

## Use Case 15d: Quantity determination for billing / payment

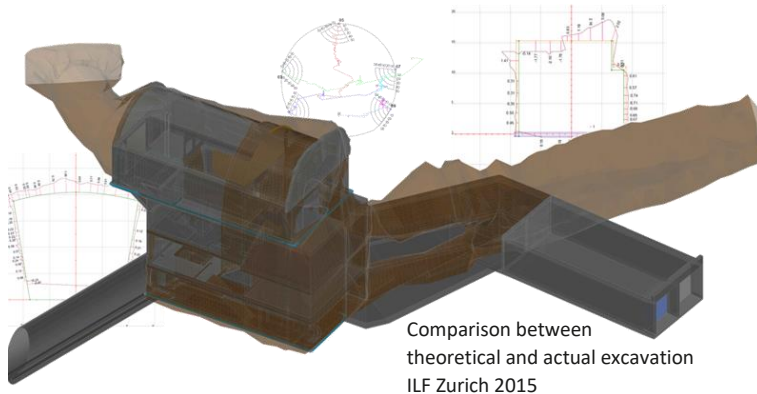
### Purpose

Most current contractual forms in underground construction include some kind of progress based payment to the contractor, based on certified measured quantities of completed work being tunnel construction components and functional systems' equipments. A BIM model provides a unique and effective way of logging and calculating the quantities of work performed or completed and communicating such information to all parties involved.

The work performed will be recorded at agreed intervals, the work performed will be invoiced, certified and payment will take place.

This use case is linked to use case 10 (quantity take off), 12a (design to tender), 15a (progress monitoring), 15b (geological documentation) and 15c (Scanning during construction).

Use case 10 will generally establish the geometry for the quantity take off and use case 12a links the quantities, via the individual components/elements, to a structured contractual classification that



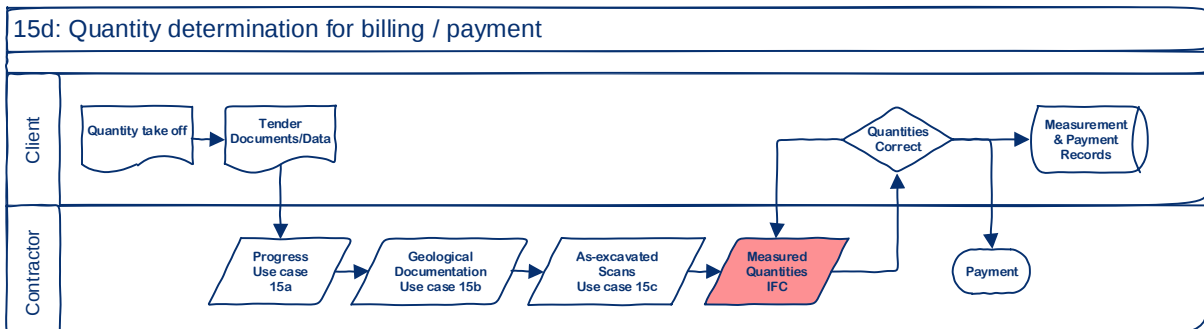
Comparison between  
theoretical and actual excavation  
ILF Zurich 2015

will form the basis of the contractor's invoices and the client's subsequent payments.

Use case 15a will monitor the progress on site and the elements constructed during the period considered, at the same time use case 15b will record the actual geological conditions encountered and use case 15c will record the actual volumes excavated. In

addition use case 15d supplements the information from use cases 15a, b and c with the actual quantities installed, for instance rock support, concrete volumes and reinforcement quantities.

Contractual forms differ, but generally there is a distinction between the theoretical dimensions of underground works and the actual as excavated and filled works and the quantities for which payment is made. Modern scanning methods allow an accurate determination of these quantities, allowing a much more transparent and fair process.



## Requirements for IFC-Tunnel:

The requirements for IFC Tunnel are a combination of the requirements of use cases 10, 12a and 15c, a precise geometric description of both the tunnel construction components, the functional systems' equipments, as well as the excavated rock or earthwork, a well-structured, identifiable geometric and semantic representation of the major price relevant parts of the works and a geometrical representation of the actual rock surface as scanned.

### Geometry:

It can be assumed that the existing geometry descriptions for volume objects (IfcSolidModel), in particular triangulated face sets, but also sweeps and extrusions are sufficient. It must be investigated how boundaries between soil/rock layers can be appropriately described. Surfaces must be modelled for membranes etc.

### Semantics:

Quantity take-off requires the application of a (national) classification system on the basis of the IFC type system. The application of the classification systems for tunnel construction components and functional systems' equipments is expected to be straight-forward. The extension of the IFC type system is part of the IFC-Tunnel project. A deeper investigation is required for the application of rock/soil classification systems, in particular in combination with the geometric description.