

Method for Assessing Damage Induced in Utilities due to Ground Movements from Major Infrastructure Projects

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Industry Challenge

Geotechnical Engineers are faced with huge challenges in predicting the movements caused by tunnelling and excavations and their impacts on utilities. Furthermore the number of parties involved in infrastructure projects often requires multiple iterations to come to a common solution, making the analyses very labour intensive, locking resources and budget from other parts of the project.

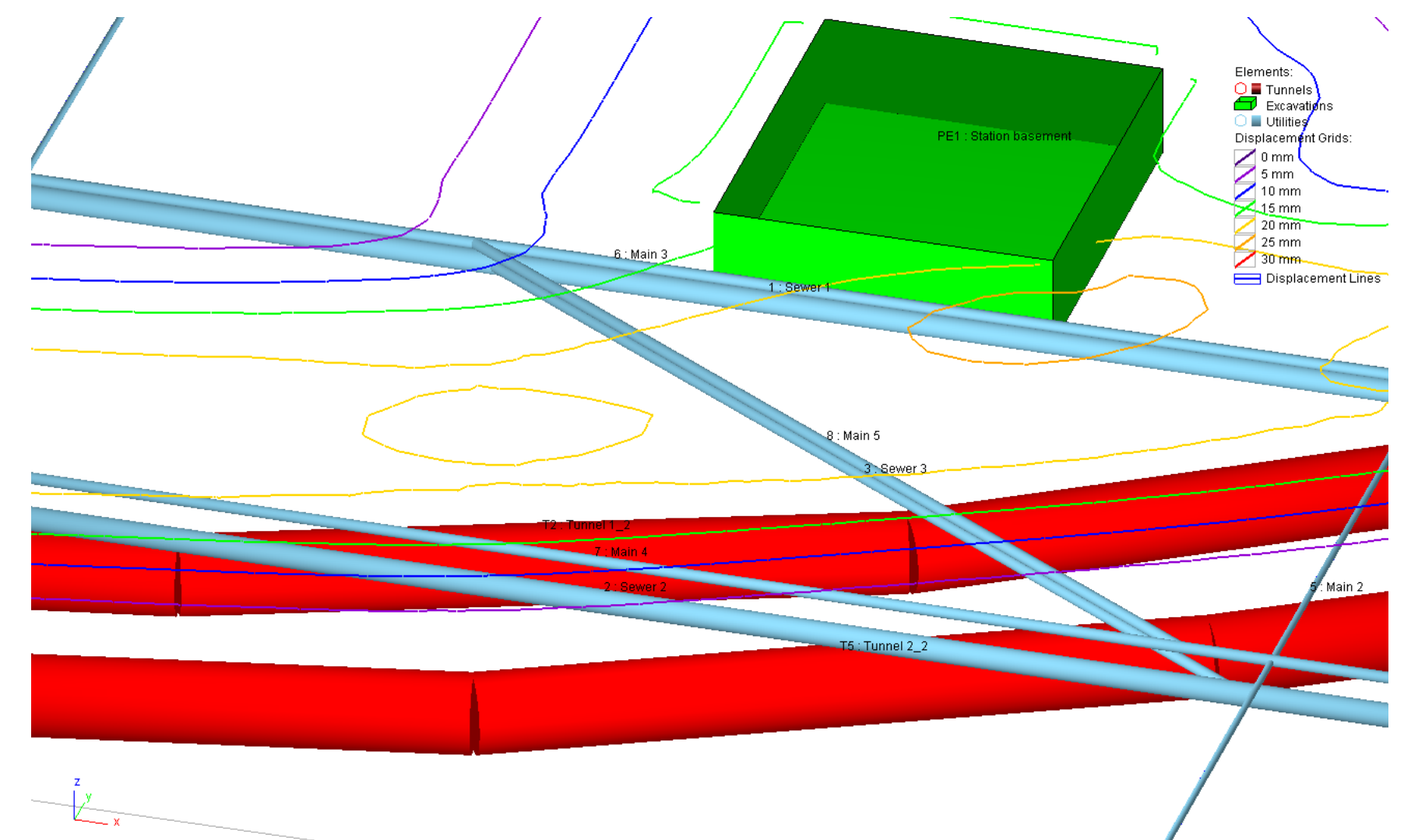
Approach to Utility Assessment

A three-phased process is proposed:

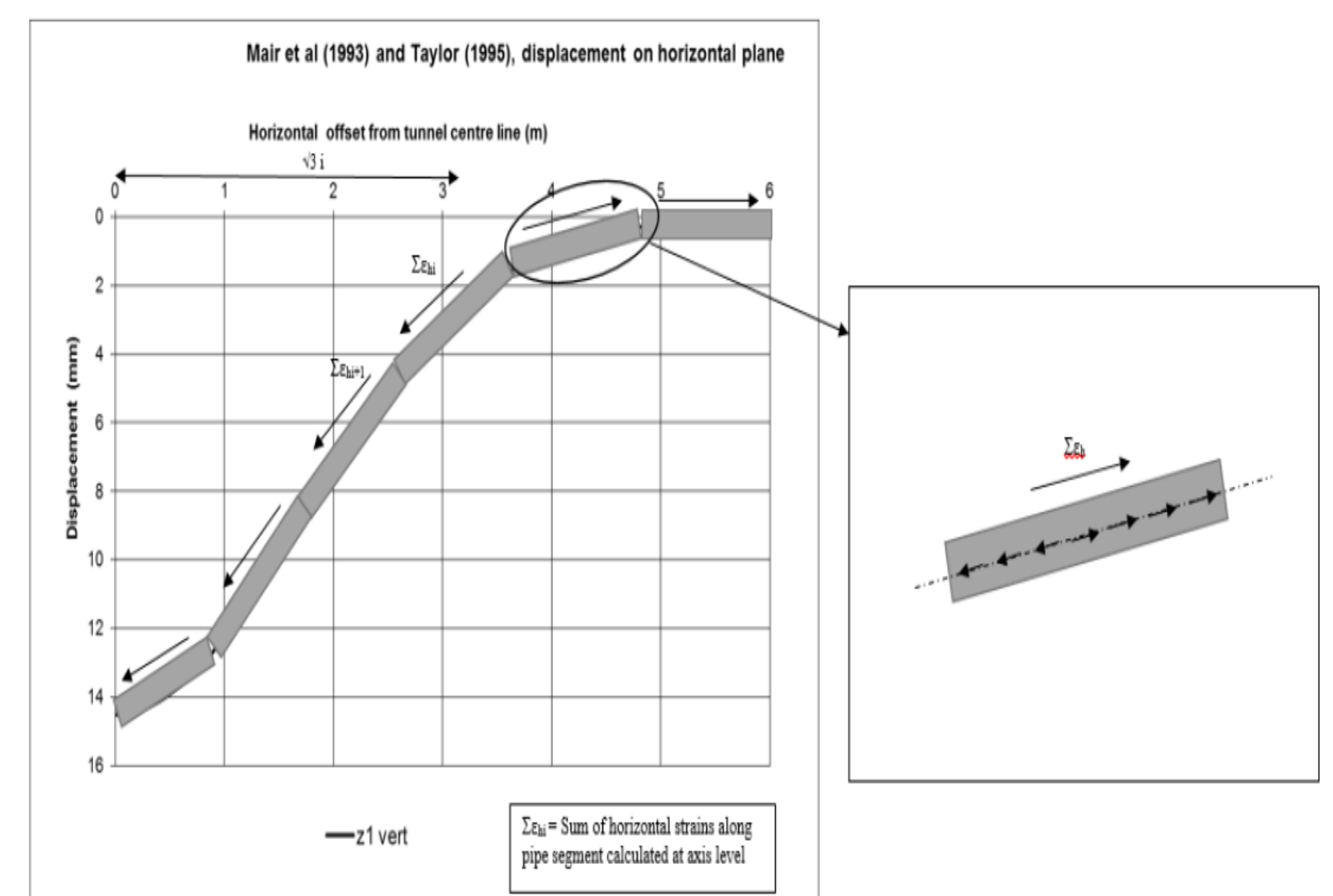
- Phase 1 considers the magnitude of likely ground movements only.
- Phase 2 determines the potential utility strain, pull-out and joint rotation. Reduction factors can be used to consider axial slip between the grounds and pipe as appropriate.
- Phase 3 consists of a more detailed analysis in which the assumption made in Phases 1 & 2 are re-assessed and more complex methods such as the Finite Element method are used.

Ground movements generated by three phases of works below are calculated using a combination of Oasys PDisp and Xdisp.

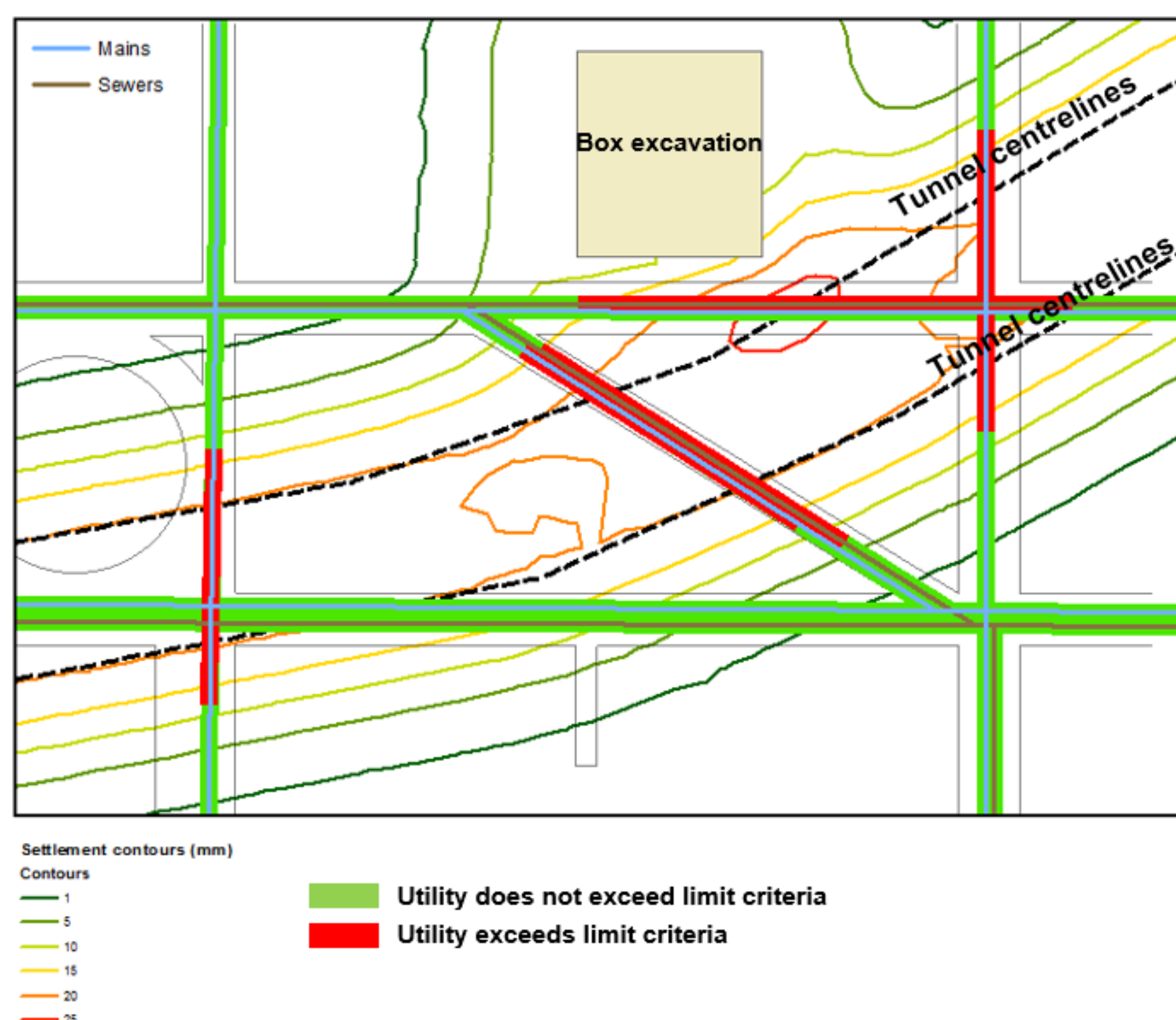
1. Demolition of buildings
2. Installation of temporary and permanent retaining walls, excavation behind the walls
3. Tunnelling
4. Displacements are calculated for each phase and imported in the subsequent phase, for the utility assessment to be undertaken. **A new approach to jointed utilities is used.**



Snapshot of Xdisp model with ground movement contours for Phase 2 Assessment



Example of strain distribution along jointed pipe segment



ArcMap assessment output example with settlement contours and pass/fail criteria

Automation Using GIS Based Systems

The output can then be manipulated with a relatively sophisticated geospatial process for direct input in GIS for improved settlement visualisation based on strain and displacement set criteria. The automation of processes not only allows evident time savings connected with direct input of data from one software to another, but reduces the risk of committing mistakes and omitting information which are typical of jobs involving manipulation of big amount of data.

In a typical project with many stakeholders, Phase 2 can take around ten iterations to complete the project. The time saved, also allows the Engineer to add value by providing the Client with alternative scenarios, for example dealing with different Volume losses hypothesis, different retaining wall movements, etc.