Overhead Contact Line Design Software Tool

ELFF®

SIGNON
MEMBER OF TÜV SÜD GROUP

Furrer+Frey®
Overhead contact lines

Overhead Contact Line Design Software Tool ELFF

ELFF is an automated overhead line design software tool. Based in an AutoCAD environment it can be adjusted to almost any OLE project. ELFF can handle a vast variety of challenges from high-output plain line design up to the most complex multi-track station areas and tunnel equipment.

COLLABORATION

COMMON DATA ENVIRONMENT

HOW IT WORKS

INPUT PROJECT DATA

+ DESIGN BORDERS

Electrification System Parameters to interface with any project.

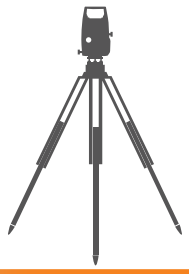
+ TRACK INFO

CAD data

+ TOPOGRAPHIC MODELS

CAD data

+ LIDAR INFO



+ POINT CLOUD SURVEYS

Laser scans of landscape, infrastructure and other complex areas undertaken with LiDAR or drones.

HOW IT WORKS

1 CONCEPT DESIGN

ELFF is BIM enabled with full project information integration.

2 DETAIL DESIGN

Much of design is automated, leaving the designer to concentrate on engineering.

ELFF WOR

SCREEN 1

User works directly into a 3D model environment. Progress instantly displayed.

INTERFACE

Designer focused and AutoCAD based, ELFF is familiar and easy to pick up for AutoCAD users. It develops new engineers and draughtsmen getting them up to OLE design speed much quicker. This allows inexperienced members of the team to work more independently.

COLLABORATION

3 ANALYSIS

Parameters can be altered during the design process with impact displayed instantly or reviewed in 3d fly-through.

4 DOCUMENTATION

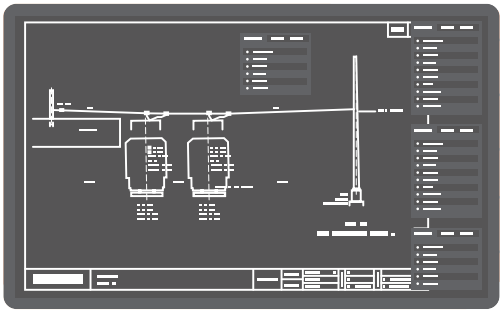
Layout, Cross sections and quantities of materials are all produced automatically from the model.

OUTPUT PROJECT DATA

KSPACE

SCREEN 2

Related information displayed on screen 2: layouts, sections, tables, bills of materials



Automated outputs derived from the 3D ELFF model

- **3D ELFF MODELS** — Models and fly-through animations
- **LAYOUT PLANS** — CAD/PDF data
- **CROSS SECTION DRAWINGS** — CAD/PDF data
- **BILL OF MATERIALS** — Spreadsheets
- **DROPPER TABLES** — Spreadsheets in Excel or PDF format

COMMON DATA ENVIRONMENT

BENEFITS OF ELFF

+ Time and budget efficiencies from streamlined design which is approximately two thirds of conventional OLE planning
+ ELFF interfaces with various softwares at input and output stages
+ Adjustable to almost any OLE project
+ ELFF produces an element of structural calculations for masts and conductors automatically
+ 3D ELFF supports stage-work design and phasing of complex deconstruction and installation

USER FEEDBACK

User Feedback from designers, installers and maintainers

FEEDBACK LOOP

infographic: Paul Weston | www.paulweston.info

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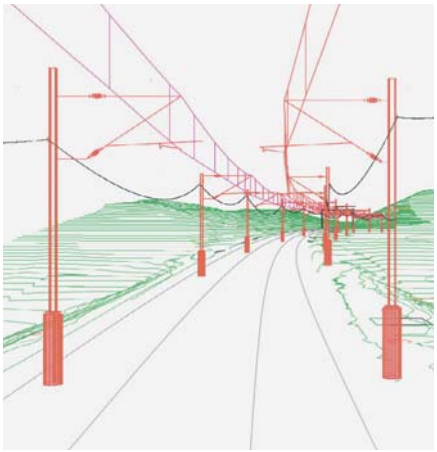
Overhead Contact Line Design Software Tool ***ELFF***



Aims

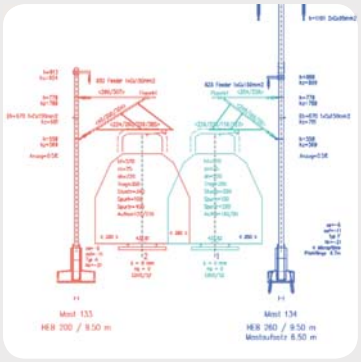
- ELFF modules help users save time and keep costs down when planning new-build, upgrade and maintenance projects.
- ELFF allows statements to be made about technical feasibility and construction costs in the shortest possible time.
- ELFF enables planning of overhead contact line systems, whatever their design, on the basis of a 3D model showing the track, surrounding area and overhead contact line.
- Can be used in all planning phases
- Can be used both for local and long-distance traffic
- No restriction in terms of construction types
- Different degrees of detail possible
- Automation of time-consuming work processes
- ELFF is a project design tool based on AutoCAD.
- Multiple languages supported
- Training and support services with state-of-the-art resources

Output

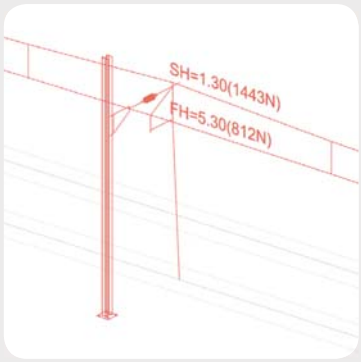
- Site or layout plans
- Cross-section profiles with assembly dimensions
- Checking of structural calculations for masts and wires
- Several types of views as required, e.g. signal sighting
- Longitudinal profiles
- Bills of materials
- Value tables for traction power lines, catenary systems, sag of the catenary and coordinates for mast foundations
- Customer-oriented output and export of digital planning documents according to the client's CAD requirements
- BIM-compatible 3D solid models

An Overview of the ELFF Modules

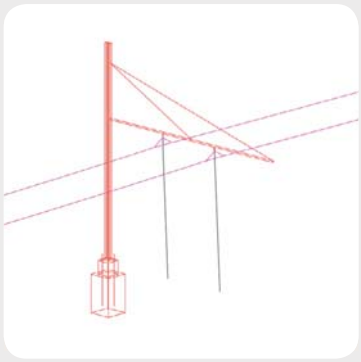
ELFF-CAP
Stage-work design and planning according to construction phase



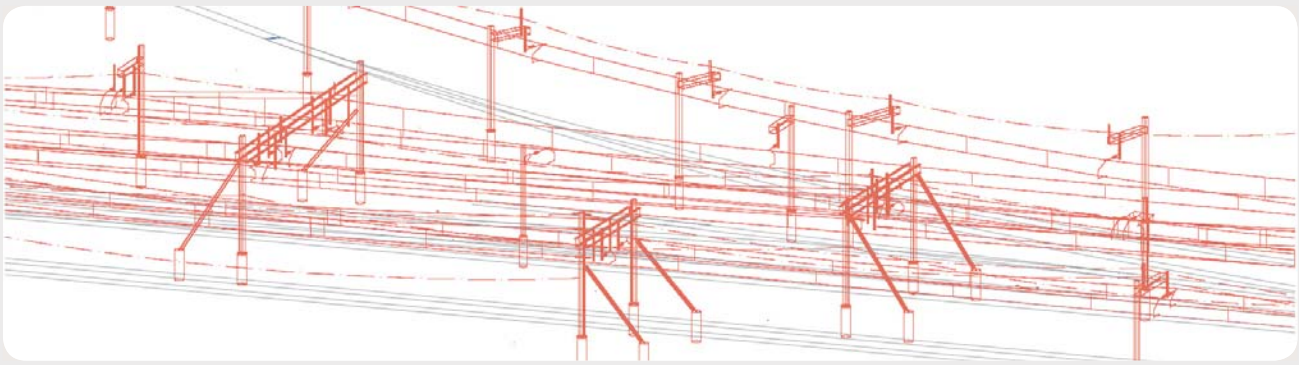
ELFF-CAT
Structural calculations for masts and wires



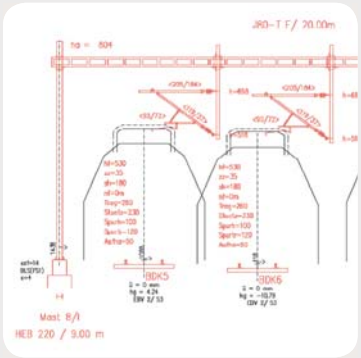
ELFF-CAEF
Single overhead contact lines / applicable to urban traffic



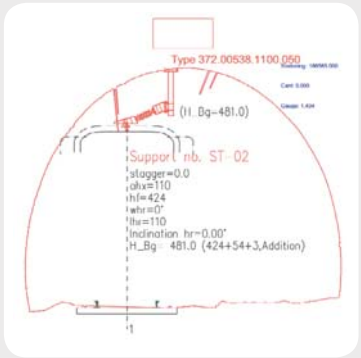
ELFF-CAD
3D Model of the Overhead Contact Line System
ELFF-CAD forms the basis for the other ELFF modules



ELFF-CAM
Creation of cross-section profiles and bills of materials



ELFF-CASS
Module for rigid overhead conductor system ROCS in tunnel



ELFF-BIM
Output data compatible with building information modelling (BIM) / 3D solid model of the overhead contact line system

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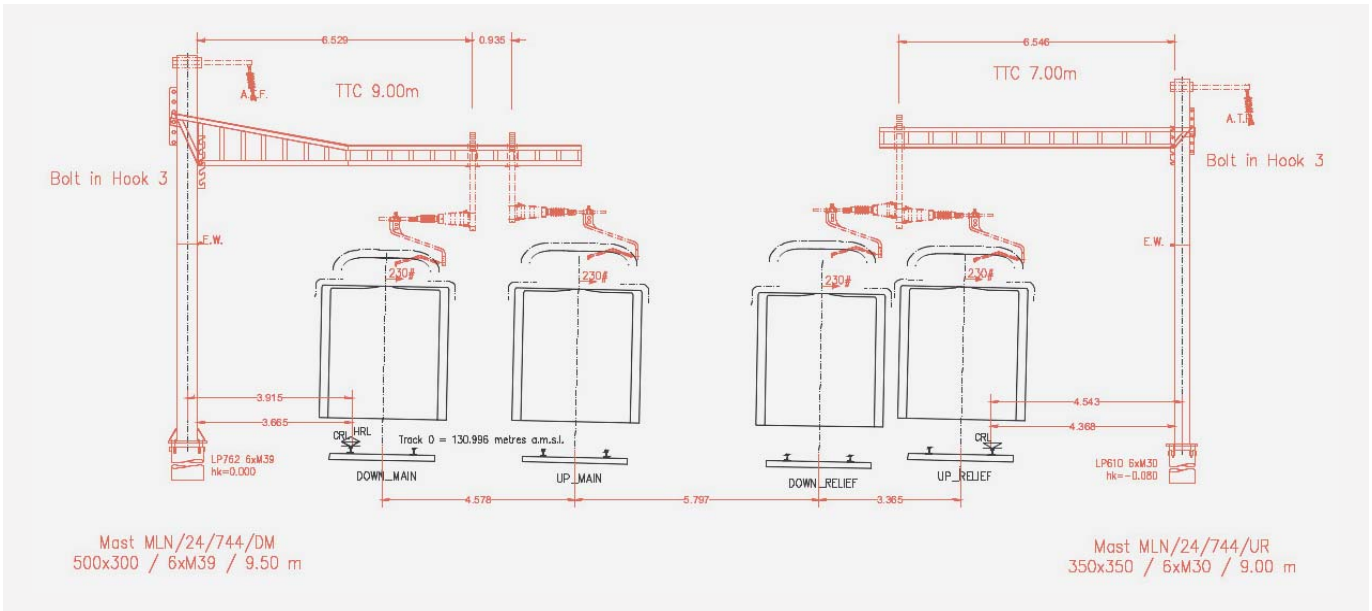
Module ELFF-CAD

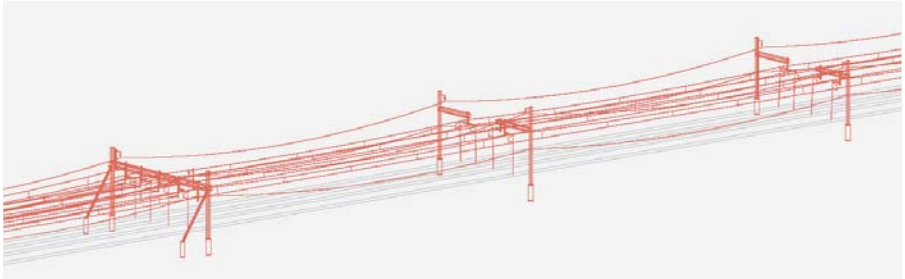
3D Model of the Overhead Contact Line System

ELFF-CAD: 3D Model of the Overhead Contact Line System

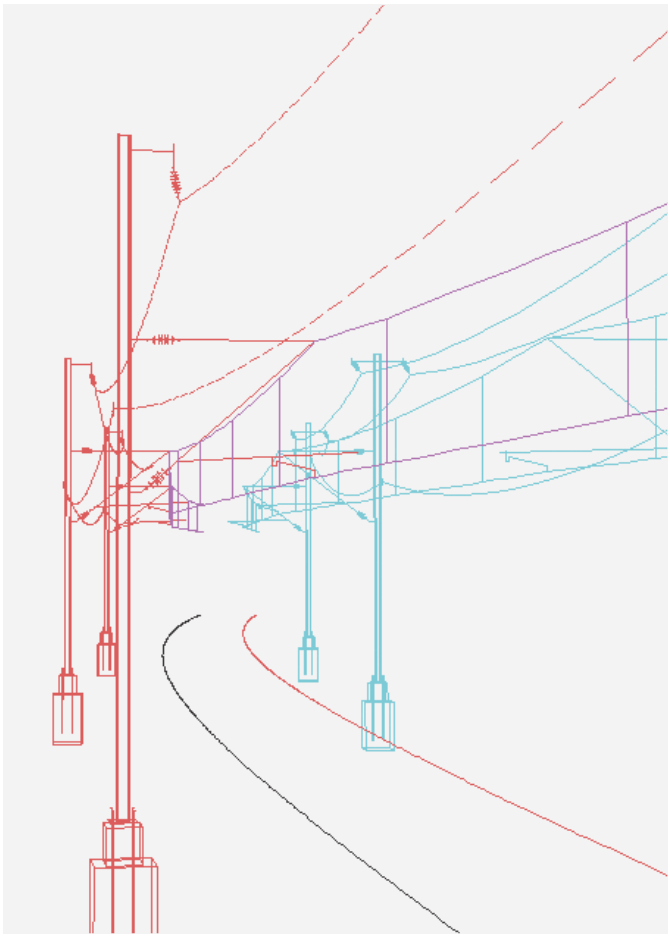
A 3D wireframe model of the overhead contact line system is created in ELFF-CAD. This 3D wireframe model forms the basis for the other ELFF modules and can be changed at any time, which means it has a dynamic structure. In each case, the track layout of the section of the overhead contact line system being mapped serves as the basis. Different views and distorted presentations, along with the option to show and hide specific objects or calculations, enable users to create or edit complex overhead contact line systems.

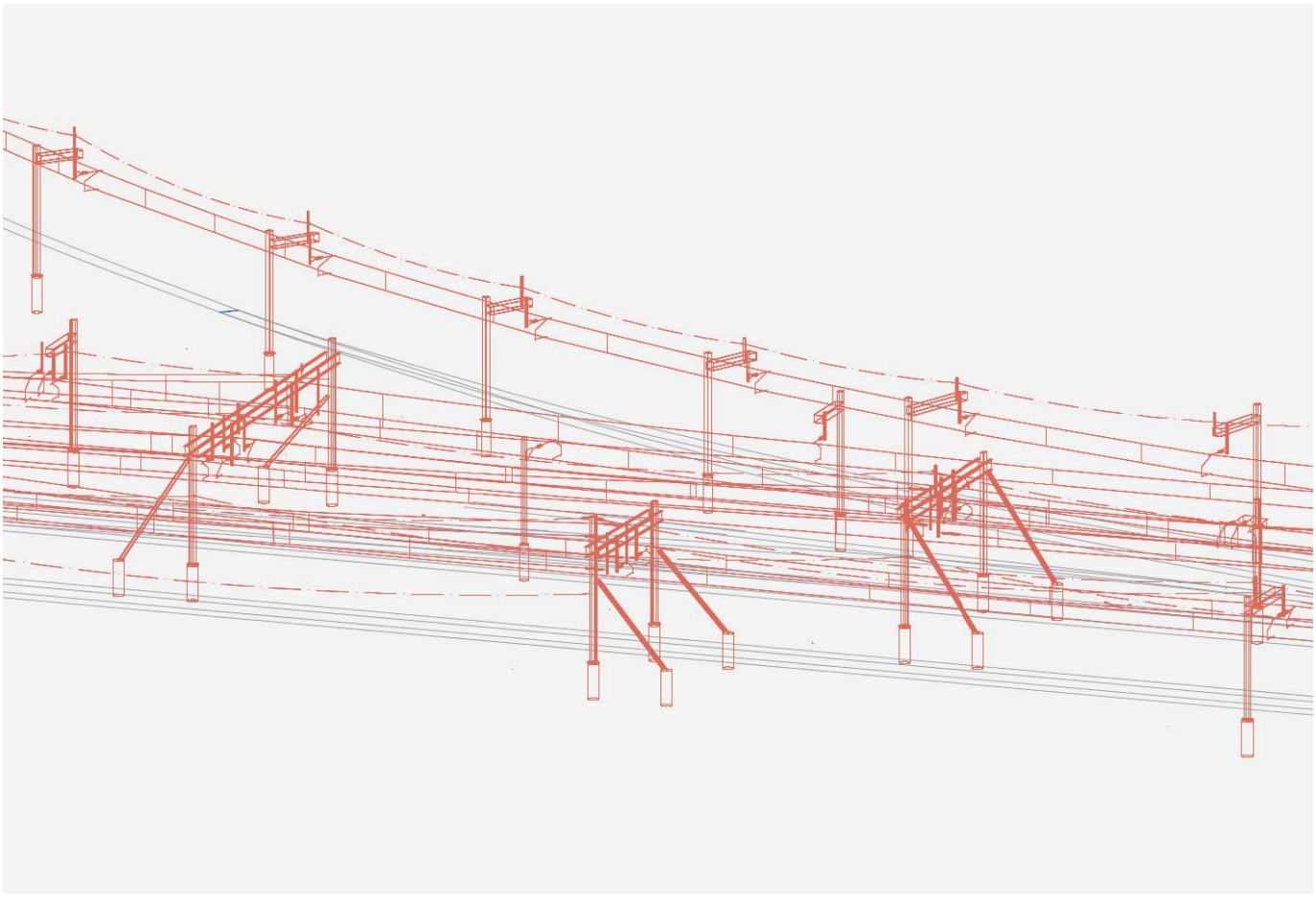
The basic idea of the ELFF project planning software is for users to work out data in ELFF CAD for the other ELFF modules in the form of a 3D wireframe model. This means the real work has already been done in ELFF-CAD, allowing further processing of data in the other ELFF modules to be largely automatic.





Module *EL*FF-CAD





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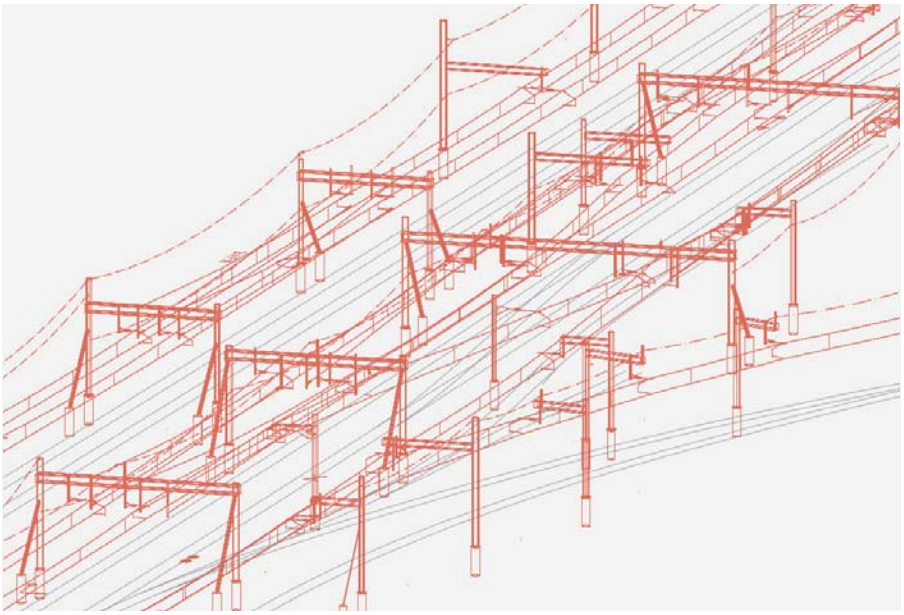
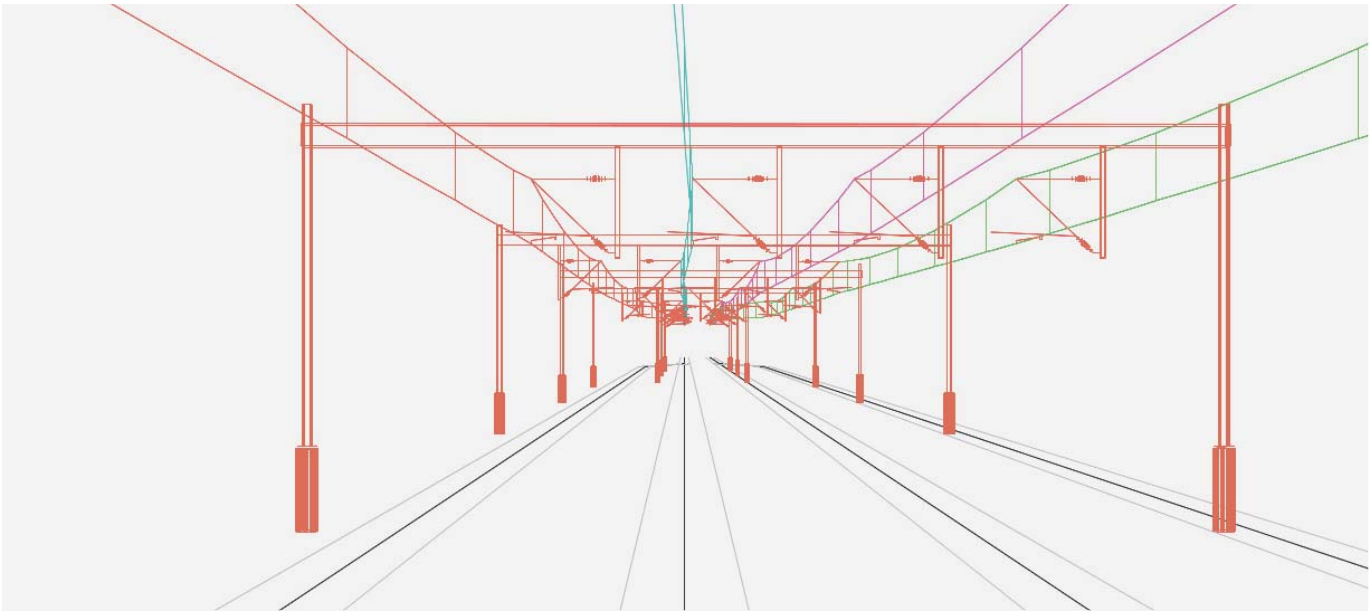


ELFF-CAD ensures users have significant advantages in terms of planning and implementing overhead contact line projects, even where there are complex, multi-track overhead contact line systems, such as in stations or in depots.



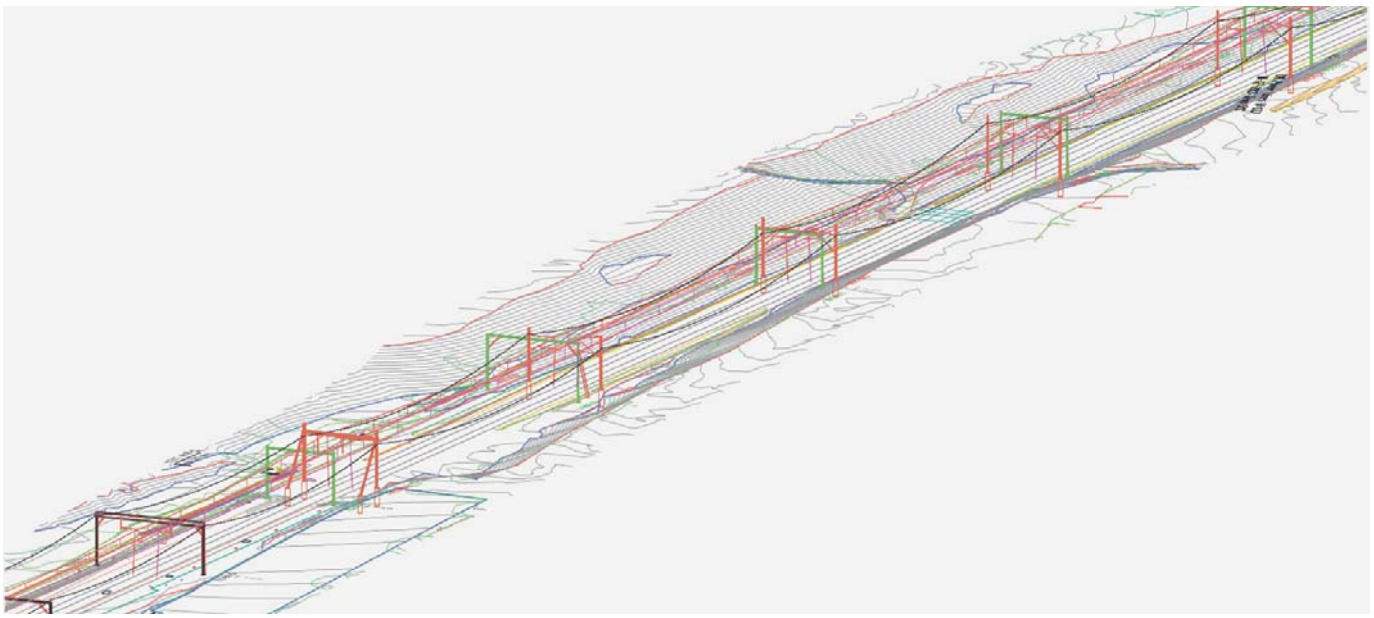
Visualisation of an overhead contact line system

Module *ELFF-CAD*

Input Data:
The track centrelines are needed to create a 3D wireframe model. Optimum results are achieved when the track centrelines are available as a 3D vector file. Track data from customer-specific sources may also be used in this respect. Important track data, such as the track cant, can be integrated into the 3D wireframe model using the software and these are taken into account in the design phase. Longitudinal spacing of support structures is supported by the program, but existing systems can also be replicated. Furthermore, there is also the option of determining foundations and mast positions using coordinate points. ELFF items are tailored to the appropriate railway standard and expanded, so that the correct parameters are provided for planning.

Aerial views, like orthophotos or digital terrain models in line format, also prove to be a useful support, enabling real mapping of the system together with the 3D wireframe model.

Referenced orthophotos in the ELFF model



Referenced terrain data in the ELFF model

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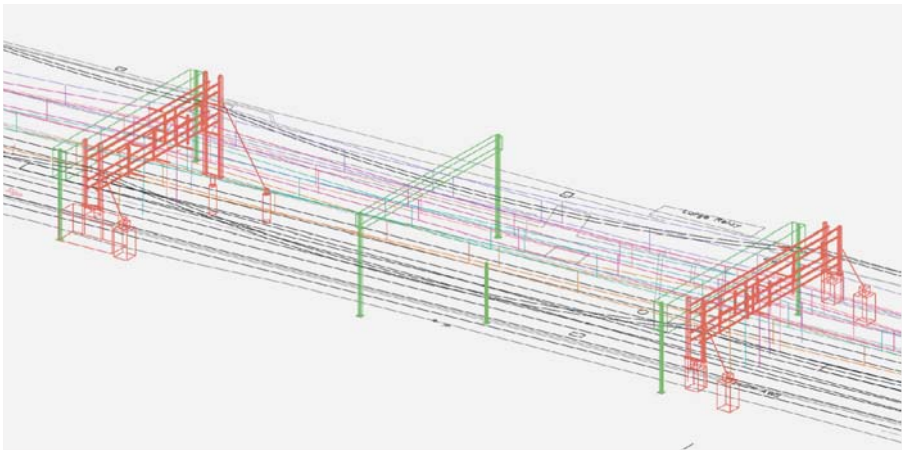
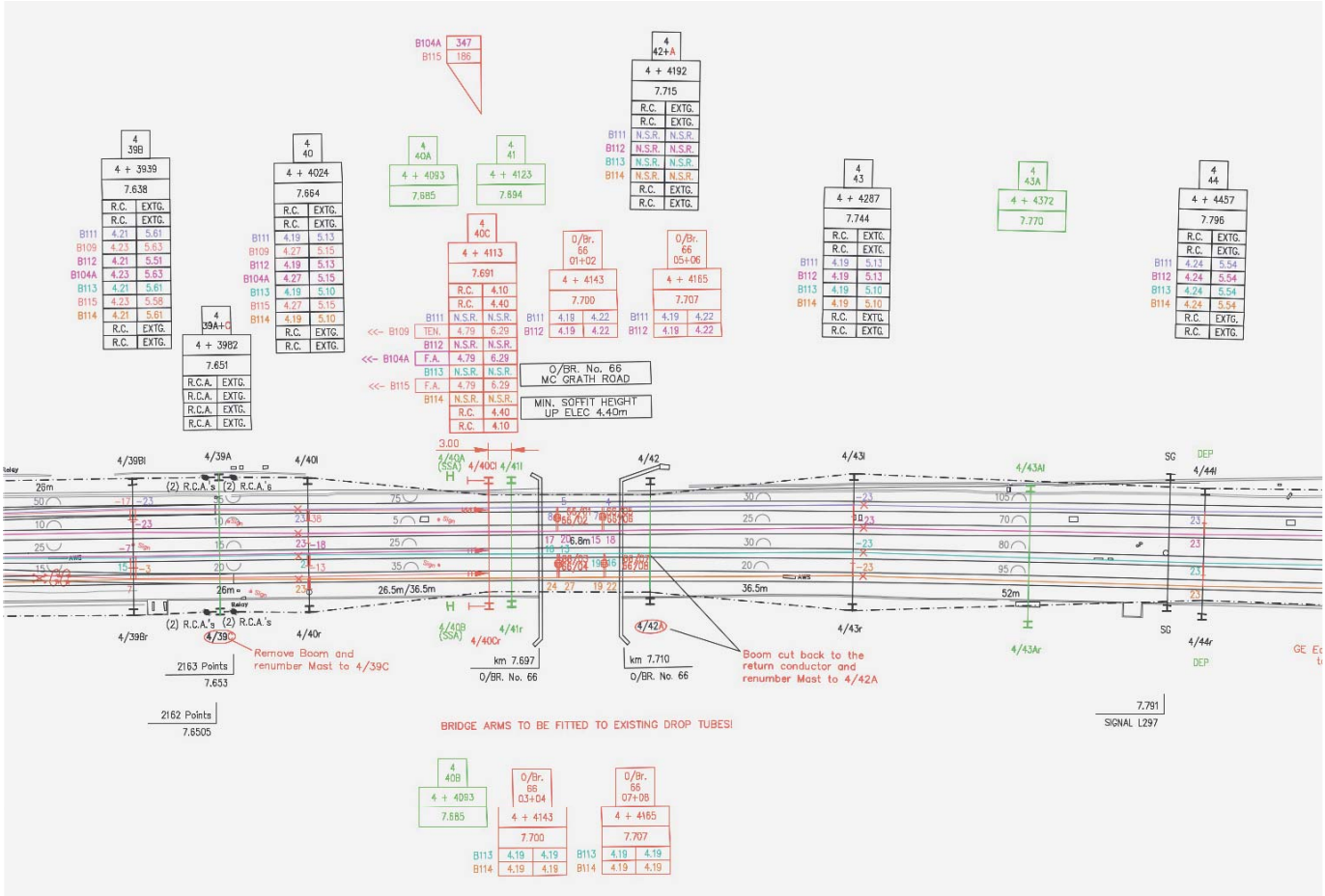


Output Data:

Views of the overhead contact line system from any angle, layout or wiring plans, cross-section and longitudinal profiles, and also mast tables and dropper schedules can be produced as lists from the 3D model.

However, the program also supports the creation of coordinate lists, such as for the foundation sites.
All output data are compatible with other CAD programs and therefore very versatile in terms of use.

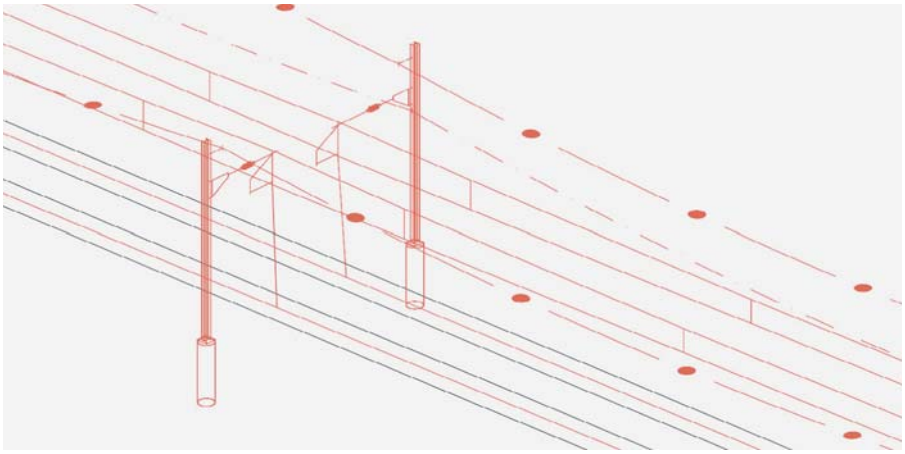
Upgrading an existing overhead contact line system

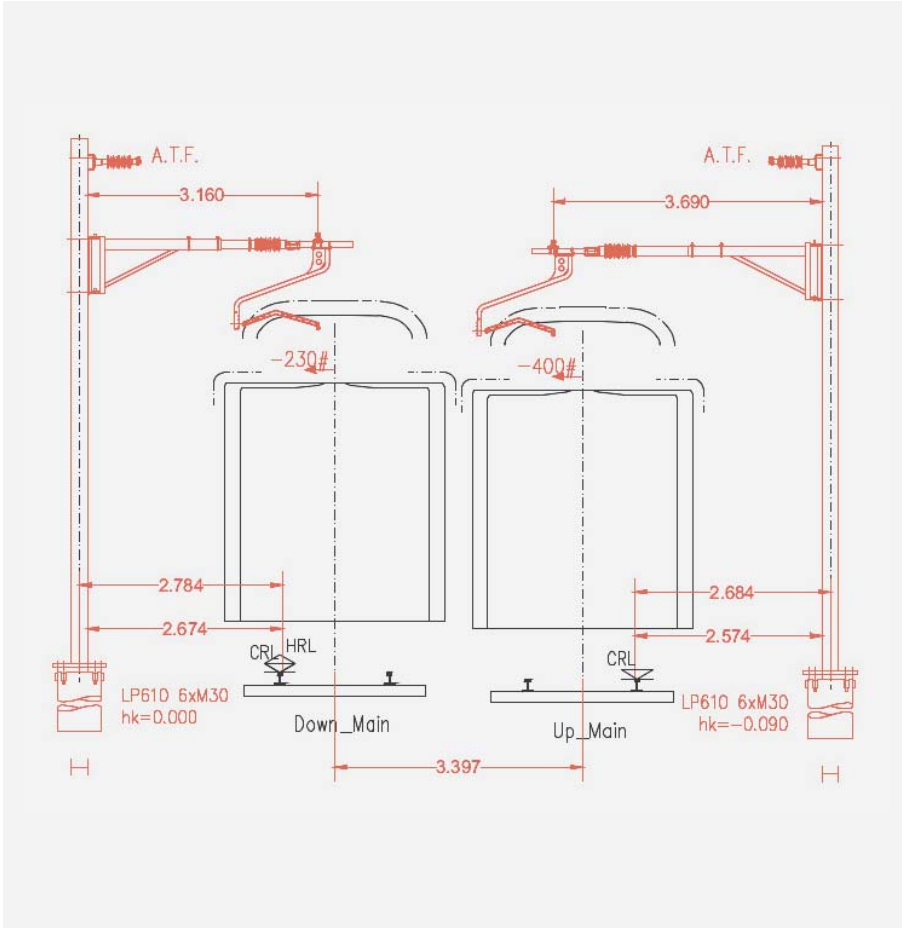


Extract from a layout plan

Module ELFF-CAM

Cross-Section Profiles with Assembly Dimensions and Lists of Materials





ELFF-CAM: Cross-Section Profiles with Assembly Dimensions and Lists of Materials

Based on the 3D model, ELFF-CAM enables detailed documentation to be produced for invitations to tender, purchase orders and assembly documentation. These are focused on the chosen overhead contact line system. Data exported from ELFF-CAD are imported into ELFF-CAM, which means cross-section profiles are automatically generated.

Input Data:

The components of a railway standard are contained in expandable component libraries and are provided with the appropriate dimensions, article numbers and prices.
These data are accessible in ELFF-CAM in the form of cross-section profiles and lists of materials, with the rules and building regulations of the relevant railway standard being taken into account. Components can also be assigned to specific groups to get a detailed overview.
Components can also be expanded with 3D solids if the project requires this. This gives users the option of generating 3D cross-section profiles, which can be used to check signal sighting or for incorporation into BIM projects.

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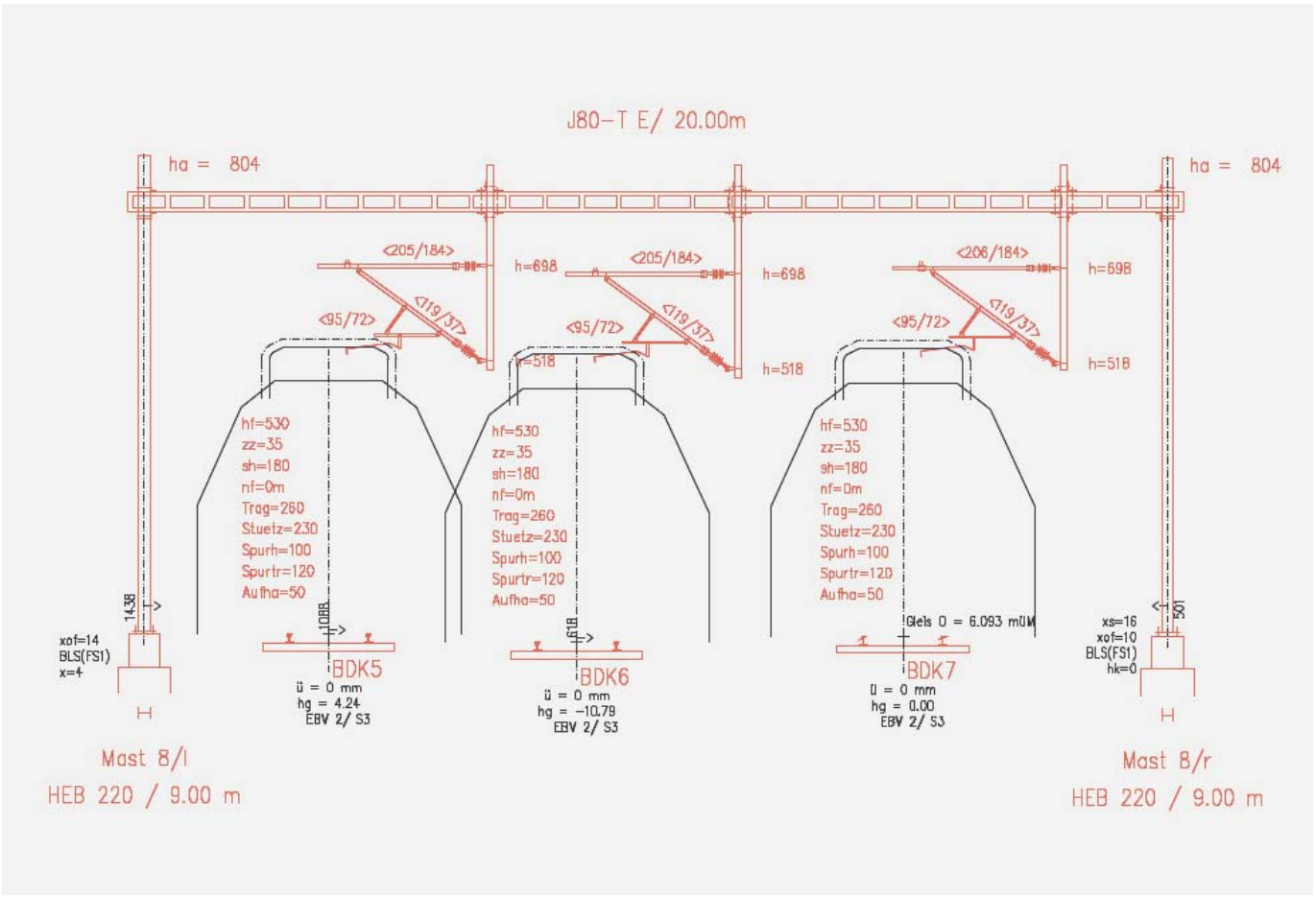


A typical example of a cross-section profile generated in ELFF-CAM provided with the information needed for assembly

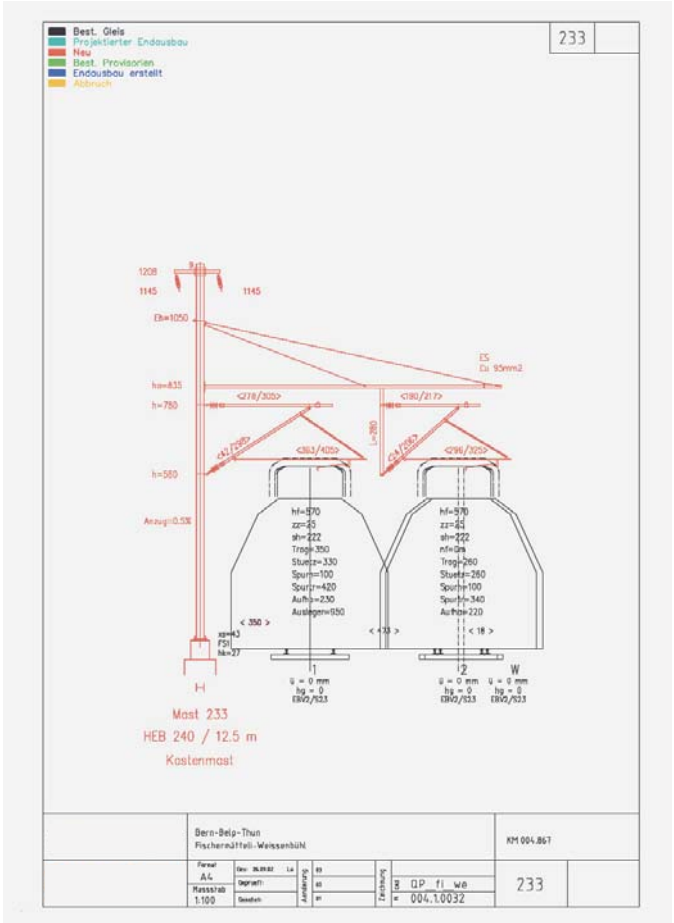
Depending on requirements, ELFF-CAM offers the possibility of producing 3D solid cross-section profiles

Module *EL*FF-CAM

Output Data:

Order-specific cross-section profiles with assembly dimensions and lists of materials are produced.
Data such as article numbers or prices, along with component dimensions can be accessed at any time for all the components used in the project.
This means there is the option for largely automatic creation of specific bills of materials or pricelists.

Alternatively, cross-section profiles and lists of materials can be generated for each support or tension length.



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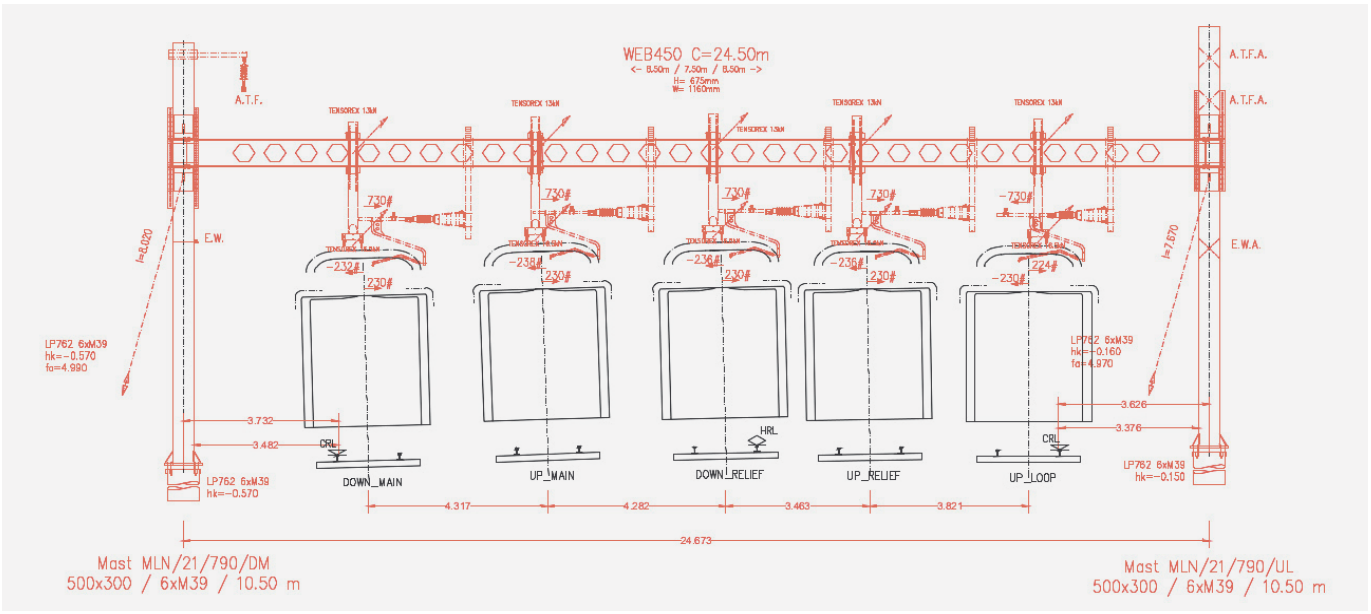
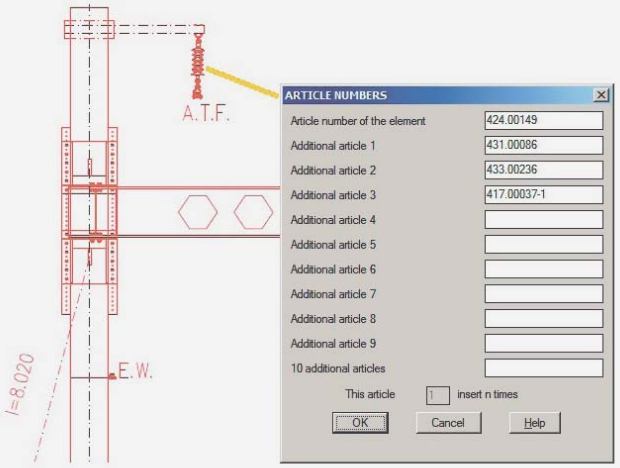
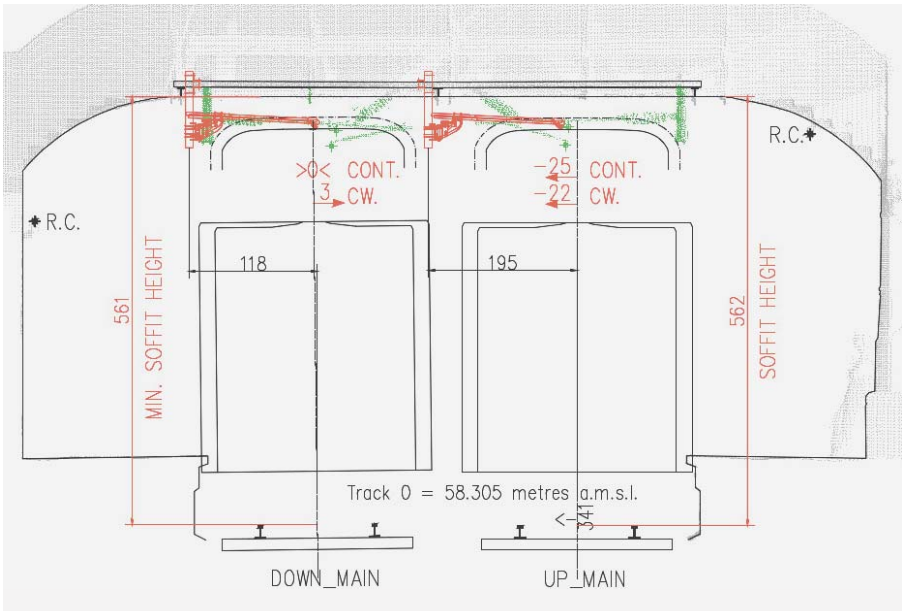


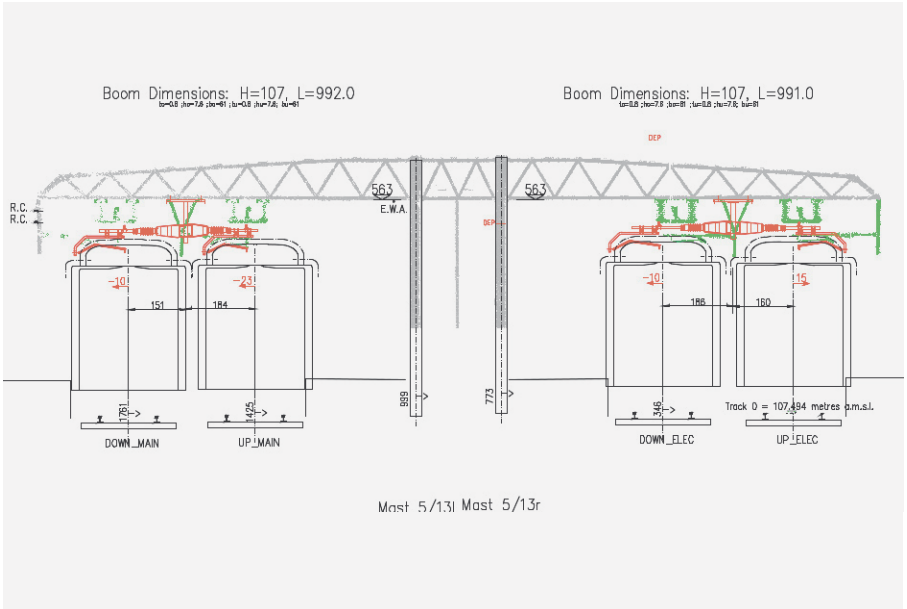


FILE WITH LISTS OF ALL C-S												
KM021790												
ARTICLE NO.	DESCR	QTY	NOTES	NONAME	C11	C18	C19	C20	C21	C24	C25	C26	C27	C28
328.00310	Washer for Bolt M39	48		48										
328.00404.64.105	Mast 500x300 f. MABL 10.5m ATFV	2		2										
334.00059.075	Adjustable Lattice Tie 200x200x6.3 RHS	1		1										
334.00059.080	Adjustable Lattice Tie 200x200x6.3 RHS	1		1										
334.00090	Foundation Bracket on 762Pile 6xM39	2		2										
334.00132	Support Br. WEB450 with tongue with stop	2		2										
334.00139	Support Br. WEB450 no tongue with stop	2		2										
334.00140	Support Br. WEB450 no tongue, no stop	4		4										
353.00762	Attachment Frame Above WEB 450	5			1	1	1	1	1					
353.00764	Attachment Angle WEB 450	10			2	2	2	2	2					
361.00529.245	Anchor Boom WEB450 24.5m	1		1										
371.00282	ø57/2.9 Registration Tube Reinforced	5			1	1	1	1	1					
371.00293.13	Cantilever Tube D=70 L=1300	3				1	1		1					
371.00293.15	Cantilever Tube D=70 L=1500	1						1						
371.00293.17	Cantilever Tube D=70 L=1700	1			1									
372.00390	Hinge Assembly Type 820, for 120 x 120	5			1	1	1	1	1					
396.00007.18	Hexagonal Bolt M16 L=180	10			2	2	2	2	2					
396.00009.74	Long Shank Bolt M16 L=740	20			4	4	4	4	4					
417.00032-3.09	Link, With D=18 Hole and D=22	10								2	2	2	2	2
417.00037-1	Clevis And Tongue, Clevis hole D=18	14		4						2	2	2	2	2
417.00094	Turnbuckle M16, with lock nut	10								2	2	2	2	2
417.00096	Dead end clevis (Fd 120) type	5								1	1	1	1	1
417.00097	Dead end clevis (570) type	25								5	5	5	5	5
417.00126	Dead end Clevis, f cable 150mm2	2		2										
417.00127	Dead end Clevis, f cable 270mm2	1		1										
424.00149	Long-Rod Insulator 25 kV	12		2						2	2	2	2	2
424.00164	Strut Insulator Strong, 25 kV	5			1	1	1	1	1					
431.00025-3	Cable Clamp Assembly	5			1	1	1	1	1					
431.00086	Pivoting Cable Clamp	1		1										
433.00236	Double Link	1		1										
442.00097	Registration Arm ring fitting, for D=48	5			1	1	1	1	1					
442.00135.10	Curved Registration Arm With Ring Typ10	3				1	1	1						
442.00135.11	Curved Registration Arm With Ring Typ11	1							1					

Modul *EL*FF-CAM

Renovation of an overhead contact line on an existing system with ELFF. Existing supports are imported into ELFF-CAM using laser scans.





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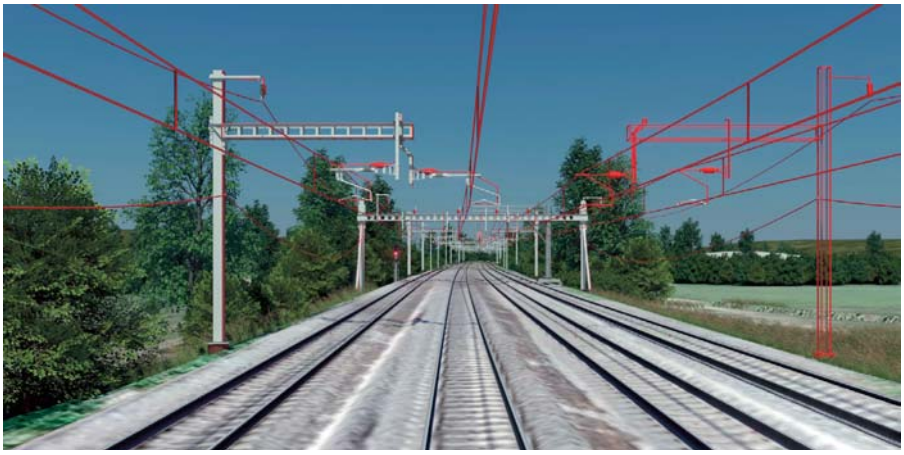
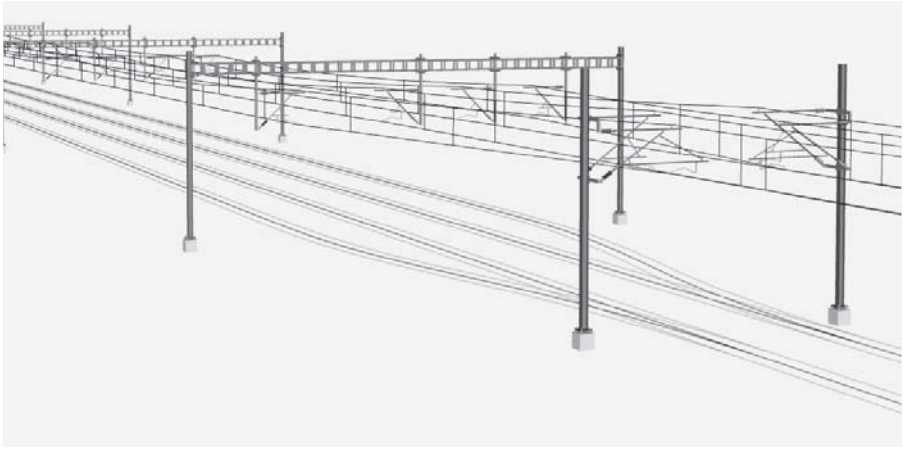
Module ELFF-BIM
Building Information Modeling





ELFF-BIM: Output of the Overhead Contact Line System in the Form of 3D Solids

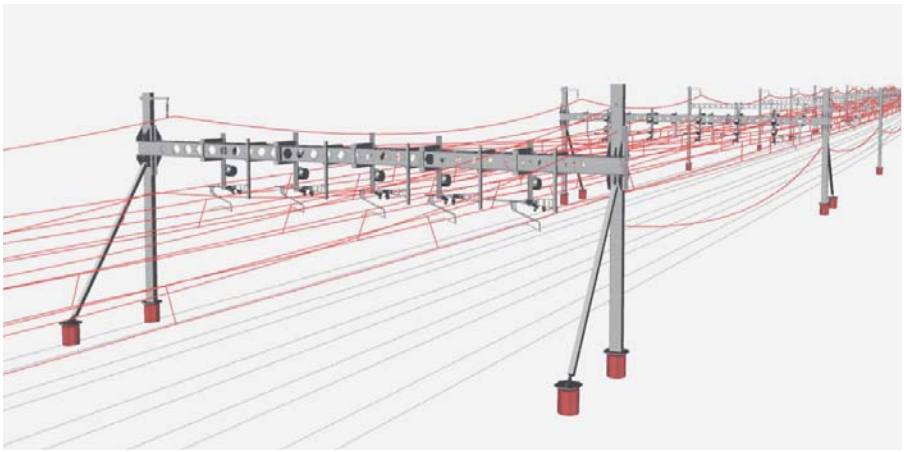
Input Data:

ELFF-BIM runs in conjunction with ELFF-CAD and ELFF-CAM.
This means the component library can be expanded with 3D solids, which are generated according to customer requirements.
These allow automatic generation of 3D solid cross-section profiles in ELFF-CAM using the basic data from ELFF-CAD.
Existing ELFF projects can be expanded at every planning phase with ELFF-BIM.
There is also the option to integrate external component libraries into ELFF-BIM.

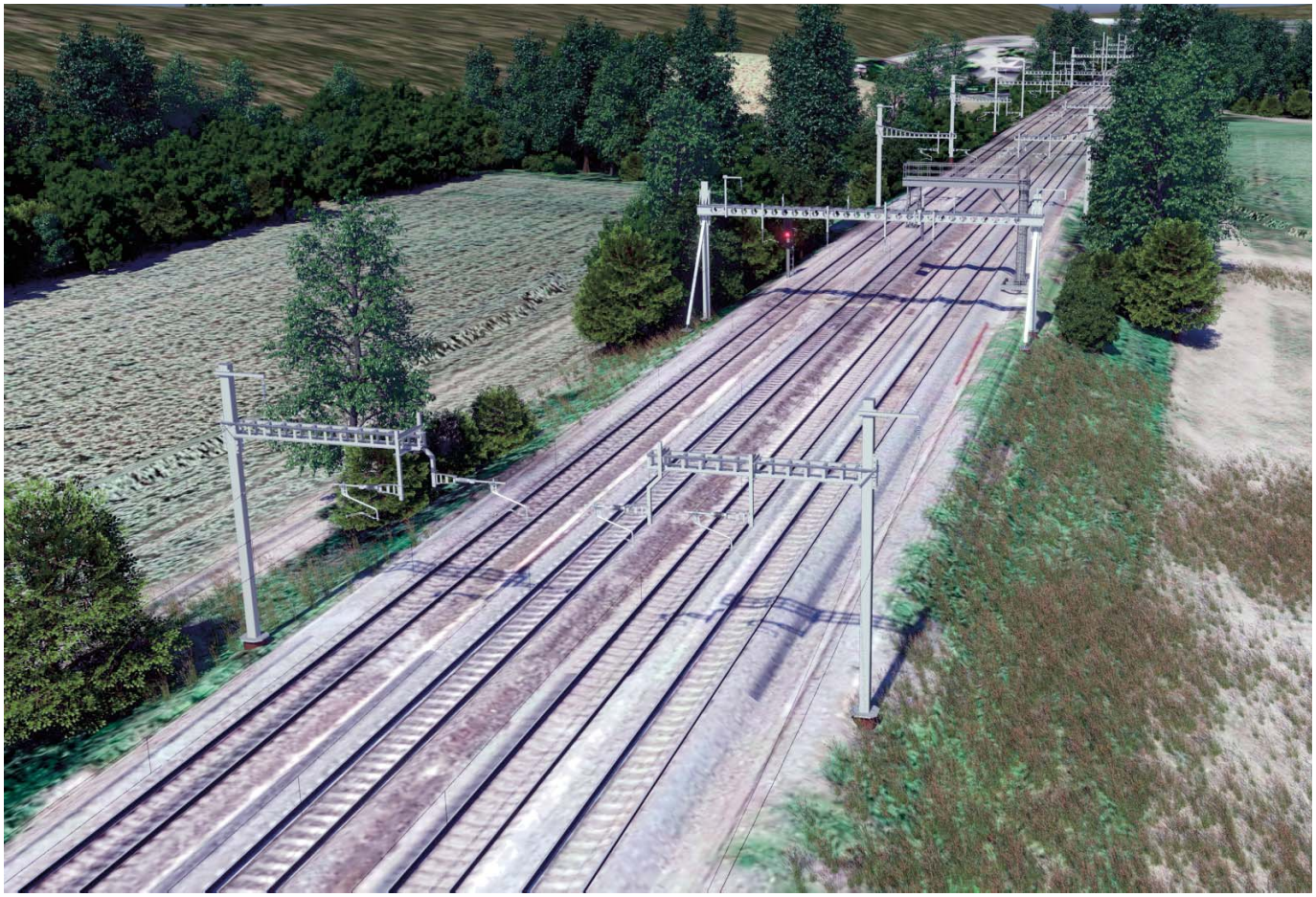
Example of a signal sighting check. In the process, the ELFF 3D solids are synchronised with a driver's cab video.

Module *EL*FF-BIM

Output Data:
ELFF-BIM allows users to generate an image of the overhead contact line system quickly in the form of a 3D solid model.
Up-to-date export of data output from ELFF-BIM is possible in various CAD formats and these can then be imported into state-of-the-art BIM projects.



ELFF 3D solids
Model of an overhead contact line system integrated into a BIM project



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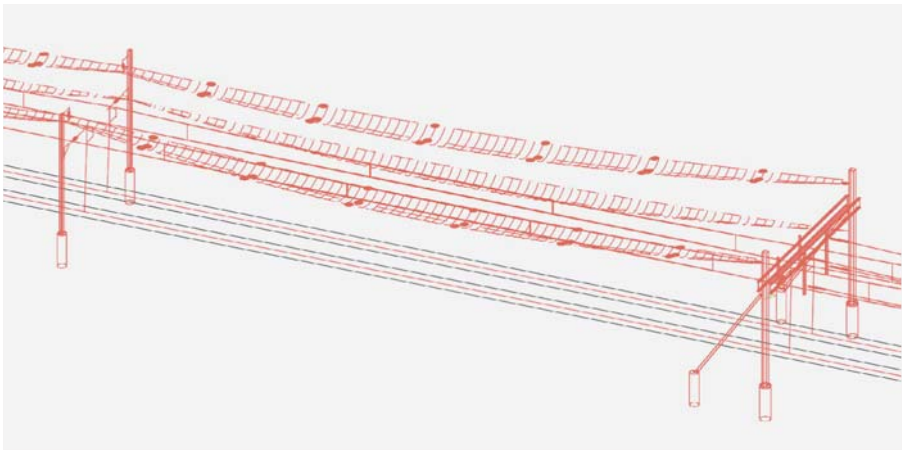
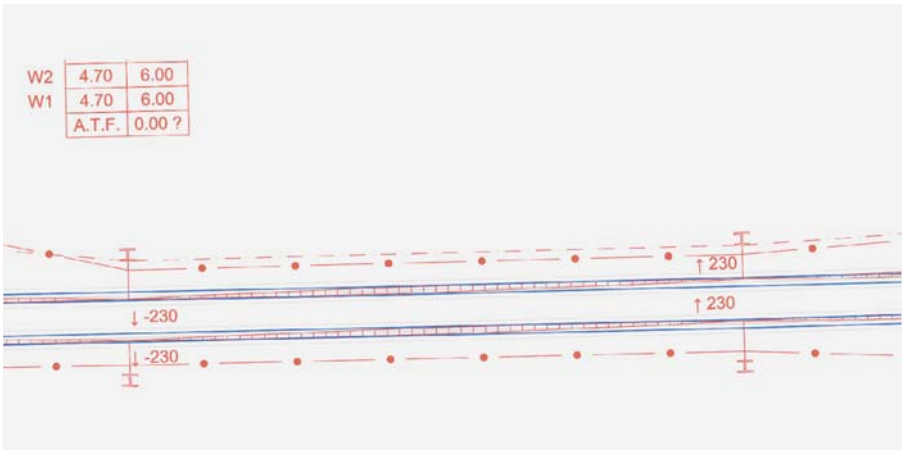
Module ELFF-CAT
Structural calculations for masts and wires



ELFF-CAT: Structural calculations for masts and wires

Input Data:

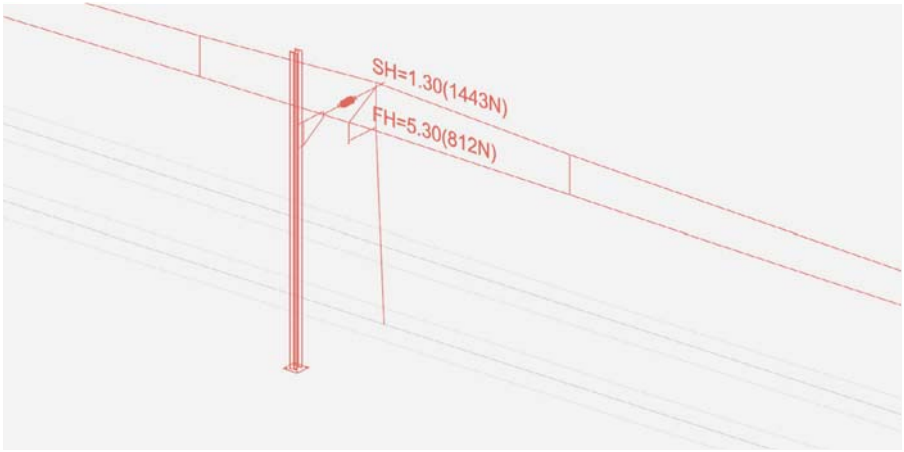
ELFF-CAT is an integral part of ELFF-CAD and contains and controls the calculations in the ELFF 3D model. Parameters specific to railway standards, such as tensile forces in the cables and wires, component weights and wind and ice loads, are provided by ELFF-CAD.

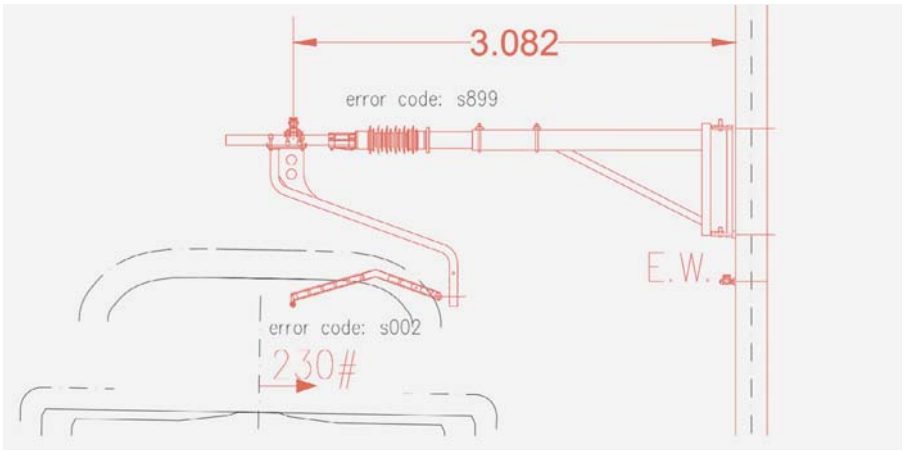


Output Data:

Structural calculations for masts and cables are carried out continuously as the 3D model is produced. As a result, ELFF-CAT provides verifiable evidence of the structural strength of components. This means users have constant control over the overhead contact line project designed in ELFF and can analyse, and if necessary correct, data such as the catenary system's wind blow-off or radial forces at the registration arms along with many other parameters, simply by showing or hiding them.

Control of contact wire blow-off in 3D and 2D view

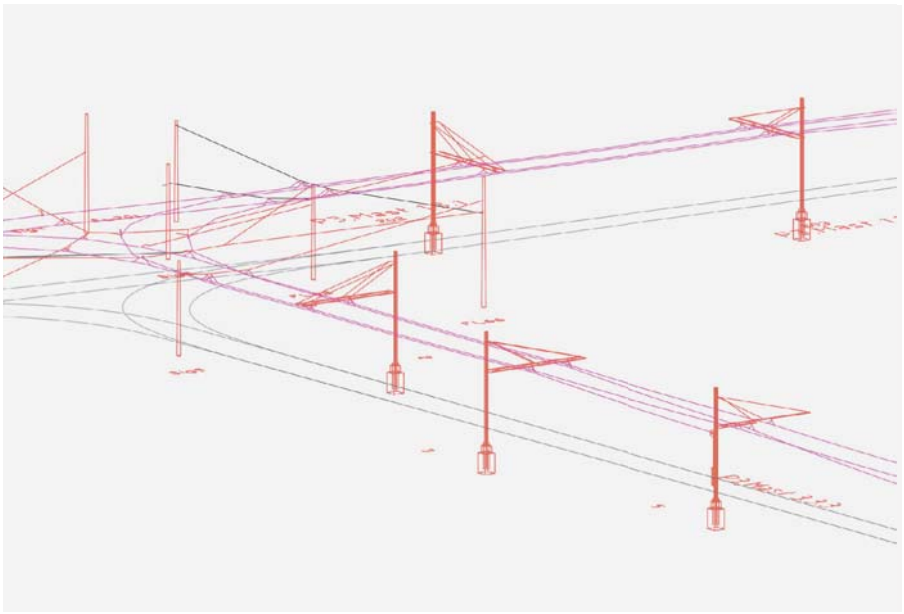




Where there is a non-compliance, error codes support users at the design stage. Example in the adjacent image, exceeding the permitted radial load

Module ELFF-CAEF

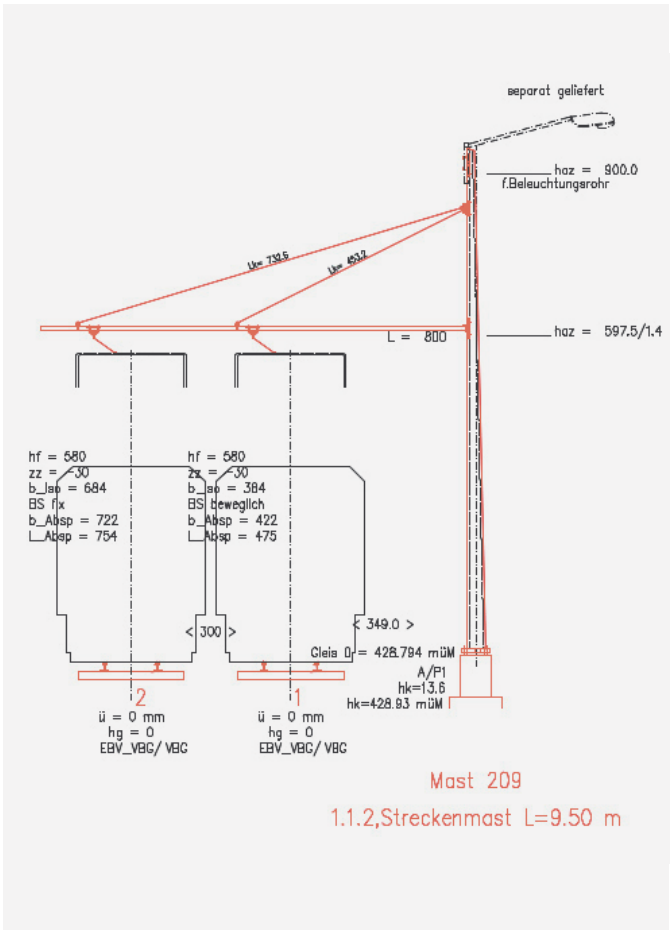
Single Overhead Contact Lines / Applicable to Urban Traffic



ELFF-CAEF: Single Overhead Contact Lines / Applicable to Urban Traffic

ELFF-CAEF is an extension of the ELFF-CAD module, which was specially developed for use in urban traffic and projects with single overhead contact lines.

The use of ELFF-CAEF enables projects for light rail systems and trolleybuses to be implemented three-dimensionally in the form of a 3D wireframe model. In addition to various views of the model / project, collision checks and the automated creation of documents needed for construction and assembly, such as cross-section profiles and bills of materials, are possible.



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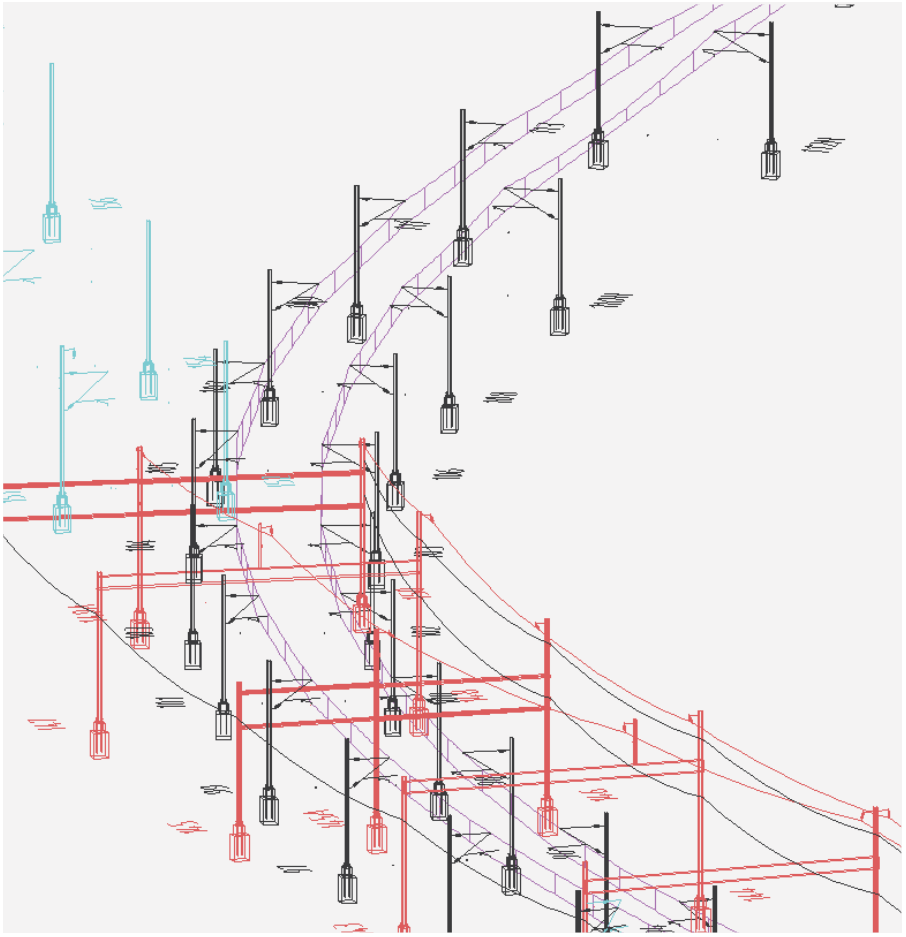
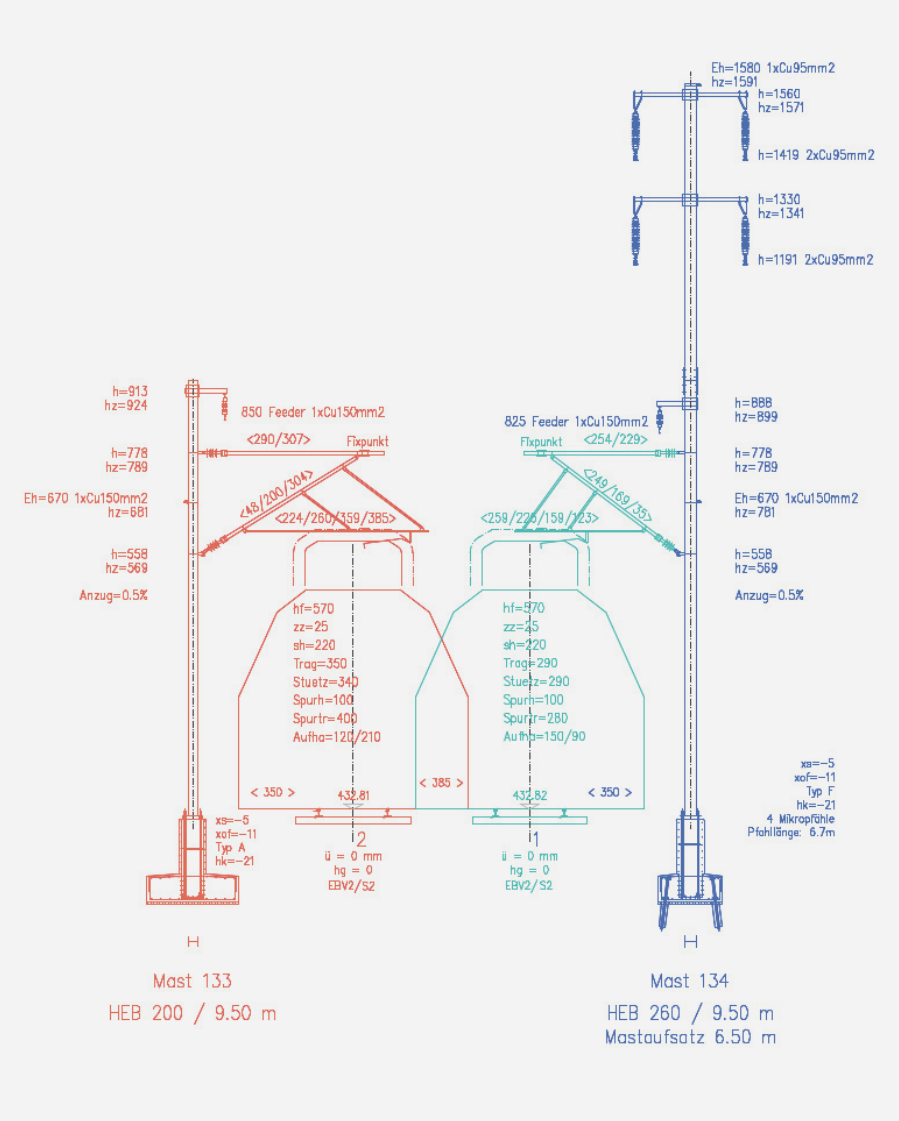
Overhead contact lines

Module ELFF-CAP

Stage-work Design and Phase Planning



Module *EL*FF-CAP



ELFF-CAP: Stage-work Design and Phase Planning

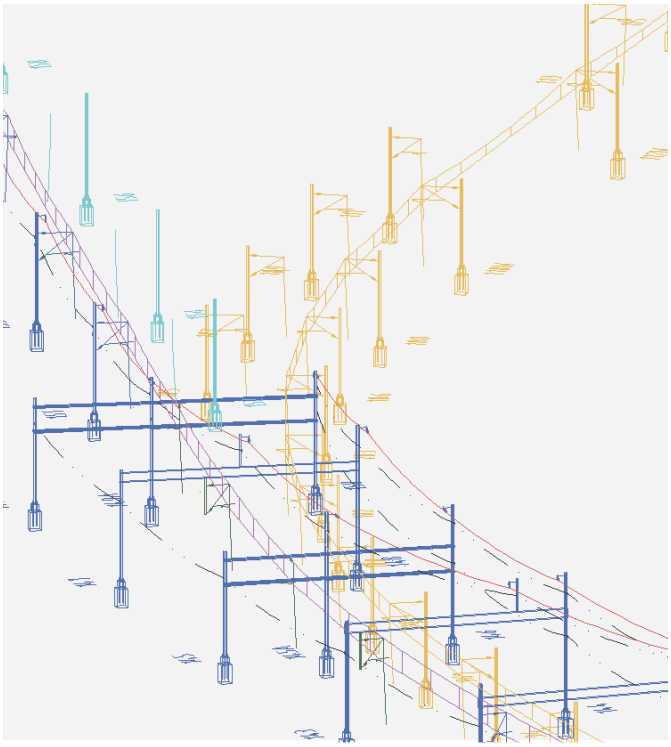
ELFF-CAP is the module for stage-work design and phase planning. A «service life» is assigned to every component, so that it appears on the plans for the corresponding construction phase, marked in the specified colour (existing stock, removal, new construction, temporary structures, etc.).

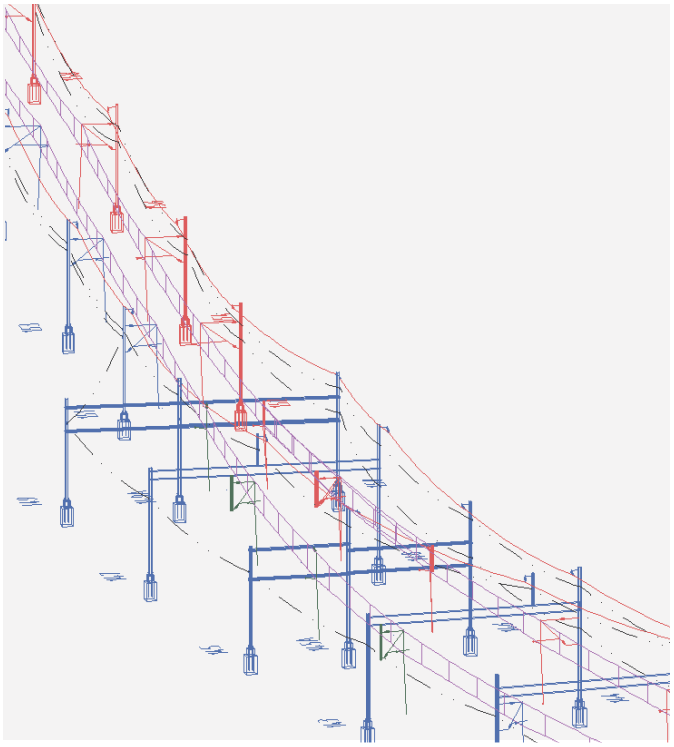
Input Data:

The only input required is to designate the construction phases and assign components to individual phases.

Output Data:

For each construction phase, ELFF-CAP produces the same documents already described for ELFF-CAD and ELFF-CAM.





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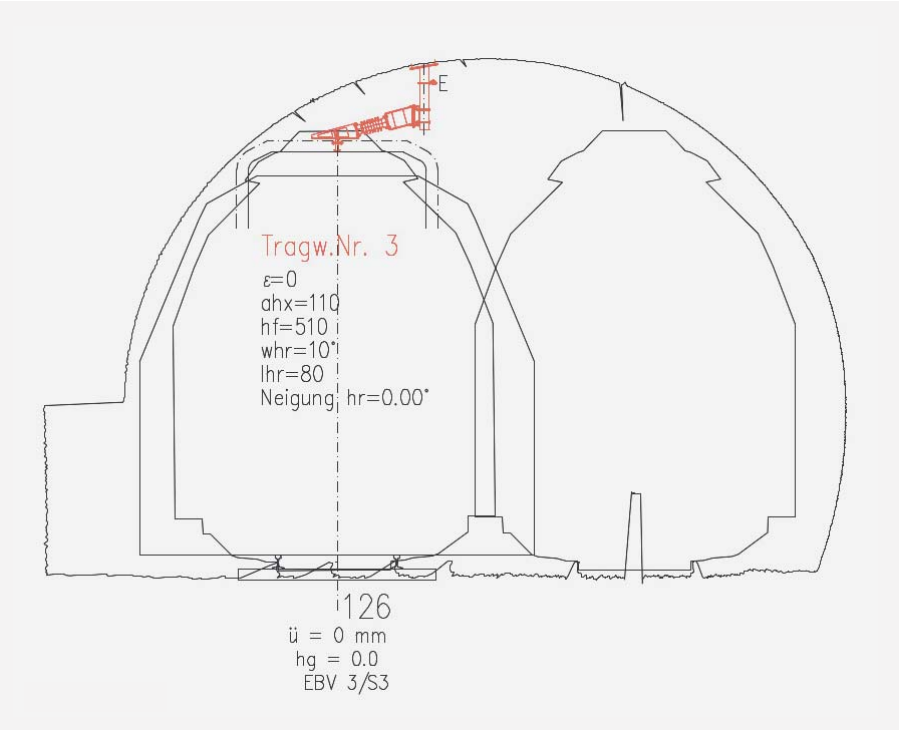
Overhead contact lines

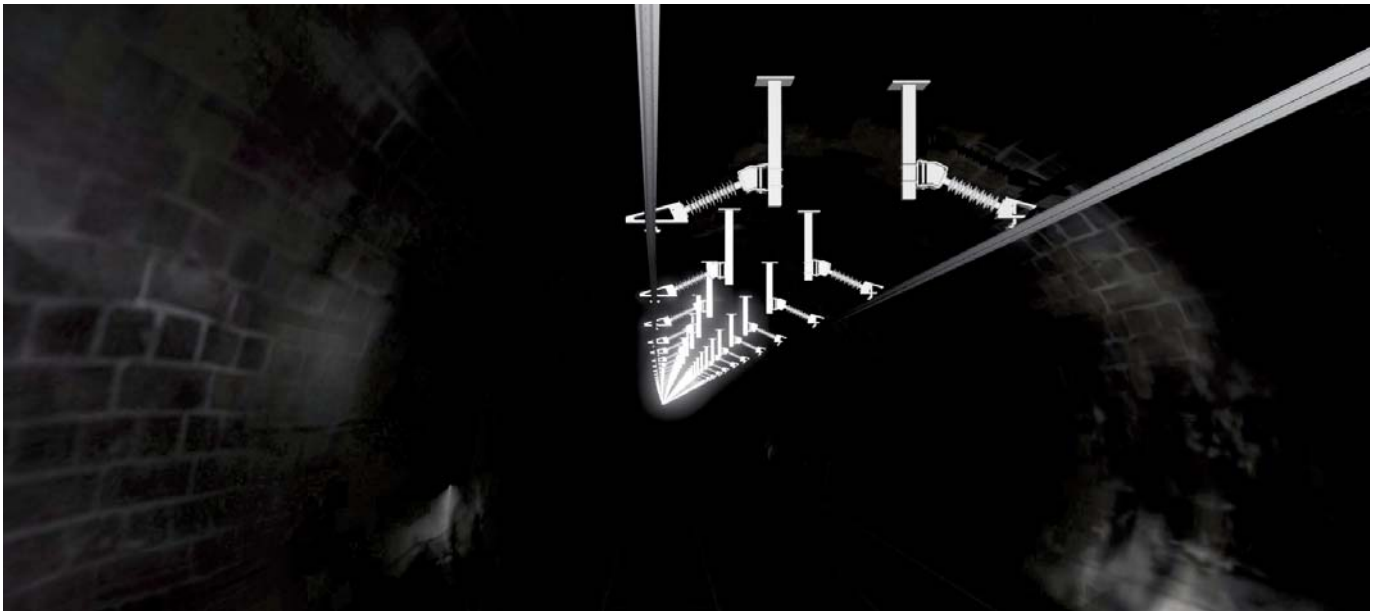
Module ELFF-CASS
Tunnel Conductor Rail Module

ELFF-CASS:
Tunnel Conductor Rail Module

ELFF-CASS is an autonomous module, which is intended to support users when creating tunnel rigid overhead conductor bar projects for tunnels. Cross-sections can be generated automatically after brief initial processing of the input data. In each case, laser scans and the corresponding track data are used as the basis. This means the assembly and construction specifications required for tunnel conductor bar projects can be produced very quickly and efficiently.



Module *EL*FF-CASS



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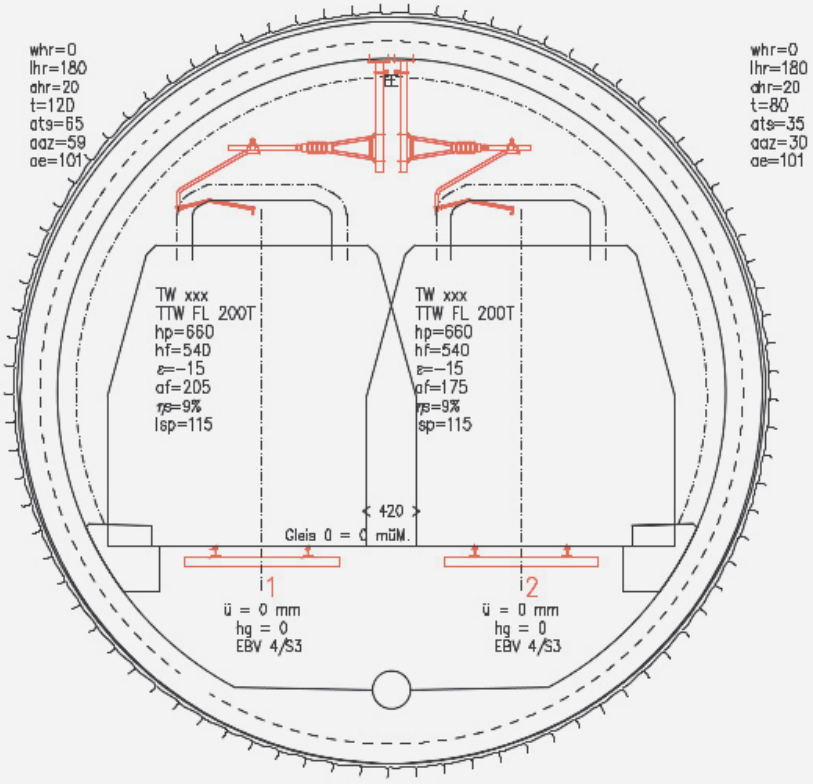
2532.12	Tragrohr t=1200	1
5152	Vollkern Stützisolator 15kV für Rohrans.	2
5323.1.2	Tragseilbock drehbar an Rohr d=70	2
6211.12	Erdseilbride d=120	2
AF635.058.000	Spurhalterklemme an Ringnut	2
Z371.209	Spurhalter-Abzugarm sh=1200	2
Z371.210	Drehbarer Flansch für 2-Spur Tunneltragw	2
Z372.098.18	Hängerohr MSH 120 lhr=1800 whr=0	2
Z442.081K	Spurhalter kurz	2



3D model of an overhead conductor bar system in the image above

Conventional overhead contact lines can also be handled using ELFF-CASS

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Overhead contact lines

Overhead Contact Line Design Software Tool ELFF

Licensing

Railway companies and overhead contact line designers can acquire licences for the modules. The associated databases are customer-specific and need to be tailored by us. Training courses are necessary and will be delivered as required. Support and updates are provided by individual agreement.

Services

Signon and Furrer+Frey provide engineering services for overhead contact line systems using the ELFF OLE design tool. Our engineering staff are experienced in designing local and long-distance railway systems both in Switzerland and abroad. Thanks to the flexibility of ELFF, comparisons between different overhead contact line designs can be made at an early stage in the design process.

SIGNON Deutschland GmbH
Schützenstraße 15-17
D-10117 Berlin

T +49 351 20589-400
F +49 351 20589-245

olacad.support@signon-group.com
www.signon-group.com

Furrer+Frey AG
Overhead Contact Lines
Thunstrasse 35
P.O.Box 182
CH-3000 Bern 6
Switzerland

Phone +41 31 357 61 11
Fax +41 31 357 61 00

adm@furrerfrey.ch
www.furrerfrey.ch

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MEMBER OF TÜV SÜD GROUP

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