Amberg Inspection

Smart tunnel maintenance

User manual

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Introduction

This is the user manual of the Amberg Tunnel 2.0 - Inspection module. It contains all information about inspection project setup and synchronization with Amberg Tunnel Cloud.

This manual builds on the manual Amberg Tunnel 2.0 - Base. General information about the software, e.g. creation of projects, definition of axes, profiles, blocks, etc., can be found in the manual Amberg Tunnel 2.0 - Base.

1 What is Amberg Tunnel 2.0 - Inspection

The module **Amberg Inspection** serves to manage inspection data in a tunnel project. Measurement data from various sources can be imported, processed and analyzed. A tight integration with the web software **Amberg Tunnel Cloud** allows an data synchronisation and sharing.

2 Tunnel inspection in general

Tunnel inspection is a complex task. The goal is to evaluate technical state of the tunnel and determine necessary maintenance work. It is a good practise to do a visual documentation first (laser scan of a tunnel or other method to get georeferenced pictures of tunnel surface). These pictures are used as a background for tunnel inspection drawings.

Amberg Inspection will support you to manage inspection data for periodic inspections. Seamless workflow with Amberg Rail and Amberg Tunnel Cloud minimizes time and effort to inspect tunnel, analyse data and deliver reports to your customer. This improves efficiency and results reliability.

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Chapter 1 General introduction

1.1 General workflow

The general workflow when working with **Amberg Tunnel 2.0 - Inspection** consists of the following steps:

1. Create a new project with the **New project wizard**. Please refer to the Amberg Tunnel 2.0 - Base manual for more details.
2. Input the design data of the project like tubes, shafts, axes, structure design with theoretical profiles, theoretical sections, block definitions and sector models to the structure part of project tree. Please refer to the Amberg Tunnel 2.0 - Base manual for more details.
3. Define inspected features in the inspection **Catalog.**
4. Add measurement node for each inspection and import data to **Images**, **Inspection drawings** and **Inspection files**.
5. Create an **Inspection task** in **Tasks** node of the project tree.
6. Create an **Inspection analysis** in **Analyses** node of the project tree.
7. **Export or Synchronize** project with **Amberg Tunnel Cloud**.

1.2 Concepts

This chapter describes the most important concepts of Amberg Tunnel 2.0 - Inspection. Further basic concepts are explained in the chapter **Concepts** in the manual Amberg Tunnel 2.0 - Base.

1.2.1 Measurements and tasks

In an Amberg Tunnel **Structure project**, each **measurement** can have multiple inspection tasks. Each task can use data from all measurements within the tube (or shaft). This is convenient to keep project as small as possible. For example: Tunnel is scanned and inspected one year. Five years later only new inspection is done. New task can reuse pictures from the old inspection without copying these.

1.2.2 Independent on source of measurements

Inspection measurements include images and optionally drawings from previous inspections. This data can be easily loaded from other Amberg softwares. To be independent of the measurement source, it is also possible import data in general formats. Image format is available for all data in jpg, png or tiff format. Images without georeferencing information can be positioned with an easy wizard. Inspection drawings can be imported from structured text file (geojson).

1.2.3 Inspection in blocks

Field part of a tunnel inspections is usually done block by block. Also final tunnel evaluation is done for each block. Therefore **blocks are a fundamental** part of an inspection project. It is strongly recommended to define blocks in tunnel inspection project (zoom functionality in Amberg Tunnel Cloud is also based on blocks).

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1.2.4 Catalog with inspection features

The concept of inspection catalog is introduced to handle broad variety of object inspected in the tunnel. Each country has different regulations what must be inspected and how should be these features visualized.

The principles of inspection catalog are following:

1. Features are organized in **groups** for easier handling.
2. Each feature has a geometry type **point** or **line** or **area**. That defines how the drawing is done. Each feature has also visualization parameters like **color, line style, line thickness, area filling**, etc. Parameters depends on a geometry type. All this together define how will the feature look like in drawings and also in the analyses.
3. Catalog can be easily **exported and imported** to different project. This makes inspection projects look consistent.

1.2.5 Create project locally, use it globally

With **Amberg Tunnel 2.0 - Inspection** you can create a complete inspection project with all the necessary data. Inspection is much faster when more people work on the same project in the same time. That is why the inspection drawing is done in **Amberg Tunnel Cloud** where users can work simultaneously. Data can be easily synchronized between office and cloud. Field inspection in the tunnel can be done without Internet connection. Just download inspection project from the Amberg Tunnel Cloud to **Amberg Inspector** and work in offline mode. Data can be sent to the cloud as soon as the Internet connection is available again.

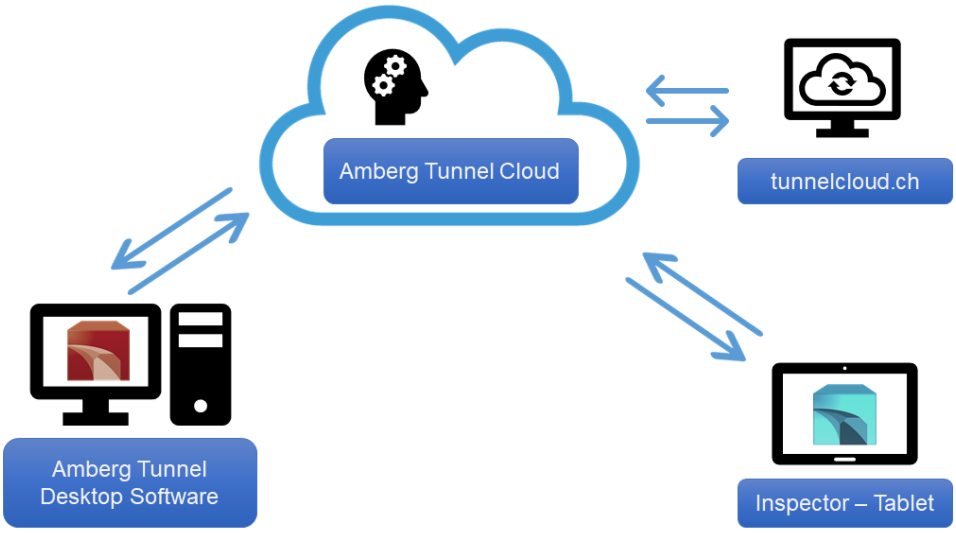

Figure 1. Inspection Software Structure

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Chapter 2 Preparations

2.1 Design data

The module Amberg Inspection is based on the Base module of Amberg Tunnel 2.0. The project definition and all design data are shared between the modules of Amberg Tunnel 2.0. For information about how to set up a project and design data, please refer to the manual Amberg Tunnel 2.0 - Base.

Inspection project must be defined in the **Structure** node of the Project Tree.

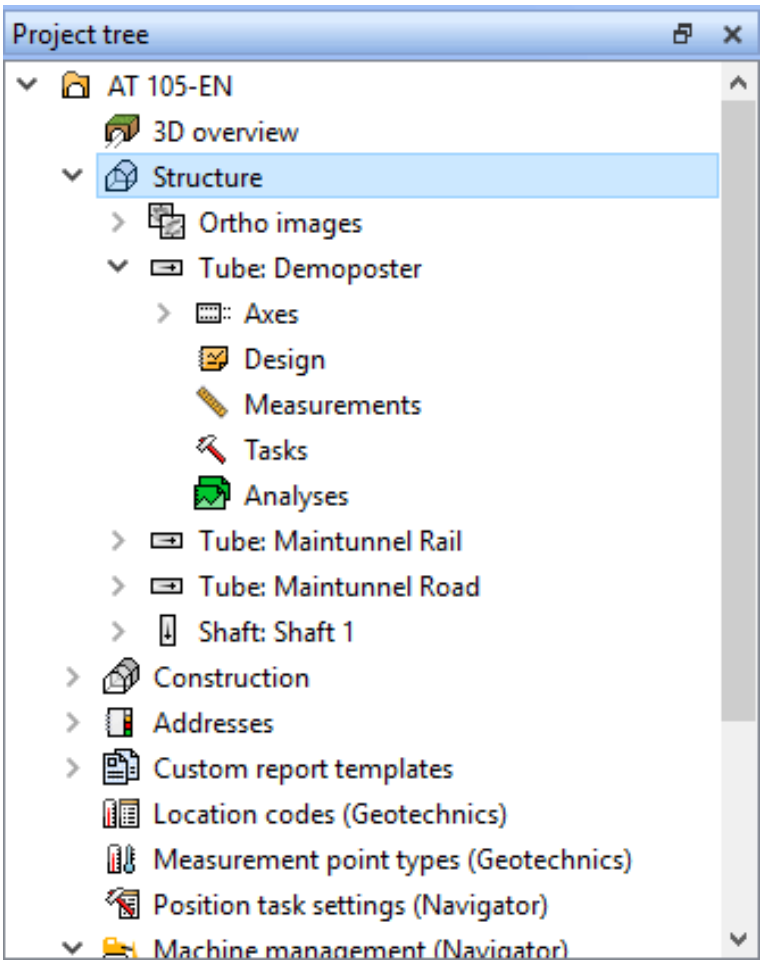

Figure 2. Structure node in Project Tree

2.1.1 Block definition

Blocks are a **compulsory** part of the project. Blocks are used for navigation in the tunnel during the inspection and for analysis.

Blocks are normally around 10 meters long. User can change the length of blocks as needed.

See Amberg Tunnel 2.0 - Base for more information how to create block definition.

2.2 Inspection catalog

The list of inspection features is managed using **Catalog** editor. To open the editor, double-click on the **Catalog (Inspection)** node in the **Project tree**.

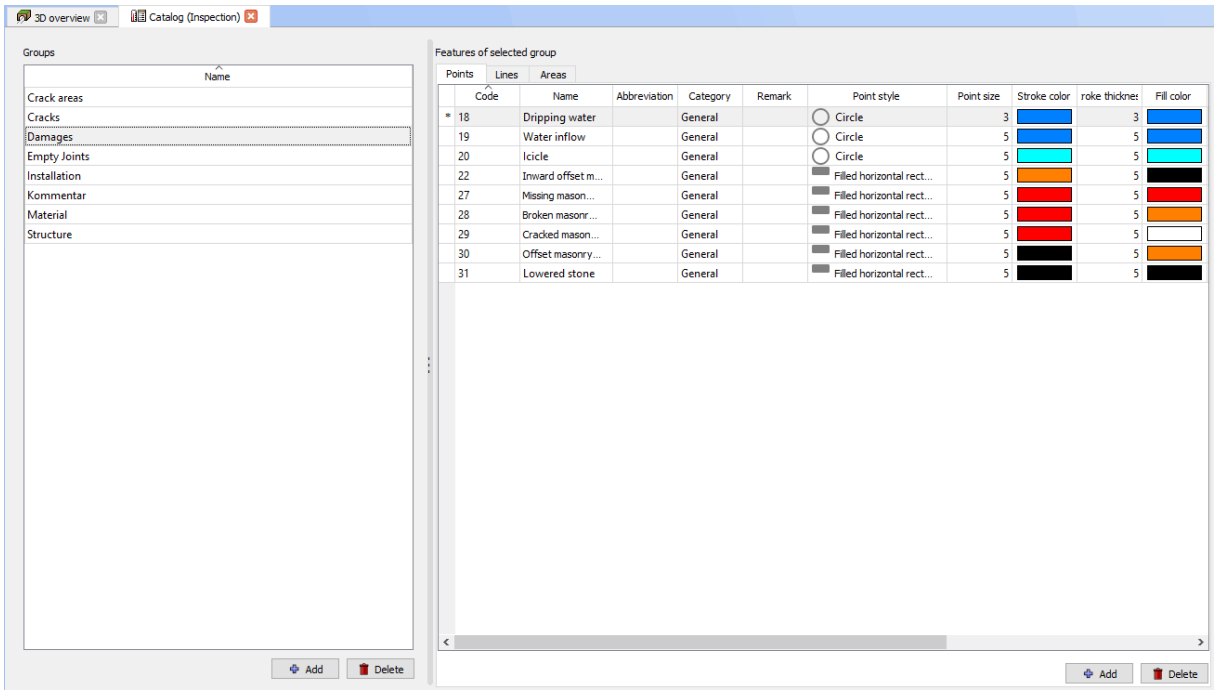

Figure 3. Inspection Catalog

2.2.1 Add new group

To add new group to a catalog, press **Add** button in the **Catalog** editor. A new row is added to the Group table. Write a group name and confirm with **Ok** button.

To **rename the group** click twice on a group name and type a new name.

Groups can contain features. Features are divided by geometry type to points, lines and areas. Each geometry type is in one tab.

2.2.2 Add new feature

In the **Feature of selected layer** window click **Add** button to add Feature. Feature is added to the active group and active tab (points, lines,areas). Fill in columns to properly define new feature.

Columns **common for all** feature types:

Code Code is unique number generated automatically. It can be changed by user but must be always unique in the catalog. If you use different catalog in different projects it is recommended to keep same code for same feature. It can be also used to manage catalogs in more languages.

Name Name of the feature. It is recommended to keep names shorter than 17 characters.

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Abbreviation	Abbreviation of a feature name (optional). Abbreviations are shown in places where full name would be too long (for example some analysis and dxf exports).
Category	(optional).
Remark	Remark to the feature (optional).

Columns **specific for points** feature type:

Point style	Select point style from a drop-down menu. The point style determines the shape of **point symbol** (circle, square, etc.).
Point size	Determine the size of a point symbol. Minimum is 1 (smallest), maximum is 20 (biggest point symbol).
Stroke color	Color of the point symbol outline.
Stroke thickness	Thickness of the point symbol outline. Minimum is 0, maximum is 10.
Fill color	Color of the point symbol filling.

Columns **specific for lines** feature type:

Line style	Select a line style from a drop-down menu. The line style is for example dashed, double, line with dots, etc.
Stroke color	Color of the the line.
Stroke thickness	Thickness of the line. Minimum is 0, maximum is 10.

Columns **specific for areas** feature type:

Area style	Select an area border line style from a drop-down menu. The line style is for example dashed, double, line with dots, etc.
Stroke color	Color of the the border line.
Stroke thickness	Thickness of the border line. Minimum is 0, maximum is 10.
Fill color	Color of a fill pattern
Fill pattern	Select a fill pattern from a drop-down menu.

2.2.3 Export catalog

To export the current catalog to an ASCII file, use the **Export to file** function from the **toolbar**. Catalog can be imported to other project. This ensures that the same features are inspected in each tunnel.

2.2.4 Import catalog

A catalog from other project can be imported. In the catalog editor select **Import** from the **toolbar** and then select the desired file to be imported via the import dialog.

Existing catalog will be overwritten by the import.

2.3 Coordinate and map settings

This settings define what map will be shown as an **overview map of the project** in Amberg Tunnel Cloud.To open the settings, double-click on the **Coordinate and map settings (Inspection)** node in the **Project tree**.

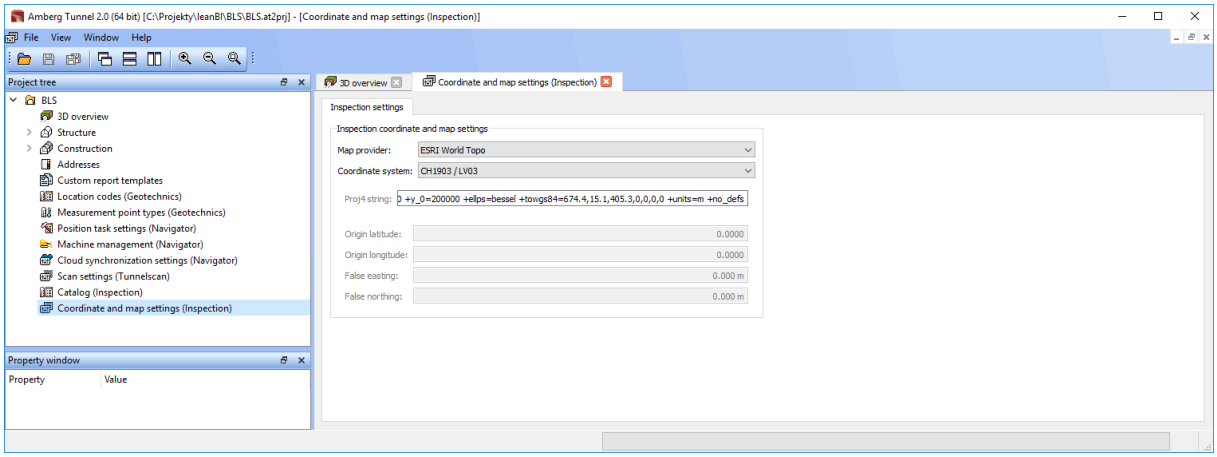

Figure 4. Structure node in Project Tree

Map provider Select which type of map will be used

Coordinate system Define how is the local project coordinate system transformed to global coordinate system. Following options are available:

- **Custom local coordinate system**: Fill Origin latitude and longitude, false easting and northing. That defines common point for local and global coordinate systems.
- **Custom proj4 string**: select this option if the proj4 string is delivered from other software. Paste proj4 string and click the save button.
- **Predefined coordinate system**: select this option if the project is designed in one of already predefined coordinate systems. The Proj4 string is filled automatically.

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Chapter 3 Measurements

Measurements are a sets of data that belong to one inspection. To add a new inspection with measurements right-click on **Measurements** node in a **Project tree** and select **Add measurement...** Enter the inspection **Name** and set **Validation date**. Validation date is a date when the inspection was done.

Each inspection measurement consists of **Images**, **Inspection Drawings**, **Inspection classes** and **Inspection Files**.

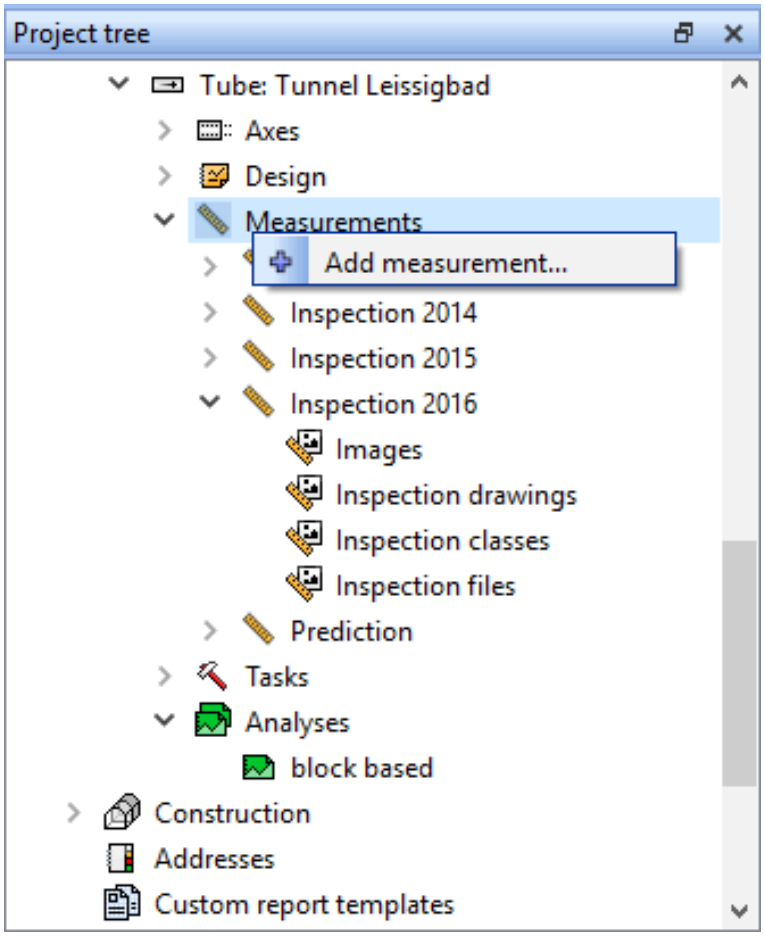

Figure 5. Measured profiles editor

3.1 Images

3.1.1 Images Detail editor

The **Images editor** lists all georeferenced images that are used as a background for the inspection.

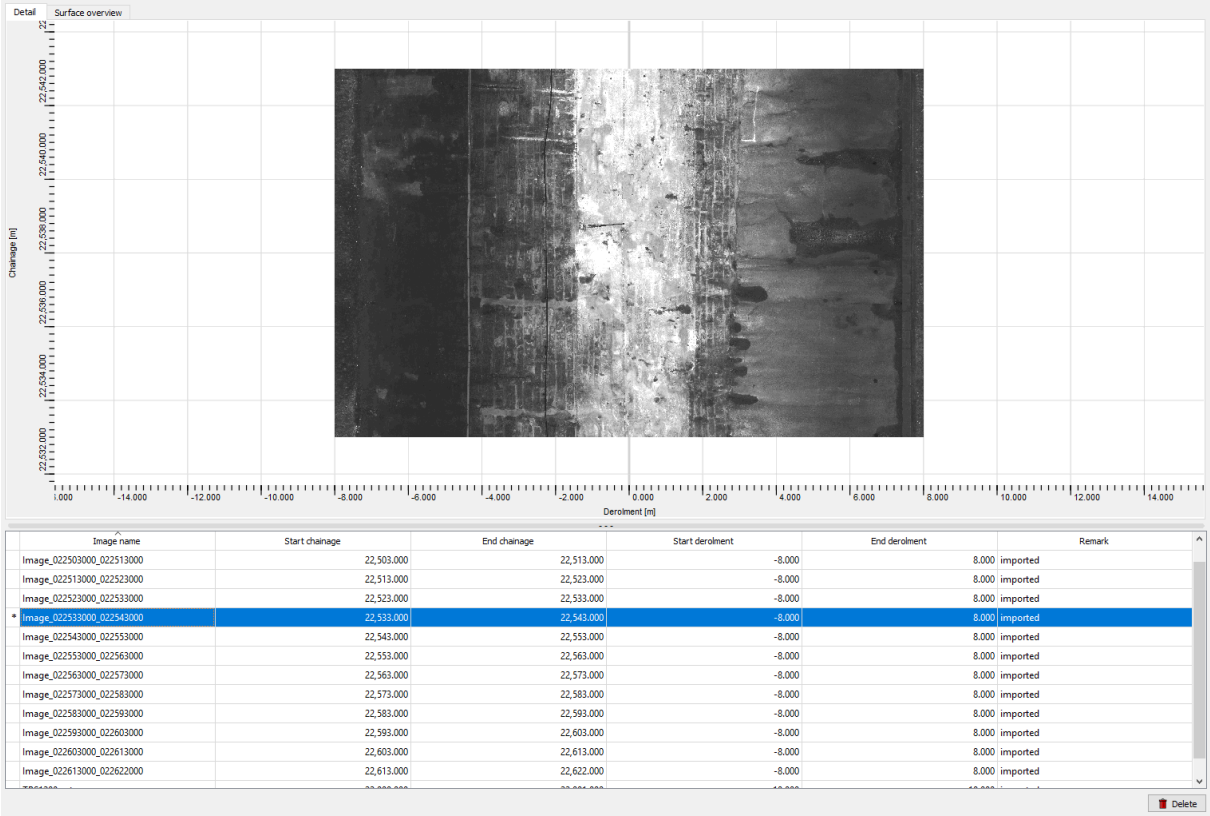

Figure 6. Inspection background pictures editor

The graphical area displays a preview of the selected image from the table in front view. The images table holds all images imported to an inspection. In the table, each image is listed with its attributes.

Image Name	Name of the imported image.
Start chainage	Chainage where the image begins. Chainage has to be within tunnel axis.
End chainage	Chainage where the image ends. Chainage has to be within tunnel axis.
Start derolment	Derolment value of the left side of the image.
End derolment	Derolment value of the right side of the image.
Remark	Remark to the image (optional).

To **see all images** in the inspection (the whole tunnel), go to tab **Surface overview**.

To **remove images** from the project, select one or multiple images in the table and press the **Delete** button at the bottom of the table.

3.1.2 Import images

To import images select **Import** icon from the toolbar or from a context menu. Find files to import. Supported formats are JPG, PNG, GIF and TIFF. If the file has position information, it is directly loaded. If the file has no position information, the **Import inspection images** wizard is opened.

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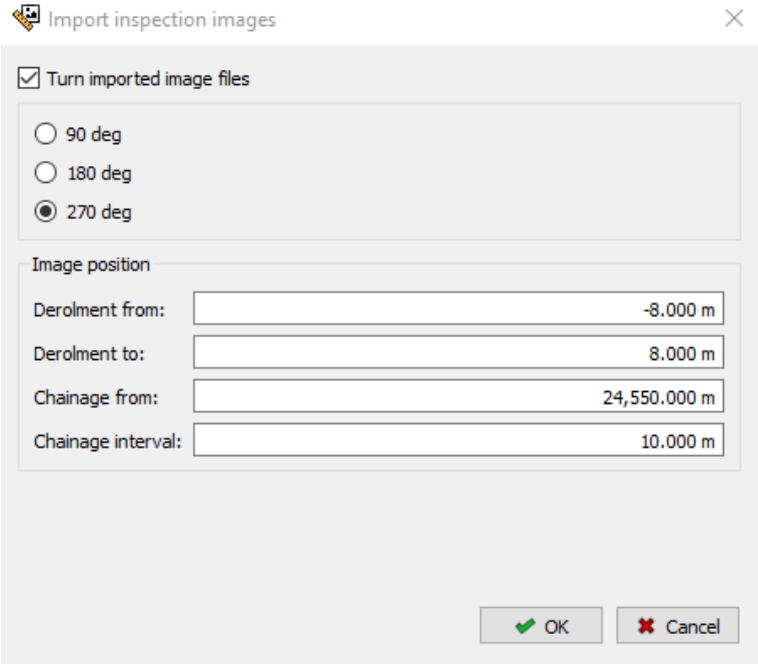

Figure 7. Import images dialog

Turn imported image files	Image can be rotated to fit axis direction. In images editor tunnel axis goes from bottom up. Images should be turned accordingly. Images are turned in clockwise direction by selected angle. Do not select this option if the image is correctly turned already before import.
Image position	Fill following values to position imported images correctly.
Derolment from	Derolment value of the left side of a image.
Derolment to	Chainage where the image ends.
Chainage from	Chainage where the first imported image begins. Chainage has to be within tunnel axis.
Chainage interval	Lenght of one image along the axis.

Press **OK** to start import. All selected images are imported one after each other.

If more images are selected, images are imported in alphabetical order.

3.2 Inspection drawings

Inspection drawings contains all the drawings that were done during inspection. It is possible to import and export drawings.

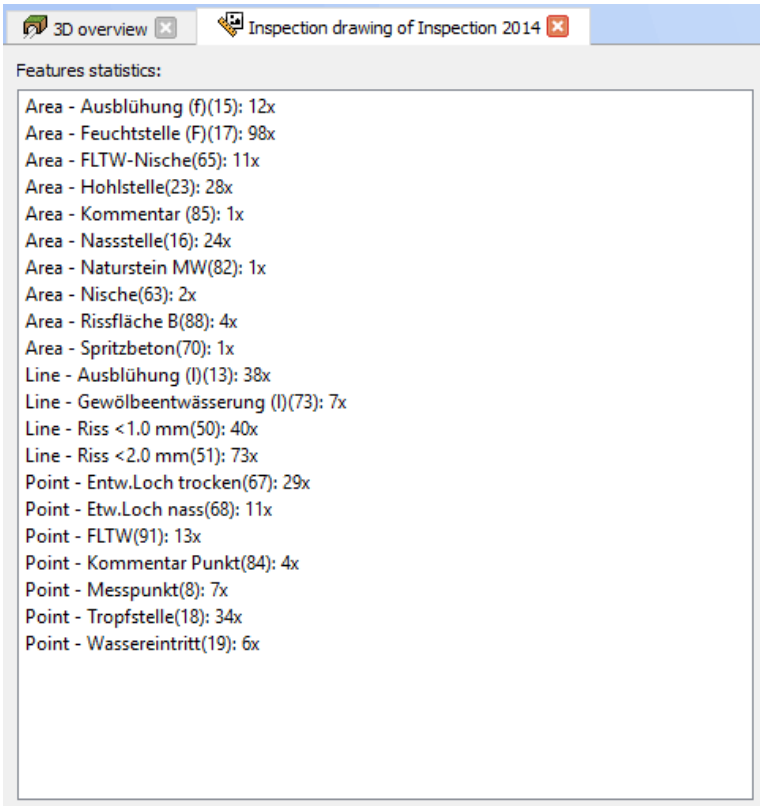

Figure 8. Editor Features statistics

Each line represents one feature. Lines consist of following informations:

Geometry type	Geometry type describes geometry of a feature. It can be point, line or area.
Feature name	Name defined in the **Catalog**.
Feature code	Code from the **Catalog**.
Number of features	How many times is this feature used in the inspection drawing.

In Amberg Tunnel it is possible to see inspection drawings only as a **Features statistics**. Drawings can be visualized and edited in **Amberg Tunnel Cloud**.

3.2.1 Import and Export inspection drawings

To import or export **Inspection drawings** use Import or Export button in a toolbar.

Import will overwrite current inspection drawings.

3.3 Inspection classes

Inspection classes are part of **Measurements** node in the project tree. Inspection class is given to each block based on **Inspection results**. This must be done manually by tunnel inspection experts. The whole tunnel has an overall classification.

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Classification value per block:

	Block stationing range	Block name	Classification	Comment
*	22,490.000 - 22,500.000	B1	1	
	22,500.000 - 22,510.000	B2	1	
	22,510.000 - 22,520.000	B3	1	
	22,520.000 - 22,530.000	B4	2	
	22,530.000 - 22,540.000	B5	3	
	22,540.000 - 22,550.000	B6	3	
	22,550.000 - 22,560.000	B7	5	falling stones
	22,560.000 - 22,570.000	B8	4	
	22,570.000 - 22,580.000	B9	4	
	22,580.000 - 22,590.000	B10	2	
	22,590.000 - 22,600.000	B11	2	
	22,600.000 - 22,610.000	B12	1	
	22,610.000 - 22,620.000	B13	1	
	22,620.000 - 22,630.000	B14	1	

Overall classification value:

Classification: 2 Comment:

Figure 9. Inspection classes editor

Block stationing range	Blocks are defined in **Design** part of the **Project tree**. See **Amberg Tunnel Base manual** for more information.
Block name	Block names are defined in **Design** part of the **Project tree**.
Classification	Classification of technical state of a block. Scale is from 1 to 5 (1 is the best, 5 is a very bad state).
Comment	Comment is displayed in Amberg Tunnel Cloud.
Overall classification value	Classification of technical state of a tunnel. Scale is from 1 to 5 (1 is the best, 5 is a very bad state).
Overall Comment	Comment is displayed in Amberg Tunnel Cloud.

3.4 Inspection files

Photos taken during inspection and other **files** can be loaded to this section. In Amberg Tunnel Cloud it is possible to link photos and files with specific places in tunnel. Thanks to this functionality the complete inspection project can be delivered to the customer via Amberg Tunnel Cloud.

3.4.1 Files Editor

The **Files editor** lists all files in the project.

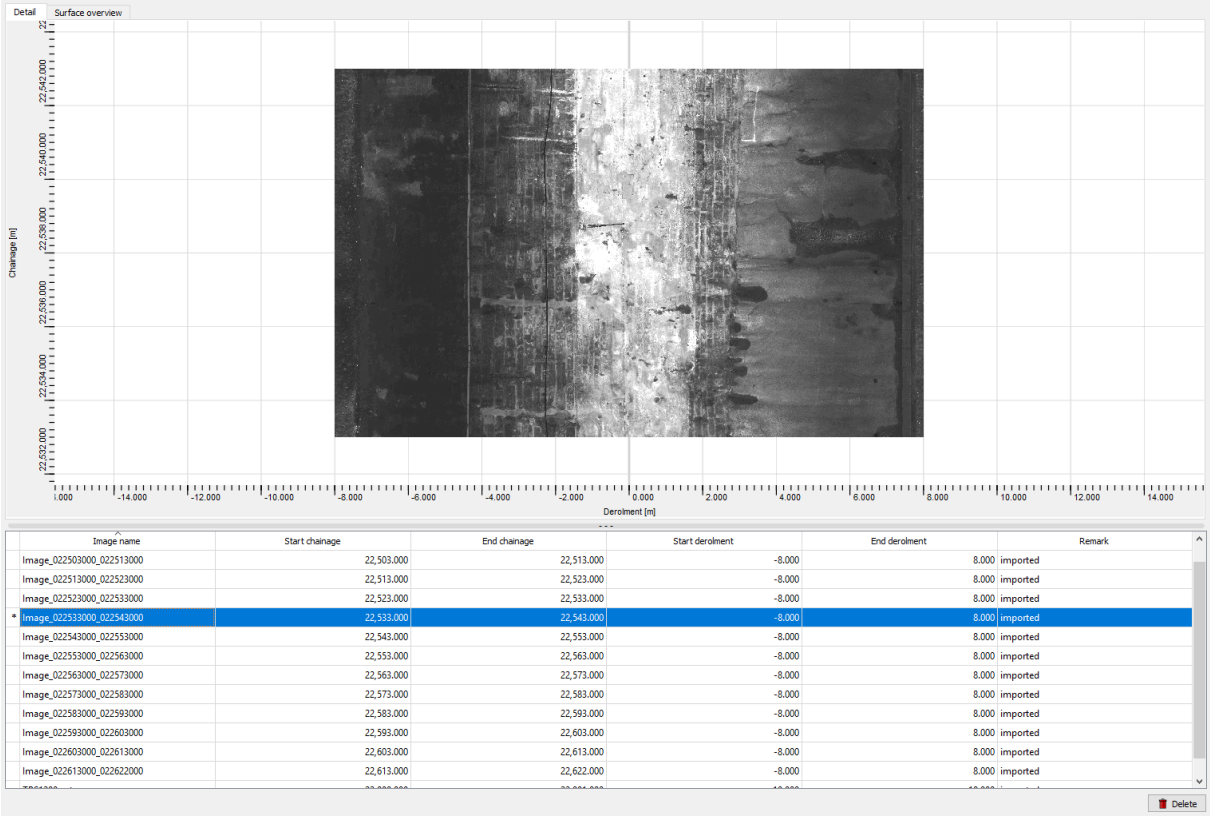

Figure 10. Files editor

The graphical area displays a preview of the selected file if the file is in image format. Preview for other file formats is not available (window is empty). The table lists all files imported to the project and their attributes.

Chainage	Chainage where is the file located. Chainage has to be within tunnel axis.
Name	Name of the imported file.
Operator	Operator who created the file.
Date and time	Date and time when the file was imported or created.
Remark	Remark to the image (optional).

To **import files** select **Import** icon from the toolbar or from a context menu. Find files to import and confirm import dialog.

To **export files** select files that you want to export from the project and click on **Export** icon from the toolbar or from a context menu. Select location to store the files.

To **remove files** from the project, select one or multiple files in the table and press the **Delete** button at the bottom of the table.

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Chapter 4 Tasks

This chapter describes how to create a task and its settings.

4.1 Add new task

To create a new task, right-click on the **Inspection** in the **Tasks** node in the Project tree. Select a **Task type** and enter a **Task name**. Press **OK** to create a task.

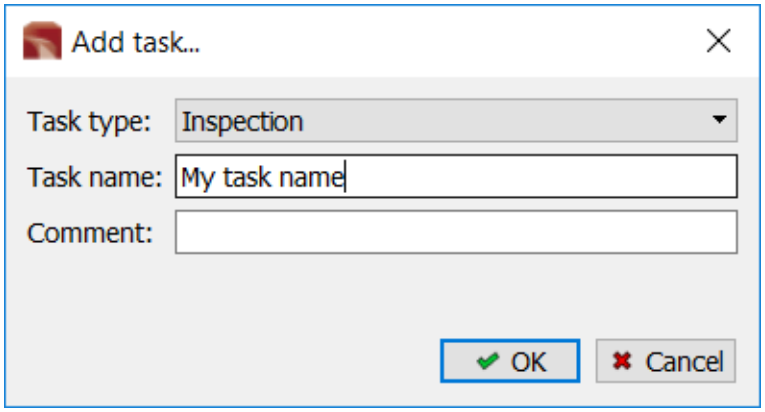

Figure 11. New task wizard

4.2 Inspection task

The task type **Inspection** enables to draw inspected features on the background of inspection images.

4.2.1 Task settings

Open the task with double-click. The page with settings is directly displayed.

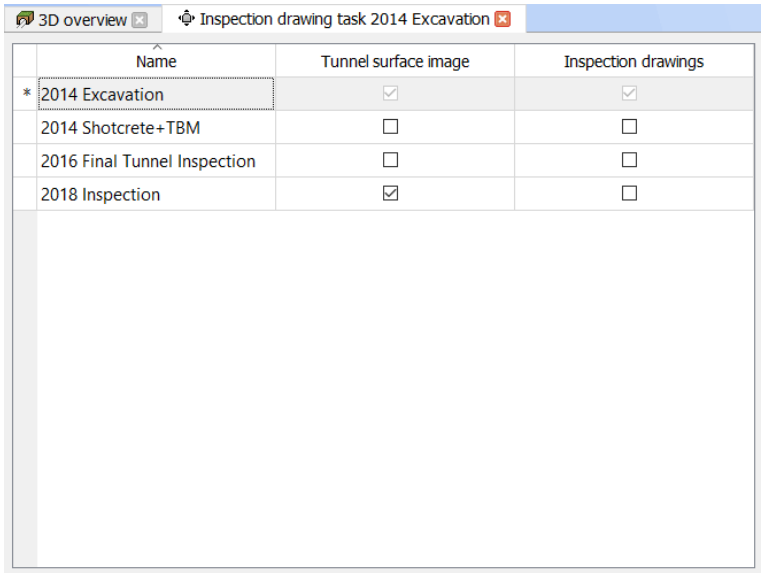

Figure 12. Inspection task settings

Settings consist of selection what data will be displayed in the inspection task. Data from the inspection where the task is created are always used. Optionally images and drawings from other inspections can be included.

If new inspection is done without acquisition of new images, it is not necessary to copy old images in **Measurements**. It is more convenient just include old images in the task settings.

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Chapter 5 Analyses

This chapter describes how to create analyses and what analyses are available.

5.1 Add new analysis

To create a new analysis, right-click on the **Analyses** node in the Project tree and click on **Add inspection analysis...**. Select an **Analysis type** and enter a **Analysis name**. Press **OK** to create an analysis.

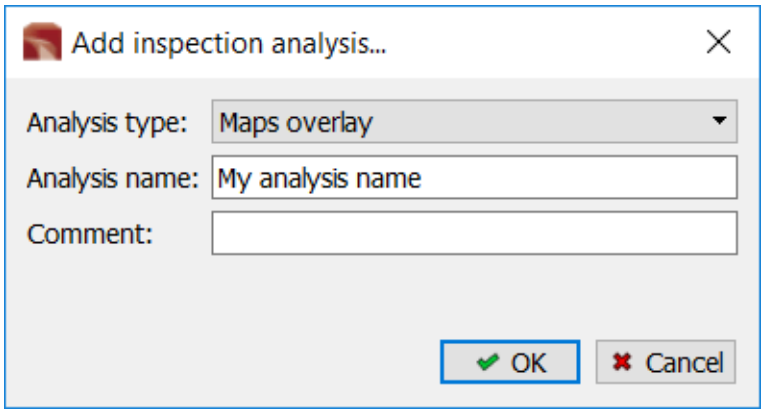

Figure 13. New analysis wizard

Analyses can be created also in Amberg Tunnel Cloud.

5.1.1 Available analyses

There are several analyses available for inspections. We can sort them into categories: **Exports**, **Maps** and **Statistics**.

Exports Exports inspection data in a specific format. Data can be then easily processed in other softwares.

- **Export DXF**: Exports inspection drawings in DXF format.
- **Export numeric results**: Exports inspection statistics in CSV (Excel table) format.

Maps Intuitive way to see inspections from different years and compare them visually.

- **Map view**: Shows one inspection.
- **Maps overlay**: Shows two overlapping inspections.
- **Maps side by side**: Shows two inspections next to each other.

Statistics Statistics show inspection results in an intuitive way.

- **Statistics by blocks**: For each block shows summary of inspected features.
- **Statistics for tunnel**: For whole tunnel shows summary of inspected features.

Analyses can be opened in **Amberg Tunnel Cloud**. It is not possible to see inspection results in Amberg Tunnel office software.

Chapter 6 Remote project management

Finished project can be **exported to Amberg Tunnel Cloud** to do the inspection work. First time the complete project must be **uploaded**. Later it is enough to **synchronize** changes. Upload time depends on a project size and Internet connection speed. It can take several minutes. Synchronization is faster than the first upload.

6.1 Export project to cloud

Finished project can be **exported to Amberg Tunnel Cloud** to do the inspection work. First time the complete project must be **uploaded**. Later it is enough to **synchronize** changes. Upload time depends on a project size. It can take several minutes.

1. Fill your **Amberg Tunnel Cloud credentials** in **File -> Options.. -> General -> Remote project**

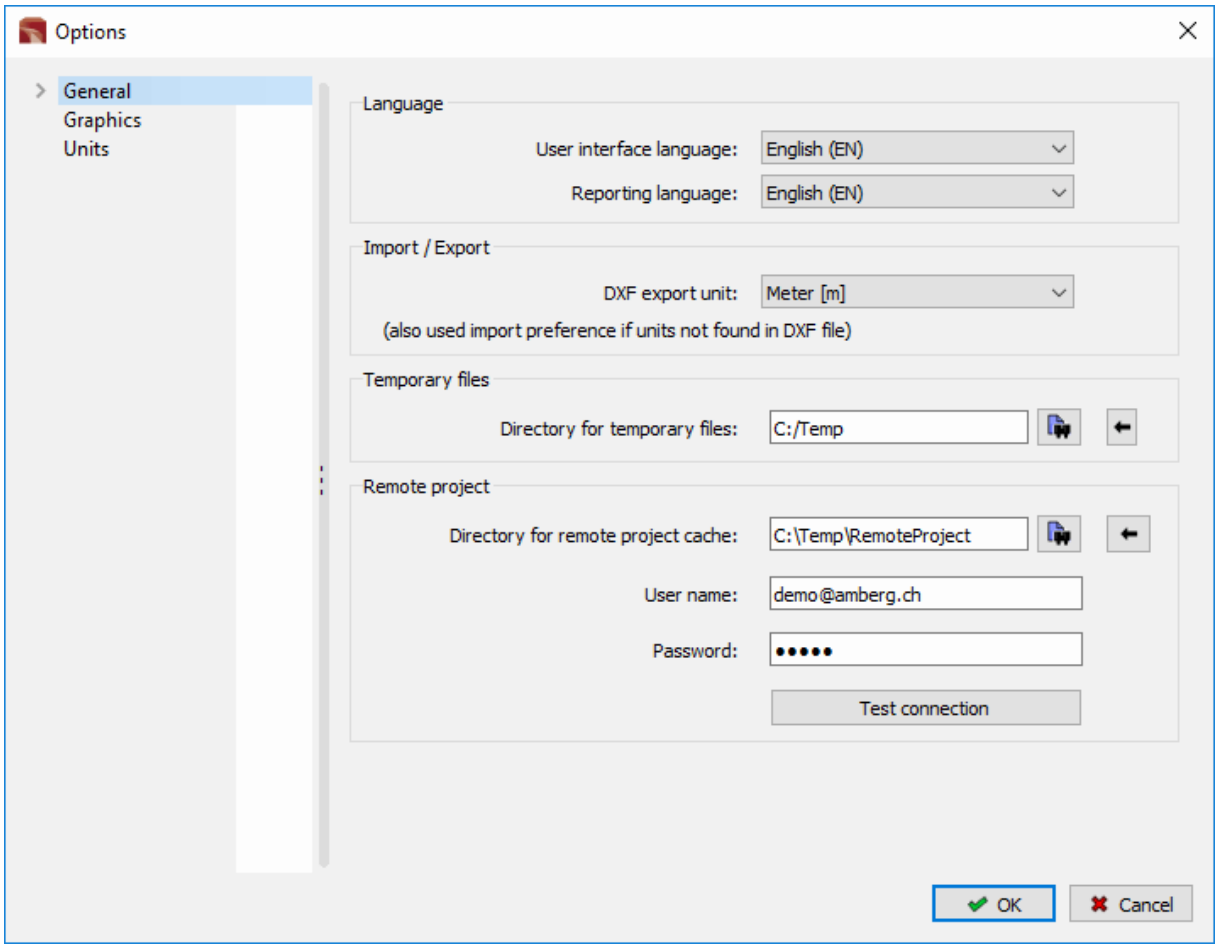

Figure 14. Project management

2. Press **Test connection** to verify that your **User name** and **Password** are correct. Click **OK** to confirm the settings.
3. **Right-click** on the **project name** in the project tree and select **Export as remote project...** . Wait until the project is exported.

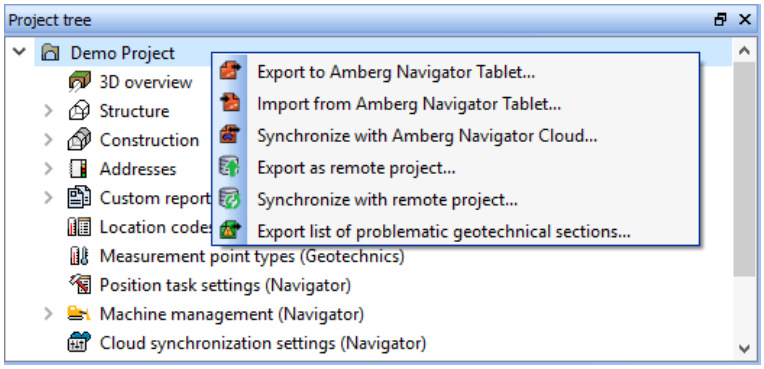

Figure 15. Project management

4. Open web browser (Chrome is recommended) and go to **https://tunnelcloud.ch**
5. Use the same **user name** and **password** that was used to export the project.
6. Do the tunnel inspection. See **Amberg Tunnel 2 - Inspection Cloud** manual for more information.

6.2 Project synchronization

When the project is changed after its first upload, it is enough to synchronize the changes. This is faster than uploading the whole project. If the same part of the project was changed by more users, the latest change will be used.

To synchronize changes in the project, **right-click** on the **project name** in the project tree and select **Synchronize with remote project...** . Wait until the project is synchronized.

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Glossary

Chainage	Stationing value along a chainage axis as a reference of the finished structure, e.g. railway or highway axis
Chainage axis	Axis in Structure view of the project
Construction	Top node for all sites, tube and shaft headings with heading axes, design data, measurement data and analyses of a project (Construction view)
Derolment	Distance from the axis measured along theoretical profile
Horizontal alignment	Geometry of an axis in a horizontal plane defined by straight, arc and clothoid elements (Situation)
Inspection feature	Object drawn during tunnel inspection (damage, installation, ...)
Shaft	Element of a finished tunnel structure. Can contain chainage axes (Structure view)
Structure	Top node for tubes and shafts with chainage axes of the finished structure (Structure view)
Theoretical profile	Polyline defining the shape of a tunnel as designed
Theoretical section	Defines the design of a construction stage by describing which theoretical profile is to be built along the heading axis
Tube	Element of a finished tunnel structure. Can contain chainage axes (Structure view)
Vertical alignment	Height/Gradient points along the horizontal alignment, optionally with arc or parabola round-offs

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