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# 2017 DIGITAL CONSTRUCTION AWARDS

## MINWORTH THP

*MWHT submitting this project in competition to demonstrate 4D planning and delivery capability.*

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# MINWORTH THP

## Minworth THP – all about

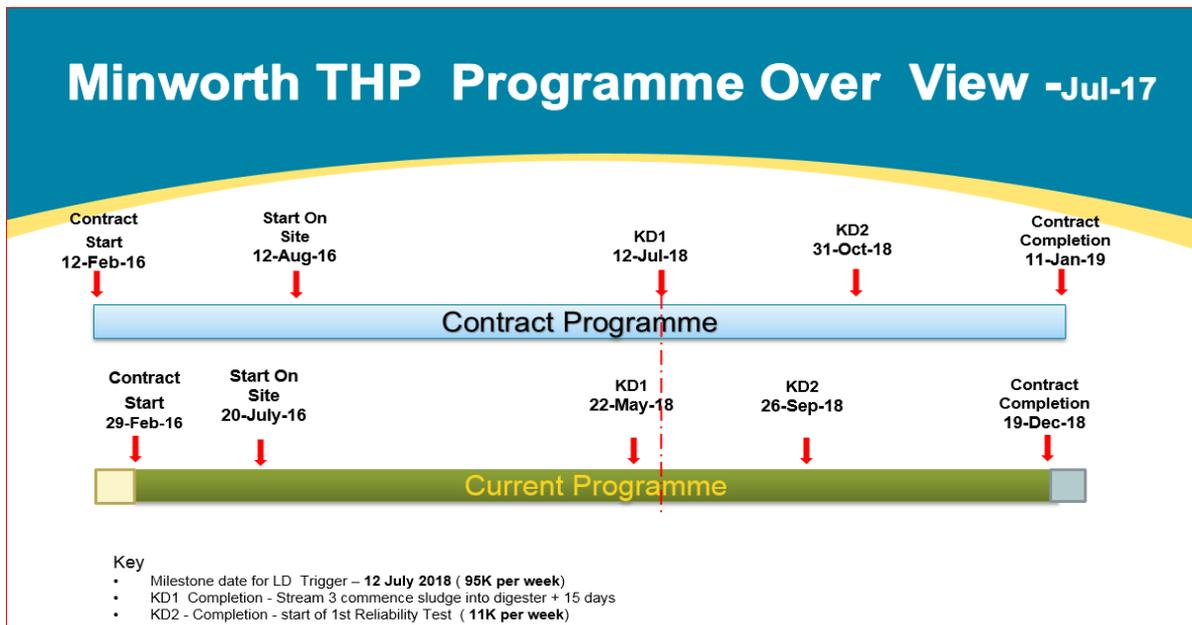
### PROJECT HIGHLIGHTS

The Minworth THP will process up to 250 tonnes of sludge per day, making it one of the largest installations in the UK. The THP process will provide significant benefits such as increased biogas yield and enhanced product (pathogen free sludge cake), generating revenue and reducing Opex. It will also reduce Severn Trent Water's carbon footprint, improve dewaterability of the sludge cake, and eliminate pollution risk from the existing Coleshill sludge main.

### FINANCIAL HIGHLIGHTS

The Severn Trent awarded MWH Treatment the contract to design and construct the Minworth Thermal Hydrolysis Plant (THP) valued at just under £40 million (CAPEX).

### PROGRAMME HIGHLIGHTS



### DESIGN AND CONSTRUCTION HIGHLIGHTS

The plant consists of three streams of Cambi B6(4) THP modules and the subcontract being executed simultaneously with the Main Contract, to allow manufacture to commence. The team have been on site since August 2016. The emphasis has been on design for manufacture and assembly (DfMA) with all major process

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units being pre-assembled in factory conditions to minimise site works. The complex installation interfaces are managed using the Synchro Pro 4D software platform. The entire project is 3D modelled and laser scanned.

The 4D tools are used extensively on specific areas of work such as the CAMBI THP installation, DUNPHY Boiler installation, Centrifuge installation and pipework installation. Augmented reality ALM was used in the digester galleries, which is a confined space.

Synchro has been used for status reporting on Design, Procurement and Construction. Synchro simulations have been used in 4D digital rehearsals. Construction completion is scheduled for October 2017 followed by a long commissioning period to convert the 12 digesters to hydrolysed sludge. Finally, there are performance and reliability tests with handover forecast for Jan 2019.

## 4D Planning – Procurement

The implementation of 4D planning approach using Synchro has been used to enhance the visual progress of procurement activity. This has resulted in improving the efficiency of procurement monitoring and progress of offsite manufactured kit. The main benefit realised is that the team has been able to monitor the progress of kit being manufactured off site. The information from expeditors report from various factory visits were used to update progress on the Synchro programme. The Resource status updates helped in ensure the offsite manufactured kit was on programme and the delivery of these equipment could be tracked regularly.

This approach of 4D planning has allowed greater collaboration between the project team, supply chain and client:



Fig1. Procurement update as on May17 showing status of various equipment

## 4D Planning - Construction

The implementation of 4D planning approach has been used to reduce the overall program durations, reduce H&S risks by use of digitally rehearsal; enhance the quality of program visualization, reduce design changes and reduce clashes during construction processes.

Synchro tools have been effective used in this project throughout the complete life cycle from initial design and procurement phase; all the way to demonstrating construction/installation and commissioning sequence. During the construction/ installation phase the Synchro simulations allowed enhanced collaboration between the project team, supply chain and client to agree the sequence for delivery of equipment to site.

Assembly of CAMBI THP and Dunphy Boiler assembly where digitally rehearsed with the site team and installation subcontractor to ensure the team were aware of the H&S aspects, sequence of installation and other onsite activities. This resulted in substantial reduction in site installation times. No H&S incidents; sufficient time to design and complete temporary works. Onsite efficiency for concurrent working and reduced traffic movements on site.



Fig 2. Cambi Supervisor and MWHT team reviewing install sequence

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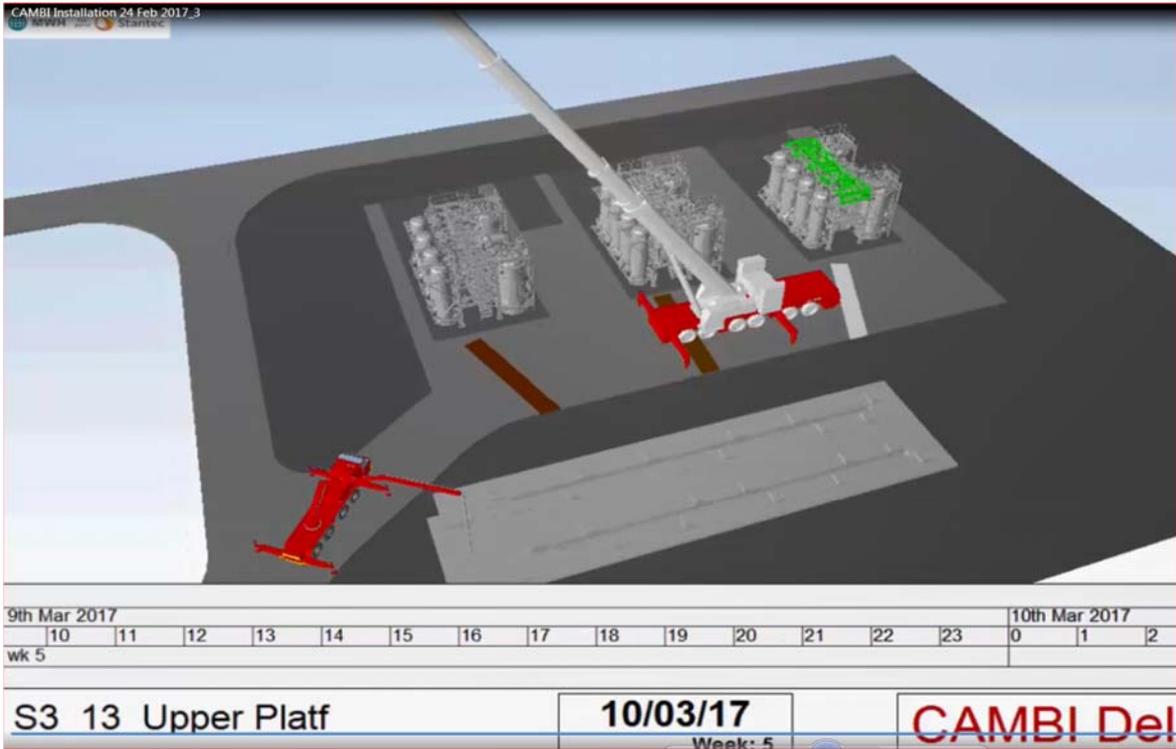


Fig 2 Final Installation sequence on Synchro identifying opportunity for concurrent working



Fig3.Digital Rehearsal with MWHT Site Manger and CAMBI Installers prior to starting on site

The main benefits of undertaking Digital Rehearsals on the Minworth THP project are that it provided the team certainty of programme delivery (removing surprise elements), has given confidence to the project team, and has significantly reduced the need for rework on site (by up to 80%). In addition, it helped rationalise the temporary works requirements, minimised the site based changes that increase the likelihood

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of a safety incident taking place, and has saved time and cost through optimisation and coordination of delivery and crainage at site.

Synchro 4D has benefitted the project delivery by:

- Reduction of rework (by up to 80%),
- Reduction of potential risk,
- Avoidance of near miss and H&S hazards (over 250 days without a lost time incident),
- Improved quality,
- Better coordination,
- Clash avoidance,
- Interface management,
- Earlier resolution of issues.

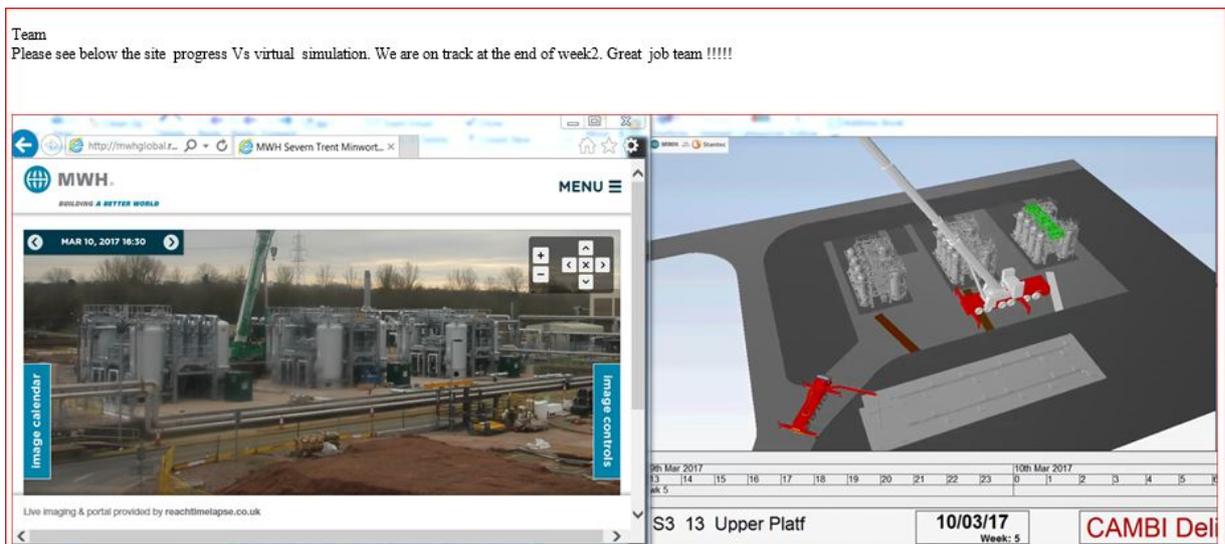


Fig 4. CAMBI THP Onsite camera with progress end of week 2 Vs Synchro simulation end of week 2

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Fig5. Dunphy Boiler Onsite camera with progress end of day 2 Vs Synchro Simulation end of day 2

Real incentives have been recognised in delivering this project with Synchro Pro 4D ahead of the programme to realise increased benefits. There is a commitment from all to explore and promote new ideas in the live project environment even though many are working outside their comfort zones. This has led to the new learnings for team members. There is a greater level of confidence in adopting the new age digital tools.

Sub Contractor	Equipment Name	Original Installation Duration in days	Actual Installation Duration in days	Difference in days
CAMBI THP	Thermal Hydrolysis Plant	30	13	↑ 17
Dunphy Boilers	Boilers	5	4	↑ 1
Alfa Laval	Centrifuge	10	3	↑ 7

Table 1. Improvement in installation Duration

## 4D Planning - Health and Safety

Reducing H&S risks on site is always at the forefront of our minds and Digital Delivery is helping to further reduce these risks:

### DESIGN FOR MANUFACTURE AND ASSEMBLY (DFMA)

DfMA is an innovative construction method where precast concrete structures and/ or mechanical and electrical plant installations are intentionally designed in modular sections that are manufactured and tested off-site in a controlled environment before being transported to site for easy assembly. Synchro has enabled the information to be compiled quickly and accurately and shared in a way that isn't possible using paper.

The simulation created early on in the project using Synchro have helped in finalising the size of cranes that will be required for a safe operations. The use of DfMA coupled with Synchro capability to simulate the installation and traffic plans have played a significant part during procurement decision making for boilers. The result of these simulations helped in reduced onsite construction /installation times significantly. Thus reducing the H&S safety risk such as working at heights, reduced number of people onsite. Reduced impact of weather. Reduced number of transport vehicle movements for delivery. Ensure the duration of cranes required on site is limited. Reduce number of active construction zones. Eliminate the need for temporary work as the permanent works could be designed to accommodate cranes.

Sub Contractor	Equipment Name	Traditional Onsite Build Duration in days	DfMA Actual Onsite Build Duration in days	Difference in days
<b>CAMBI THP</b>	Termal Hydrolysis Plant	132	30	↑ 102
<b>Dunphy Boilers</b>	Boilers	155	15	↑ 140
<b>Alfa Laval</b>	Centrifuge	34	3	↑ 31

Table 2: Reduction in onsite times from traditional onsite build vs DfMA times

This decision has resulted in no onsite lost time incidents as of August 2017. All major DfMA equipment are now installed on site.

## VIRTUAL REVIEWS OF SAFETY, ERGONOMICS AND GENERAL ACCESSIBILITY

- 4D planning approach has enabled the site operations team, to get a first-hand perspective of our design intent in advance of it being built. This is really valuable as it gives the opportunity to review the proposed installation in context and feedback raised can then be incorporated at minimal additional cost. We have used augmented reality technique to review design in the Digester gallery area. The digester gallery requires significant modification during the THP construction phase and the ability to take detailed measurements and assess access by all the design team, remotely has given significant program savings and reduce the need for multiple visit in to confined spaces.

### Innovation Bulletin

SEVERN  
TRENT  
WATER

6th March 2017  
Ref: TS10529

#### Thinking Outside of the Virtual Box

**Brief description**

As part of our digital applications approach on the Minworth Thermal Hydrolysis Plant (THP) project we have used HoloLens headset technology to run an Augmented Reality Access Lifting & Maintenance (AR ALM) review.



This has proved to be an exciting enhancement of how we can use emerging technologies to support our design processes and digital platform offering.

**Benefits**

The AR approach used has enabled the site Operations team, one of the key stakeholders who will ultimately inherit the asset we are designing, to get first hand and first person perspective of our design intent for a particularly challenging area, in advance of it being built.

This is really valuable as it gives the opportunity to review the proposed installation in a way that is not normally possible and any feedback raised can

then be incorporated as appropriate at minimal additional cost.

This is a really positive step forward for improved engagement with the Operations team as well as achieving agreement of the design.



**Details**

This approach is an extension of our Virtual Reality (VR) capability. Using the 3D model which has been developed for the project we extracted and loaded the new digester recirculation pump assets and associated pipework onto the HoloLens headset system. This was then referenced geospatially relative to the existing digester gallery corridor where the heat exchangers, pipework and pumps are being retained.

The result of this enables the headset wearer to understand exactly where the new assets (shown virtually) are proposed to be fitted, giving a really valuable contextualisation of the overall 'as installed' picture in the physical location of where the equipment will ultimately be fitted.

Seek and Share Standards

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## RIGHT FIRST TIME

- Most accidents on construction sites occur where there is a change to the original plan and rework is undertaken. Office based digital rehearsals of installation sequences, in 3D and 4D environments, reduces the number of unplanned changes at site therefore minimizing the risk of accident. It is also a powerful tool for formulating the methodology and communicating it to the site team in the task briefing.

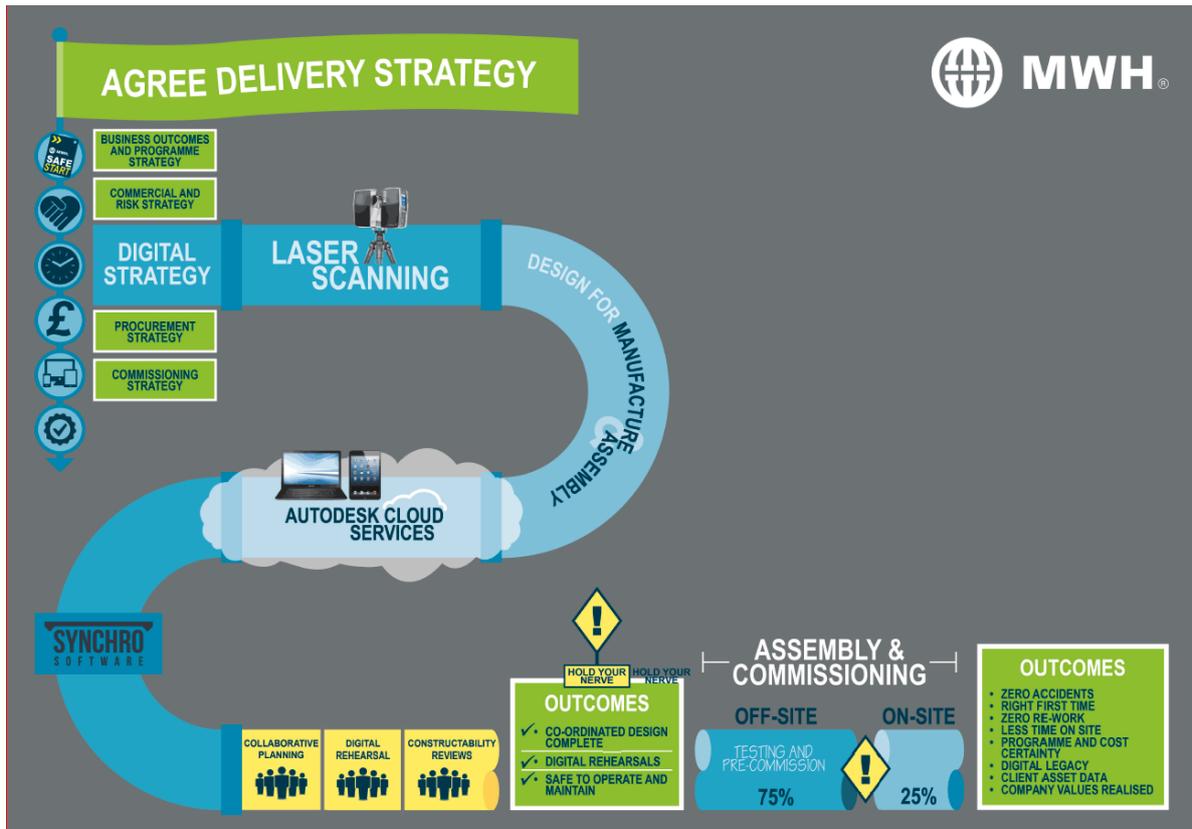
*“The use of the BIM 3D modelling software has proven to be extremely beneficial when engaging with the Operational and Maintenance end user teams. 3D representations of the proposed layout of the plant are posted at key points of congregation at site for the teams to review and post comment on to feedback. The Minworth THP design teams have also attended the Site team meetings and ‘Comm cells’ to present developments and updates at regular intervals to secure the ongoing engagement that is essential to transition the O&M teams through the processes that will lead to the new THP plant being brought into service. Feedback has been extremely positive.”* **David Nyul, Severn Trent Water Programme Manager, Asset Creation**

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## 4D Planning - Workflow

### STRATEGY

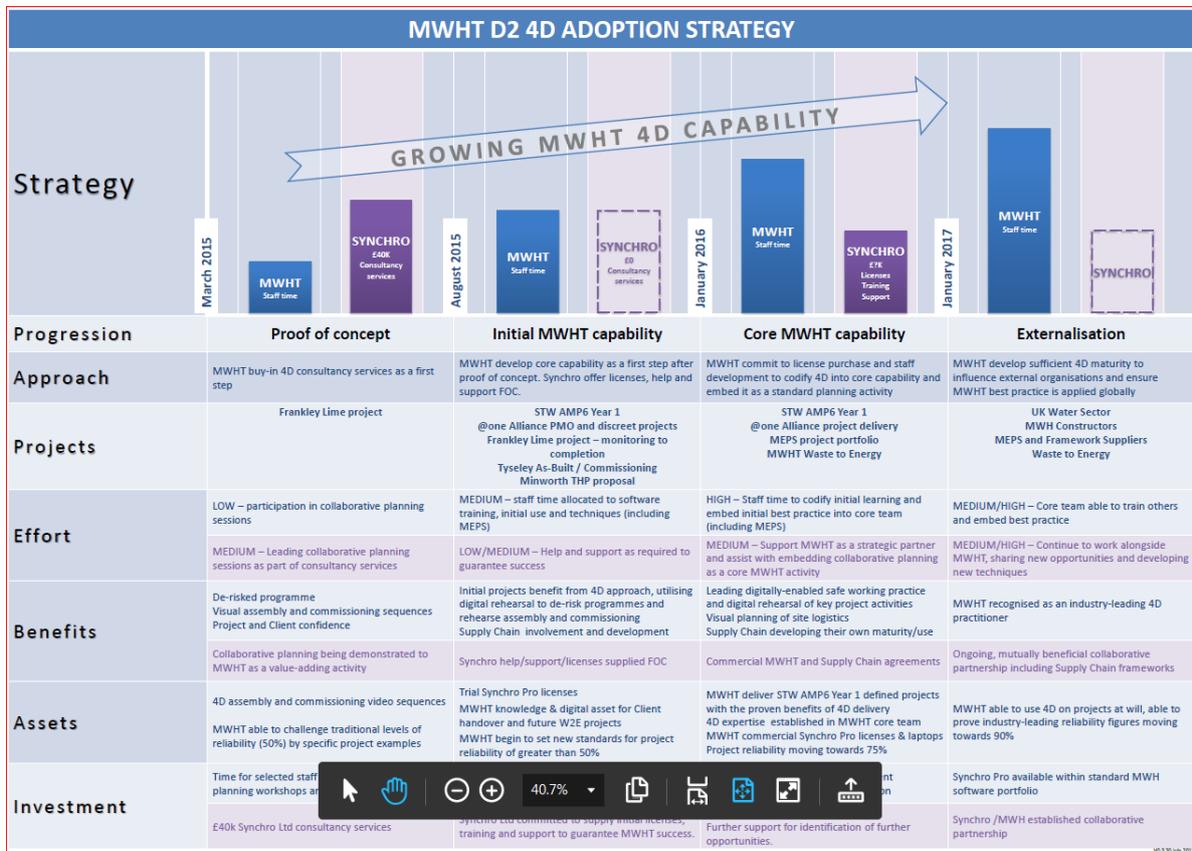
The S- pipe figure below depicts the Digital delivery strategy for MWHT. Synchro takes a significant integrator role in delivering the outcome.



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## GROWTH PLAN

A growing wealth of evidence from across the global engineering sector, including the UK water sector, shows the successful application of Digital Delivery during asset creation enables substantial efficiencies to be made over a more traditional 'design and build' approach. The below figure shows the Development plan for MWHT 4D Capability.



## 4D Planning – Case Study



### MINWORTH THP PROJECT ACHIEVES KEY MILESTONE

The Minworth THP Project achieved a key milestone on 27 February 2017 with the commencement of the delivery and installation of the Cambi B6(4) modules.

This operation had been planned with military precision including detailed load schedules and 4D synchro digital rehearsals. It is impressive to note that Cambi have manufactured and assembled the three streams valued at £8 million in just 12 months.

This is a great example of the DfMA approach with three weeks to position the modules followed by six weeks to complete site mechanical and electrical installation. The benefit of the standard design is that the installation team have experience in installing the same equipment from numerous sites. These photos show progress made in three days!



The design and construction of the civil works to the THP base slab involved demolition of a redundant sludge tank, backfilling with 25,000 tons of structural fill, underground drainage/process pipework and a myriad of electrical ducts! The designers and construction team have worked tirelessly to achieve the stretch programme and sub-contractors, Drapers and Bell Formwork, have performed very well. The BIM approach has helped the collaborative team to visualise the structures and manage the interfaces.

Congratulations to the Minworth team and Cambi for an incredible effort to get to this stage having only been on site since August (seven months)!

Well done to every member of the team and thanks for all the hard work.



## Over all Program simulation

CAMBI THP installation

Dunphy Boiler installation -<https://youtu.be/Seu7jyd-Ie0>

Alfa Laval Centrifuge installation

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