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Leading the BIM way: Implementing BIM and Asset Lifecycle Management as a Contracting Authority in Road Infrastructure Projects in Flanders, Belgium.

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Learning Objectives

- Look beyond the visual impression of BIM models
- Value the importance of the information included in the model to cover the whole lifecycle of an asset
- Learn about the importance of a standardized language in BIM models
- Learn how to apply data standards (our OTL) and different Levels of Geometry in the BIM Execution Plan to match BIM requirements in a contract with the specific project's needs

Description

For infrastructure managers, up-to-date asset data is crucial to meet the expectations for qualitative and safe roads. Using BIM (Building Information Model/Modeling/Management) helps us build our infrastructure more efficiently and collect the asset data we need. As the “information management” aspect is essential for an efficient asset management, our vision leads the way on how we can evolve towards a more data-driven organization, how we can implement BIM, and what we consider to be our role as a contracting authority in standardizing the BIM implementation. By providing a standardized Object Type Library (OTL) and uniform BIM specifications in our contracts, we encourage all stakeholders to start implementing BIM. Moreover, a general BIM Protocol and uniform BIM Execution Plan for every project help us standardize the level playing field in our BIM projects. Different software packages and tools such as Autodesk Civil3D, Revit, Navisworks and the BIM360 collaboration platform help us deliver and verify intelligent models following our specifications.

Speaker(s)

As program manager of the BIM and AIM implementation program at the Flemish Agency for Roads and Traffic (AWV), Natasha Blommaert is responsible for the development of the BIM vision and the organization, implementation, IT coordination and standardization of BIM for road infrastructure. She focuses on getting every stakeholder involved to work together towards an advanced and digital asset information management to improve the realisation, maintenance and exploitation of the Flemish road infrastructure. With her BIM, CAD and GIS experience and change management expertise, she is also an enabler of digitization of the construction industry

in general and a regularly invited speaker on events about BIM, digital twins, infrastructure management, digitization and standardization, smart applications etc.

In the Flemish Road Agency she also coordinates the GIS and Data Management team and she represents the Agency in various national and international boards or steering committees, e.g. CEDR, PIARC...

Timothy Nuttens is BIM Manager at the Flemish Agency for Roads and Traffic. He focuses on the practical aspects of how to implement the OTL data standard in BIM models and the collaboration with engineering firms and contractors in the agency's projects. He also works on developing the BIM guidelines for these projects by elaborating the necessary contract documents and a standardized BIM Protocol and BIM Execution Plan for infrastructure projects. Together with his team, he is also responsible for the support of the internal colleagues involved in BIM projects throughout all project phases.

The importance of an information model for lifecycle asset management

AWV – The Flemish Agency for Roads and Traffic

The Flemish Agency for Roads and Traffic mainly focusses on construction, maintenance and exploitation of regional roads and motorways in Flanders, Belgium. Therefore, we are an infrastructure builder and an infrastructure manager, involved in and responsible for the whole lifecycle of infrastructural assets. We are responsible for almost 7.000 km of roads, 7.700 km of bicycle paths, 17.000 electromechanical installations and 1.600 traffic lights, all to realize a smooth, safe and sustainable mobility for all road users. In addition, we also manage many bridges, tunnels, ecoducts and other road infrastructure elements such as sound barriers, traffic signs, guardrails etc.

Our BIM vision

We took on the pioneering role in BIM for infrastructure not only by taking up the leading role in standardization and implementing BIM in the Flemish government, but also by guiding and supporting all our project partners to apply BIM in the infrastructure world. Also, the other entities of the Mobility and Public Works policy area are supporting our vision and will follow our example for e.g. water-bound infrastructure according to the same guiding principles we use.

As an asset manager, we naturally face major challenges not only to realize a smooth and safe mobility, but especially because we are confronted with ageing infrastructure. That is why we want to make optimal use of the possibilities that modern digital methods or technologies can offer us and how they can innovate our way of working. For us, BIM is becoming the key to support the road authority of tomorrow in its tasks and to connected and automated driving where we hope to be able to provide BIM models as the necessary high definition digital twin of our infrastructure.

Our BIM vision therefore focuses on these 3 tracks:

Working with the help of a **BIM Model** facilitates a new and more integrated way of collaboration between the construction parties involved, by shaping digital twins together.

In addition, **BIM Modeling** offers the possibility to save on costs, to implement the added value of a virtual model into the construction process.

And finally, **BIM Management** ensures that all relevant asset information is stored in a structured and uniform manner and can be used for asset management throughout the whole lifecycle.

As a contracting authority, we not only focus on BIM modelling during the design and execution phase of a project, but we focus even more on the aspect of BIM management. Because the data is not only relevant when building up and using the model during the investment projects, the data becomes essential for the operation and maintenance during the decades after the projects are realized. Good management and maintenance of our road infrastructure is based on up-to-date, complete and trustworthy information about all our assets. Using BIM gives us the opportunity to efficiently collect the available information across the entire life cycle of those assets (Fig. 1). By gathering that information once, as close to the source as possible, and exchanging it in a standardized way, we can make that uniform data available to those who need it at any time during the life cycle. We want to collect, manage, share and transfer the data between any party, at any time, be it during the design phase of a project, during the execution

of the works on site or during the maintenance in the period after realization. And it should simplify our operations through better information and knowledge about our assets.

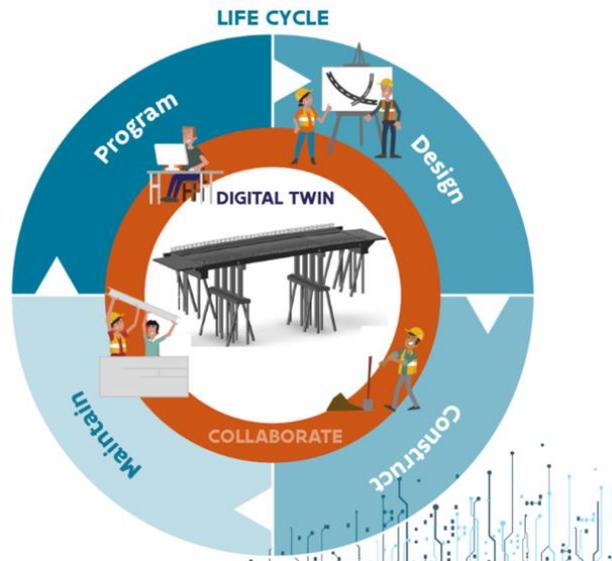


FIGURE 1: THE LIFECYCLE OF OUR ASSETS

BIM as Information Management process is therefore central in all our processes. And as a contracting authority, we believe it is our responsibility to support the use of BIM and to promote a maximum automation of all these steps. Tools we are developing ourselves, will therefore be maximally put available to all stakeholders and partners with whom we manage the infrastructure, such as engineering offices, contractors, surveyors, other infrastructure managers, municipalities...

For us, BIM implementation is more than just modeling a BIM model and exchanging information, we want to reach out to all stakeholders and help make it a win-win situation for everyone. By focusing on teamwork across organizational boundaries, everyone will improve their performance and all our road users will benefit from this.

More information is available on our website (in Dutch): <https://wegenverkeer.be/zakelijk/bim>.

Our BIM tooling

After transfer of the BIM data from an engineering firm or contractor to us, all design, construction and maintenance information is stored in a central master data model, our Asset Information Management (AIM) database. All parties involved, use this centralized database throughout the life cycle of the assets. Everyone can consult and enrich the same authentic data source, being the centralized master BIM model, which is our philosophy behind Building Information Management or AIM.

Our BIM vision is supported by a number of necessary tools to have the data delivered, processed, validated, verified, approved and stored. And of course make them searchable and consultable in the AIM database.

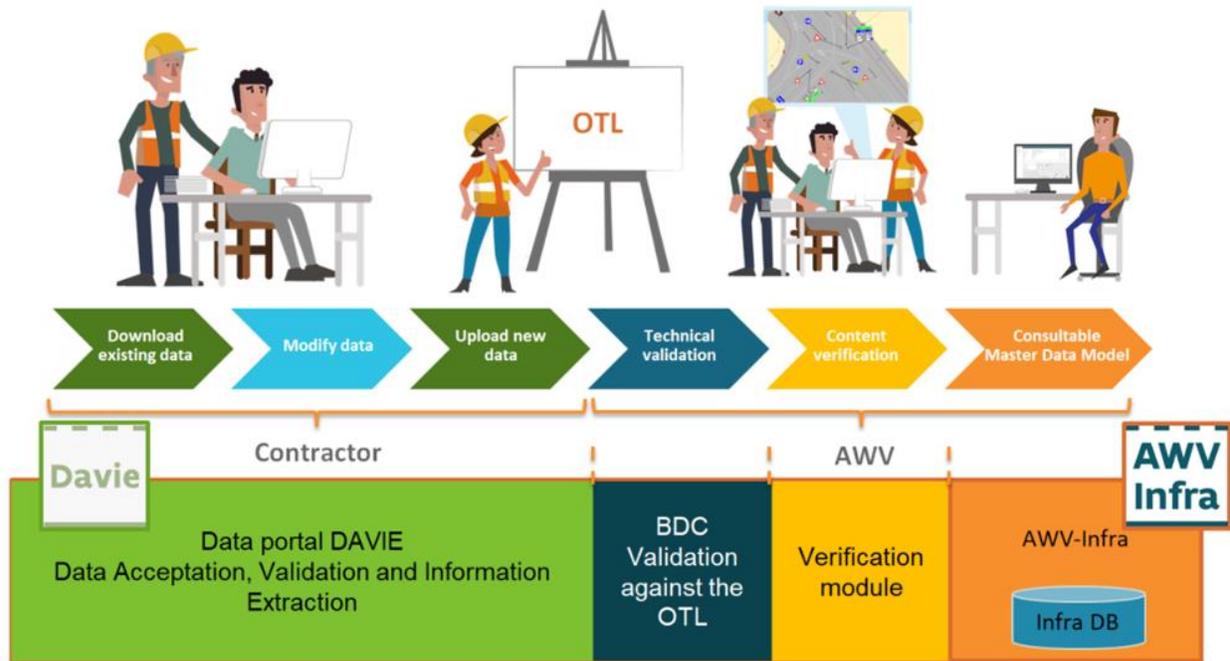


FIGURE 2: DATA FLOW

The data flow (Fig. 2) goes through several steps and is supported by several ICT applications, for example:

- A data exchange portal, for supplying newly enriched or modified data, as well as for downloading available existing data to encourage reuse of data;
- The BIM conversion component that converts the BIM files (e.g. from BIM360) via Forge and automatically validates them against the ObjectTypeLibrary;
- The verification module that enables our internal employees, such as engineers, supervisors and site inspectors to perform content checks;
- And finally the AIM database, called AWW Infra, in which the information is stored for consultation, but also for editing during every maintenance action or inspection.

An Object Type Library as standardized language in BIM models

A digital BIM model must of course contain the correct information, which is useful during every phase of the life cycle. What knowledge, data and information do we want to be linked to each object in a BIM model? How can we ensure that all BIM models are shaped on the same structured base over the coming years? For this we created the OTL or Object Type Library as a common language and semantic data standard that the entire construction industry can use in Belgium. The OTL establishes uniformly which information we wish to collect during the entire life cycle of an asset.

The OTL describes these object types with their definition, properties or attributes and relations and can be consulted at wegenenverkeer.data.vlaanderen.be (in Dutch). The online documentation contains the different Vocabularies, the Master Implementation Model and the different thematic and supporting implementation models. The OTL is published as a human-

readable version, in the form of web pages and is furthermore technically unlocked via machine-readable technical artifacts. It is centralized, prepared and managed by the Agency for Roads and Traffic, through intensive stakeholder participation and collaboration.

The starting point of the OTL are objects in the real world: a camera installation, a lighting pole, a cabinet, a bridge, a tunnel, a traffic sign, the vertical road structure... But also less visible and yet essential parts for the correct operation of physical parts such as software components. The OTL describes these objects and records relevant properties (including option lists) and relationships. Thanks to this library, everyone can now start building BIM models uniformly, linking geometry and information together.

In collaboration with Autodesk, the first steps were taken to insert the OTL in the BeNeLux country kit for Civil3D 2020, providing users tools to link the OTL compliant information to the geometry.

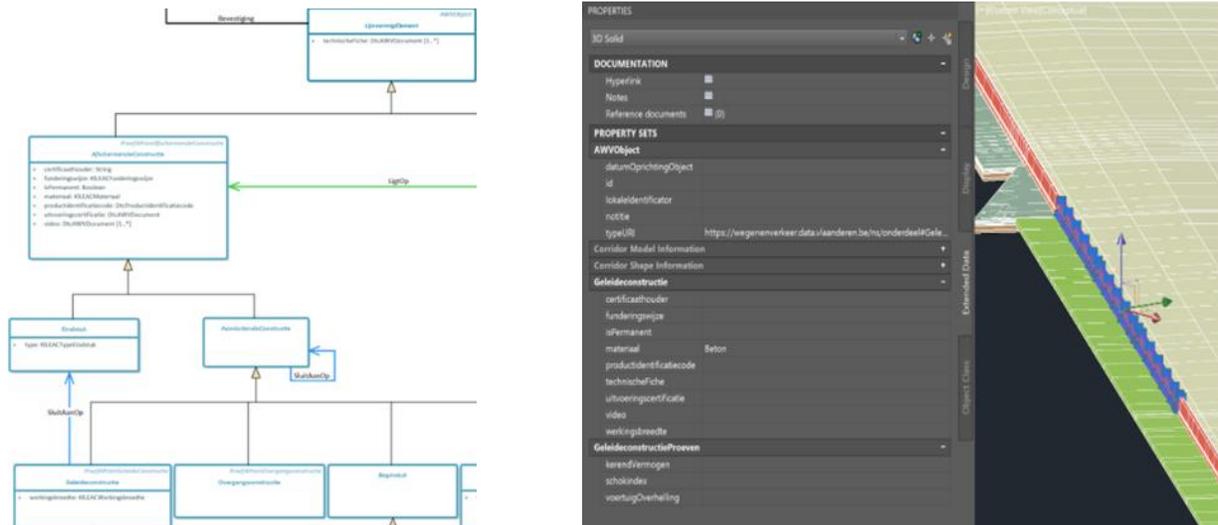


FIGURE 3: IMPLEMENTING OTL INFORMATION REQUIREMENTS (DIAGRAM LEFT) IN CIVIL3D PROPERTY SETS

BIM during the design and execution phase of a project

Advantages of BIM in a project

As described above, our long term vision is focussing on a better, more efficient asset management for which the BIM methodology can really help us collecting the asset information we need. But also on the short term, using BIM can result in a lot of advantages and create an added value on a project's level, during the design and execution phase.

Four of the most commonly known or accepted advantages are the following:

- Working together around a central BIM model allows us to better collaborate with all project partners involved and to collaborate more efficiently.
- We can use that central BIM model to detect design errors, problems or possible risks much faster, earlier in the project flow. That way, we can respond to these findings much faster and often much cheaper. The quality of our final design will therefore be much higher.

- A higher qualitative design results in less unexpected costs and delays during the execution phase, so in a cheaper project. Even when the cost of the design phase is higher due to more intensive collaboration and inspection of the design, this should be more than compensated with the savings during the execution phase.
- Furthermore, because we will have less unexpected problems during construction, chances are much higher that we can finish the project in time.

But what does that mean for a specific project? What can or should we do in a specific project to create these added values?

How can BIM help me improve a specific project?

In which project phase can we start using BIM?

A first factor to take into account is when in the project's flow we can start using BIM. Ideally, we can start working with BIM from the first idea or concept design of the project. During the design phase, we can build up the central BIM model with more design details, more detailed geometries and more and more of the desired information. When the design is finished, we transfer the BIM model to the contractor for execution and let him deliver an as-built BIM model and the end of the execution phase. Based on the OTL, this as-built model will then contain exactly the information we need for the later operate and maintain phase.

However, we also have projects starting to use BIM which are already in a more detailed design phase, or projects that are ready to be constructed, without having a BIM design model. We are convinced that in these projects, there can still be an added value of using BIM, but other decisions will have to be made or other focus points will have to be chosen to make sure we can still profit from the BIM way of working.

BIM applications

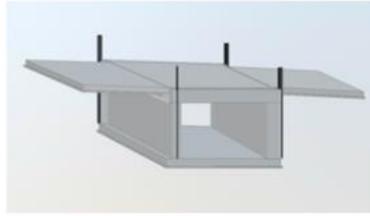
A second factor to take into account when thinking about using BIM in a project is to decide how we are going to use the BIM model in that project to get the most out of it, in relation to the total cost of the project, the complexity of the project... Choosing for which purposes we are going to use the BIM model in the project is selecting one or more so-called 'BIM applications'.

For our use, we have divided these BIM applications in 3 groups (Fig. 4) :

- Which sources of information should be added to the model? Which input are we going to insert in the model?
- Based on the available data in the model, both geometries and information added to objects, which analyses or queries do we want to do? Or for which specific analyses in other software packages do we want the BIM model to be used as source of information?
- And third, which output or deliverables do we want to generate based on the BIM model?



Collecting Information



Analyzing Information



Communication & generating output

FIGURE 4: THREE GROUPS OF BIM APPLICATIONS

As source of information during the design phase, we have of course the design itself. We can opt whether or not to add more detailed construction models, visualising for example reinforcement bars, formwork or other construction specific items to efficiently prepare, improve or follow up the actual construction works.

The existing terrain situation should also often be included in the model. But depending on the project's need, this existing situation can be very limited or it can be very detailed. The question is whether 3D points or lines coming from a topographical measurement are sufficient, or do we need these objects to be modelled as 3D objects? If they need to be modeled as 3D objects, is a low level of geometric detail sufficient or do we need very detailed 3D objects of the existing situation, e.g. because we need to attach a new bridge part to the existing bridge? In addition, there is also a lot of public data available that we can add to allow a better visualisation and interpretation of our model. In the example below (Fig. 5), we've added a coloured point cloud based on lidar measurements and 3D building volumes, that can give us, without any further processing needed, a better interpretation of the wider project environment.

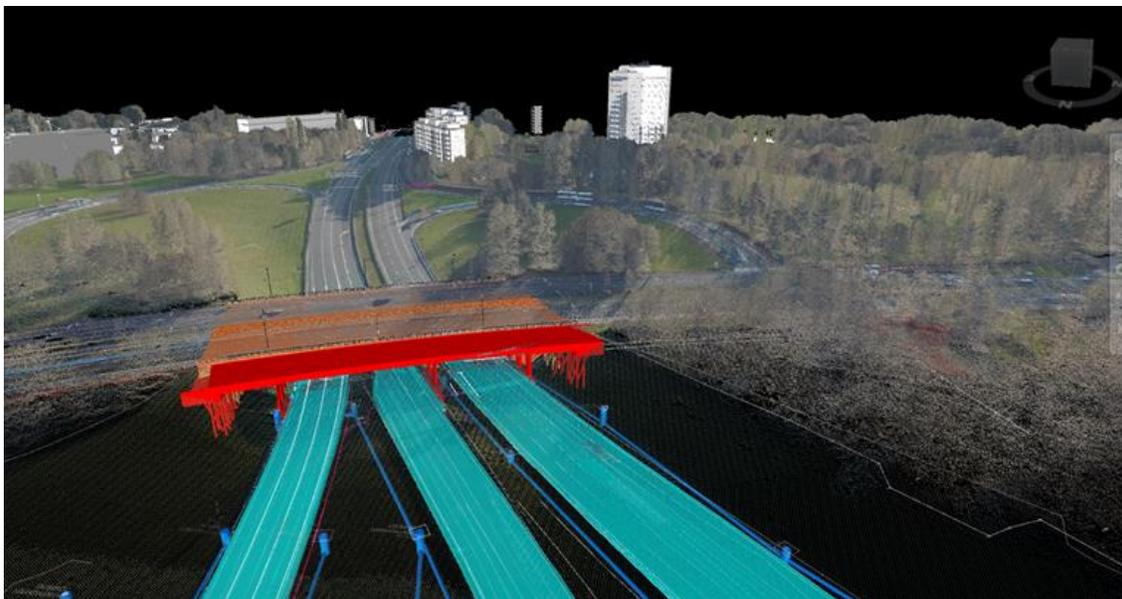


FIGURE 5: MODEL OF EXISTING AND NEWLY DESIGNED INFRASTRUCTURE COMBINED WITH AVAILABLE PUBLIC DATA SOURCES FROM THE INFORMATIE VLAANDEREN AGENCY

Based on all the available information in the BIM model, a lot of analyses and queries are possible. One of the most common is the so called clash detection, or the term we use 'clash and issue detection'. Clash detection refers to looking how good or bad different parts of the design match together, or how well they match into the existing situation. Issue detection is about finding problems ('issues') in the model that which can not be detected by running a clash detection analysis. For example, one type of curbstone connected with another type. Although their 3D geometries do not clash, such an abrupt switch between these two types is often not supposed to occur in a qualitative design. We see in our projects, that Navisworks is often used to perform this kind of analysis in an automated way. It is also the tool we use internally at our agency.

Where the 3D clash and issue detection is a BIM application that is generally included in our BIM projects, there are a lot of BIM applications that are not always usefull in a project. Including the project's phasing to be visualised in the BIM model for example, is that for my specific project an added value or not? Is the extra cost and effort worth it? Other analyses, such as specific water drainage analysis in the model, noise pollution, shadow analysis when building a large construction... can also be selected.

Finally, we can look at possible deliverables based on the BIM model. Here we can choose to include some specific 2D drawings, some cross sections or an object based bill of quantities for example, linking the cost elements with geometrical elements in the model. Often, some rendered visualisations, VR or AR applications to better communicate with the public and give them a better impression of what is going to be build in their backyard is included.

What to BIM exactly?

If we have made a project specific choice of BIM applications to include in our project, the next step is to see what that really means. Which objects have to be included in our model to put these applications into practice, how detailed do these objects have to be modelled and which information do they have to possess to make the required analyses possible? What is the so-called level of detail we need in our model?

In our case, the level of information (LOI) is clearly described and fixed in our data standard, the OTL. The use of the OTL is mandatory, this means that, no matter which BIM applications are included in a project, all information we want to receive in an as-built model is always compliant with OTL. Our information needs has to be covered in every project.

The level of geometry (LOG) can vary from project to project or from project phase to project phase. We can even vary the LOG between different types of objects or between different locations in the project. Depending on the chosen BIM applications, a minimum LOG is often required, to make sure we can obtain the desired results. The other way around is also applicable, when you first have an idea of the LOG you want to use in your model, more BIM applications will become possible or not to realize.

We define our LOG in levels ranging from 0 to +4, ranging from basic geometries to very detailed 3D models. Geometry included in our BIM models can thus vary from Level 0, which can be visualised as a classical topographical measurement, including points, lines and polygons as geometries to detailed 3D geometries up to Level 3 or 4 (Fig. 6). Level 3 includes

very detailed 3D objects, including all exterior details, where Level 4 even includes fixing bolts or internal details such as reinforcement bars. We have also foreseen a LOG -1 for objects that do not have to be visualised and modelled themselves, but for which there is nevertheless a information need.



FIGURE 6: EXAMPLES OF DIFFERENT LEVELS OF GEOMETRY (LOG)

Standardized contract documents

The way we try to maximize the standardization is to make our contract documents as uniform as possible. It starts with some general chapters in the main contract/tender document, but it also means we have a BIM Protocol in place, which applies for all of our agency's projects that include BIM. This BIM Protocol is a AWW general document, describing our BIM vision, the whole BIM process which is set in place, the general rules of information exchange, specific BIM tasks that are included in the project and some specific BIM roles we want to have included in the project team. This is a one-way document, describing the general BIM playing field in our project.

Also included in the contract documents in a BIM Execution Plan, describing the project specific BIM aspects for that project. But again, by starting from a general template. Also in this case we maximize the uniformity in our documents. The BIM applications can be selected from a general list, so that application A used in different projects is always described the same. Also the required minimal level of geometry is represented in a uniform way, using a LOG table, describing for each project phase and each group of objects which is the required LOG.

We have also chosen to always use the same collaboration platform in all of our BIM projects. Again to maximize uniformity, specifically for all of our colleagues, so that they do not depend on the platform that is chosen by the engineering firm or contractor. We, as contracting authority, provide a BIM360 environment in all our BIM projects (Fig. 7).

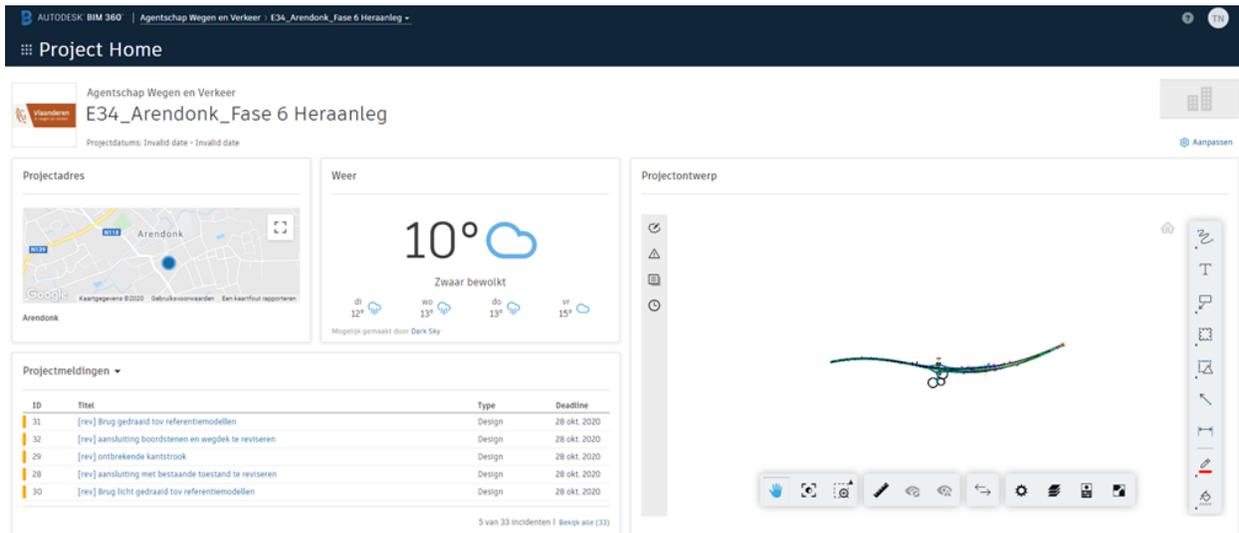


FIGURE 7: BIM360 ENVIRONMENT

Conclusions

A good management and maintenance our road infrastructure is based on up-to-date, complete and reliable information about all physical terrain objects ("assets"). The use of BIM gives us the opportunity to efficiently collect, save and manage the necessary information over the entire lifecycle of these assets. The OTL is the semantic data standard that provides us a common language to speak with all the project partners. Besides that it helps us to collect the information in a uniform way.

Based on the project phase in which we can start to BIM, and based on the selected BIM applications and Level of Geometry, we always try to maximize the added value of BIM for a specific project, taking into account the possible advantages, but also the extra effort, time and costs. Every project is different, this means that BIM in a project is never the same. Using BIM in a project has to focus on what is needed and important for that specific project in the specific circumstances.

We have already begun to include and require BIM in more than 10% of our annual investment projects this year. This by including guidelines and specifications in our tenders, the BIM Protocol and BIM Execution Plan. For ourselves, but also for all our project partners, a large degree of standardization is essential to use BIM more efficiently in our projects.