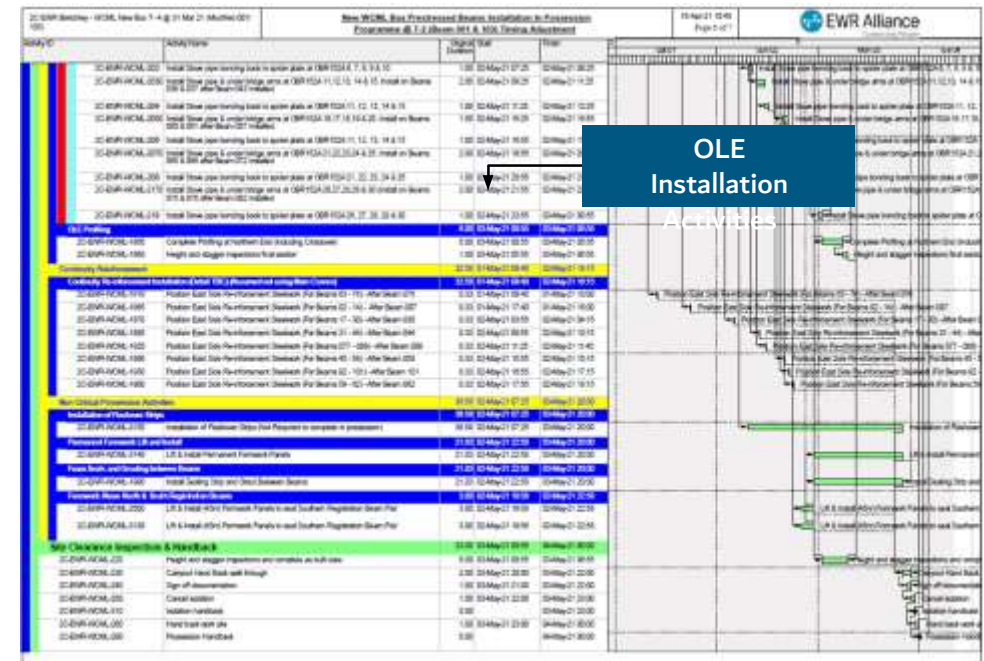
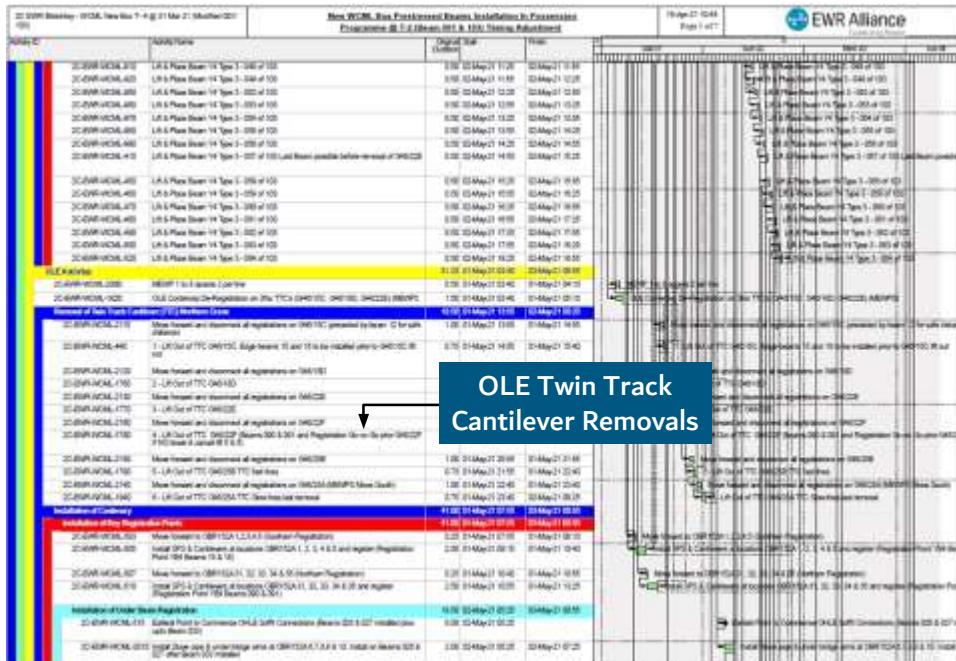


POSSESSION PROGRAMME

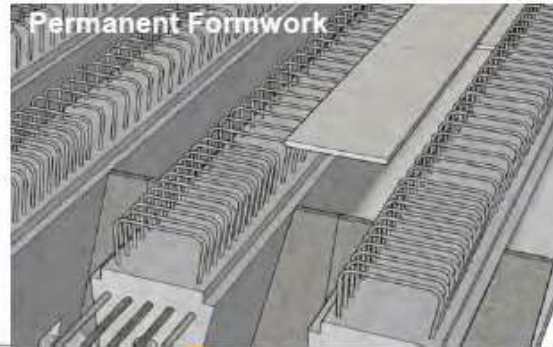
All Activities in Primavera driving 4D Animation

390 Activities in Total

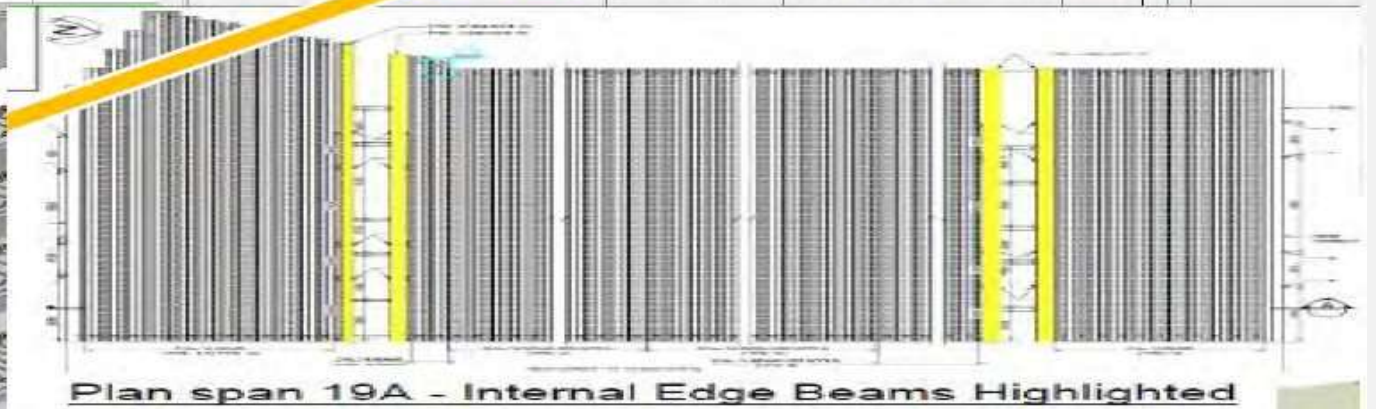
Directly downloaded via XML file to 4D Animation software -Fuzor 2021



- Non Critical Works



Activity ID	Activity Name	Original Duration	Start	Finish
Non Critical Possession Activities				
36.58 02-May-21 07:25 03-May-21 20:00				
Installation of Flashover Strips				
2C-EWR-WCML-3150	Installation of Flashover Strips (Not Required to complete in possession)	36.58	02-May-21 07:25	03-May-21 20:00
Permanent Formwork Lift and Install				
2C-EWR-WCML-3140	Lift & Install Permanent Formwork Panels	21.03	02-May-21 22:58	03-May-21 20:00
Foam Seals and Grouting between Beams				
2C-EWR-WCML-1990	Install Sealing Strip and Grout Between Beams	21.03	02-May-21 22:58	03-May-21 20:00
Formwork Above North & South Registration Beams				
2C-EWR-WCML-2500	Lift & Install (45nr) Formwork Panels to seal Southern Registration Beam Pair	3.00	02-May-21 19:58	02-May-21 22:58
2C-EWR-WCML-3130	Lift & Install (45nr) Formwork Panels to seal Southern Registration Beam Pair	3.00	02-May-21 19:58	02-May-21 22:58



REVIEW AND APPROVAL

- › Programme sequenced to provide optimal timings to complete all 103 beams
- › Query, what if one of the crane breaks down? Can we still install the 14 OLE Support Beams?
- › To de-risk the programme, it was agreed that the remaining 10 OLE support beams should be installed early in the sequence.

T-16 MEETING UPDATE

- › Peer Review held
- › Plan to be re-sequenced to install the 14 OLE support beams first

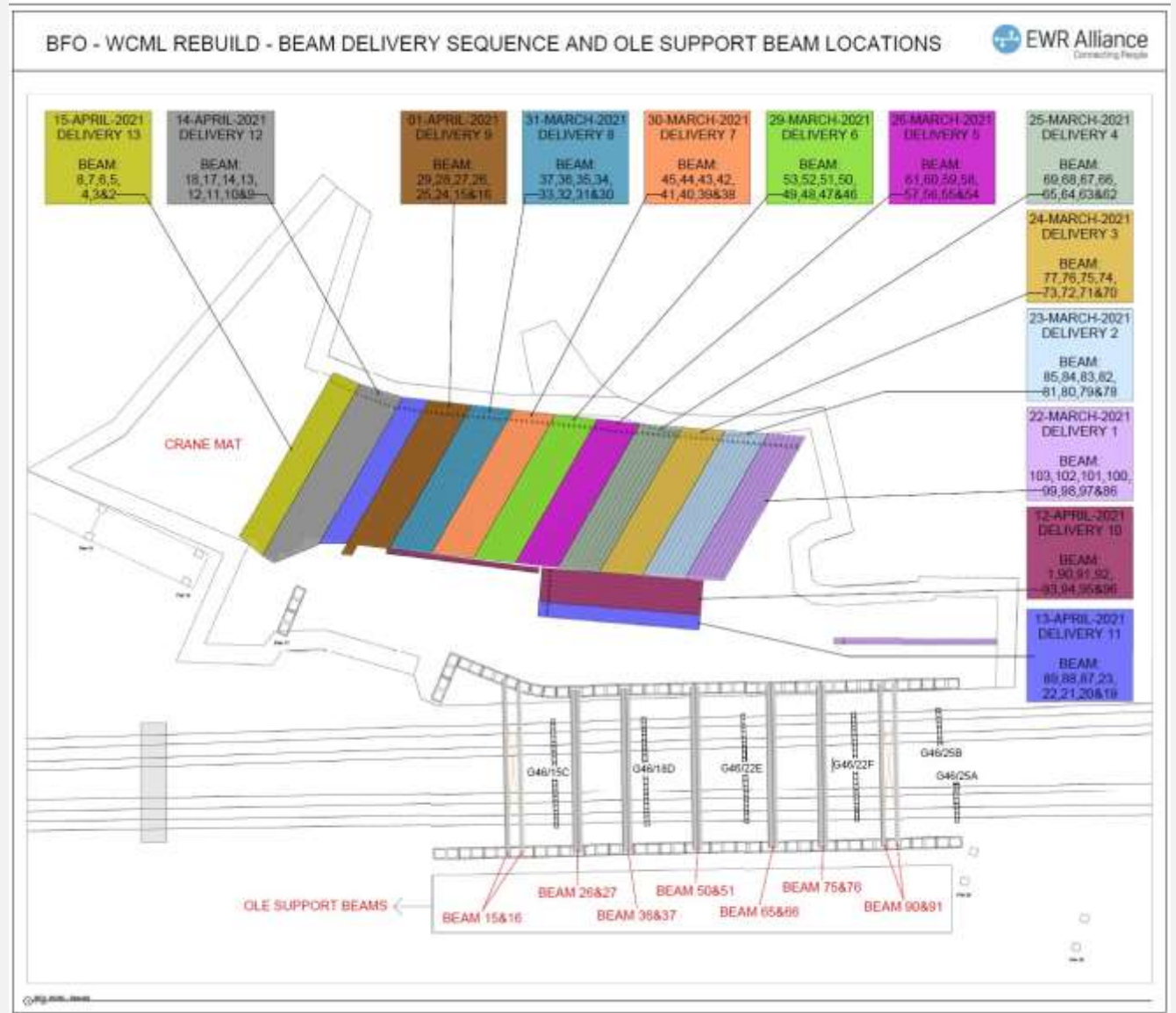
POST T-16 UPDATE

- › Lifting team is going to bring in bigger cranes (600t instead of 500t), this means the crane movement is going to be different and lifting time needed to be updated
- › Beam number 001 and 103 were going to be delivered later, a day before the possession.
- › Beam number 004 must be installed before 005 to provide support.
- › OLE team will be working in two different directions, 4 MEWPs each side.
- › Programme & 4D Model updated



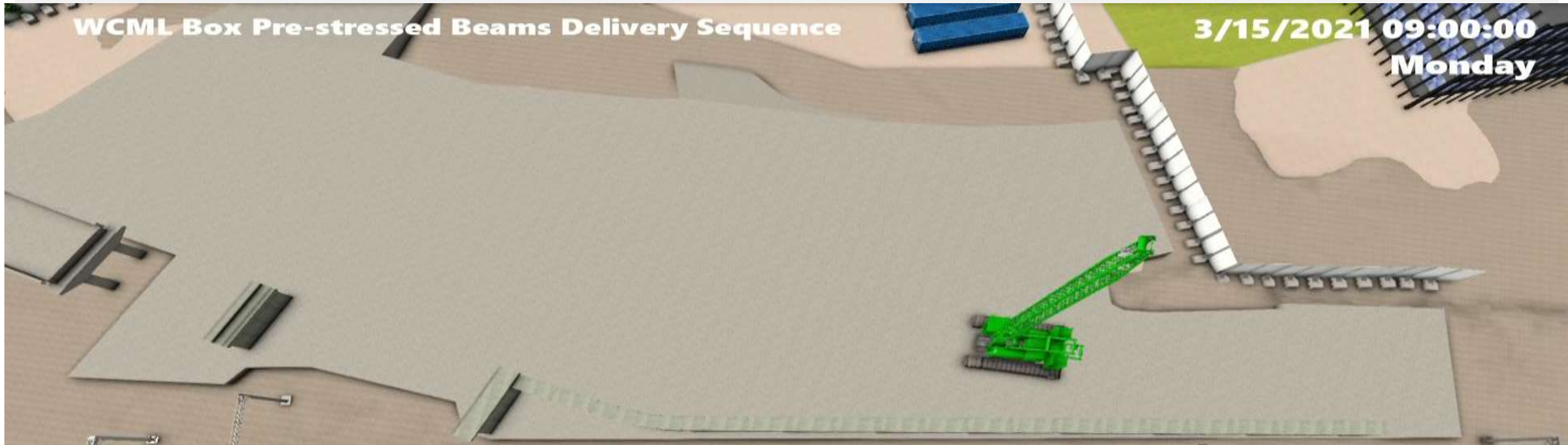
PLANNING & PREPARATION

Once the sequencing was confirmed it also enabled the confirmation of the sequence in which the 103 beams needed to be delivered into the laydown area in the weeks prior to the possession to support the installation and the optimised crane movements.



BLETCHLEY FLYOVER, WEST COAST MAIN LINE, REBUILD

BEAM DELIVERY SEQUENCE – 4D BIM VIDEO



ID	Name	Start	End
2C-WCML Beams.Northern Crane	Northern Crane	2/17/2021 00:00:00	2/17/2021 00:00:00
2C-EWR-WCML-1650B10	Northern Crane Delivered to Site	3/15/2021 09:00:00	
2C-EWR-WCML-1650B20	Northern Crane Assembly	3/15/2021 09:00:00	3/17/2021 09:00:00
2C-WCML Beams.1	Delivery 1 - 22 March 2021	2/17/2021 00:00:00	2/17/2021 00:00:00
2C-EWR-WCML-1740B	Lift & Place Beam Edge Beam YE4 Type 20 - 103 of 103 (Northern End)	3/22/2021 08:00:00	3/22/2021 09:00:00
2C-EWR-WCML-1700B	Lift & Place Beam Y4 Type 1 - 102 of 103	3/22/2021 09:00:00	3/22/2021 10:00:00
2C-EWR-WCML-1690B	Lift & Place Beam Y4 Type 1 - 101 of 103	3/22/2021 10:00:00	3/22/2021 11:00:00
2C-EWR-WCML-1680B	Lift & Place Beam Y4 Type 1 - 100 of 103	3/22/2021 11:00:00	3/22/2021 12:00:00
2C-EWR-WCML-1670B	Lift & Place Beam Y4 Type 1 - 099 of 103	3/22/2021 13:00:00	3/22/2021 14:00:00
2C-EWR-WCML-1660B	Lift & Place Beam Y4 Type 1 - 098 of 103	3/22/2021 14:00:00	3/22/2021 15:00:00

REVIEW AND APPROVAL

- › Programme re-sequenced
- › 4D model re-run
- › Reviewed and agreed by all parties
- › QSRA run – facilitated by the 4D modelling to confirm the works would be completed within the possession timescales

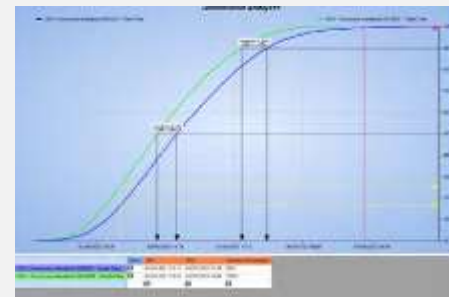
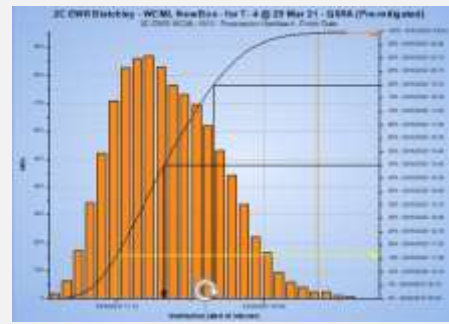
T-4 READINESS MEETING UPDATE

- › Approved



POSSESSION PROGRAMME CRITICAL PATH – 13.28 HRS FLOAT + 4HRS DWWP – FULL QSRA

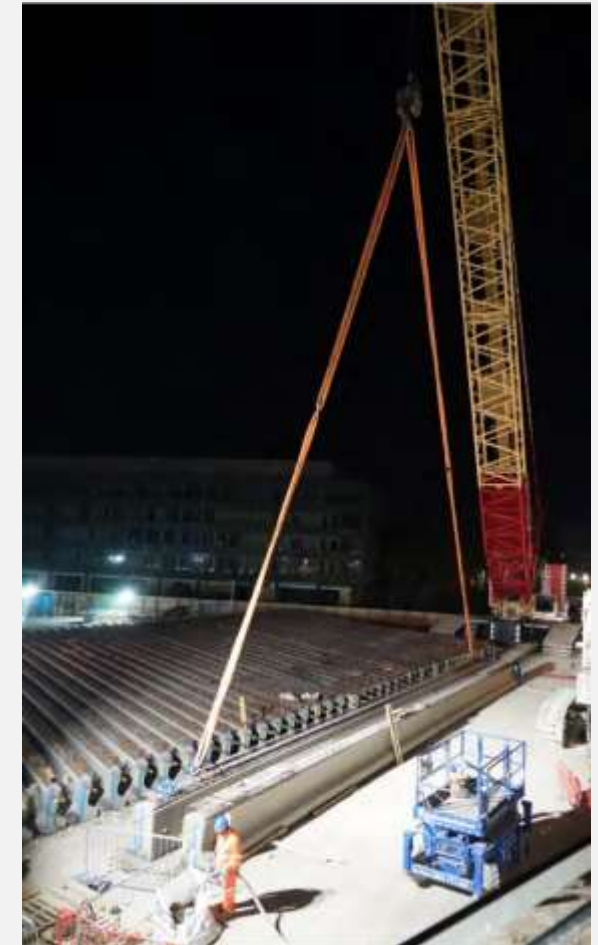
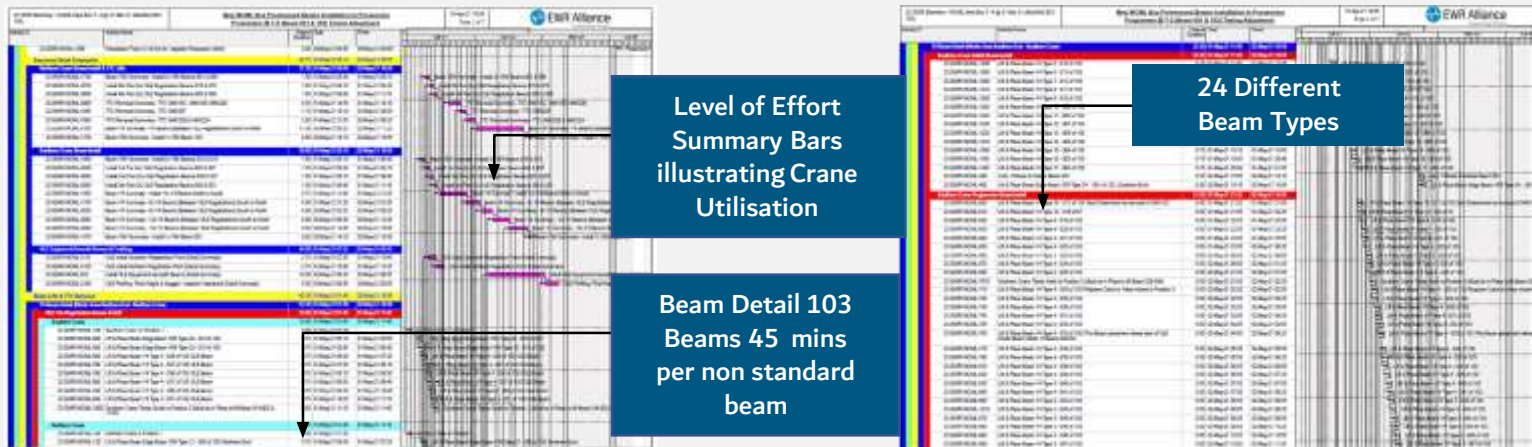
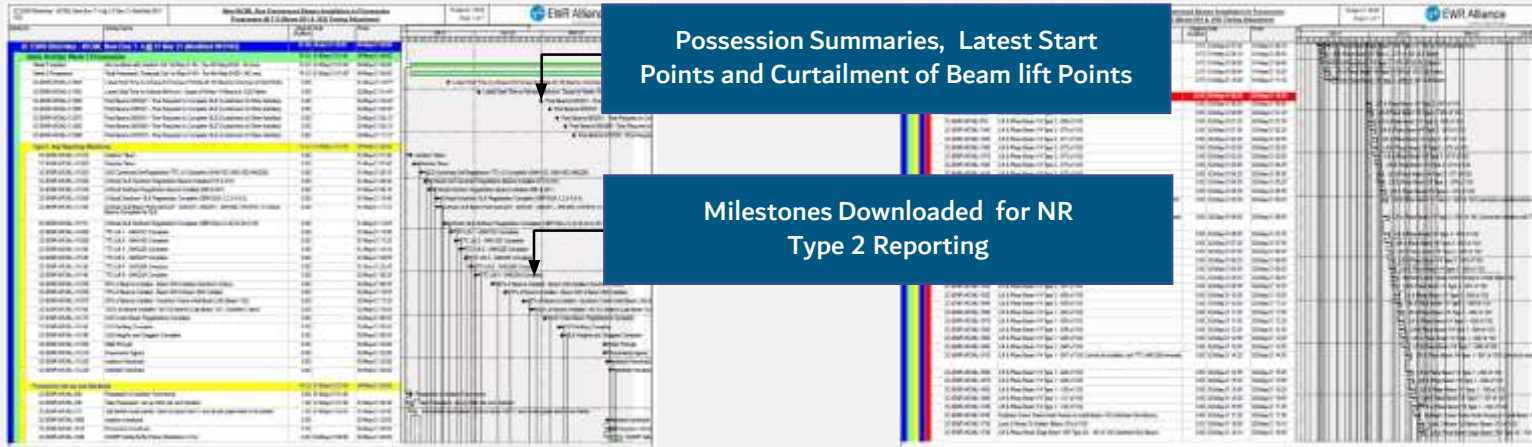
PROGRAMME FLOAT TIME USED TO PROGRESS NON-POSSESSION CRITICAL ACTIVITIES



QSRA RESULTS AS FOLLOWS

- P50 - 15:00 on 3 May
- P90 - 21:15 on 3 May
- P99 - 04:00 on 4 May

POSSESSION PROGRAMME



BLETCHLEY FLYOVER, WEST COAST MAIN LINE, REBUILD

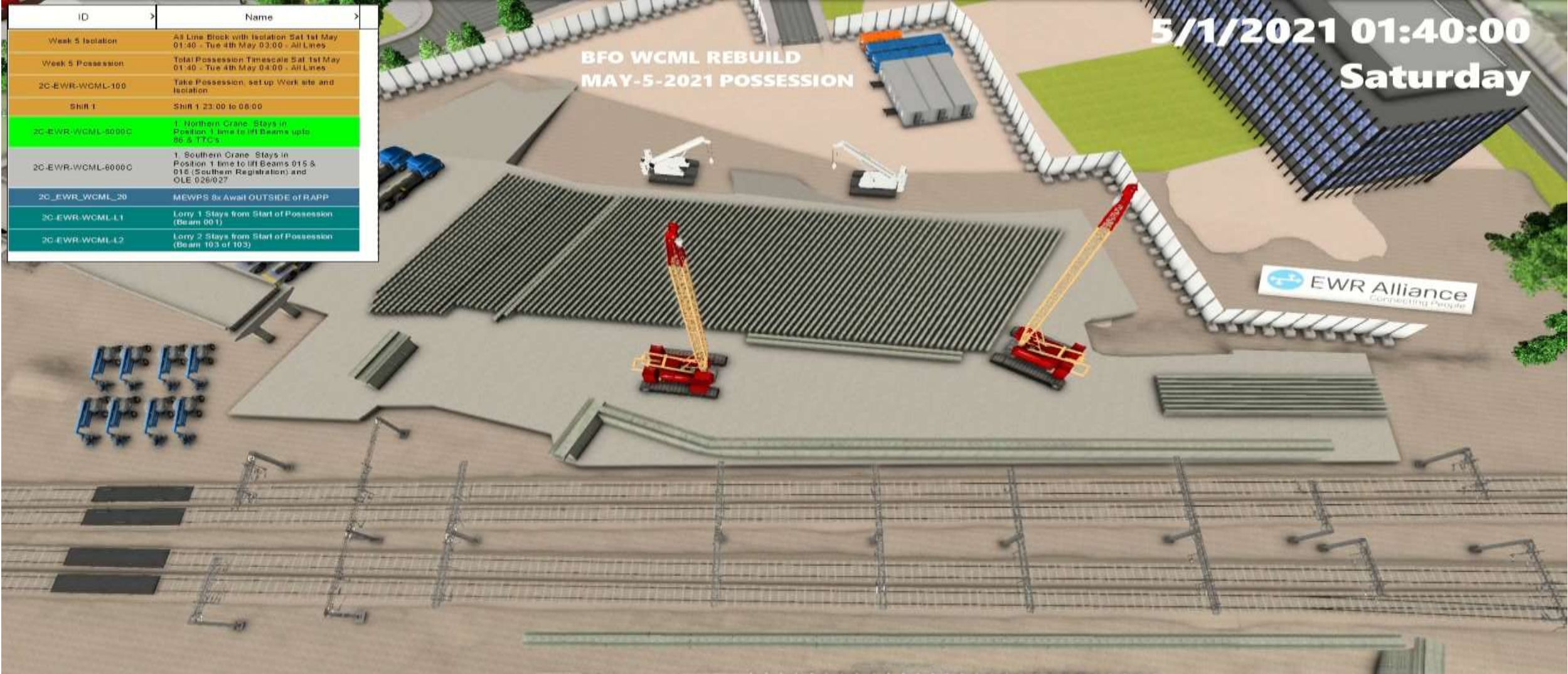
SET UP PRIOR TO POSSESSION



BLETCHLEY FLYOVER, WEST COAST MAIN LINE, REBUILD

ALL ACTIVITIES FOR WEEK 5 POSSESSION

ID	Name
Week 5 Isolation	All Line Block with Isolation Sat 1st May 01:40 - Tue 4th May 03:00 - All Lines
Week 5 Possession	Total Possession Timescale Sat 1st May 01:40 - Tue 4th May 04:00 - All Lines
2C-EWR-WCML-100	Take Possession, set up Work site and Isolation
SHIFT 1	SHIFT 1 23:00 to 08:00
2C-EWR-WCML-5000C	1. Northern Crane. Stays in Position. 1 time to lift Beams upto 86 & TTC's
2C-EWR-WCML-6000C	1. Southern Crane. Stays in Position. 1 time to lift Beams 915 & 916 (Southern Registration) and OLE 026/027
2C_EWR_WCML_20	MEWPS 8x Await OUTSIDE of RAPP
2C-EWR-WCML-L1	Lorry 1 Stays from Start of Possession (Beam 001)
2C-EWR-WCML-L2	Lorry 2 Stays from Start of Possession (Beam 103 of 103)



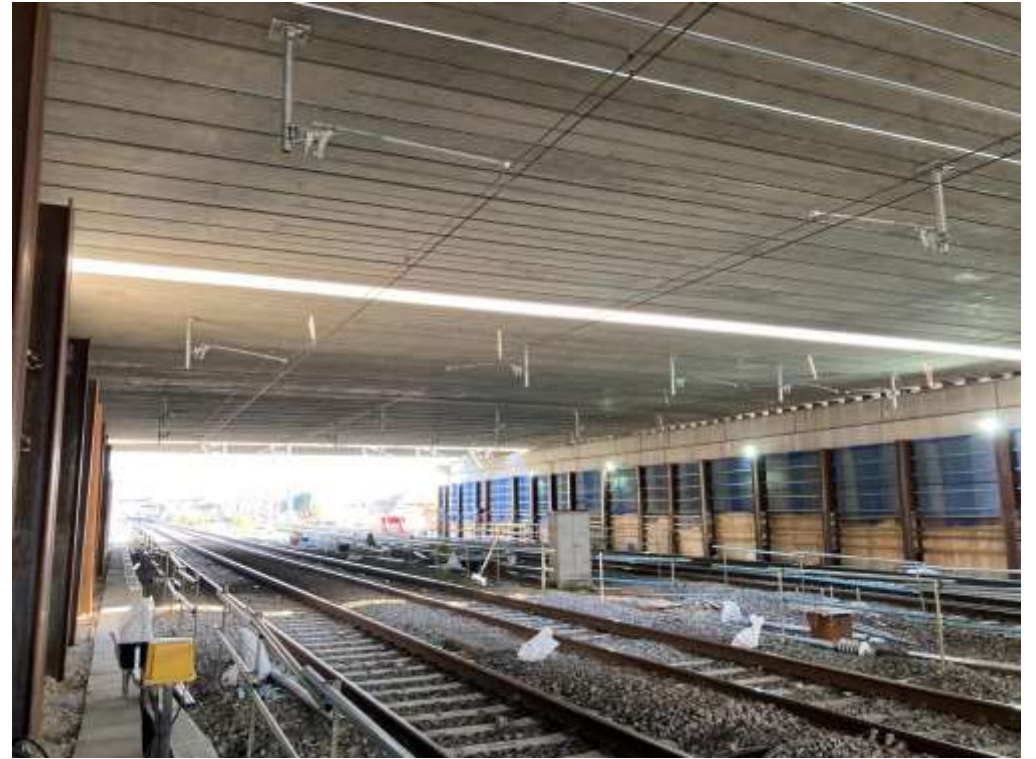
BLETCHLEY FLYOVER, WEST COAST MAIN LINE, REBUILD

TWO CRANES OPERATING TOGETHER



BLETCHLEY FLYOVER, WEST COAST MAIN LINE, REBUILD

COMPLETED WORKS



BLETCHLEY FLYOVER, WEST COAST MAIN LINE, REBUILD

EWR ALLIANCE WASH-UP MEETING AFTER THE POSSESSION BY JEFF BOOTH (PROJECT LEADER)

Successful delivery founded on good planning, briefing and execution of the plan...

- › Detailed planning commenced in earnest one year ahead of the works
- › 4D model properly utilised to review the multi-disciplinary plan - driven from P6 programme
- › 8 DWWP Sessions from T-40 to T-1
- › Specific ALT briefings to allow challenge to plan
- › Alliance Partners Operational Peer Review



CONCLUSION

WORKS SUCCESSFULLY COMPLETED DURING THE POSSESSION – LAST BEAM LANDED ON SUNDAY AT 20.50 (TARGET ACHIEVED), 31 HOURS AHEAD OF POSSESSION HANDBACK PROGRAMME

By providing an integrated and highly visual view of the works, the project was able to successfully complete the works and whilst the P6 primavera programme was instrumental in planning the works, without the 4D modelling we would have been unable to:

- › Agree and validate on an optimised sequencing of the works
- › Undertake clash analysis and avoid clashes on site during the possession and potential conflicts
- › Ensure safety exclusion zones were adequate and briefed
- › Fully brief everyone on the sequencing and ensure understanding
- › Fully de-risk the programme
- › Gain full buy-in from the leadership team and stakeholders

Achieving the works during the possession meant:

- › No delays to the re-opening of the WCML (which can result in millions of pounds of charges!)
- › Project remains on programme to achieve its completion date thus avoiding EOT costs
- › No additional possessions required saving £k's
- › No loss of reputation (reputation increased)
- › Confidence and motivation for completion of the remaining works



A night sky photograph featuring a prominent, blue-tinted Milky Way galaxy stretching across the center. The galaxy is composed of numerous stars and interstellar dust, appearing as a bright, hazy band. The background is a deep, dark blue, densely populated with individual stars of varying magnitudes. The overall scene is a vast, star-filled expanse of the universe.

Q & A



THANK YOU



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