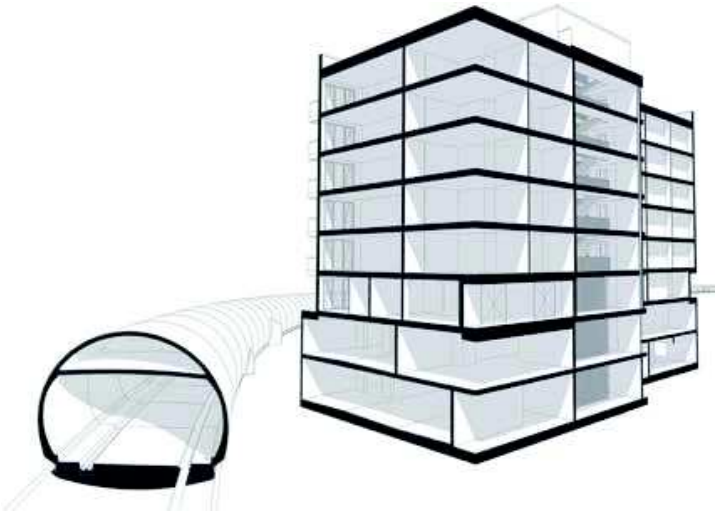
ALL ABOUT TUNNEL STRUCTURE



INTRODUCTION

Infrastructure projects like bridges, roads, railways and tunnels are, in comparison to high rise projects, bigger, more expensive, last longer and are much more risky. BIM – Building Information Modeling - and its tools are now becoming a common language in the Infrastructure sector to reduce the current problems through a better transparency of costs, life cycle orientated construction design and a better cooperative working. The iC Group has decided to change completely to BIM in 2014 and is now in the stage of the practical usage. In the beginning of 2016 the iC Group decided that the rudimental clash detection software solutions are not efficient enough to handle complex interdisciplinary building construction and infrastructure projects and changed to the Solibri Model Checker. The implementation of the Solibri Model Checker in the iC Group and the project specific support for individual solutions was handled together with the Austrian Software Supplier A–NULL Bausoftware and especially their BIM-Quality management expert Hannes Asmera, who has already become an important partner for the development of intern model checking standards and rule sets for big infrastructure projects. Three of the current infrastructure projects of the iC Group are the tunnel projects Karawanken South on the Slovenian side with DARS as Client and ELEA iC as lead designer, Karawanken North on the Austrian side with ASFINAG as Client and iC Salzburg as lead designer and Tunnelkette Granitztaal in Austria with ÖBB as Client and iC Vienna as lead designer. At these projects Solibri Model Checker is used to assure high quality and to optimize the coordination of the different disciplines.

The requirements in tunnelling and Infrastructure Projects are different comparing to Building construction Projects

Tunnels belong to the infrastructure constructions and differ from high rise construction in regard to:

1. Location
2. Development and Operation
3. Systematic

LOCATION

A building construction normally belongs to one or more sites. Tunnel constructions are typically linear constructions and do not belong to a site but rather to a traffic route.

KEVIN BAUER, BSC

Kevin is part of the BIM Management team at the iC Group. He sees the BIM process as a chance to change the complete processes in the construction industry and as first step for complete digitalized cities and infrastructures.

DEVELOPMENT AND OPERATION

Building constructions serves people in residence purposes, like living, working or leisure and will be provided by private and public investors. Infrastructure constructions satisfy the basic need of mobility through the supply of traffic routes by the public sector instead. Furthermore, because of the fact that the investor or developer of an infrastructure construction is normally also the operator, a lifecycle cost-orientated design and a continuous data chain from the development, via the design and construction through to the operation has a very big status. It thereby can be differentiated in following traffic types:

1. Road traffic
2. Rail traffic
3. Water traffic
4. Air traffic

SYSTEMATICNESS IN INFRASTRUCTURE CONSTRUCTIONS

The mother of all disciplines in the infrastructure construction is the alignment which will be evaluated in early phases through comparison of different varieties. The alignment is already implemented in the Industry Foundations Classes via IfcAlignment in the IfcPositioning Elements and is the basis for all, yet not IFC standardized, civil spatial structure- and civil elements. Below the spatial element and physical element structure should be from the logical point of view a separation by the following most important infrastructure disciplines which were already pronounced by buildingSmart as their upcoming standardization projects:

1. Road
2. Rail
3. Bridge
4. Tunnel
5. Subgrade and Geology

BIM IN TUNNELING TUNNEL SPATIAL STRUCTURE

A building construction model is through the IfcSpatialStructureElement structure via IfcSite, IfcBuilding, IfcBuildingStorey and IfcSpace in various spatial levels divided. The same holds true for tunneling models. In IFC there is unfortunately yet no defined spatial structure for tunnels. From practical experience it is already known that a tunnel needs a spatial structure as followed:

TINA KRISCHMANN

Tina is part of the ODE office for digital engineering team. She worked as an architect for 10 years before joining ODE who deal with the digitalisation of the building sector and support companies concerning PIM-, BIM- and FIM-structures.

DISCIPLINES IN TUNNELING PROJECTS

At a building construction project many different disciplines, for example architecture, structural engineering and MEP, work together and create in each case an extra discipline model. The same systematic applies in tunneling projects.

By the comparison of the currently available disciplines in Solibri to the necessary disciplines in tunneling and in general infrastructure projects - under the consideration by the logic that new disciplines are only necessary if the appropriate elements are missing, it occurs that following disciplines for tunneling and in general infrastructure projects are missing in Solibri:

1. Tunneling
2. Subgrade and Geology
3. Geotechnics
4. Road
5. Rail
6. Bridge

TUNNEL ELEMENTS

The needed elements in tunneling also differ from building construction elements. Unfortunately, there are no standardized IFC Elements concerning tunnelig yet. This is a very important topic which should be handled by buildingSmart as soon as possible to provide an international and software independent data standard for the description, exchange and sharing of infrastructure constructions. Through the current Tunneling projects in the iC Group we have already had to identify tunnel specific civil elements and their relationship . Following a tunnel with some of its elements is visualized exemplary.

COMMENT ON ALL ABOUT TUNNEL STRUCTURE

Concerning building construction, BIM has exceedingly improved its level of accuracy over the last years. Hundreds of properties have been defined, classified and assigned.

We can now look at a building with different eyes, because we see so much more than just the pure model – information has become as important as the 3D-element itself.

DACH REGION

The DACH region comprises of Germany, Austria and Switzerland. The combined regional population is 97.8 million people.

TUNNEL ELEMENTS

Tunnel lining structure

Water proof membrane

Mined tunnel

Support shotcrete

Reinforcment system

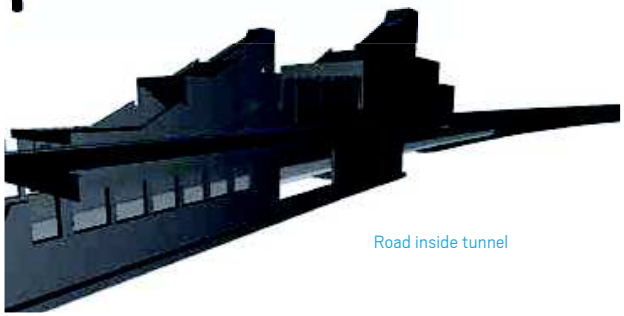
Anchor system

Tunnel inverted filling

Tunnel distribution system

BRIDGE / ROAD

TUNNEL / ROAD



Based on the buildingSMART IFC-structure it is possible to implement all IFC-properties to building elements that are needed to do a befitting check in Solibri Model Checker. It is not only about checking for clashes - even more, it is about checking if the right elements do not clash to see if there is a problem within the bearing structure or the interior accessories.

Information brings opportunities for checkin rules. It's not very hard to create a rule in Solibri Model Checker, for example checking if a fire-rated wall holds a fire-rated door of the same class, if you are working with IFC-properties.

More complex structures, either regarding scale, standards or technical issues, are planned and built with much more efficiency than ever before using BIM as a tool. The completion of a building is not the end of a BIM-Model, since Facility Management is becoming increasingly aware of the advantages. The more complex and technical a structure is, the more important the management of its data and carried information over its lifecycle is. The upcoming department of FIM (Facility Information Management) is specifically focusing on these aspects.

While we are taking advantage of the proceeding development of building construction, it seems there is a huge part that we should not forget to follow up on. Infrastructure is as complex as building construction – just facing different issues.

There are different elements, systems, necessities and operational procedures that need their own defined properties and classifications – otherwise the smoother way of checking these structures will decrease back again on elaborate workarounds.

As there already is a working coordination (see buildingSMART) of the different domains of Architecture, HVAC, Electrical, Structural, Facility Management and their correlation, not everything needs to be generated from the start.

Defining a new domain, for example tunneling, will share some properties with the other domains, but there the need to generate new ones still remains – and all of them need their complement structure in Solibri Model Checker regarding disciplines, components and even rules.

The advantage of integrating new domains for infrastructure in Solibri Model Checker is obvious: there is seldom a structure standing alone - there is always a connection. Being able to check complete projects of building construction and infrastructure, their conjunctions and dependencies within one program is reasonable – and essential.