TC on BIM (Building Information Modelling) and DigitalTwins (DT)

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TOPIC

Building Information Modelling (BIM) for a digital representation of physical and functional characteristics of a facility and foundation. The BIM-model can be used as a knowledge resource into a DigitalTwin, providing a reliable basis for decisions during the life-cycle of a structure and its foundation. While the BIM-model is purely digital, the DigitalTwin is a combination of the digital and physical world.

BACKGROUND:

Interest for geotechnical profession

Building Information Modelling (BIM) is a relatively new concept to the construction industry and geotechnical engineering. With its inception in recent years, the geotechnical profession and industry is still coming to grips with its utilisation, with around 54% of projects utilising BIM as of 2014 in the UK alone. BIM has become an extremely relevant topic within infrastructure , transportation, building and construction, earthworks and buried structures. In the UK, the government has instilled an initiative for all centrally-funded projects to utilise BIM as a design tool.

It is increasingly important to coordinate efforts and develop a geotechnical strategy for BIM utilisation, clarify the BIM process and the limitations for geotechnical engineers and how the process can be improved . Geotechnical data integration has the potential to improve the BIM process. One key aspect is the integration of geotechnical data into the BIM strategy. A survey in the UK (Tawelian & Mickovski, 2016[1]) has shown that geotechnical profession fully supports the integration of geotechnical data into the BIM process, and that the majority considers that BIM would provide significant cost and time savings in major infrastructure projects.

The degree of uncertainty inherent in geotechnical engineering, associated with the need for effective collaboration throughout all project phases, makes BIM an attractive methodology for the entire construction sector. BIM technology was applied, for example, to an underground parking lot project in Lisbon, Portugal, where BIM was used from the design to the pre-execution: a 3D BIM model was created along with the topography and geotechnical and geological layers and then was used to explore several tasks, from the structural design to the construction site scheduling, quantities and cost measurement activities, and generating models (Gondar et al 2019[2]). Tawelian & Mickovski (2016) demonstrated the use of BIM for design and construction of landslip prevention

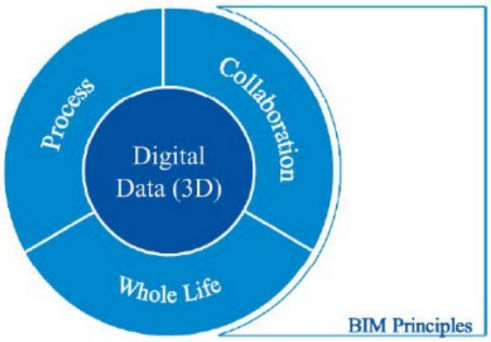
[1] Tawelian, L.R. & Mickovski, S.B. (2016). The Implementation of Geotechnical Data Into the BIM Process. *Procedia Engineering.* **143:** 734–741 (also Advances in Transportation Geotechnics . 3rd International Conference on Transportation Geotechnics (ICTG 2016). Elsevier.

[2] Gondar, J., Pinto, A, & Fartaria, C. (2019). The use of BIM technology in geotechnical engineering. Proc. 17th ECSMGE Geotechnical Engineering Foundation of the Future. Reykjavik, Iceland, ISBN 978-9935-9436-1-3. doi: 10.32075/17ECSMGE-2019-0530

measures for a failed trunk road embankment in Scotland. The integration of software tools, geo-data and interoperability among different platforms are key aspects of the BIM process.

Whereas traditionally geotechnical work on a larger civil engineering project has been done linearly and in closed process, the BIM process brings together all the different aspects of geotechnical design and integrates them into the other aspects of the construction.

BIM rests on four pillars:



Process: Agreed repeatable procedures, methods and workflows, to allow information to be quickly captured, processed and shared.

Collaboration: Visualizing and analysing data with information from other disciplines, to enable engineers to see the big picture and make decisions that ae better informed.

Whole Life: Building on data and knowledge collected over the life of the project so that it can be reused and refined. By managing data and knowledge, they can be used throughout the life of the construction and in future projects.

Digital Data (3D): Digital data are the core and enabler of BIM (Svensson, 2016)[3].

It is important to understand the difference between a classic 3D-model and a BIM-model. The latter has a large amount of metadata/information, hence the "I" in BIM. Today the geotechnical profession struggles with the lack of standardization when it comes to BIM-models, making sharing and collaboration cross company/country challenging.

DigitalTwins have gained increased interest in recent years, promoting connection between the digital and physical worlds. Professor Ralph B. Peck described advantages and limitations of the observational method in his Rankine lecture[4]. Using DigitalTwins in projects is a way to further develop the use of the observational method in geotechnical engineering.

While the BIM-model is a digital copy of the design with, for example, information about how to execute the field work, the DigitalTwin is a virtual representation that works as a real-time digital copy or counterpart, where observations will guide adjustments during ongoing construction, operation, maintenance etc. Combining the measurements with probabilistic assessment or machine learning (ML) will increase the quality of the model.

Increasing the complexity of a DigitalTwin will increase its value. In general, a DigitalTwin is divided in three different levels based on its maturity/function:

1. Descriptive: "What happened?"
2. Predictive: "What will happen?"
3. Prescriptive: "How can we make it happen?"

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[3] Svensson, M. (2016). GeoBIM for optimal use of geotechnical dat. NGM Reykjavik. Proc. 17th Nordic Geotechnical Conference. Challenges in Nordic Geotechnics. pp. 605-611.

[4] Ralph B. Peck (1969) Advantages and Limitations of the Observational Method in Applied Soil Mechanics. Ninth Rankine Lecture, Geotechnique, June 1969, 19, pp. 171-187

Interest for ISSMGE

ISSMGE needs to keep up with the new developments of the profession. A large portion of the consulting business is using either BIM solutions or hybrid methods to take advantage of the integration of all data available and for improved visualization. The BIM technology is evolving and its entrance and interaction with geotechnical engineering cannot be stopped.

In addition, there is an increasing interest in exploring DigitalTwins for linking the real and physical world. The use of DigitalTwins will increase in the coming years and is foreseen to become a key component in future geotechnical projects.

The new TC on BIM and DigitalTwins should be of high interest to the younger members of ISSMGE and the national member societies in ISSMGE. The new TC on BIM and DigitalTwins will also help bring knowledge from countries with experience in BIM and DigitalTwin solutions to the countries still considering using the approach.

The TC will also be an asset to the ISSMGE in its cooperation within the Federation of International Geo-engineering Societies (FedIGS) (cooperation between ISSMGE, IAEG, ISRM and IGS).

TOR

Goals of TC222 on BIM and DT

The TC has four main goals:

1. Provide a forum to ISSMGE members to disseminate and exchange knowledge and practice on BIM and DigitalTwins for Geotechnics.
2. Establish guidelines and technical recommendations for the implementation of BIM and DigitalTwins in Geotechnics, and collaborate on such development with e.g. the Open Geospatial Consortium (OGC) and BuildingSmart. Collaborate also with TC 309 on Machine Learning and Big Data
3. Assist with technical programs for international and regional conferences organized by or in cooperation with ISSMGE.
4. Interact with industry and overlapping organizations working in areas related to the TC's specialist area.

Objective 1 – Dissemination

TC222 shall provide a forum to ISSMGE members to disseminate and exchange knowledge and practice on BIM and DigitalTwins in Geotechnics.

The level of knowledge and the state-of-the art varies significantly between countries and continents. The TC aims to provide a source for knowledge and act as a coordination element for the user of BIM and digital twins in geotechnical engineering. This will be achieved through:

- Host workshops and/or special sessions in future international and regional conferences.
- Organize symposia and workshops to promote cooperation and exchange of information
- Arrange webinars for presenting state-of-the-art and recent development

Objective 2 – Guidelines & Recommendations

TC222 will be a link between the ISSMGE member geotechnical societies and the ongoing standardization work for BIM and Digital Twins in practice. This means collaboration and

development together with, for example, BuildingSmart and potentially the Open Geospatial Consortium (OGC). This important work, including cross-discipline standardization, is an essential element for the success of future geotechnical BIM projects

The TC will also,where necessary, establish guidelines and technical recommendations for the implementation of BIM and Digital twins in geotechnics, looking at both research and practice.

The TC will establish and keep contact with other TCs which are relevant for the work of TC 222, such as TC206 (Interactive Design), TC219 (System Performance), TC220 (Field Instrumentation), TC304 (Risk), TC307 (Sustainability) and TC 309. (Machine Learning and Big Data)

Objective 3 – Conference Assistance

TC222 will assist with the technical programs in international and regional conferences organized by or in cooperation with ISSMGE. It will be natural to have at least one session on BIM and digital twins in geotechnics in the upcoming international and regional conferences. Attempts will be made to include a session at the forthxcoming ISSMGE 2022 in Sydney, Australia.

In addition, the TC will encourage the participation of the members of the TC in both international, regional and national conferences, as well as encourage them to organise local workshops on the theme BIM and/or DT.

Objective 4 – Industry links

TC222 will endeavour to reduce the existing gap between the State-of-the-Art and the State-of-the-Practice in the field of BIM and digital twins. TC222 will invite experienced practicing engineers to join the technical committee as members and encouraged them to organize sessions with practice-oriented topics and discussion workshops involving academics and practitioners.

The TC will strive to be visible in other arenas/conferences than those arranged by the geotechnical society, for example BILT, infraBIM Open etc.

Responsibility

Norwegian Geotechnical Society

Chair and Secretary of new TC

Mr Magnus Rømoen, member of Norwegian Geotechnical Society
Mr Mats Kahlström, member of the Swedish and Norwegian Geotechnical Societies

Core members

Presently under discussion: the list will be ready by the time the summer vacation is over.

Each ISSMGE member society is invited to nominate two members, and additional members can be corresponding members.