

1 Use Case 02c: Geotechnical model for construction and maintenance

1.1 Purpose

Detailed geological/geotechnical models are used for prevention from accidents (face collapse, ground subsidence, water inflow, etc.) and implementation of countermeasures during construction and maintenance. Models used for the design (UC 2b) are renewed or updated using tunnel face observation (UC 15b), forward drilling survey, seismic profiling, etc. Required performance of the models are revealing geotechnical risk for construction, three-dimensional relationship between risk area, geotechnical condition and tunnel. That information has to be transported in IFC format.

Expected exchange scenario is a model data exchange from geological/geotechnical modelling software into construction and asset management software.

The relation to other Use Cases and exchange scenarios are displayed in the detail-process map for geotechnical applications.

1.2 Requirements for IFC-Tunnel:

Required geometric- semantic:

Same as 2b, to be comparable to predicted conditions.

- Geology, Hydrogeology
- Geotechnical parameters
- Geophysical parameters

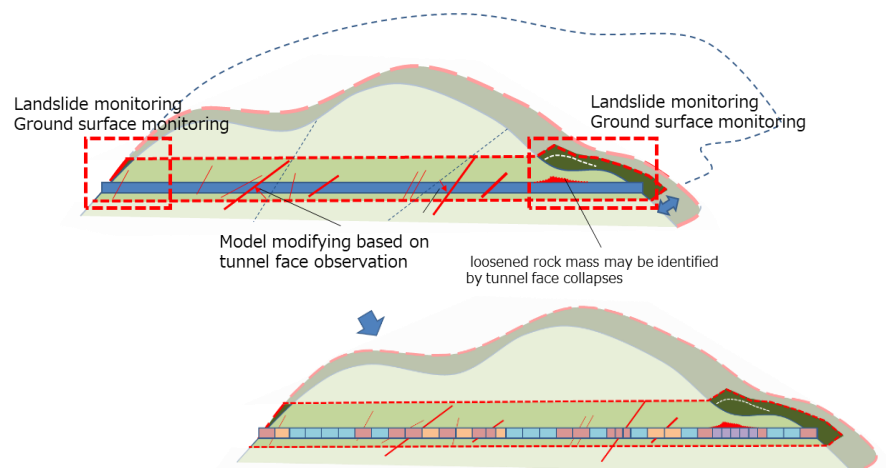


Fig.UC2c-1: A schematic draw of Detailed geological/geotechnical models for construction management and maintenance. The model is created based on forward drilling survey, tunnel face observation, etc. Modeling area: tunnel length × less than 50 meters.

Required parameters as attributes:

(same as 2b), geological formation, age, etc.

- Ground classification
- Geotechnical parameters for ground types and discontinuities
- Geophysical parameters for ground types and discontinuities

Linkage is needed;

- Factual data used for modelling (UC 1b and 15b)
- Risks determined by the model

Required attribute for uncertainty evaluation;

- Uncertainty in factual data
- Spatial distribution of knowledge (factual data)
- Complexity of geological conditions
- Modelling parameter (e.g. Spatial interpolation algorithm, reference area for calculation, etc.)

Notice: From the viewpoint of tunnel management, 'span object model' may be suitable, i.e. tunnel object model per excavation span unit accompanied with geological/geotechnical parameters as attributes. Linkage may be required;

- Observation and measurement data (frontage images and sketches, documents, photo, water leakage data, forward drilling survey, etc.) (UC 15b)
- Quality control records (support pattern, spray concrete, steel support, rock bolt, lining concrete, waterproofing, initial crack survey, additional support method) (UC 15a, UC 15b, UC 10, 11 and UC 15d)
- Inspection record, and repair record for maintenance and management (UC 17 UC 15C)

1.3 Geometry:

Geological and geotechnical models are expressed as surface models and solid models. In some cases, data from the front face exploration are represented by cylinders or voxel models. The workpiece span object may be swept or an irregular triangular net. To demonstrate the uncertainty of geological models, geometry of fact data must be represented.

1.4 Semantics:

All entities must be consistent with the existing geological and geotechnical engineering standards (GEOSiML, ISO etc.).

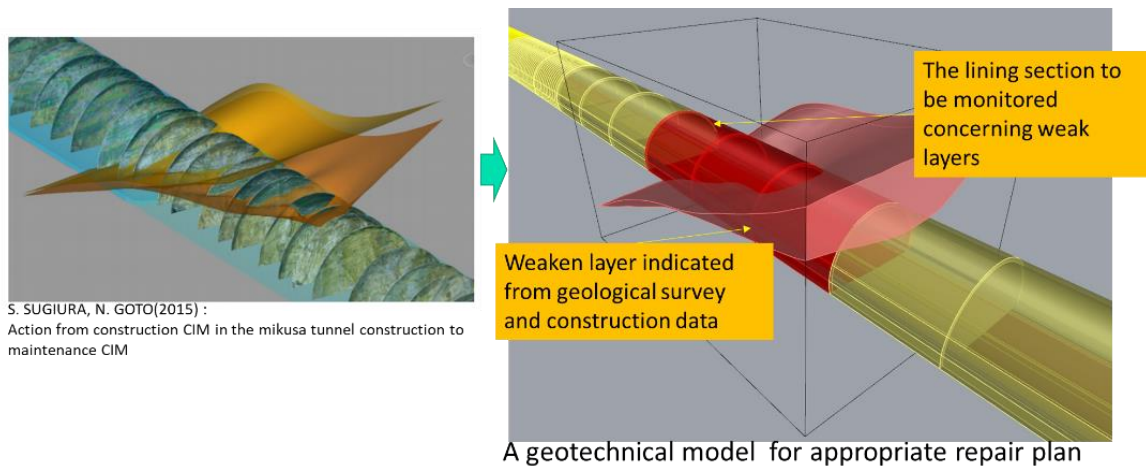


Fig. UC2c-2: An example of geotechnical model for maintenance (cited from R Kudo, S.Nishiyama, Y.Okui, M.Muramoto, H.Shima,2020 :Geological and Geotechnical models in BIM.)

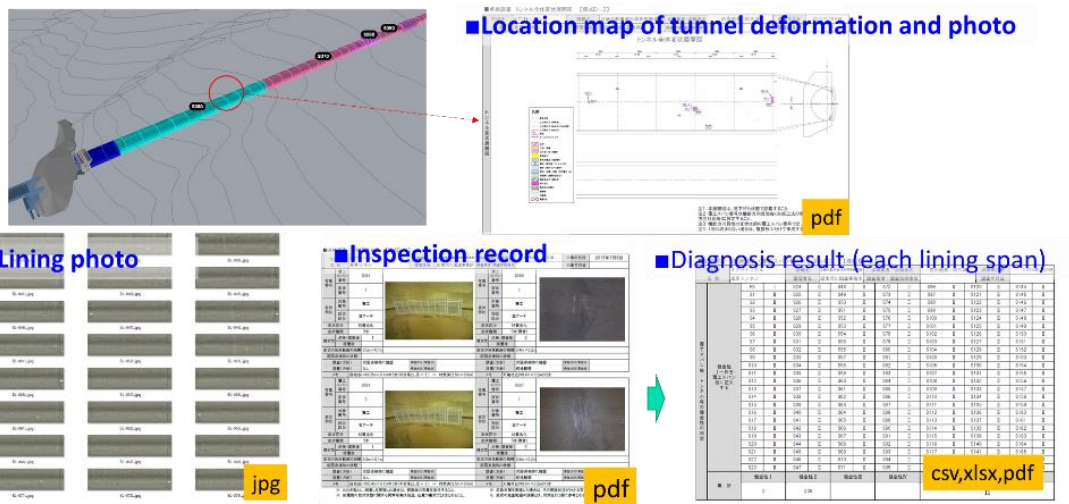


Fig. UC2c-3: An image of data linkage between geotechnical model and maintenance data (cited from R Kudo, S.Nishiyama, Y.Okui, M.Muramoto, H.Shima,2020 :Geological and Geotechnical models in BIM.)