EUROSTRUCT 2021 – 1st Conference of the European Association on Quality Control of Bridges and Structures
August 29 – September 1, 2021, Padova, Italy

BIM Bridge Engineering Workflow with SOFiSTiK and Revit on a case study of 3 Motorway Bridges on the BAB A3 in Germany

Robert Herceg[1], Thomas Braml[2], Emanuele Agostini[3]

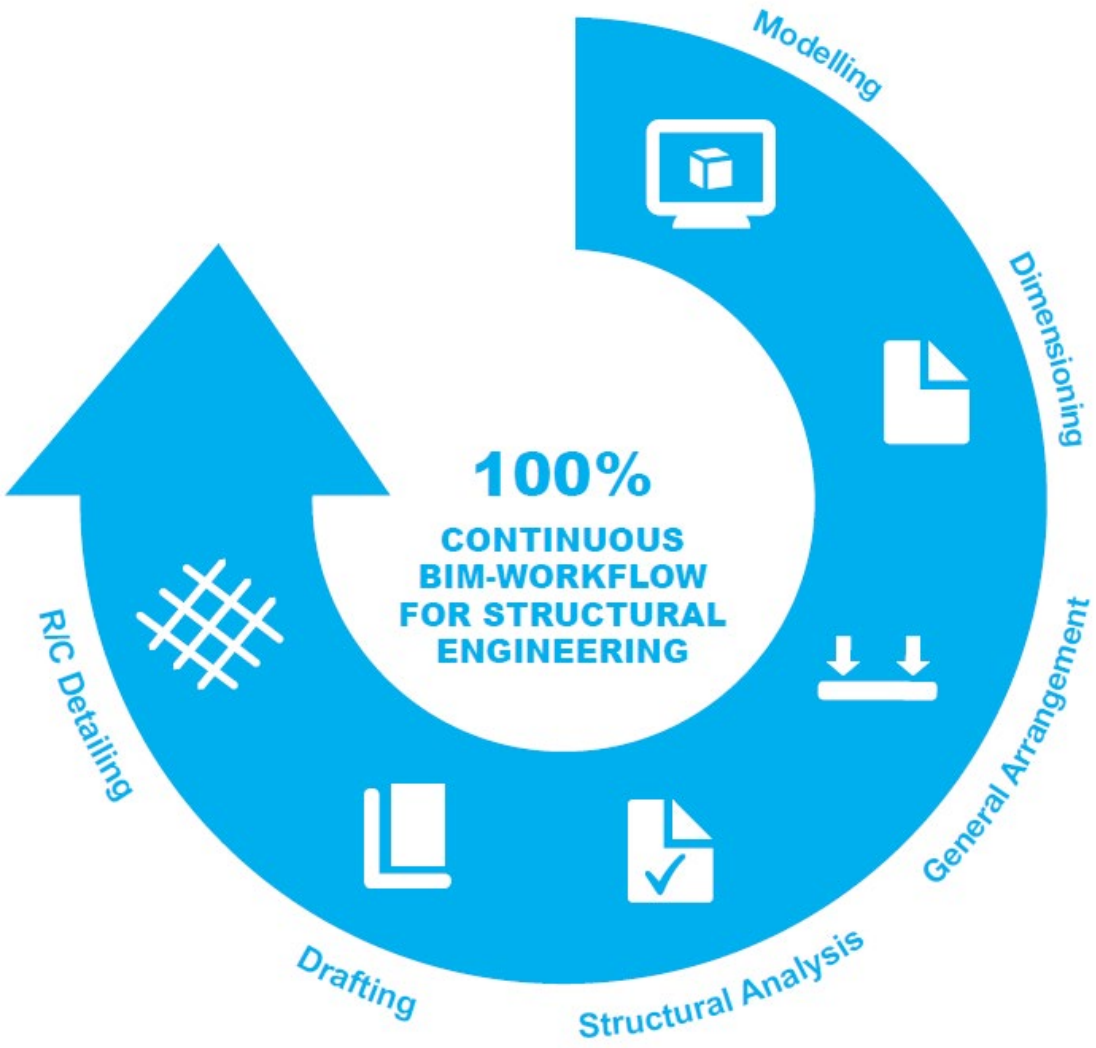
[1]*SOFiSTiK AG, Germany*

[2]*HFR Ingenieure GmbH, Germany*

[3] *Venmises S.r.l.s, Italy*

SOFiSTiK Challenge = BIM Workflow for Structural Engineering

- BIM Development on Autodesk®Revit® since 2005
  - Primary focus Building Design
  - Reinforcement Detailing and Generation
- Since 2018 BIM development for Bridge Engineering
- FE Analysis integration in Revit and with open API link
- Standard 2D AutoCAD/SOFiCAD drafting workflow linked to BIM

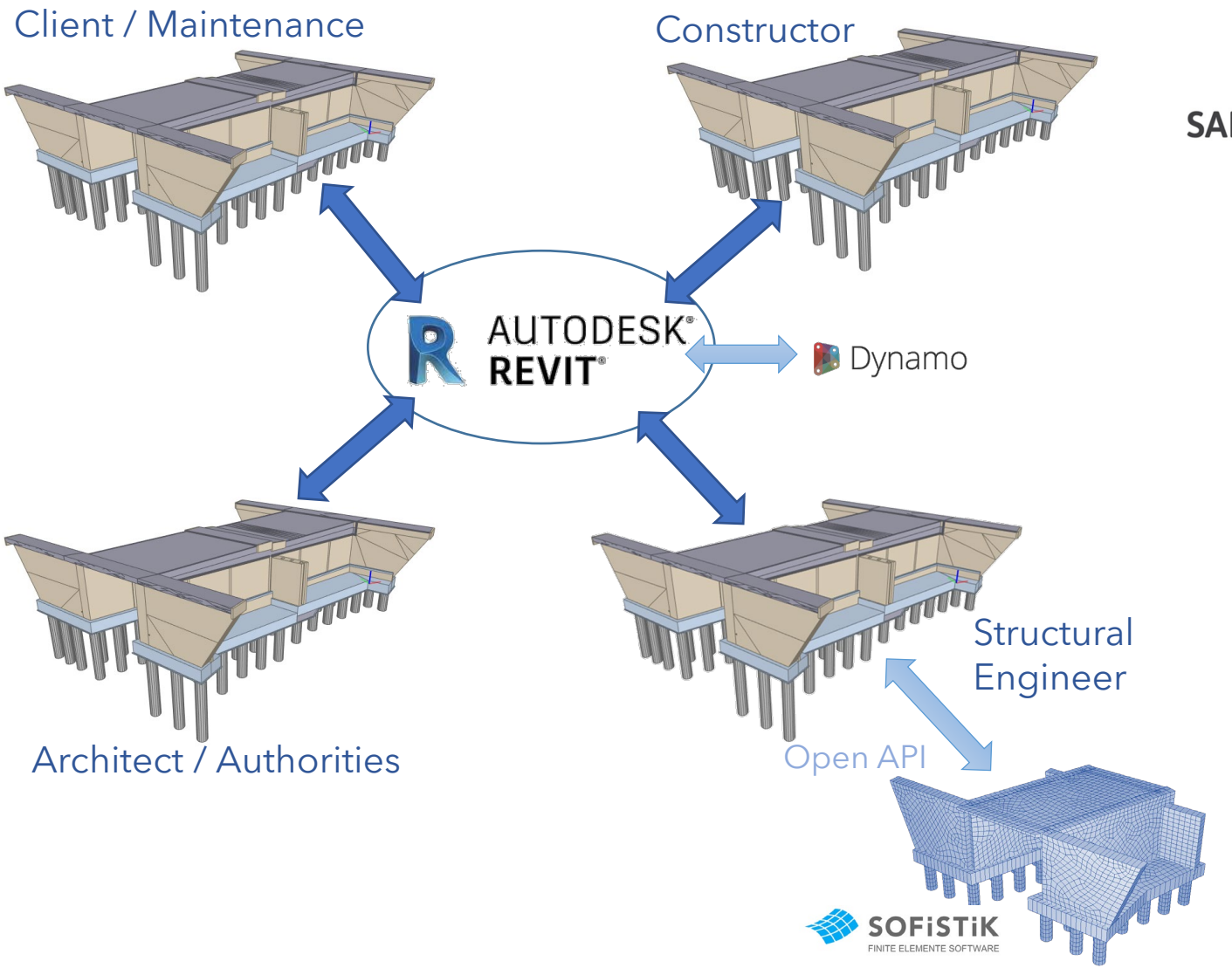


- Only supporting Revit? Is this a „real“ BIM? Definitively NO!
- Closed BIM vs Open BIM
  - Closed BIM support one software standard, e.g. Autodesk Revit
  - Open BIM interacts with different software standards

SOFiSTiK Approach

- Working on one closed BIM Solution, but Open Workflow + Open Software
- IFC Connector for Structural Model Data exchange
- SAF (Structural Analysis Format) Connector, initiated by Nemetschek
- Grasshopper (Rhino) programming interface for data exchange
- Open API for local BIM in Revit

CLOSED BIM



OPEN BIM

SAF

IFC

SCIA A NEMETSCHEK COMPANY

Tekla Structures

Bentley Advancing Infrastructure

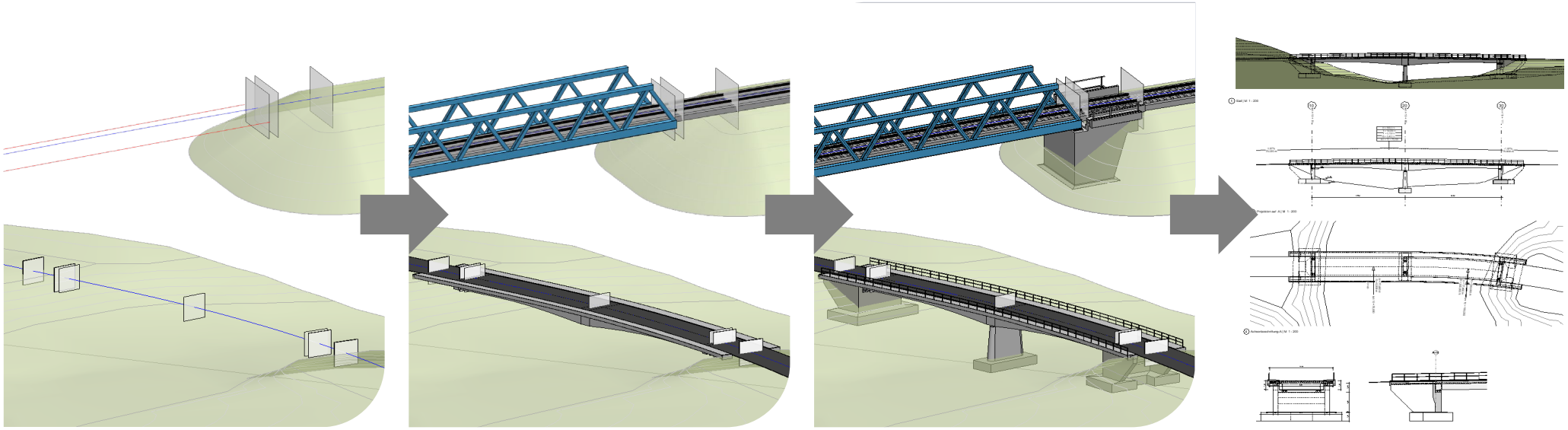
ALLPLAN A NEMETSCHEK COMPANY

GRAPHISOFT Archicad

Special Solutions like Bridge Monitoring Systems

SOLUTION = SBIM (SOFiSTiK Bridge and Infrastructural Modeler)

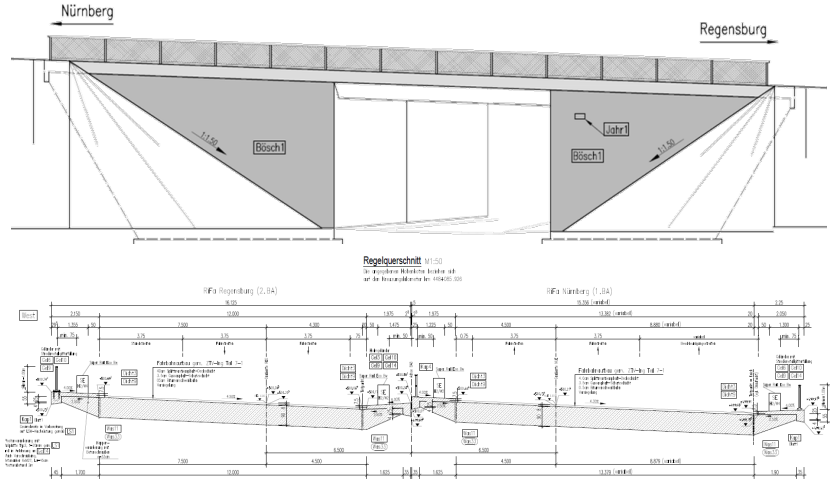
- Since 2018 for Autodesk®Revit®
- BIM design processes for infrastructure projects for conceptual, preliminary and detailed phases for bridges, tunnels other linear structures based on a axis definition with parametric modelling

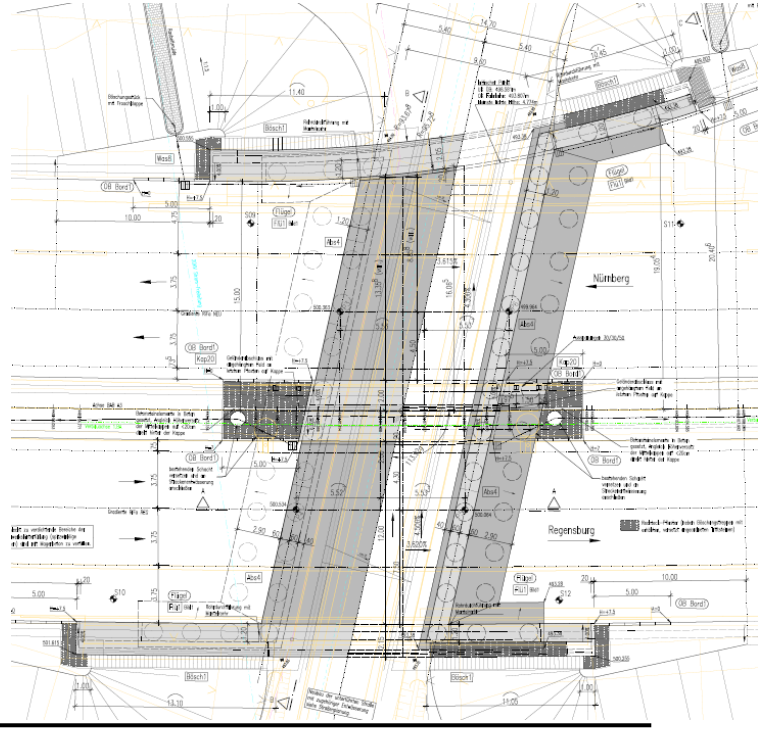


Create an Axis | Extrude the Superstructure | Place the Substructures | Create drawings

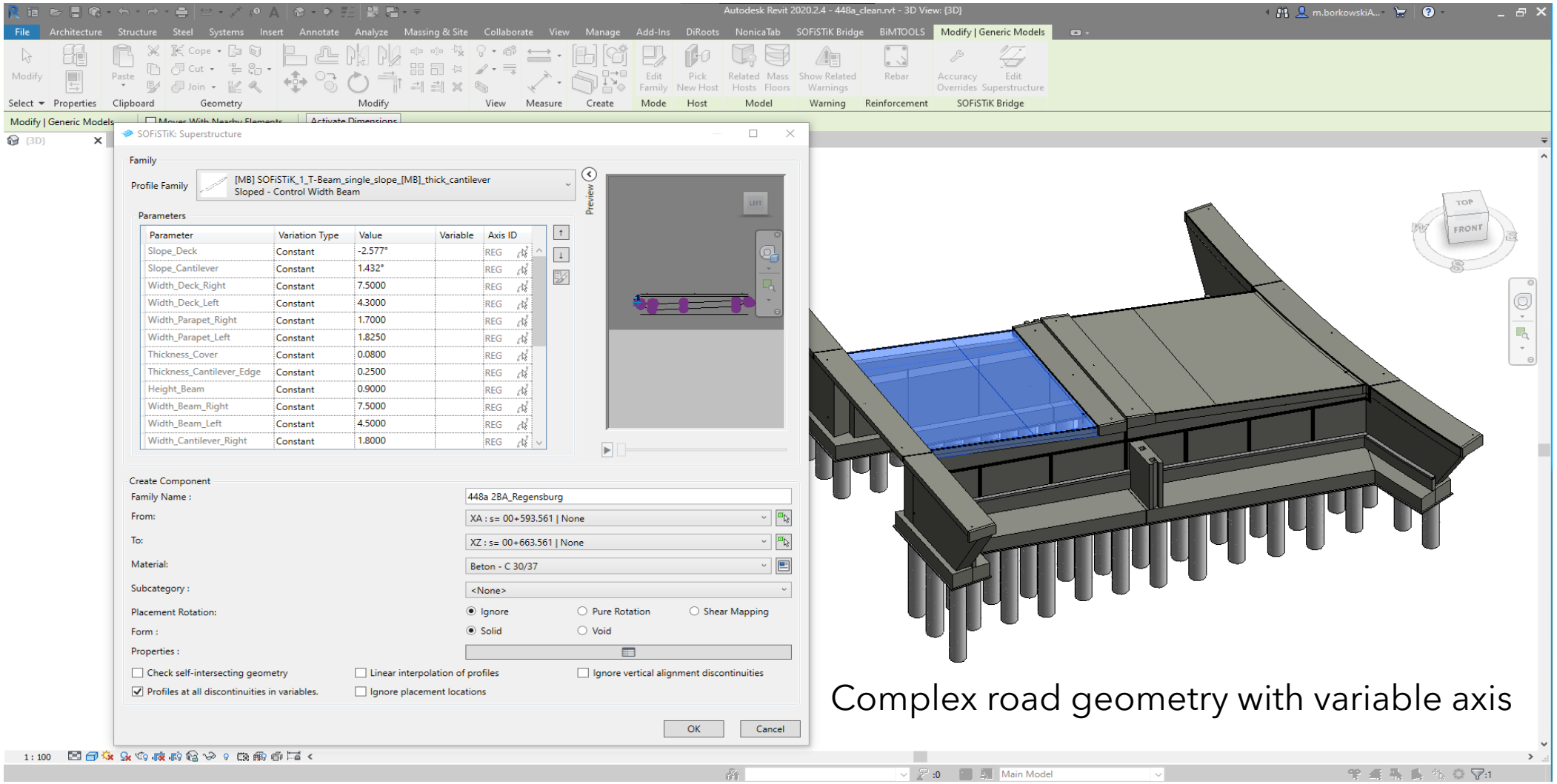
Case Study by HFR Ingenieure, Munich

- „Simple“ Bridges, standard daily work of design offices
- Motorway BAB A3, Nuremberg and Regensburg
  - BW446a, replacement of the existing underpass over a country lane as open frame structure - Length 9.305m, Width 31.60m and Height 4.74m
  - BW447a, replacement of the existing underpass over a country lane as open frame structure - Length 8.70m, Width 32.60m and Height 4.832m
  - BW448a replacement of a existing underpass over a country lane as open frame structure - Length 11.06m, Width 33.158m and Height 4.774m
- Client Die Autobahn GmbH des Bundes
- Construction Company STRABAG AG
  - Demand of BIM (REVIT) model from designers
  - 4D (construction schedule) and 5D (costs calculation and forecast)
- Implementation of a new BIM Workflow for Bridge engineering in the office based on the existing tools SOFiSTiK FE Analysis software, Autodesk Revit, AutoCAD and SOFiCAD



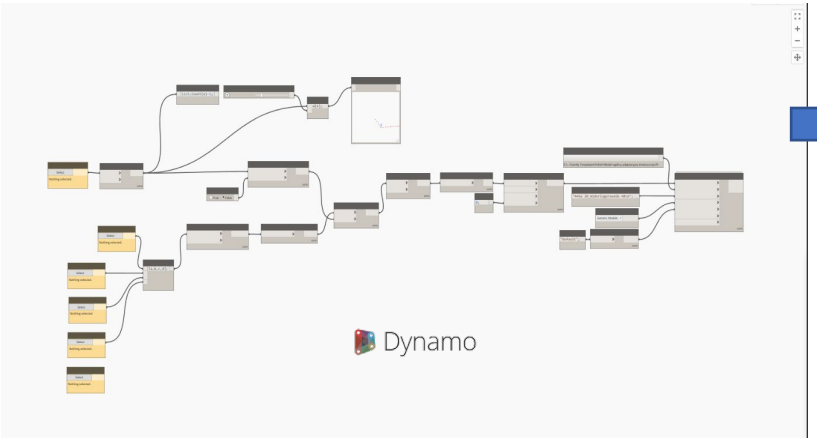


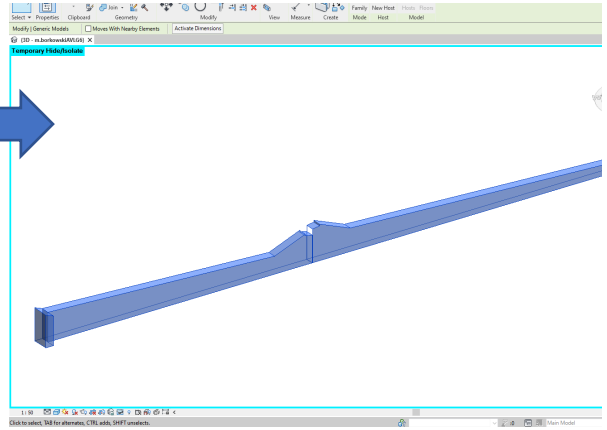
BW448a | Bridge Generation in Autodesk®Revit® with SBIM

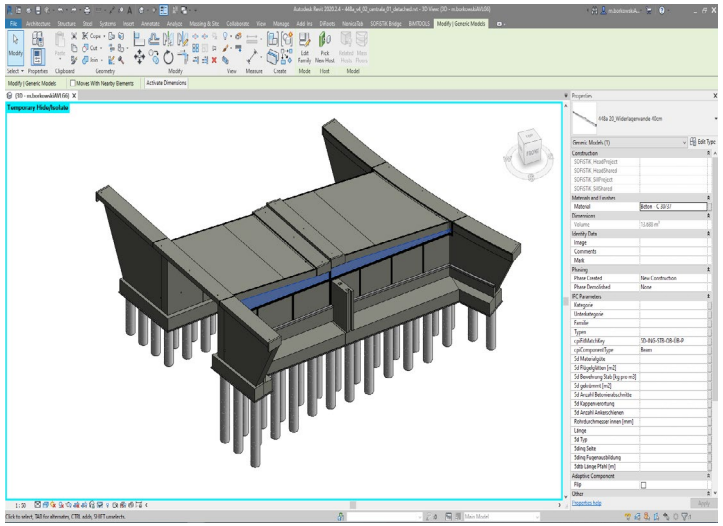


Dynamo programming in Revit, e.g. self jointing elements

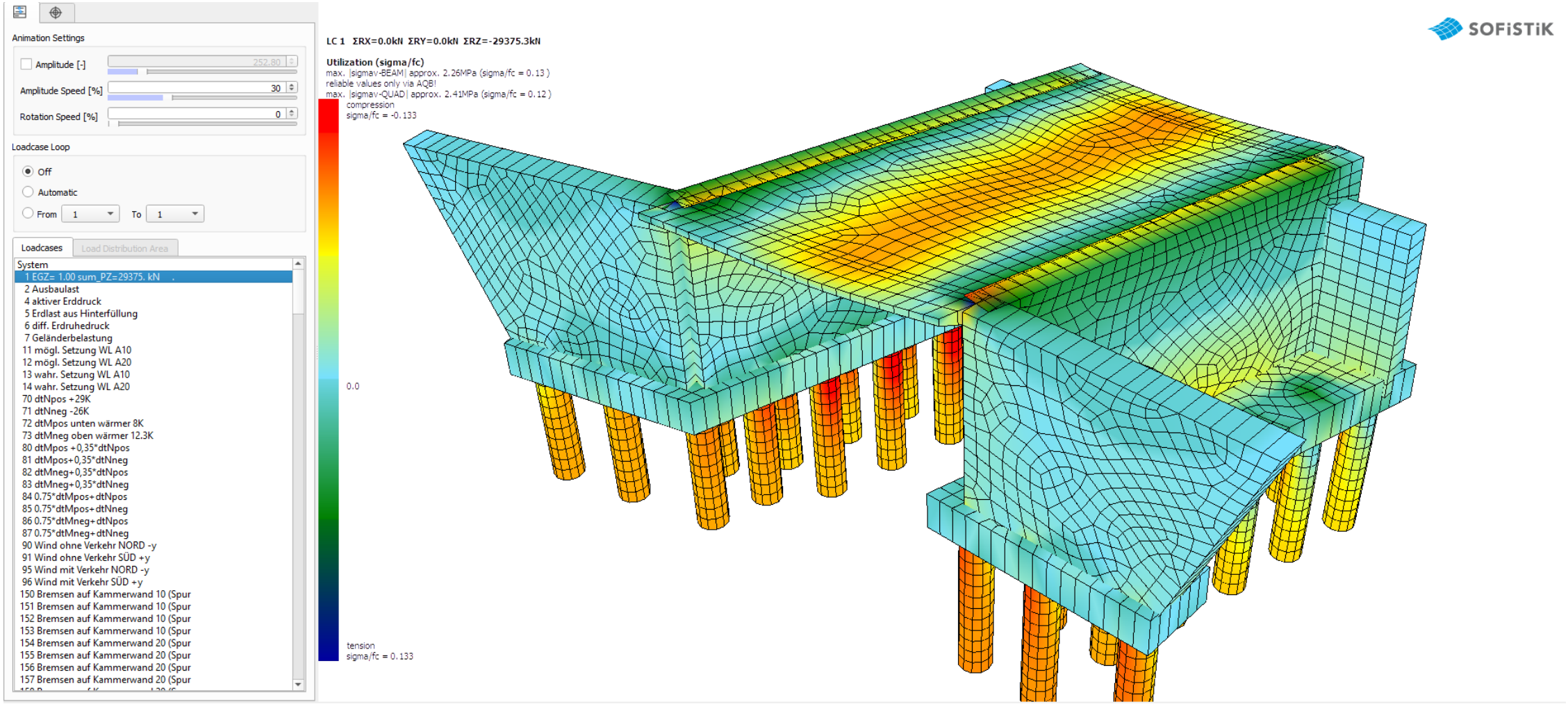
- 8 wall elements joining abutment
- Difficult of jointing order control because of clothoid geometry
- Solution: Creation of desired shape element with Dynamo



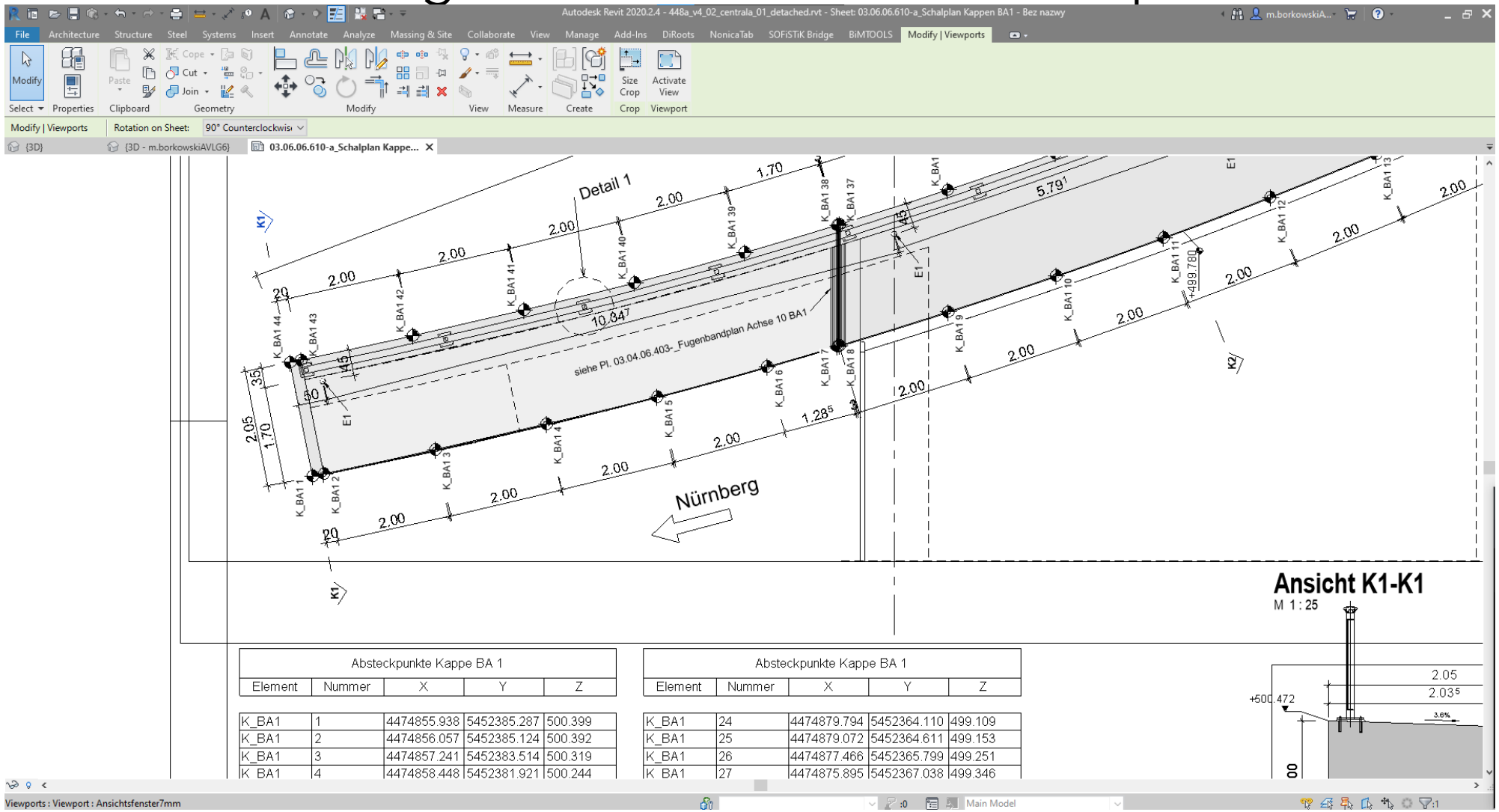




SOFiSTiK FE Analysis based on the Revit model – CS1



Construction drawings in Revit with SBIM and export to PDF



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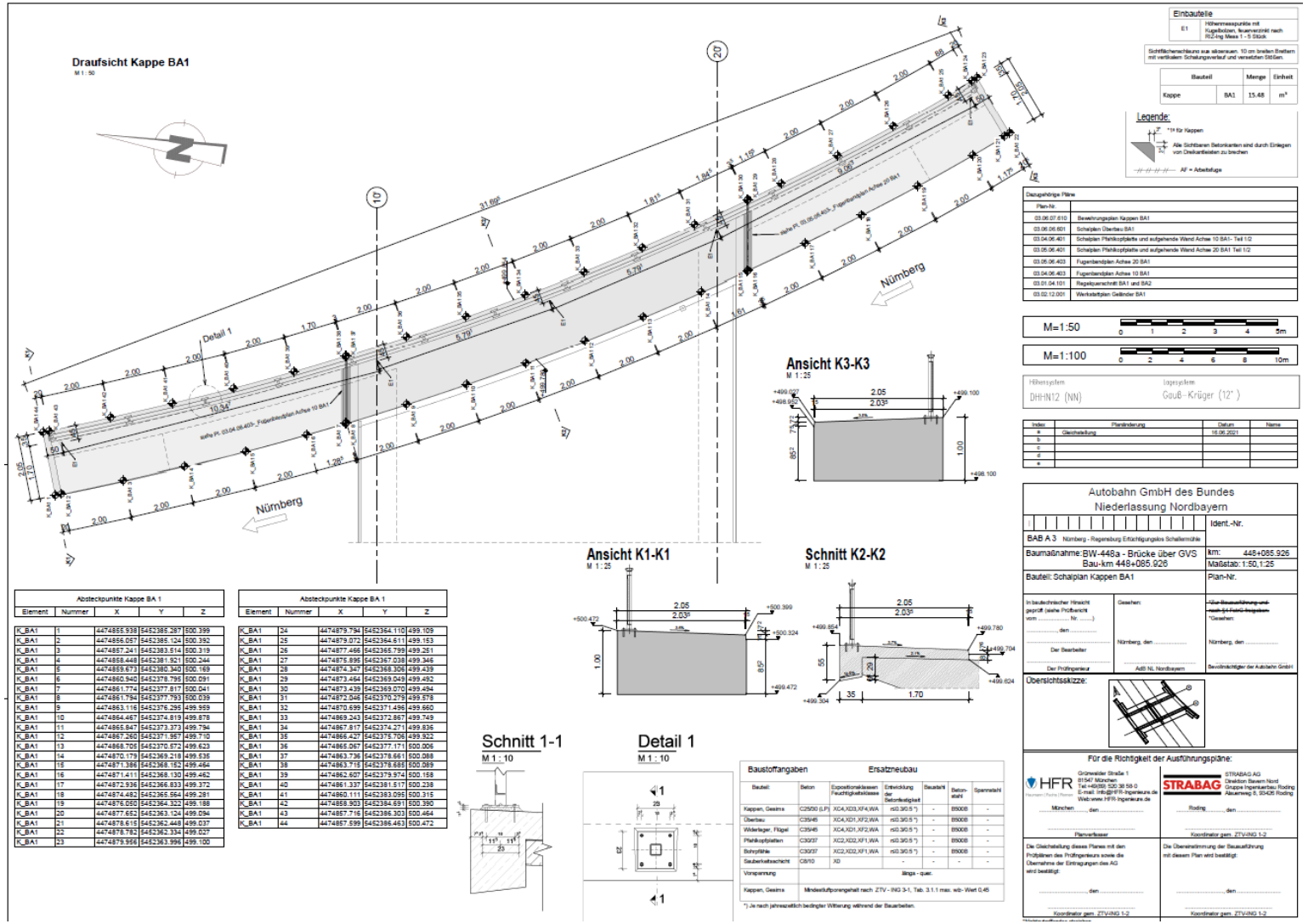
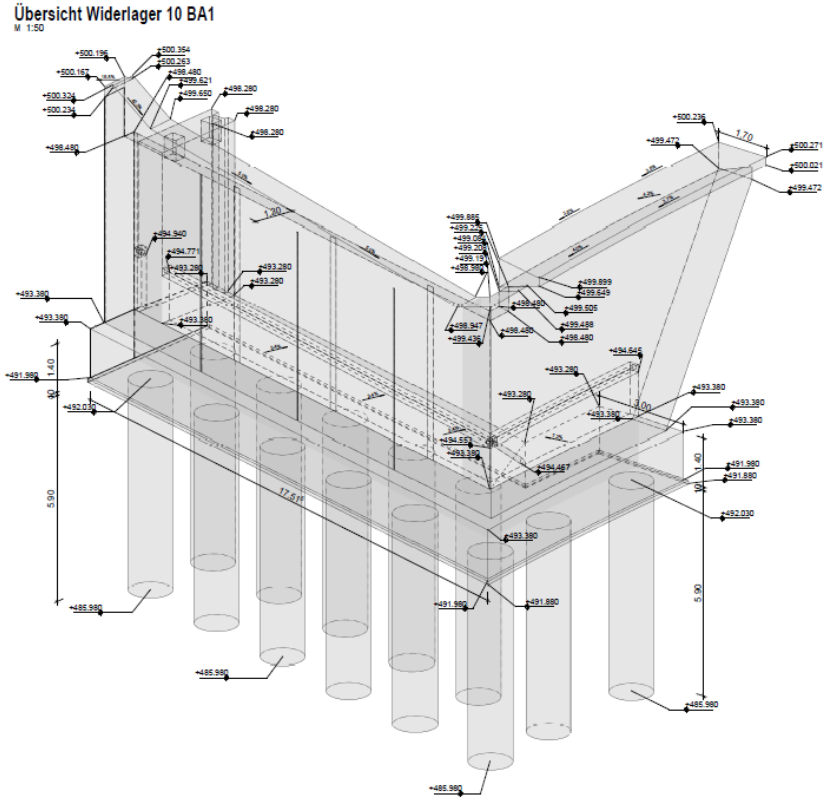
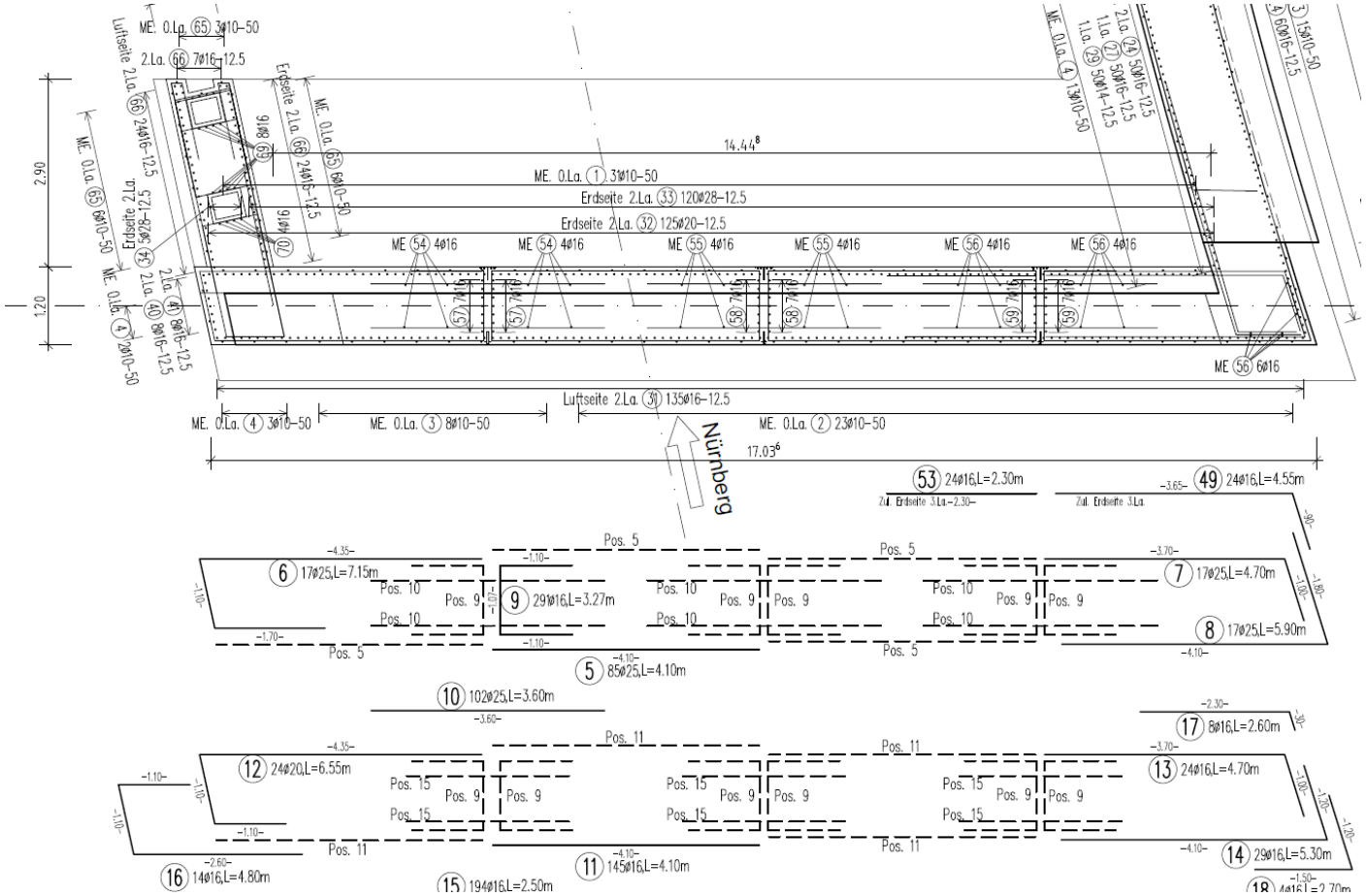




Reinforcement Drawings – Hybrid Solution

- Some details in Revit + Export to SOFiCAD / AutoCAD



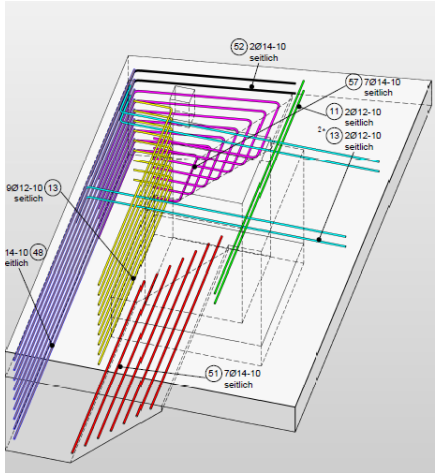
Pos.	Stk.	d	Länge	Ges.L	Gew.(kg)
1	31	10	5.10	158.10	97.548
2	23	10	5.55	127.65	78.760
3	23	10	6.05	139.15	85.856
4	20	10	6.45	129.00	79.593
5	85	25	4.10	348.50	1341.725
6	17	25	7.15	121.55	467.967
7	17	25	4.70	79.90	307.615
8	17	25	5.90	100.30	386.155
9	291	16	3.27	951.57	1503.481
10	102	25	3.60	367.20	1413.720
11	145	16	4.10	594.50	939.310
12	24	20	6.55	157.20	388.284
13	24	16	4.70	112.80	178.224
14	29	16	5.30	153.70	242.846
15	194	16	2.50	485.00	766.300
16	14	16	4.80	67.20	106.176
17	8	16	2.60	20.80	32.864
18	4	16	2.70	10.80	17.064
19	17	25	8.67*	147.39	567.451
20	17	25	8.06*	137.02	527.527
21	32	16	10.44*	334.08	527.846
22	32	16	9.82*	314.24	496.499
23	52	16	3.47	180.44	285.095
24	110	16	4.55	500.50	790.790
25	26	16	3.71	96.46	152.407
26	2	16	4.31*	8.62	13.620
27	76	16	3.21	243.96	385.457
28	52	16	3.84*	199.68	315.494
29	78	14	2.81	219.18	265.208
30	49	14	2.18	106.82	129.252
31	135	16	5.50	742.50	1173.150
32	125	20	4.40	550.00	1358.500
33	120	28	3.50	420.00	2028.600
34	5	28	3.20	16.00	77.280
35	1	20	12.00	12.00	29.640
36	2	20	3.00	6.00	14.820
37	8	16	1.70	13.60	21.488
38	8	16	1.70	13.60	21.488
39	8	16	4.50	36.00	56.880
40	8	16	2.20	17.60	27.808
41	8	16	4.60	36.80	58.144
42	10	16	1.40	14.00	22.120
43	5	14	1.64*	8.20	9.922
44	1	16	3.72	3.72	5.878
45	2	16	3.97	7.94	12.545
46	11	16	10.75	118.25	186.835
47	6	16	10.75	64.50	101.910
48	10	16	10.75	107.50	169.850
49	24	16	4.55	109.20	172.536
50	33	12	4.90	161.70	143.590
51	32	16	4.90	156.80	247.744
52	33	12	2.00	66.00	58.608
53	24	16	2.30	55.20	87.216
54	8	16	6.05	48.40	76.472
55	8	16	5.85	46.80	73.944
56	14	16	5.60	78.40	123.872
57	14	16	7.30	102.20	161.476
58	14	16	7.10	99.40	157.052
59	14	16	6.85	95.90	151.522
60	17	25	4.00	68.00	261.800
61	43	20	4.00	172.00	424.840
62	23	12	2.10	48.30	42.890
63	60	16	2.97	178.20	281.556
64	80	16	2.57	205.60	324.848
65	15	10	4.85	72.75	44.887
66	55	16	2.70	148.50	234.630
67	23	16	2.91	66.93	105.749
68	15	16	2.25	33.75	53.325
69	8	16	2.65	21.20	33.496
70	4	16	3.35	13.40	21.172
71	10	16	2.00	20.00	31.600
72	424	8	1.21	513.04	202.651
73	160	14	1.30	208.00	251.680
74	60	8	1.01	60.60	23.937
75	73	12	1.57	114.61	101.774
76	31	12	1.59	49.29	43.770
77	14	12	1.56	21.84	19.394
78	28	12	1.60	44.80	39.782
79	15	12	1.40	21.00	18.648
80	14	10	3.15*	44.10	27.210
81	10	16	2.30	23.00	36.340
82	23	20	4.90	112.70	278.369
83	17	25	4.90	83.30	320.705

* = im Mittel

Gesamtstahlmenge

d(mm)	Ges.L	kg/m	Gewicht(kg)
8	573.64	0.395	226.588
10	670.75	0.617	413.853
12	527.54	0.888	468.456
14	542.20	1.210	656.062
16	6953.24	1.580	10986.119
20	1009.90	2.470	2494.453
25	1453.16	3.850	5594.666
28	436.00	4.830	2105.880

Gesamtgewicht (kg) 22946.077



CONCLUSION | BIM Bridge Design Workflow with SOFiSTiK and Revit

- Time consuming design of the 1st Bridge due to programming
  - But faster and more effective design of the other two bridges than with standard workflow procedure
  - Huge time advantage in modifications from the construction process
- BIM based Bridge Design Workflow will continue at HFR
- SOFiSTiK BIM Bridge Design tools are proven and with an experienced development
  - Very fruitful co-operation between HFR and SOFiSTiK during the project
- Further processing of the BIM model possible
  - Construction Schedule Process
  - Costs Calculation and Estimation
  - Bridge Monitoring, etc.

Thank you for your attention!

contact: Robert.Herceg@sofistik.de