

Deep Basement Excavation in Cambridge - Park Street Case Study

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1. Proposed Development

Card Geotechnics Limited (CGL) was engaged by Dawson Wam (DW) and Gilbert Ash (GA) to **design** the retaining walls, associated temporary works, as well as excavation/construction sequencing and Ground Movement Analysis (GMA), required to enable the construction of what is understood to be the **deepest basement** in Cambridge to date.

The proposed development comprised the demolition of an existing multi-storey car park and construction of a new six-storey hotel building with a three-storey basement up to **13m deep**.

A number of **sensitive assets / constraints** are present around the basement, including party walls, neighbouring listed structures, Park Street and Round Church Street.

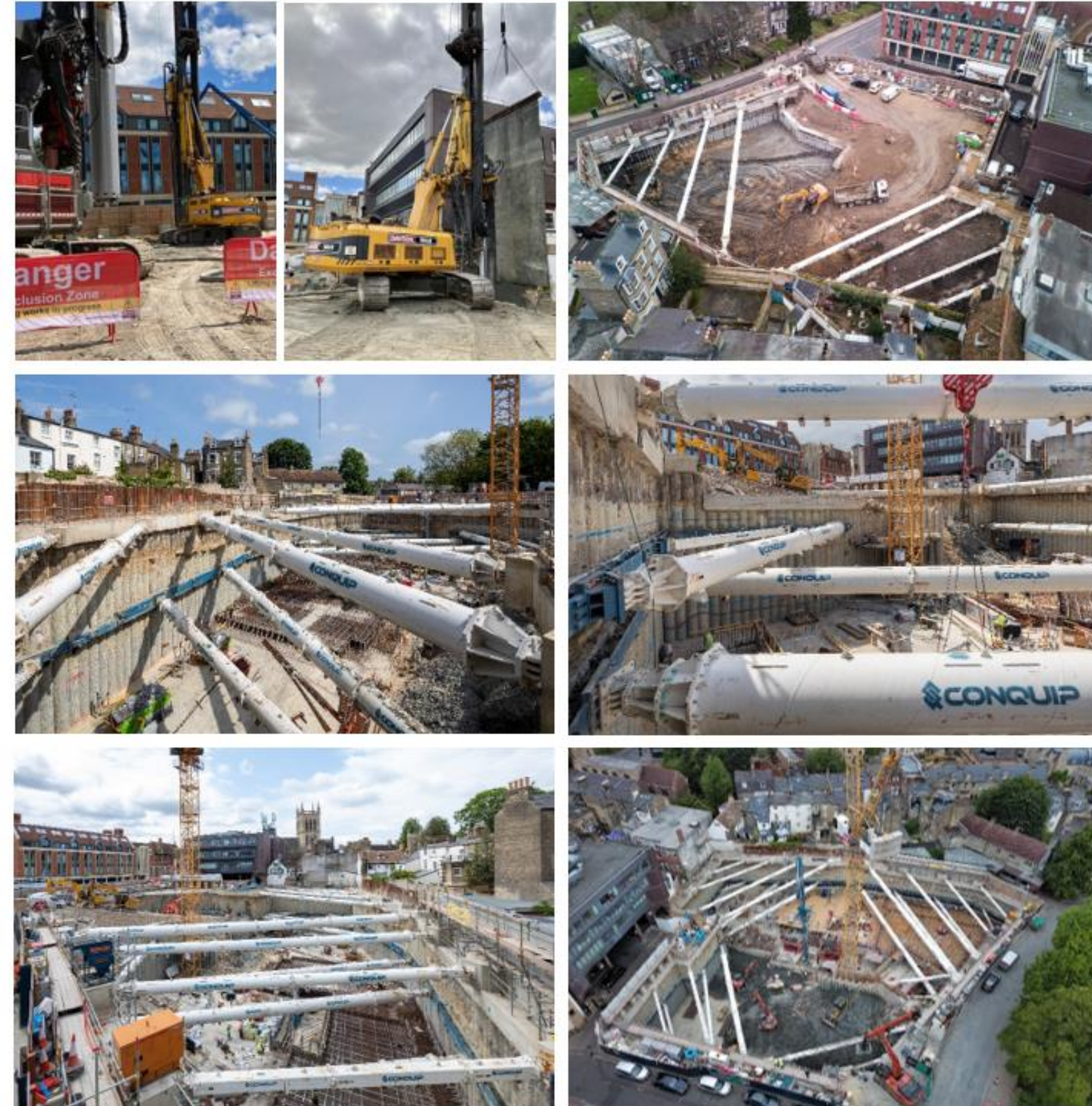


Figure 1. Basement Piling, Excavation and Propping

2. Geological Context

Ground conditions on site comprised a variable thickness of predominately granular Made Ground and River Terrace Deposits (~4m thick) underlain by **Gault Clay**. Groundwater was approximately 2.5m below ground level.

CGL characterised the underlying soils using laboratory and insitu testing, as well as relevant literature¹ to derive '**moderately conservative**' design parameters, particularly for retaining wall analysis where the strain level² of 0.01% and 0.1% is appropriate.

Potential variation in ground conditions locally associated with the '**Kings Ditch**³' was **de-risked** through sensitivity analysis on potential design implications of this feature on relevant sections.

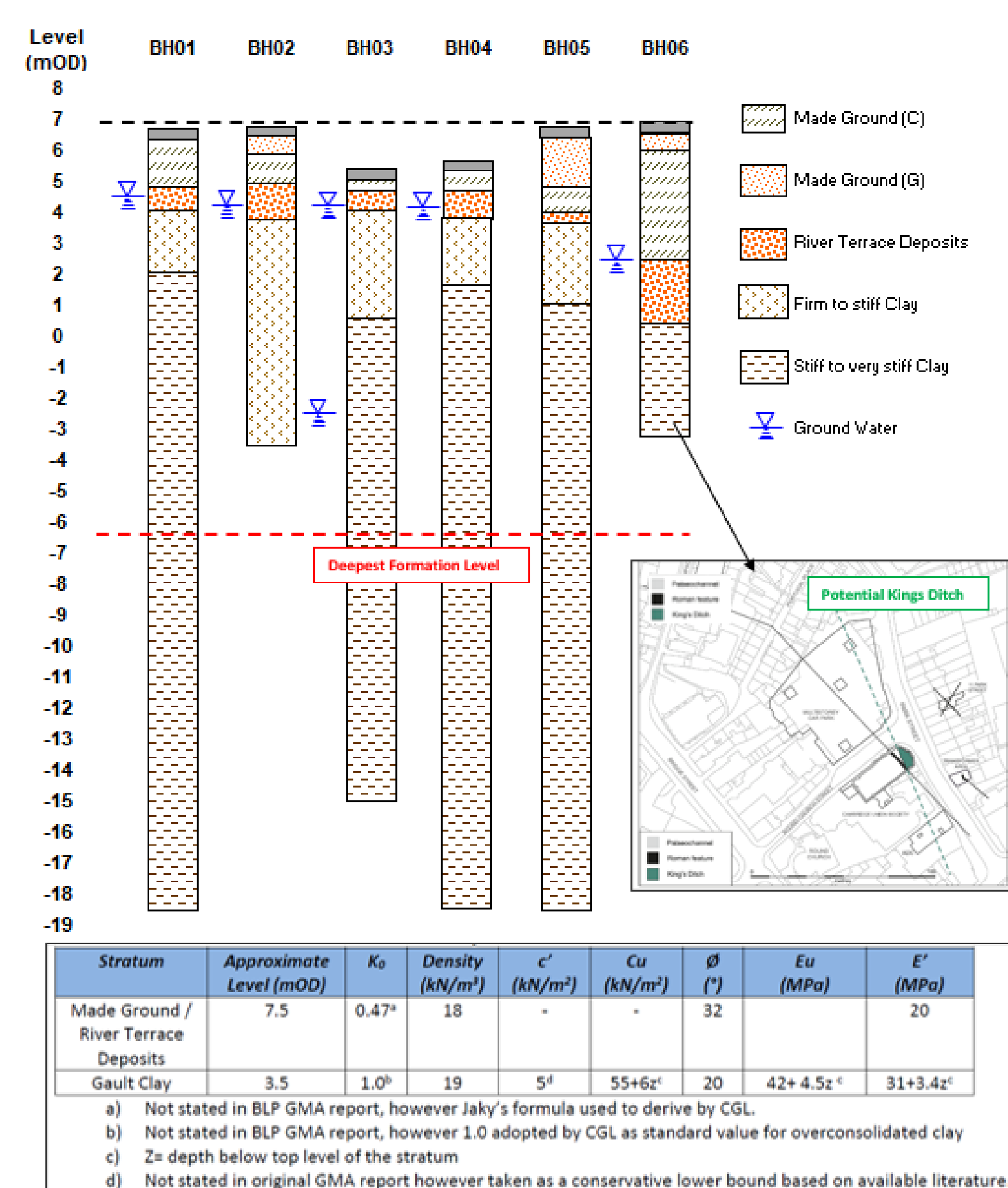


Figure 2. Ground Model & Characteristic Parameters

3. Tender Value Engineering

CGL in conjunction with DW **value-engineered** a 900mm diameter hard/firm secant piled wall with hard piles spaced at 1.35m c/c to a **750mm hard/hard secant pile wall**, with male piles spaced at 640mm c/c. CGL's alternative **optimised basement methodology** also allowed for the **removal of extensive enabling works**, which was achieved by raising the capping beam levels around the perimeter and moving the perimeter wall pile line out closer to the boundary. The latter was possible due to DW's **vibration-free cased CFA** system, which enables **close proximity piling** with **improved installation verticality tolerances**. CGL also **optimised** two levels of propping frames, including a **new buttress wall**, that enabled **early excavation and erection of the tower crane** resulting in substantial **programme benefits**.

CGL also undertook a preliminary ground movement analysis and demonstrated that the alternative basement piled wall and construction methodology/sequencing provided **consistent or improved results with regard to predicted ground movements**, and corresponding impact on the critical constraints/assets assessed for the **existing party wall agreements** to remain **appropriate**.

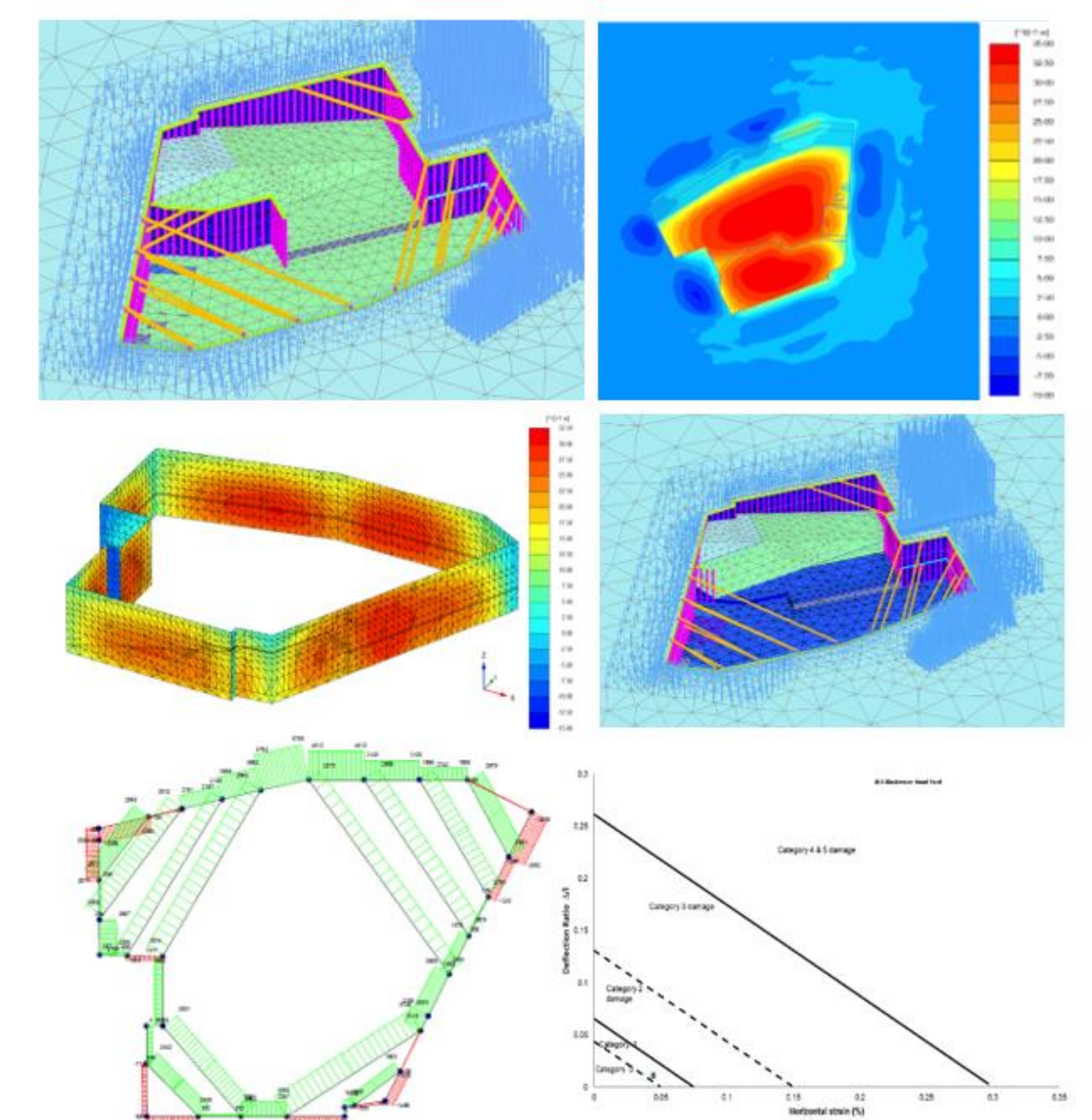


Figure 3. Detailed 3D FEA Modelling, Design & Impact Assessments

4. Detailed Design

CGL refined the **PLAXIS 3D FEA modelling**, undertook **verification checks** using WALLAP and used the worst-case structural actions predicted to undertake a detailed **geo-structural design** of the **hard/hard secant wall**, the **temporary buttress wall** and two levels of **temporary propping**. CGL **collaborated** with GA and DW in developing an **optimised construction sequence and reduced programme** for the works. CGL also supported in:

- **Designing the piled wall to cantilever** up to 3m initially to enable **efficient and unrestricted archaeology investigation and clearance**.
- **Optimising the foundation solution**, adopting a raft with strategically placed tension piles.
- Refining the **detailed monitoring strategy** (comprising in-place inclinometers in the pile wall and arrays of 3D EDM survey targets on the façades of all neighbouring buildings) and trigger limits / contingency measures to control and manage risk during the works on site in line with the principles of the **Observational Method**⁴.

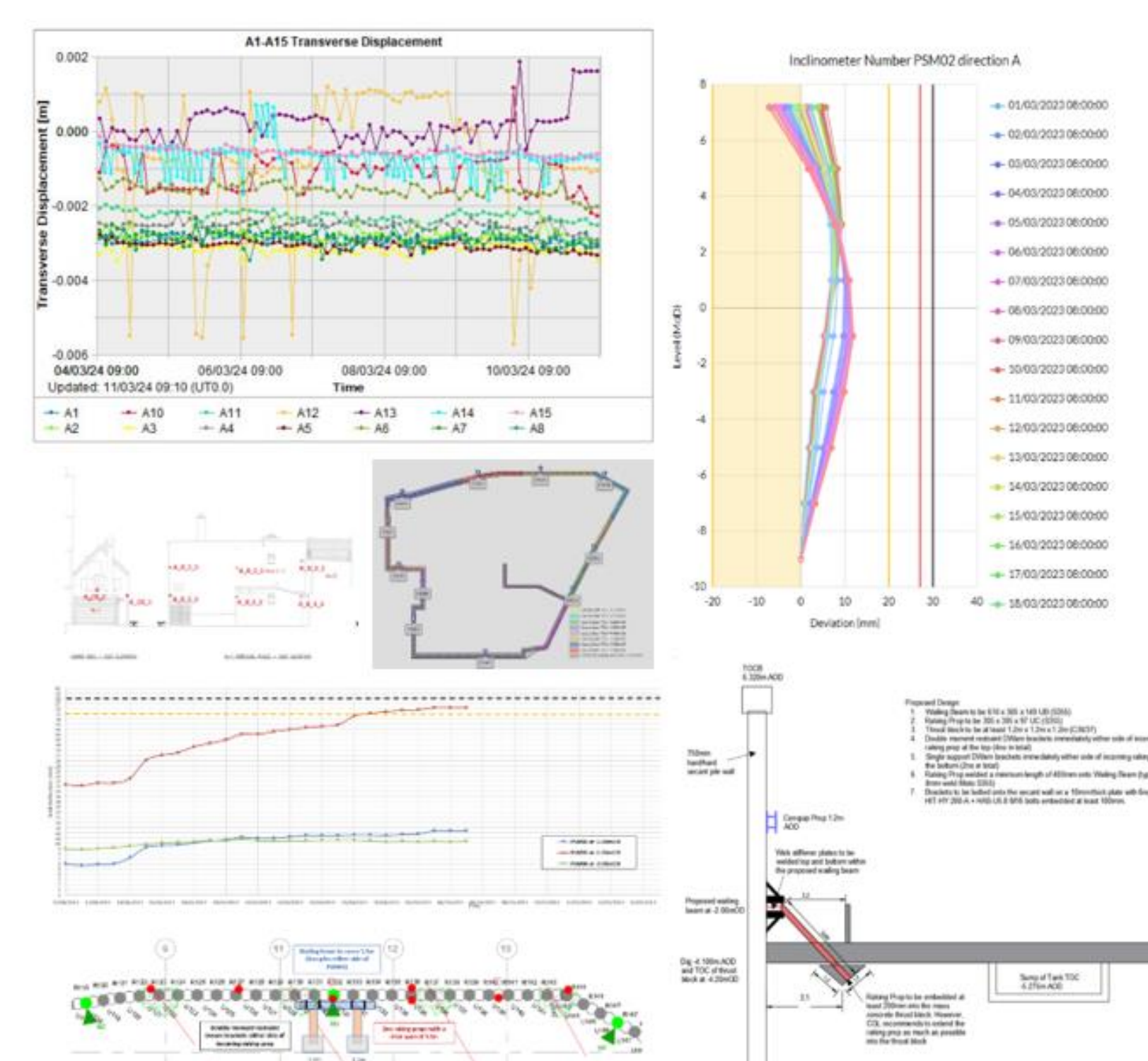


Figure 4. 'Real Time' Monitoring and Reactive Design

5. Live Construction Support

CGL provided **reactive support** and undertook regular **monitoring performance reviews**, which enabled:

- **Early prop removal** locally through back analysis of wall performance from the monitoring to allow the main core walls to progress to ground floor level earlier than planned, which unlocked considerable **programme advantages** for the contractor.
- **Reactive contingency prop design** in the localised area where the '**Kings Ditch**³' was encountered, and wall deflection exceeded the amber trigger limit in the corresponding inclinometer location.

The **information and experience gathered** from this scheme will be used to produce a **case study paper** in relation to the ground movements / back analysis from **underpinning, piling and retaining wall deflection monitored data**, which will be used to **inform future similar developments**.

Contact

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2. CIRIA C760 (2017). Guidance on embedded retaining wall design
3. Cessford C and Dickens A. 2019. Medieval to Modern Material Culture and Sequence at Grand Arcade, Cambridge: Archaeological Investigations of an Eleventh Century Suburb and Town Ditch.
4. CIRIA R185 – The Observational Method in ground engineering: principles and applications

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Timelapse – Scan Me!

