

Pretensioned hollow deck bridge

CONTENT

Part	Pages	Date	Rev. Date	Rev.
A. CALCULATION ASSUMPTIONS 1. GENERAL & MEASUREMENTS 2. STATIC SYSTEM 3. LOADS	1: 1 - 1: 18 2: 1 - 2: 128 3: 1 - 3: 107			

Appendix	
1.	System 001 : Input receipt
2.	System 001 : Results reactions
3.	System 001 : Results bearings
4.	System 001 : Results longitudinal beams
5.	System 001 : Results transversal beams

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A1:1
		Date :	Created :

1. GENERAL / MEASUREMENT

1.1	CONSTRUCTION TYPE	page 1:2-3
1.2	MEASUREMENTS	page 1:4-10
1.3	CONSTRUCTION STAGES	page 1:11-12
1.4	FOUNDATION	page 1:13
1.5	CODE OCH TENDER DOCUMENTS	page 1:14
1.6	TECHNICAL SERVICE LIFE	page 1:14
1.7	ENVIRONMENT	page 1:14
1.8	MATERIAL	page 1:15
1.9	GEOTECHNICAL CLASS	page 1:15
1.10	SAFETY CLASS	page 1:15
1.11	CONCRETE COVER AND CRACK CRITERIA	page 1:16-18

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A1:2
	Pretensioned slab bridge: hollow deck	Date :	Created :

1.1 CONSTRUCTION TYPE

Bridge superstructure is performed as a pretensioned slab bridge with a total of 8 spans.

In the transverse direction, there are 8 void tubes Ø650 at a distance of 1.0 m from each other.

End supports are constructed as free standing abutments with expansion joints.

All foundations are constructed with slabs on compacted fill.

Spans according to the presentation below.

Span nr.	Length
1	19,1
2	25,0
3	23,2
4	31,0
5	31,0
6	25,0
7	25,0
8	19,1
-	m

The impact of phased construction is considered in the determination of load effects.

The bridge has a total of 8 cast joints (stages I-VIII).

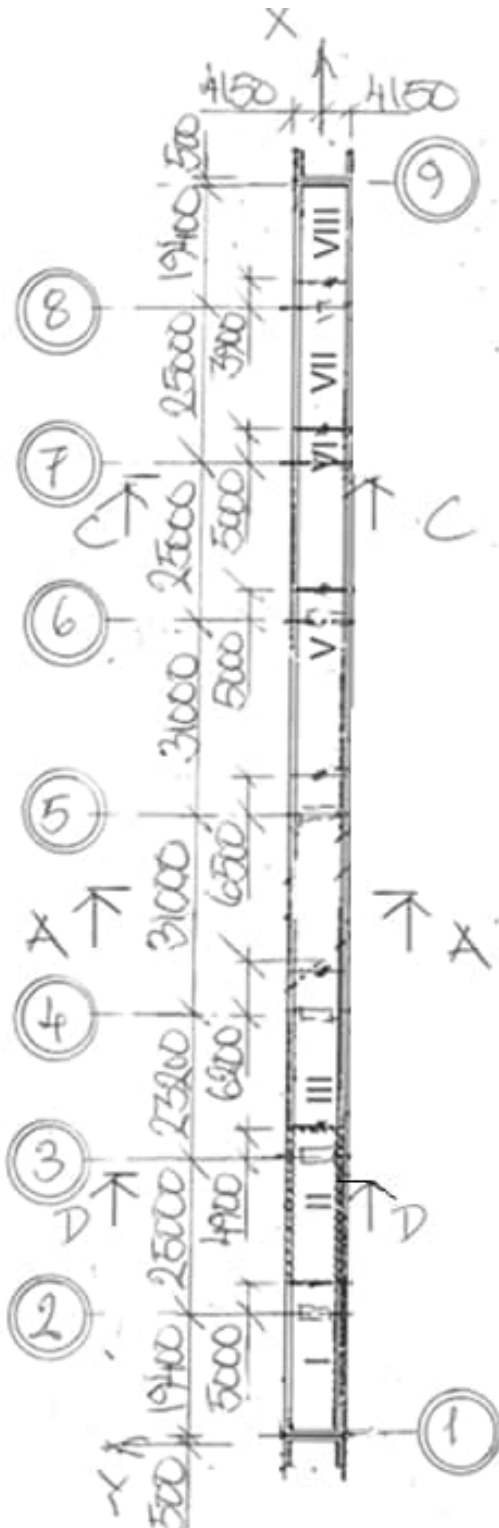
	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A1:3
	Pretensioned slab bridge: hollow deck	Date :	Created :



PLAN

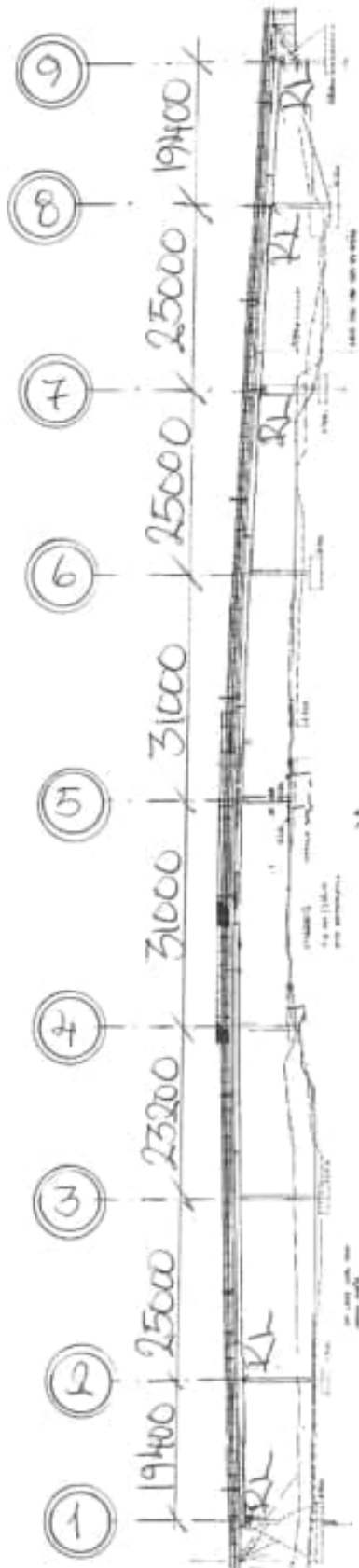
	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A1:4
	Pretensioned slab bridge: hollow deck	Date :	Created :

1.2 MÅTT



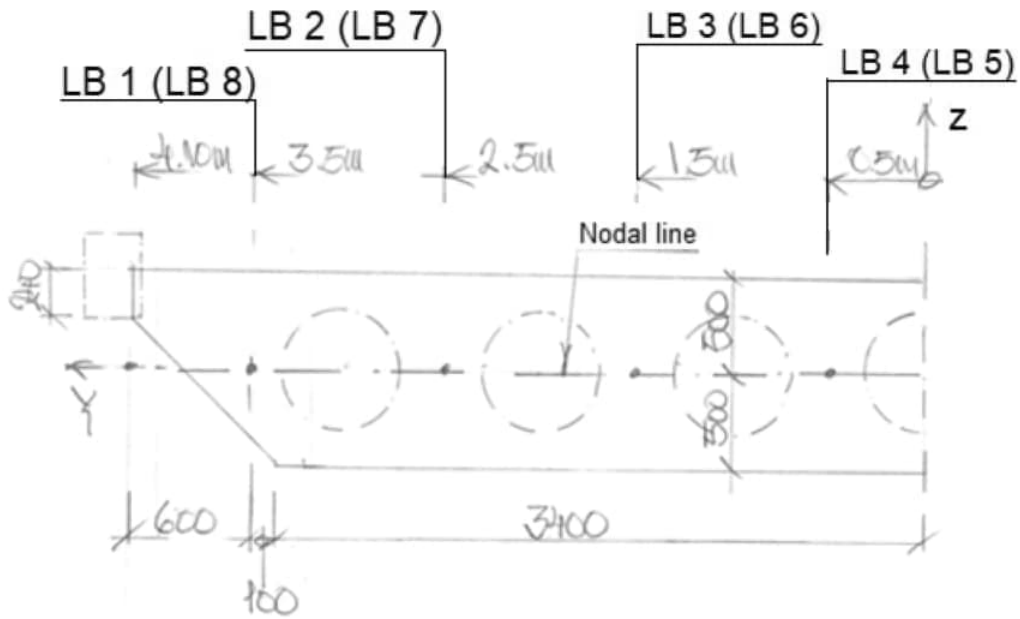
PLAN
Overview

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A1:5
	Pretensioned slab bridge: hollow deck	Date :	Created :



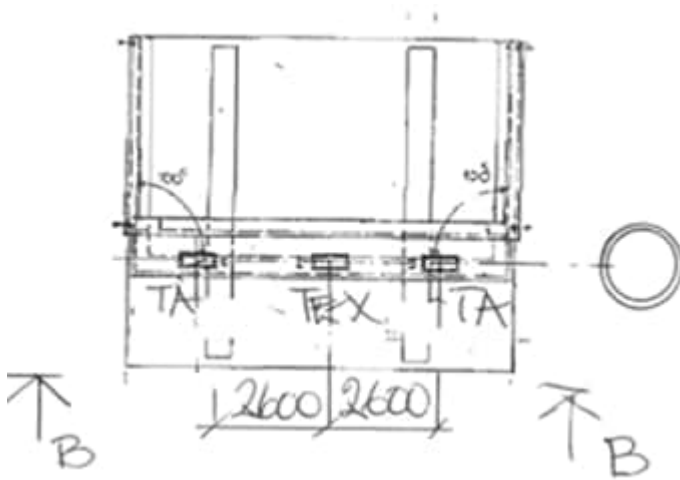
ELEVATION

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A1:7
	Pretensioned slab bridge: hollow deck	Date :	Created :



DETAIL 1
Calculations

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A1:8
	Pretensioned slab bridge: hollow deck	Date :	Created :

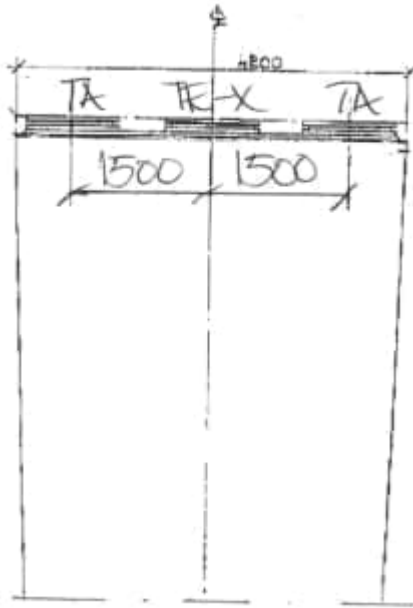


PLAN
Support 1 & 9



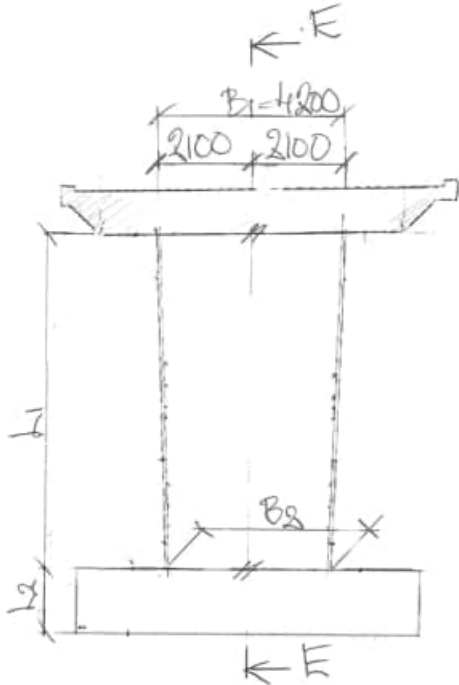
VIEW B-B
Support 1 & 9

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A1:9
		Date :	Created :

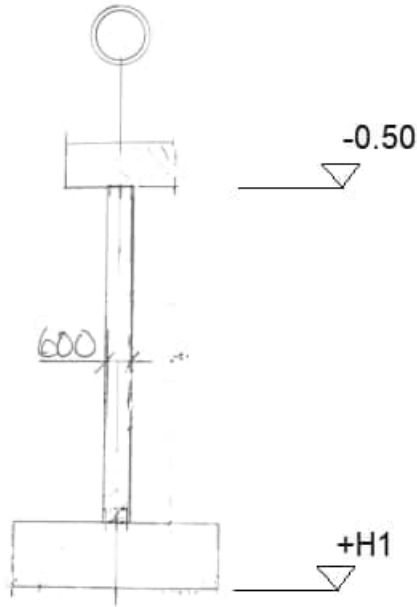


SECTION C-C
Support 2, 7 & 8

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A1:10
	Pretensioned slab bridge: hollow deck	Date :	Created :



SECTION D-D
Support 3-6



SEKTION E-E
Support 3-6

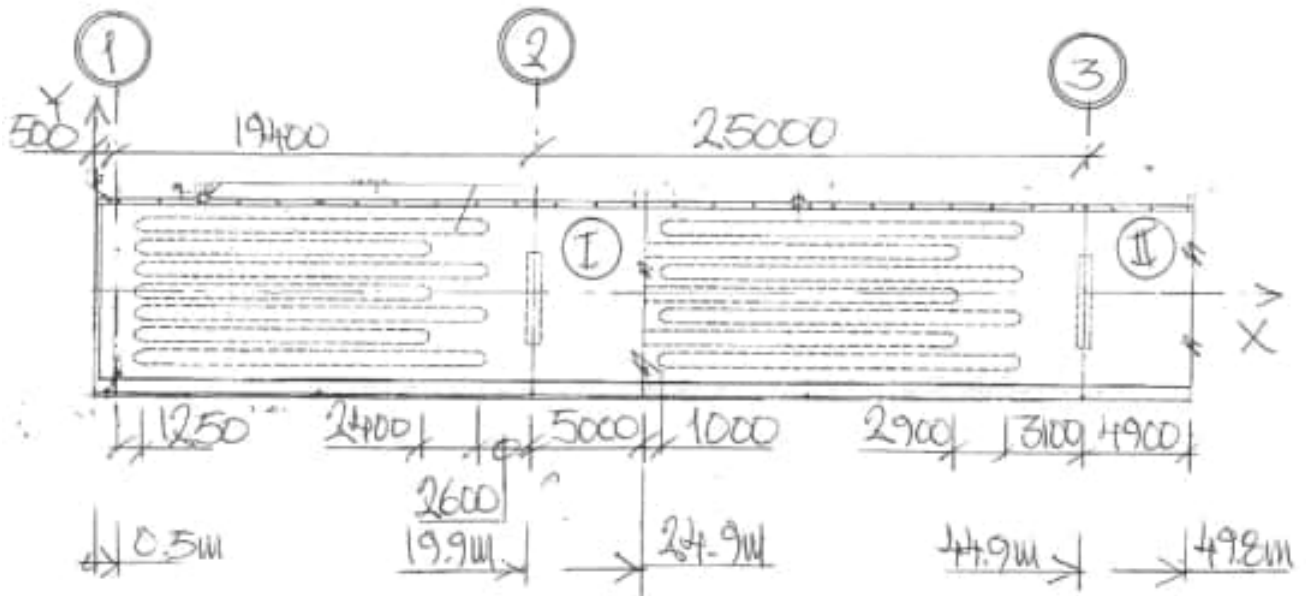
Support	B1	B2	L1	L2	+H1	Line
3	4200	3500	10970	1300	-11.77	P1300→P1301
4	4200	3500	9680	1400	-11.58	P1400→P1401
5	4200	3700	7470	1450	-9.37	P1500→P1501
6	4200	3600	8280	1400	-10.18	P1600→P1601
-	mm	mm	mm	mm	m	-

Tabell
Support 3-6

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A1:11
	Pretensioned slab bridge: hollow deck	Date :	Created :

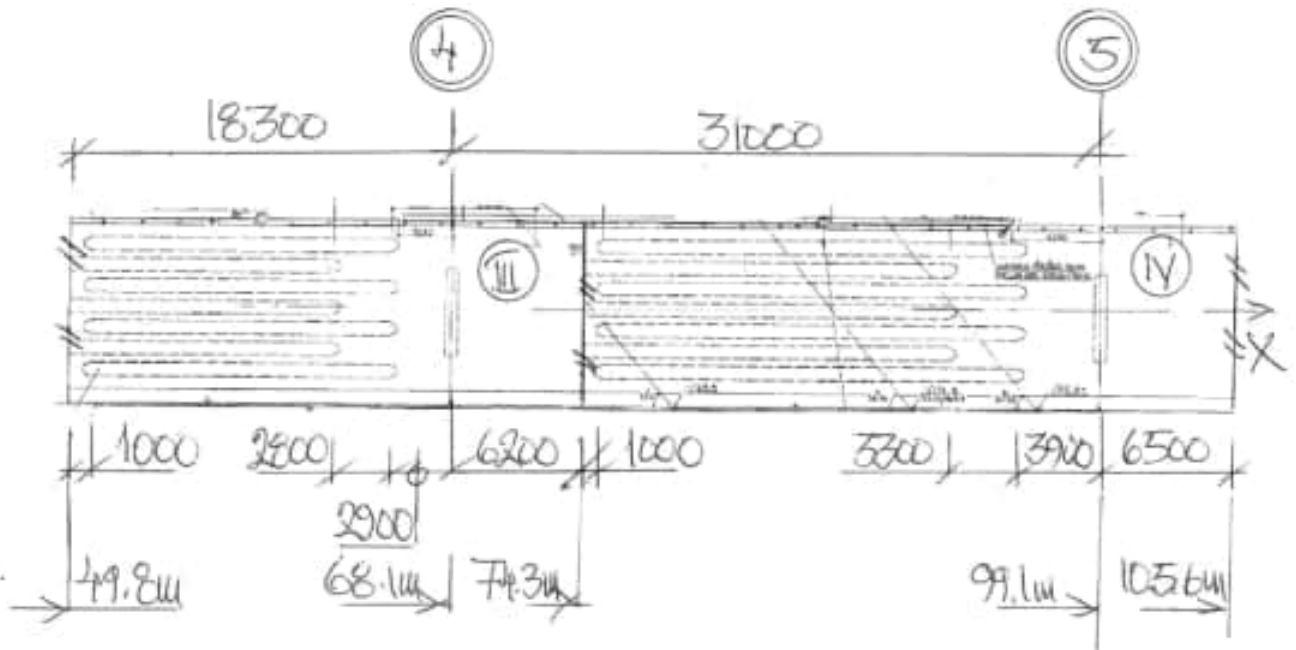
1.3 CASTING STAGES

There is a total of 8 casting stages with as seen below.



PLAN

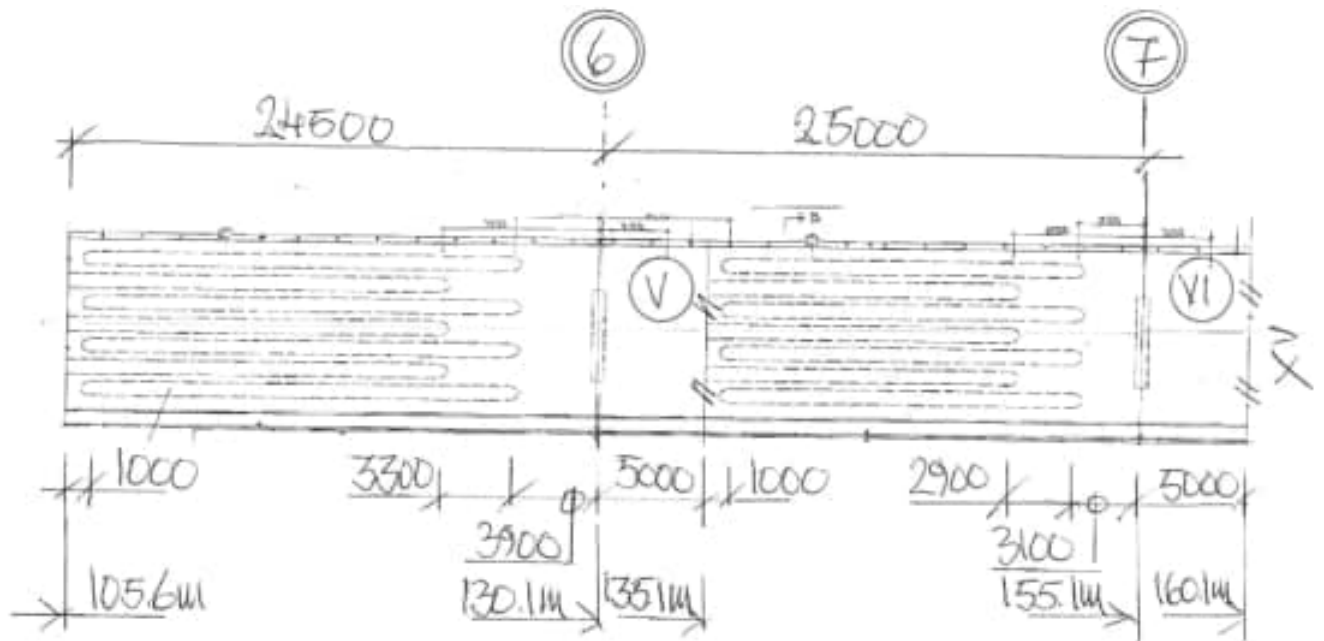
Casting stage 1 & 2



PLAN

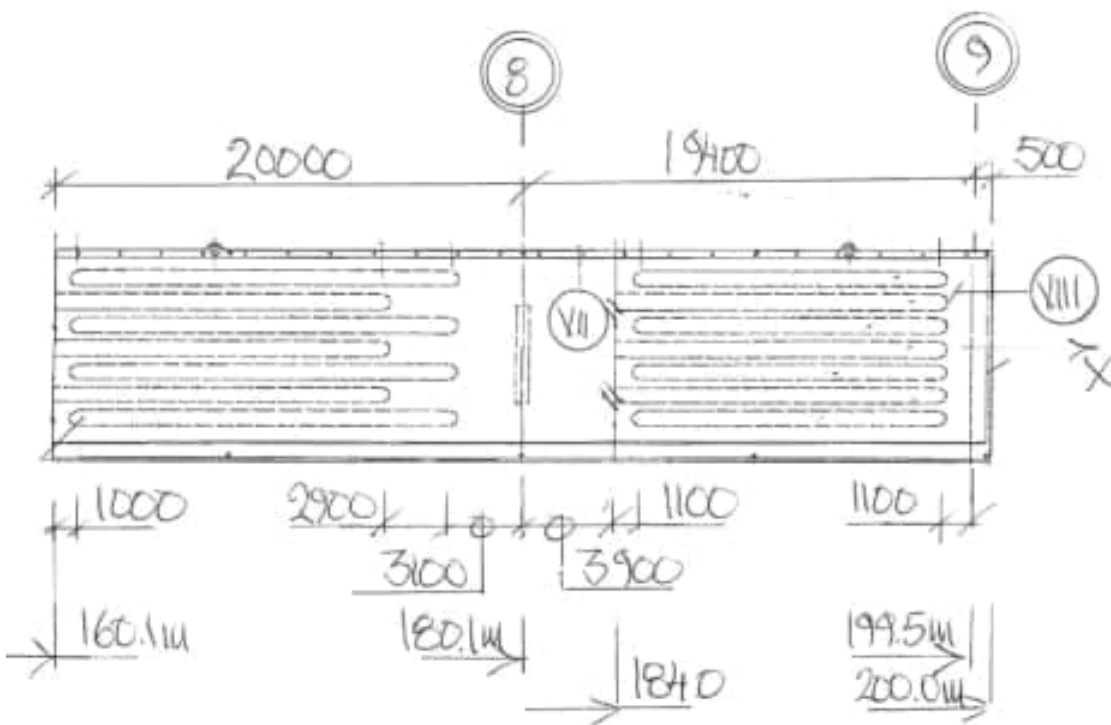
Casting stage 3 & 4

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A1:12
	Pretensioned slab bridge: hollow deck	Date :	Created :



PLAN

Casting stage 5 & 6



PLAN

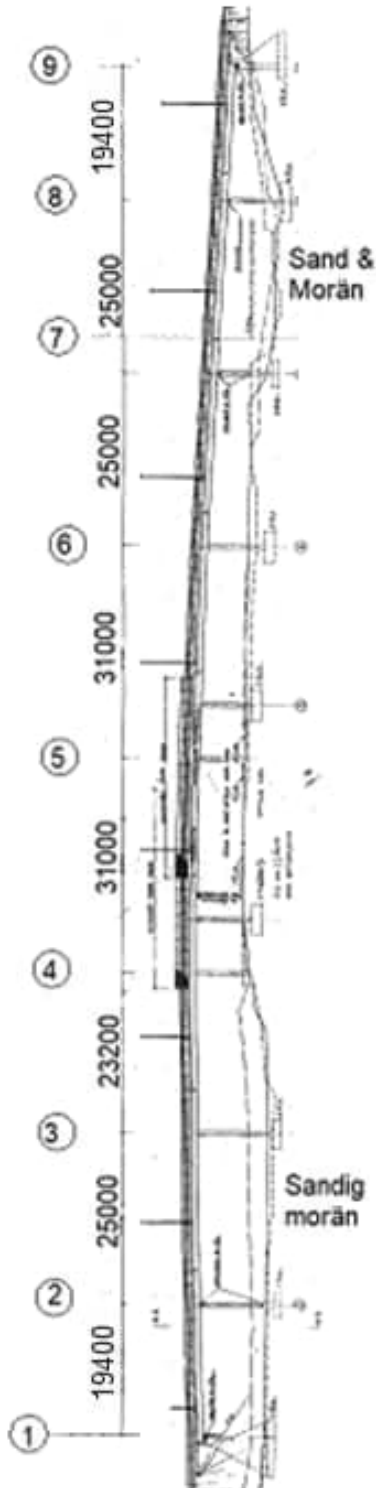
Casting stage 7 & 8

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A1:13
	Pretensioned slab bridge: hollow deck	Date :	Created :

1.4 FOUNDATION

Foundation at all support on compacted filling.

Benith filling sand, "morän" and sandy "morän" according interpretation seen below.



	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A1:14
	Pretensioned slab bridge: hollow deck	Date :	Created :

1.5 CODE OCH TENDER DOCUMENTS

- "Bro och broliknande konstruktion allmänna krav" (TRVINFRA-00226 v5)
- "Bro och broliknande konstruktion byggande" (TRVINFRA-0027 v6)
- "TSFS 2018:57 med ändringar tom TSFS 2022:50"
- "AMA Anläggning 23"
- "TRV ändringar och tillägg till AMA 23" (TDOK 2023:0125 v3)
- "Geokonstruktion dimensionering och utformning" (TRVINFRA-00230 v2)
- Document SS-EN 1990 to SS-EN 1999, see TRVINFRA section A.1.2.3.2

1.6 TECHNICAL SERVICE LIFE

Technical life span 120 years (L100).

1.7 ENVIRONMENT

Road traffic environment ("vägmiljö") is assumed for the overlying traffic road since salt is used at winter.

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A1:15
	Pretensioned slab bridge: hollow deck	Date :	Created :

1.8 MATERIAL

Concrete : C30/37 & C35/45 (CEM I 42.5 N, Anläggningscement klass N)

Reinforcement : B500B

Compacted fill : "Förtärkningslagermaterial" according to AMA CEB.415

Backfill : "Grovkrossad sprängsten" according to AMA CEB.524

Surfacing : See document RKFM

Pretension: VSL system or equivalent

1.9 GEOTECHNICAL CLASS

Geotechnical class GK2

Geotechnical class GK2

1.10 SAFETY CLASS

Geotechnical resistance: SK 2

Bridge structure : SK 3

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A1:16
		Date :	Created :

1.11 CONCRETE COVER AND CRACK CRITERIA

Class identification bridge components .:

Bridge components	Exposure class ^{1.)}	Life spann	max vct _{ekv} ^{2.)}	ζ ^{3.)}
Substructure:				
▫ Wingwall towards filling	XD1/XF4	L100	0.45	1.5
▫ Wingwall from filling	XD1/XF4	L100	0.45	1.5
▫ Abutement below ground	XC2/XF3	L100	0.50	1.0
▫ Abutement in air	XC4/XF3	L100	0.50	1.2
▫ Bottom slab in general	XC2/XF3	L100	0.50	1.0
▫ Bottom slab underside	XC2/XF3	L100	0.50	1.0
▫ Link slab in general	XD3/XF2	L100	0.40	1.8
▫ Link slab underside	XD3/XF2	L100	0.40	1.8
Superstructure:				
▫ Edge beam	XD3/XF4	L100	0.40	1.8
▫ Bridge deck	XD1/XF4	L100	0.40	1.5

Footnote:

- 1.) TRVINFRA-00227 section 5.3.2.3
- 2.) TSFS table 12.1
- 3.) TSFS table 12.3

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A1:17
	Pretensioned slab bridge: hollow deck	Date :	Created :

Design parameters low corrosion sensitive reinforcement (rebars):

$c_{min,dur}$: minimum cover with regard to environmental impact

$c_{min,b}$: minimum cover with regard to adhesion requirements

Δc_{dev} : execution tolerance

$c_{min} = \max(c_{min,b}; c_{min,dur}; 10mm)$: SS-EN 1992-1-1 eq. 4.2

$c_{nom} = c_{min} + \Delta c_{dev}$: SS-EN 1992-1-1 eq. 4.1, noted as BM on the drawing

Construction part	$c_{min,dur}$ ^{1.)}	$c_{min,b}$ ^{2.)}	c_{min}	c_{dev} ^{3.)}	c_{nom}	$W_{k,till}$ ^{4.)}
Substructure:						
▫ Wingwall towards filling	30	20	30	10	40	0.20
▫ Wingwall from filling	30	20	30	10	40	0.20
▫ Abutement below ground	20	20	20	10	30	0.40
▫ Abutement in air	25	20	25	10	35	0.30
▫ Bottom slab in general	20	20	20	10	30	0.40
▫ Bottom slab underside	20	20	20	10	30	0.40
▫ Link slab in general	45	20	45	10	55	0.15
▫ Link slab underside	45	20	45	10	60 ^{5.)}	0.15
Superstructure:						
▫ Edge beam	45	20	45	10	55	0.15
▫ Bridge deck	25	20	25	10	35	0.20

Footnotes:

1.) TSFS table 12.1

2.) SS-EN 1992-1-1 section 4.4.1.2 table 4.2

3.) SS-EN 1992-1-1 section 4.4.1.3

4.) TSFS table 12.2

5.) TSFS chapter 12 paragraph 3§ $k_1 = c_{min} + 15$ mm when casting against building foil.

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A1:18
		Date :	Created :

Design parameters high corrosion sensitive reinforcement (pretension):

$c_{min,dur}$: minimum cover with regard to environmental impact

$c_{min,b}$: minimum cover with regard to adhesion requirements

Δc_{dev} : execution tolerance

$c_{min} = \max(c_{min,b}; c_{min,dur}; 10mm)$: SS-EN 1992-1-1 eq. 4.2

$c_{nom} = c_{min} + \Delta c_{dev}$: SS-EN 1992-1-1 eq. 4.1, noted as BM on the drawing

Construction part	$c_{min,dur}$ ^{1.)}	$c_{min,b}$ ^{2.)}	c_{min}	c_{dev} ^{3.)}	c_{nom}	$w_{k,till}$ ^{4.)}
Superstructure:						
▫ Top bridge deck	25	90	90	10	100	*
▫ Other part of bridge deck	25	90	90	10	100	*
	mm	mm	mm	mm	mm	mm

Footnotes:

1.) TSFS table 12.1

2.) SS-EN 1992-1-1 section 4.4.1.2 (3) specifies pretension tube $\phi 90$

3.) SS-EN 1992-1-1 section 4.4.1.3

4.) TSFS table 12.2 states that crack width is not needed when "tensile stress" for SLS-F is less than $f_{ctk,0.05}/\zeta$

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:1
	Pretensioned slab bridge: hollow deck	Date :	Created :

2. SYSTEM ANALYSIS

2.1	GENERAL	page 2:2-3
2.2	SKETCH SYSTEM ANALYSIS	page 2:4-33
2.3	CROSS SECTION PROPERTIES	page 2:34-96
2.4	MATERIAL	page 2:97-99
2.5	BOUNDARY CONDITIONS	page 2:100-105
2.6	MESH	page 2:106-109
2.7	STAGED CONSTRUCTION	page 2:110-127
2.8	SEARCH AREA	page 2:128

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:2
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.1 GENERAL

Regulations, SS-EN 1992-1-1 section 5.3.1 (3) specifies criteria for “slab” and “beam” as follows:

- Slab: $B > 5H$
- Beam: $B \leq 5H$

The studied bridge deck is therefore a slab structure, since $B > 7.5H$, and not a beam.

Edge beams are not considered to contribute any stiffness, only load.

The bridge deck is modeled as grillage using longitudinal and transverse beams.

There are a total of 8 longitudinal beams. These are modeled as 3D beam elements and defined along longitudinal nodal lines. Each beam has a width of 1 m.

Transverse beams are introduced at both the bottom and top of the bridge deck. These are assigned a maximum width of 3 m in accordance with technical code practice. The transverse beams are included to enable evaluation of bending moments and shear forces between the voids. These beams are also modeled as 3D beam elements defined along transverse nodal lines. A stiffness increase of 1:3 is applied when determining their thickness.

To avoid shear reinforcement (stirrups) to resist torsion and shear effects, the chosen analysis model must account for this. This is achieved by assigning negligible torsional stiffness to both longitudinal and transverse beams, thereby preventing torsional forces from developing in these elements. This assumption results in a somewhat reduced load distribution in the transverse direction.

The columns at supports 3–6 are modeled as 3D beam elements. At their top, these elements are rigidly connected to the lower transverse beams using beam joints (JSH4). At their base, the columns are modeled with pinned connections, consistent with the original analysis.

Traffic load evaluation is performed using the Vehicle Load Optimiser (VLO) for Swedish traffic loads.

The bridge is constructed in a total of 8 casting stages (STAGE 1 through STAGE 8).

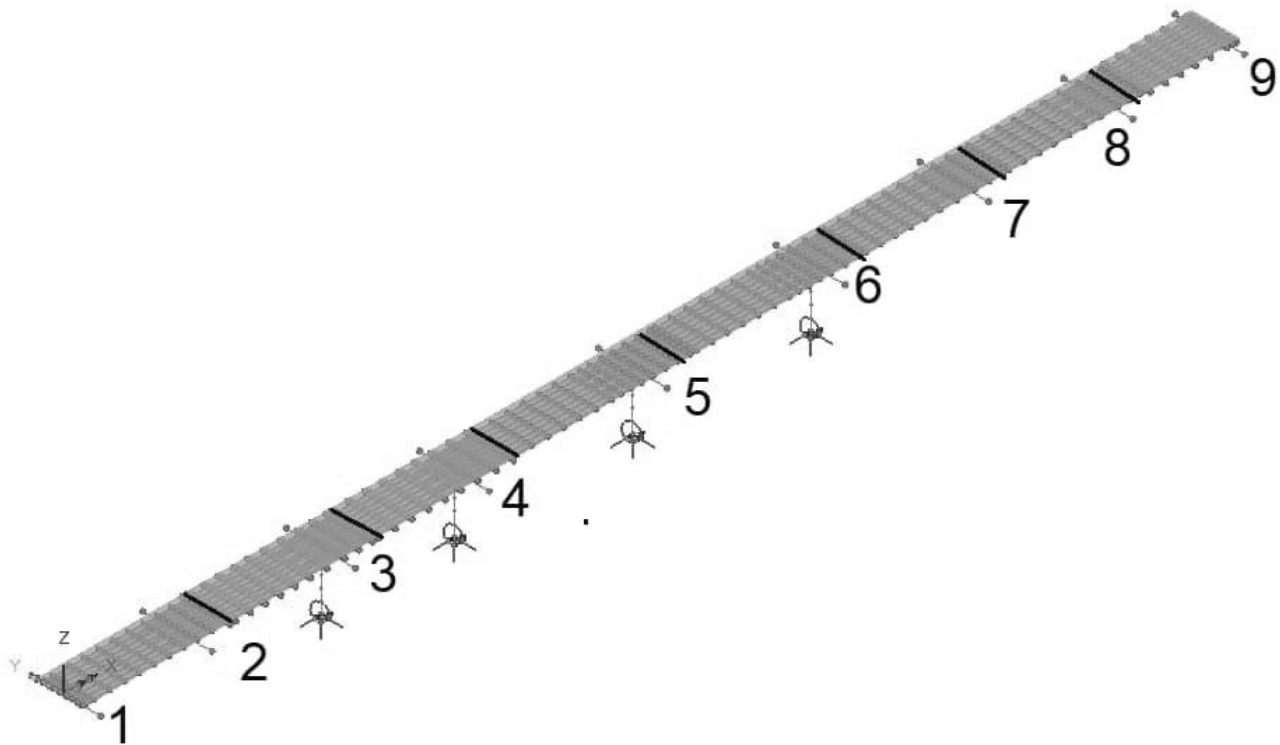
LUSAS allows multiple structural systems within a single model. For this bridge, 9 different structural systems are used. One for each construction stage and one for operational stage.

The reason for selecting a 3D analysis is that line supports are not present at each support location. Longitudinal beams LB1 and LB8 have no supports at all, while LB2 and LB7 lack supports at several locations.

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:3
	Pretensioned slab bridge: hollow deck	Date :	Created :

Appendices:

Appendix	Name
1	Input receipt
2	Results reactions
3	Results bearings
4	Results longitudinal girders



3D Overview

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:4
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.2 SKETCH SYSTEM ANALYSIS

2.2.1 Geometry

To describe geometry first POINTS are defined.

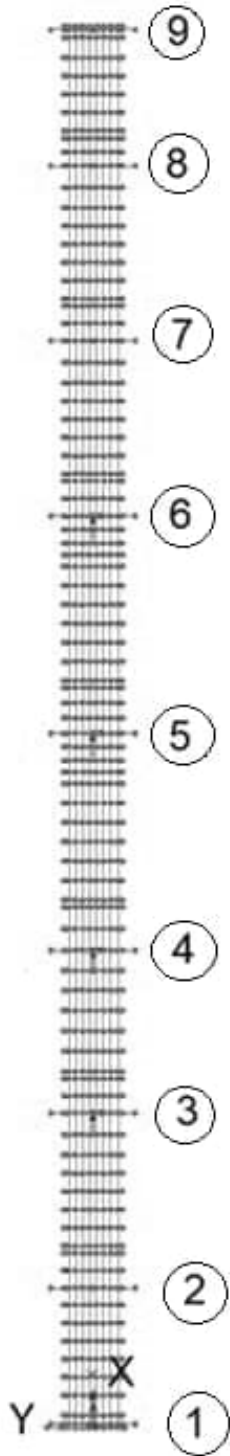
Beam elements are defined by applying attributes to LINES.

Attached pictures are retrieved from graphical sketches generated of POINTS and LINES.

All coordinates needed to describe POINTS are found in Input Receipt.

All POINTS needed to describe LINES are found in Input Receipt.

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:5
		Date :	Created :

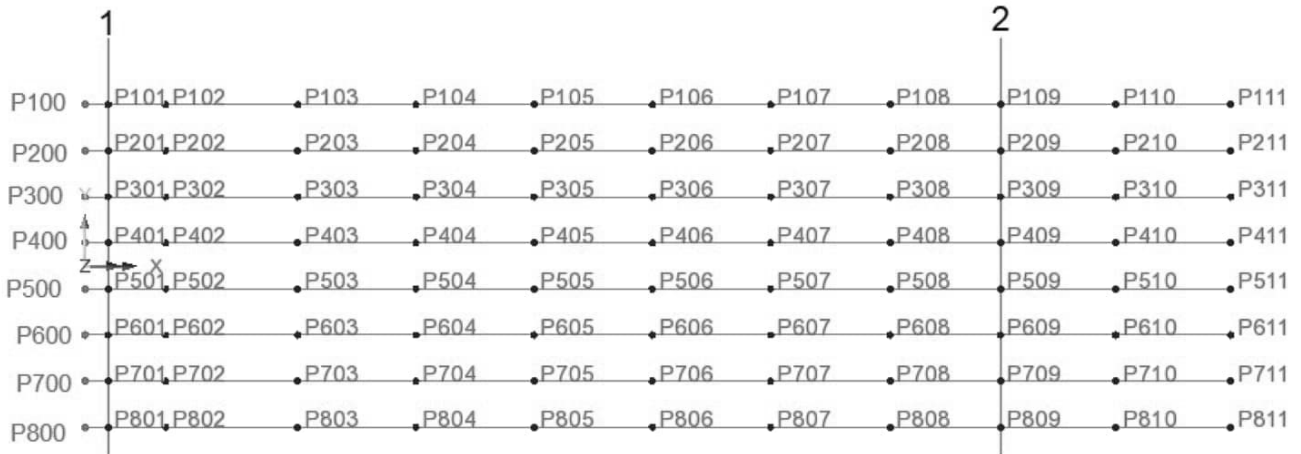


PLAN (nodal lines)
Overview

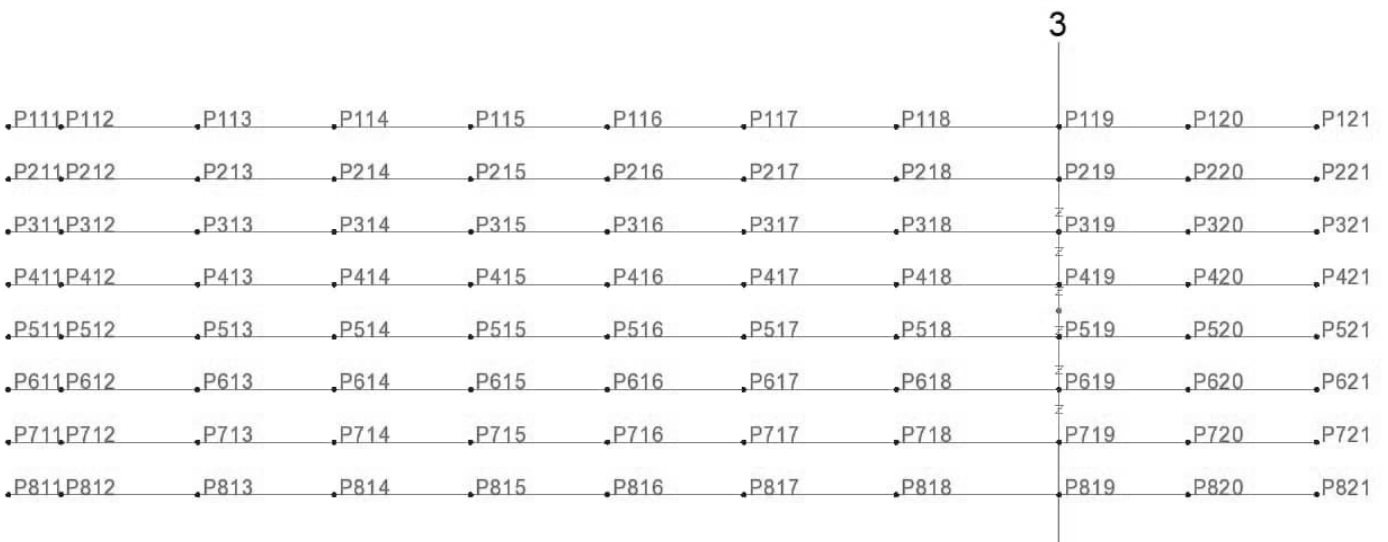
	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:6
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.2.1.1 Geometry : POINTS

Casting stage 1 - Longitudinal beams (LB):

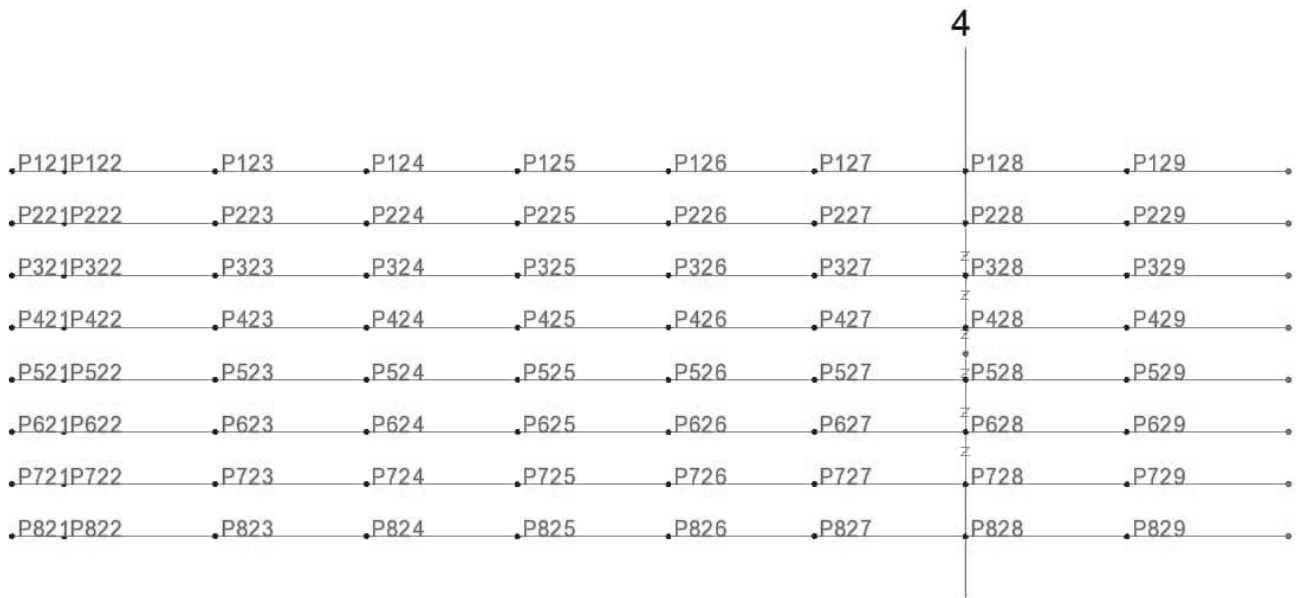


Casting stage 2 - Longitudinal beams (LB):

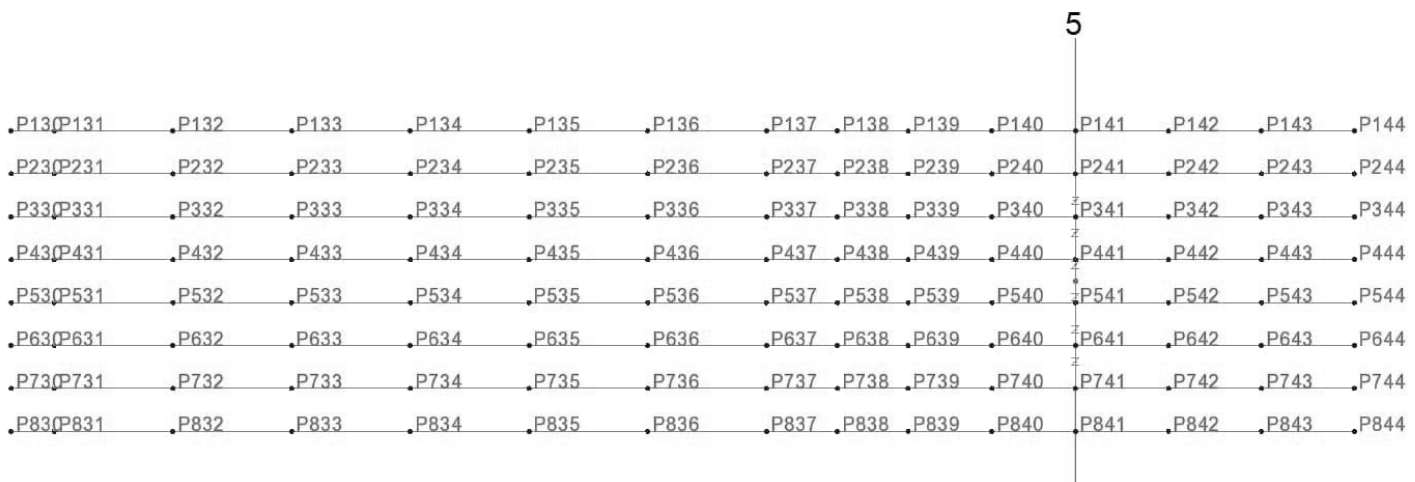


	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:7
	Pretensioned slab bridge: hollow deck	Date :	Created :

Casting stage 3 - Longitudinal beams (LB):

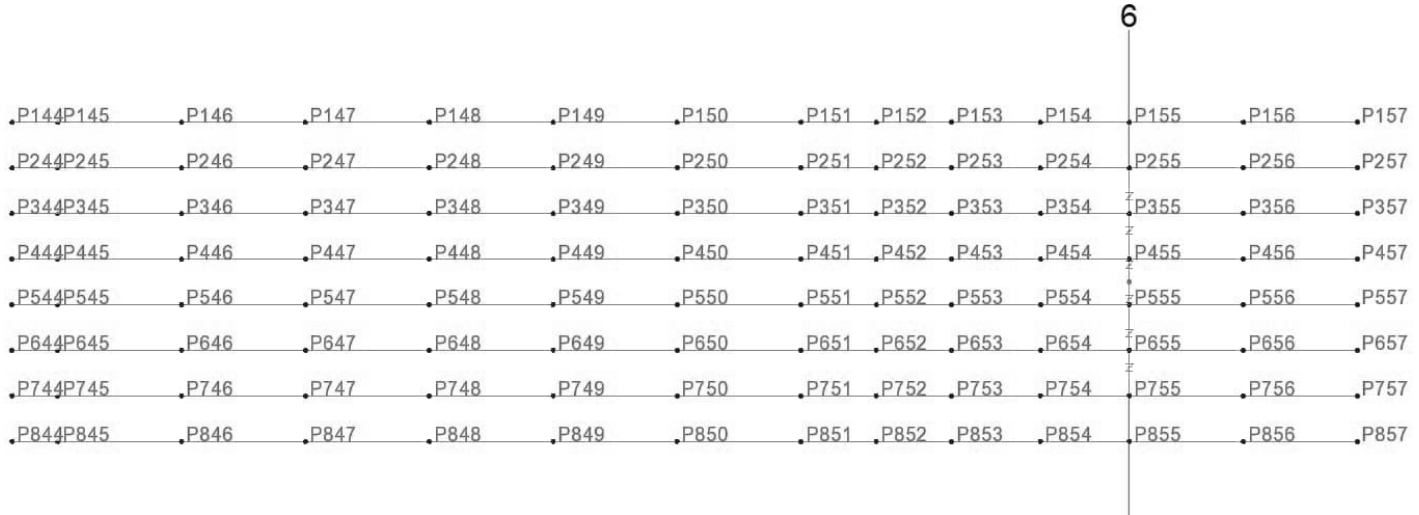


Casting stage 4 - Longitudinal beams (LB):

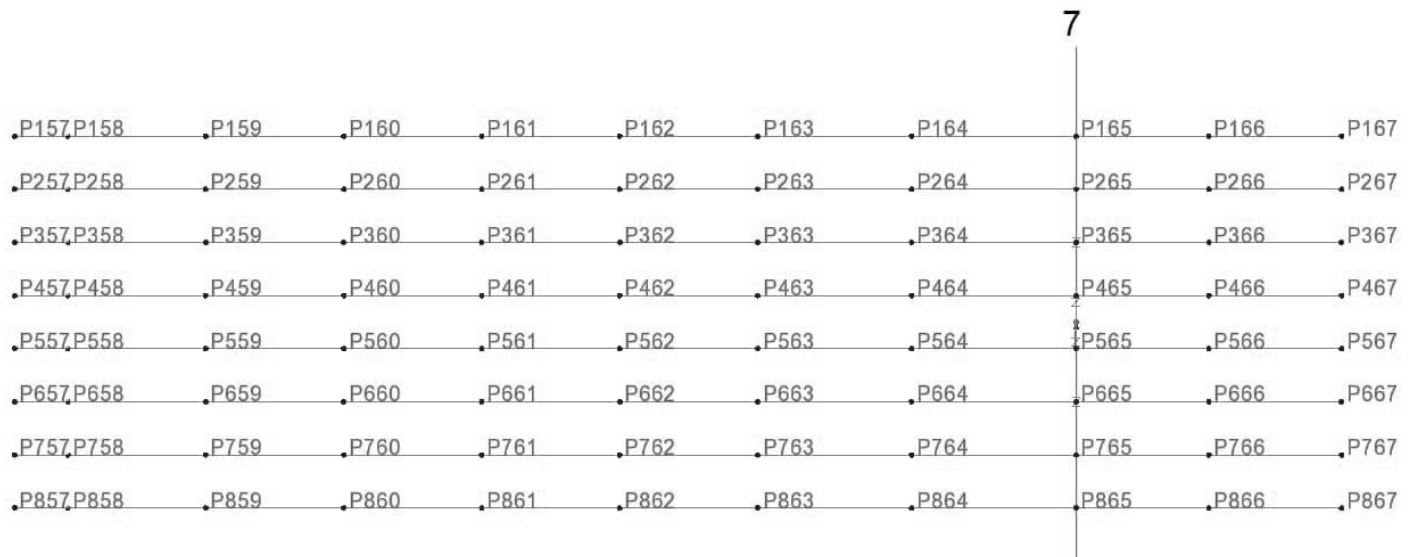


	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:8
		Date :	Created :

Casting stage 5 - Longitudinal beams (LB):

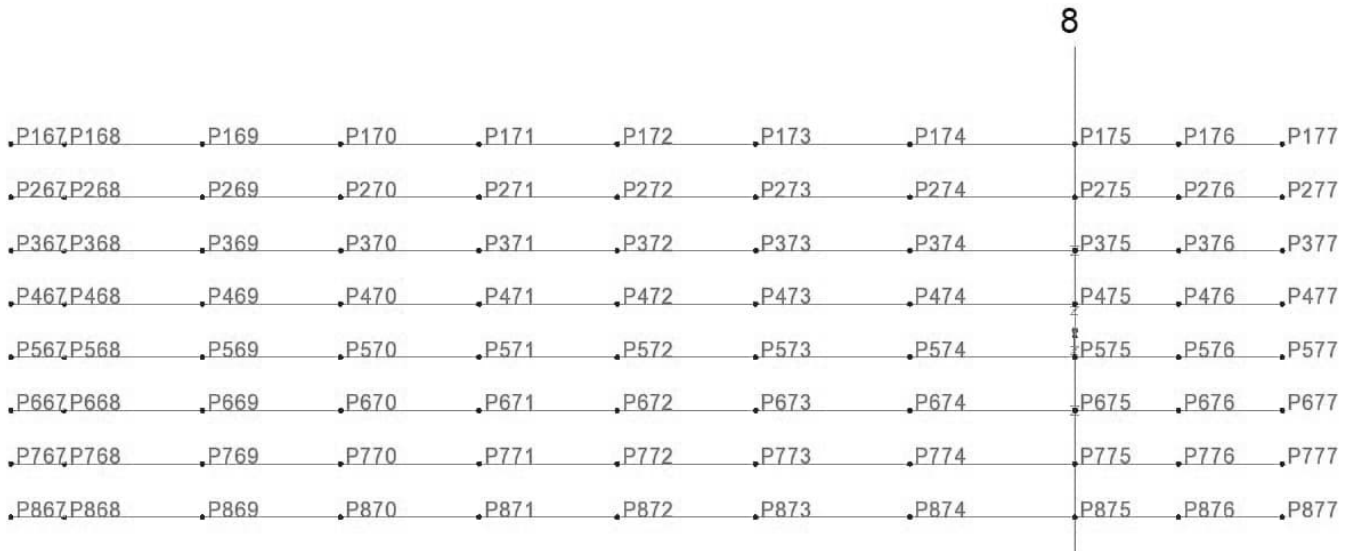


Casting stage 6 - Longitudinal beams (LB):

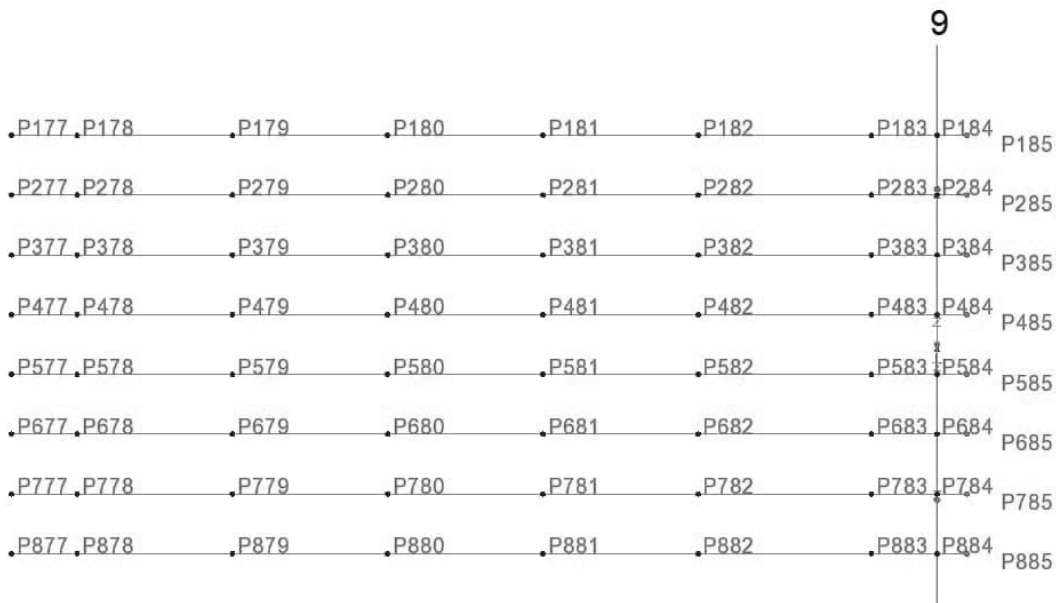


	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:9
	Pretensioned slab bridge: hollow deck	Date :	Created :

Casting stage 7 - Longitudinal beams (LB):

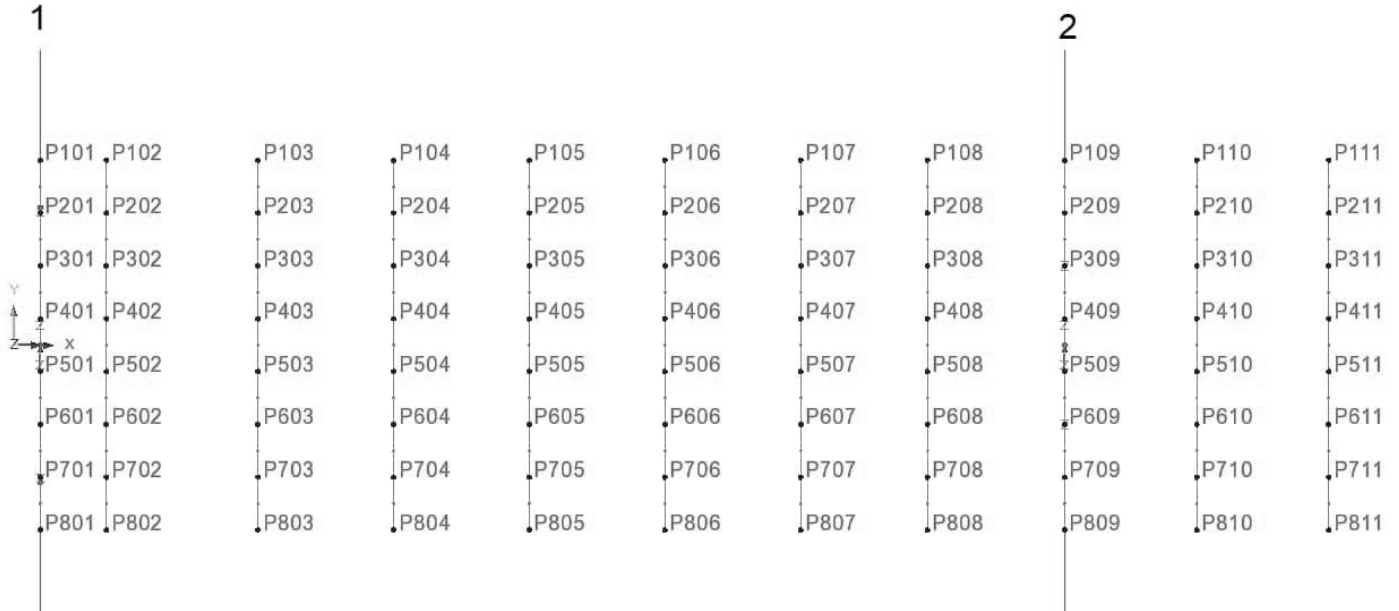


Casting stage 8 - Longitudinal beams (LB):

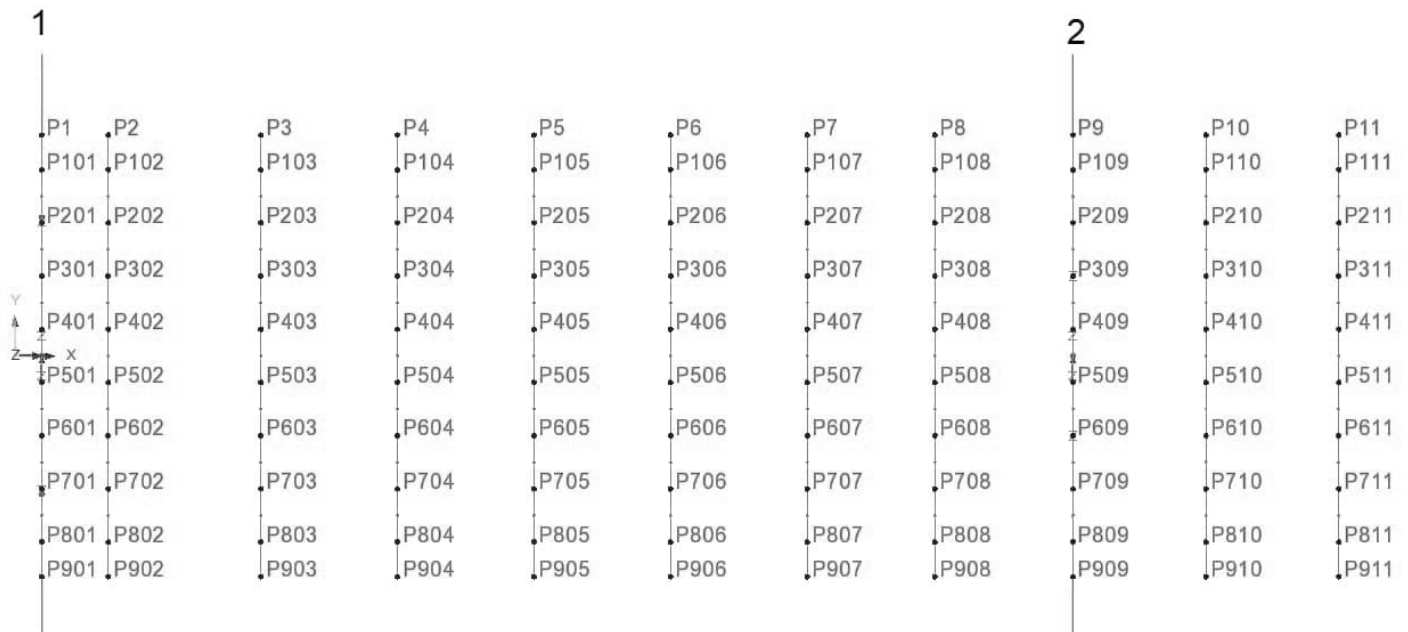


	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:10
	Pretensioned slab bridge: hollow deck	Date :	Created :

Casting stage 1 - Transversal beams UK (TB-UK):

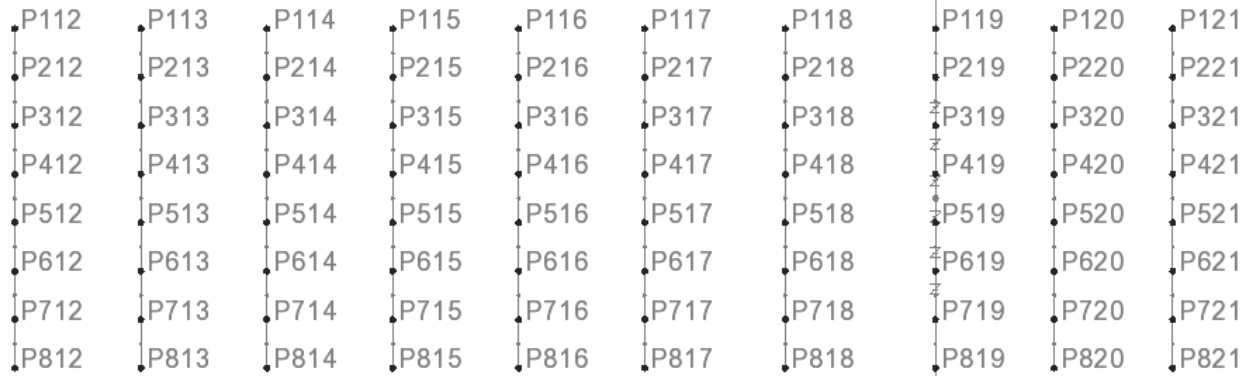


Casting stage 1 - Transversal beams OK (TB-OK) & Edge beams (EB):

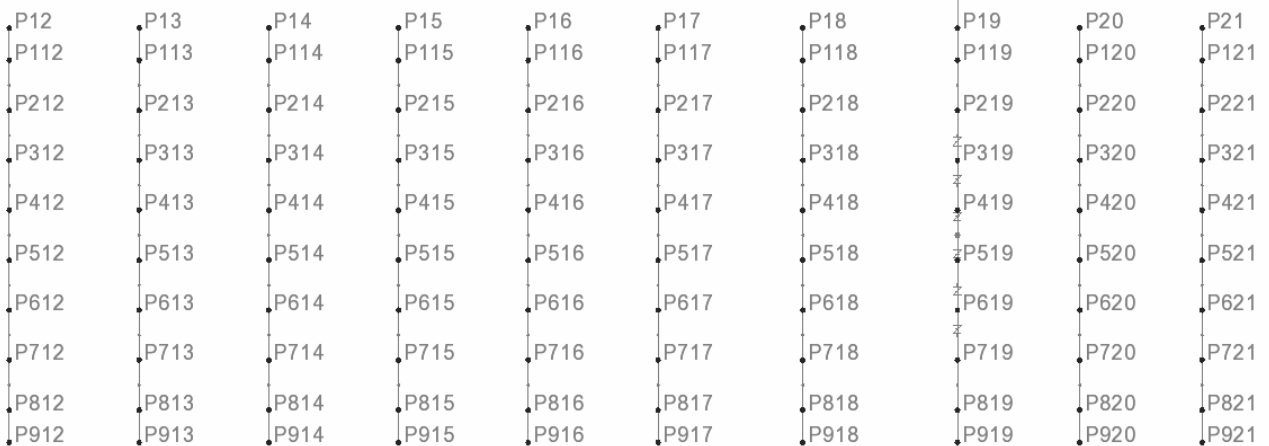


	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:11
	Pretensioned slab bridge: hollow deck	Date :	Created :

Casting stage 2 - Transversal beams UK (TB-UK):

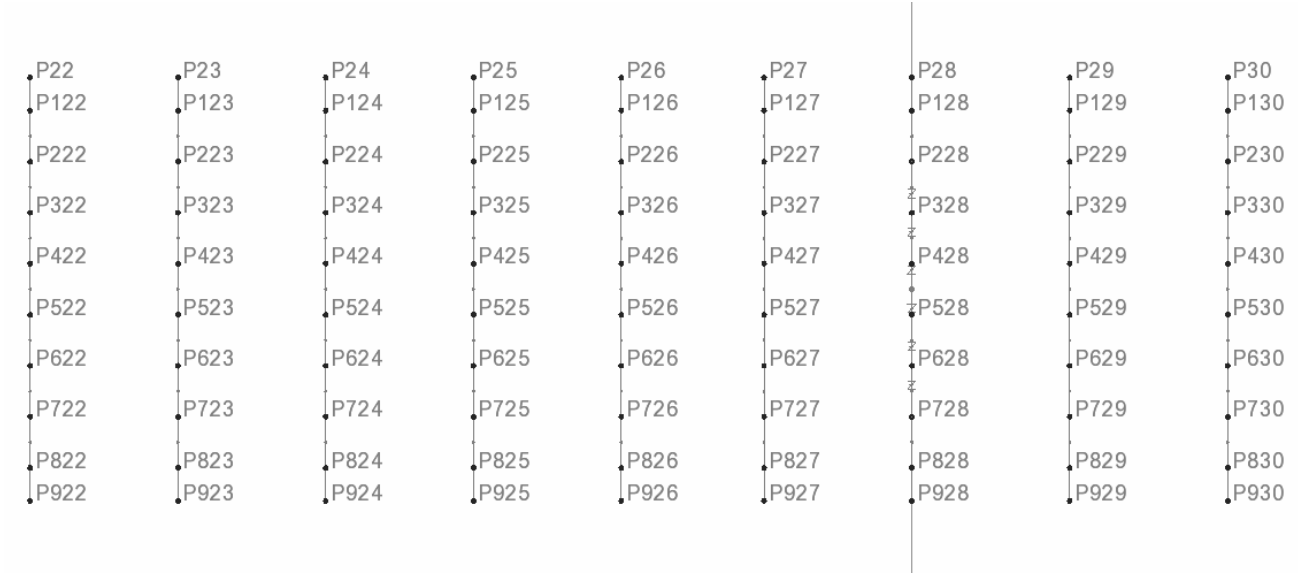


Casting stage 2 - Transversal beams OK (TB-OK) & Edge beams (EB):

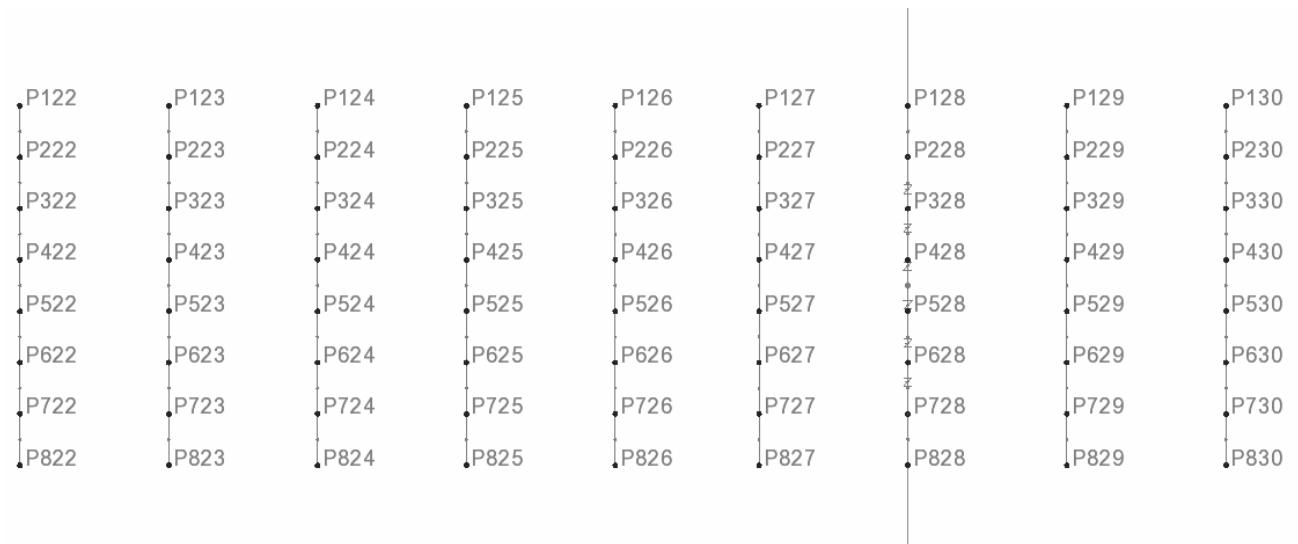


	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:12
		Date :	Created :

Casting stage 3 - Transversal beams OK (TB-OK) & Edge beams (EB):

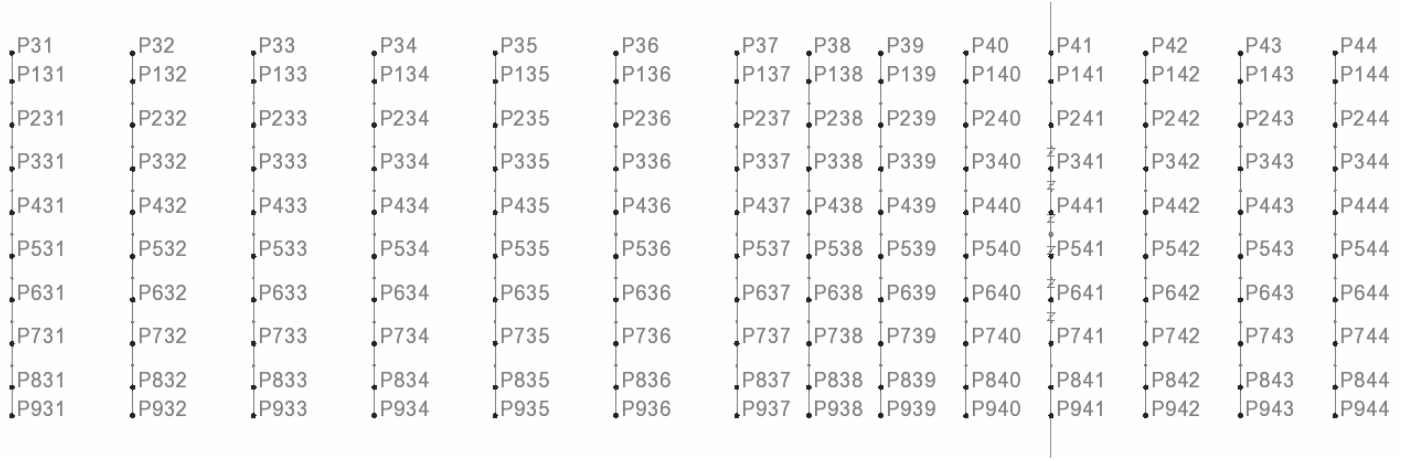


Casting stage 3 - Transversal beams UK (TB-UK):

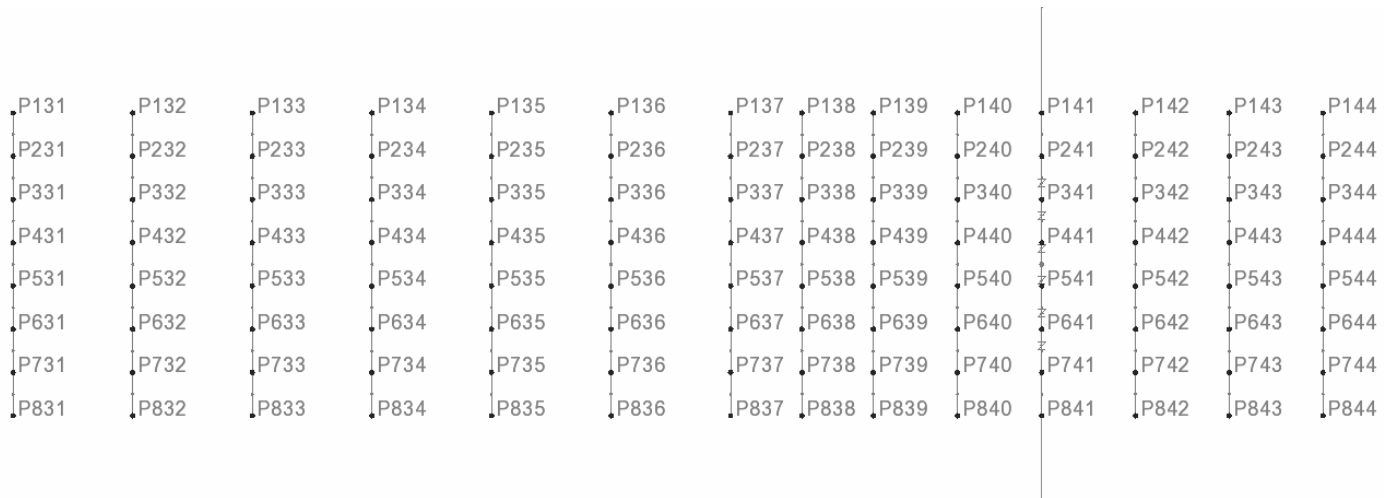


	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:13
		Date :	Created :

Casting stage 4 - Transversal beams OK (TB-OK) & Edge beams (EB):

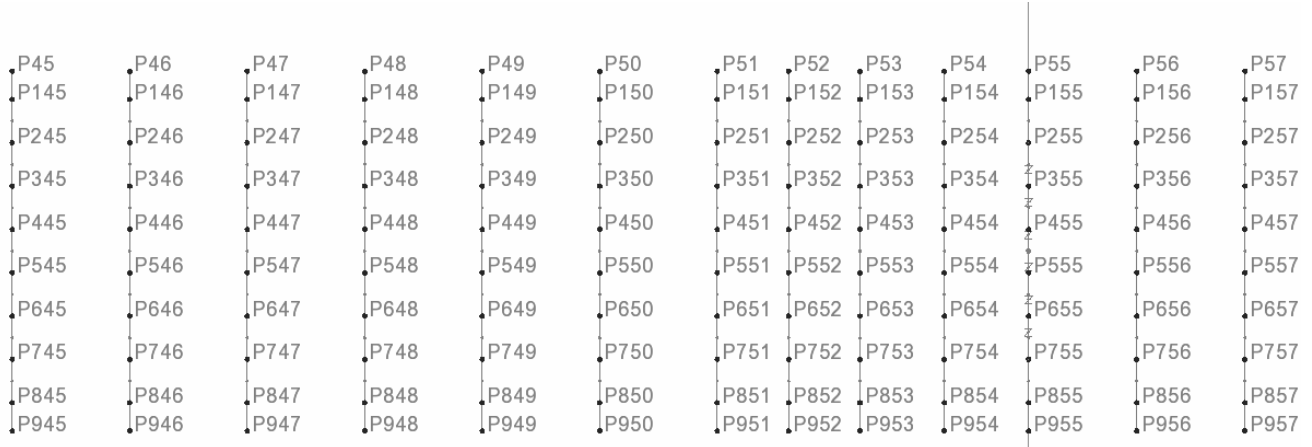


Casting stage 4 - Transversal beams UK (TB-UK):

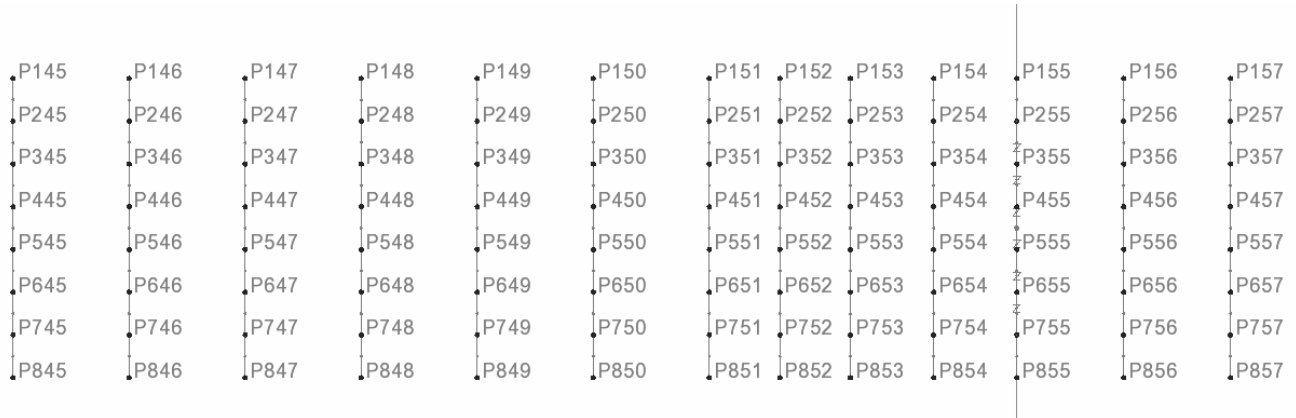


	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:14
		Date :	Created :

Casting stage 5 - Transversal beams OK (TB-OK) & Edge beams (EB):

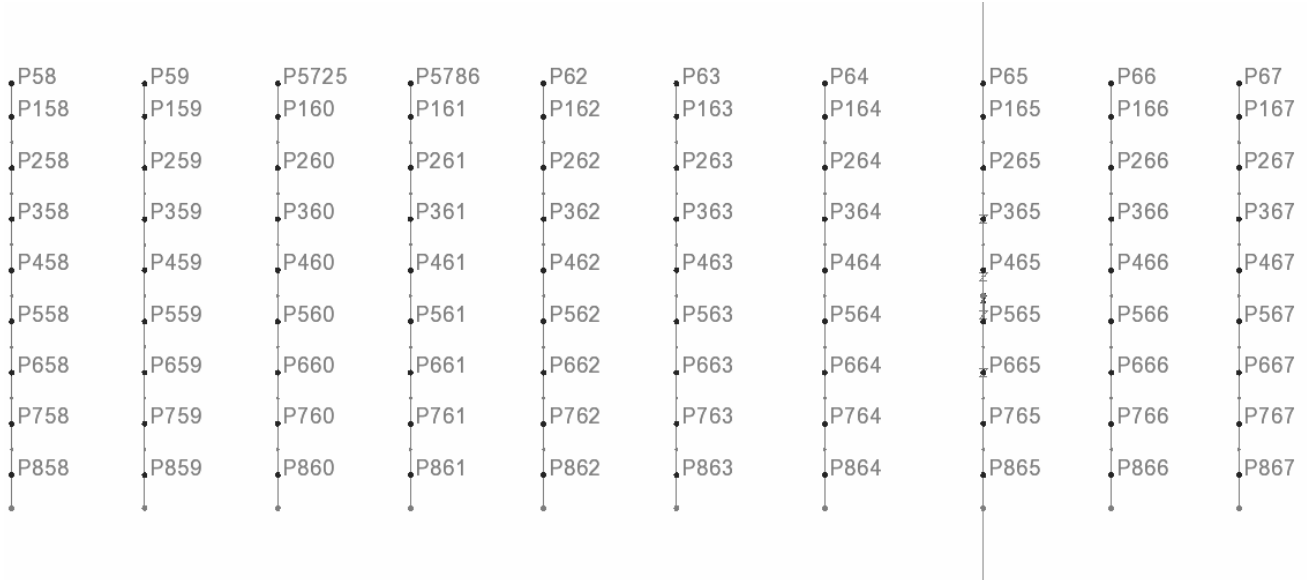


Casting stage 5 - Transversal beams UK (TB-UK):

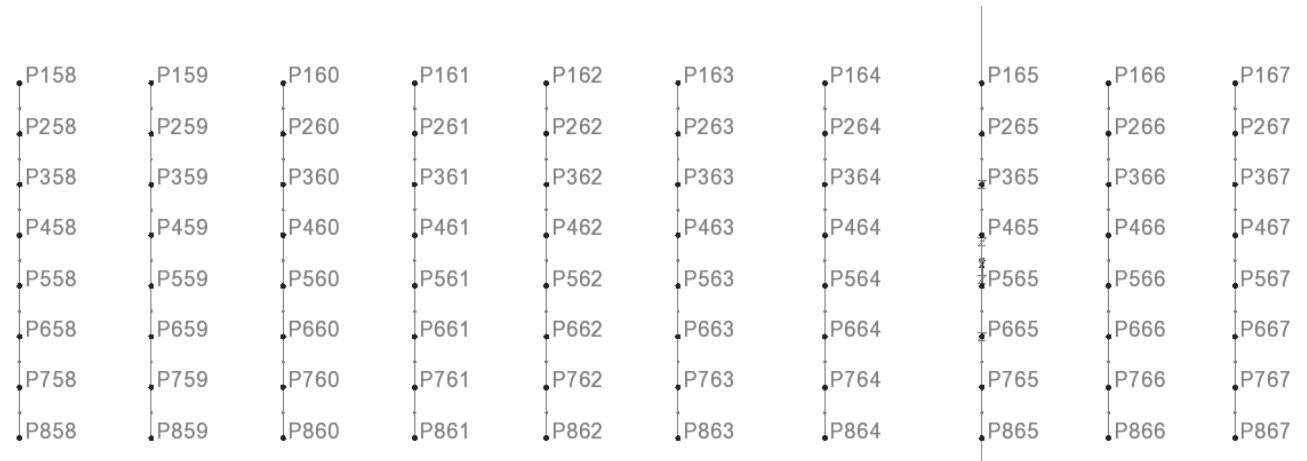


	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:15
	Pretensioned slab bridge: hollow deck	Date :	Created :

Casting stage 6 - Transversal beams OK (TB-OK) & Edge beams (EB):

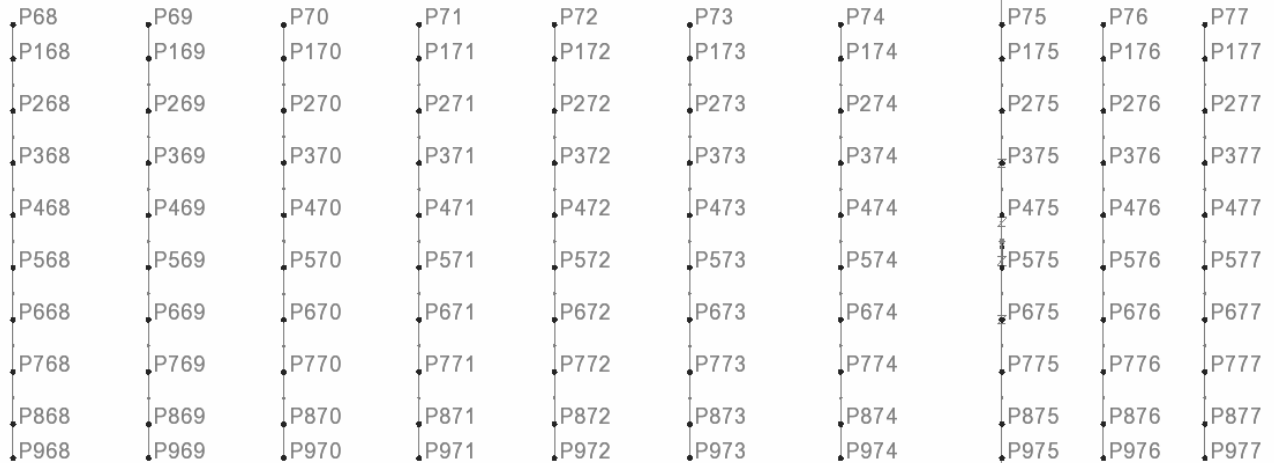


Casting stage 6 - Transversal beams UK (TB-UK):

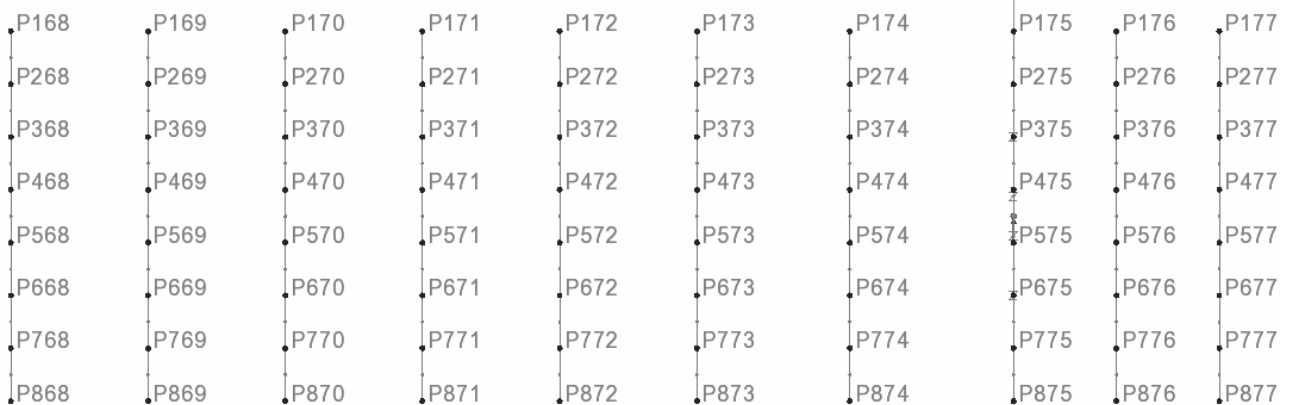


	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:16
		Date :	Created :

Casting stage 7 - Transversal beams OK (TB-OK) & Edge beams (EB):

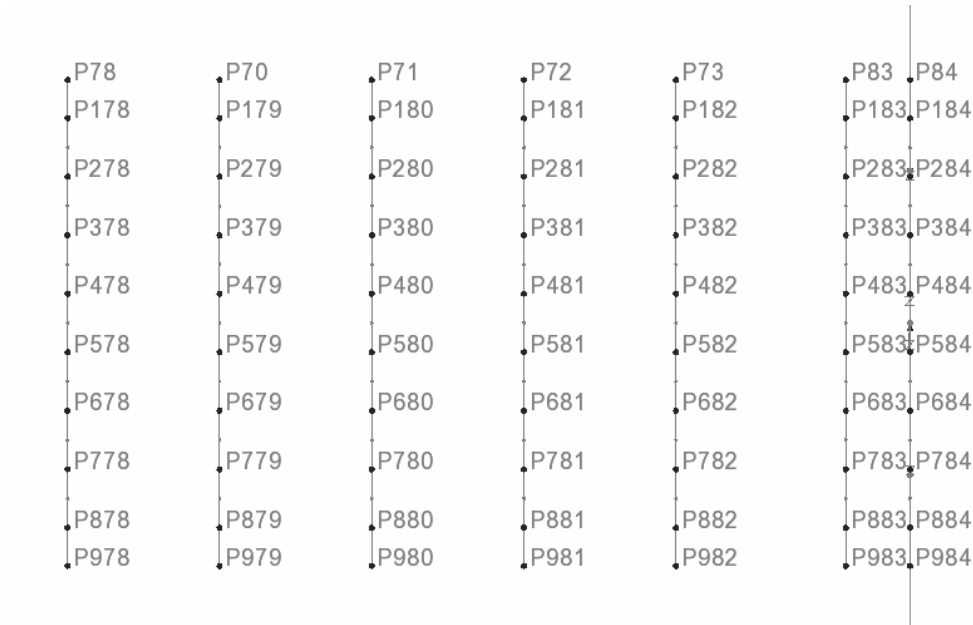


Casting stage 7 - Transversal beams UK (TB-UK):

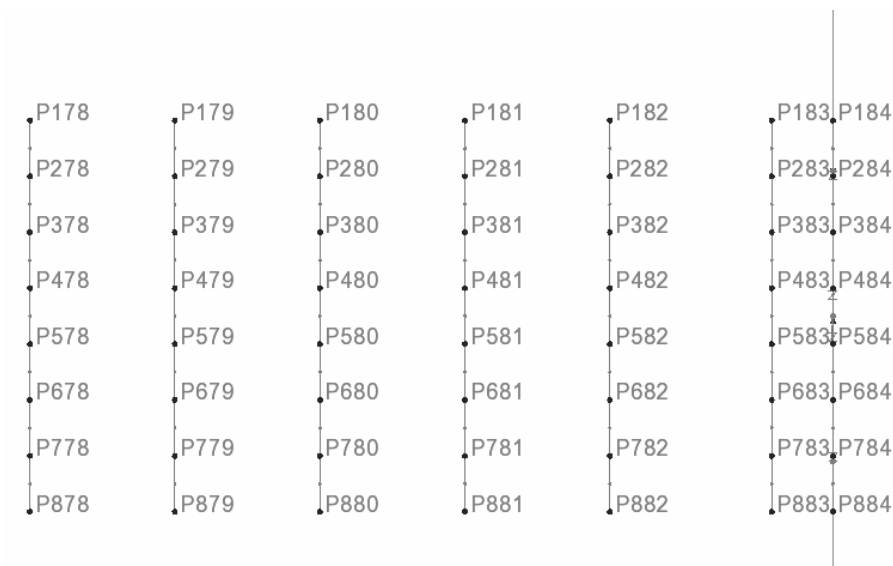


	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:17
	Pretensioned slab bridge: hollow deck	Date :	Created :

Casting stage 8 - Transversal beams OK (TB-OK) & Edge beams (EB):

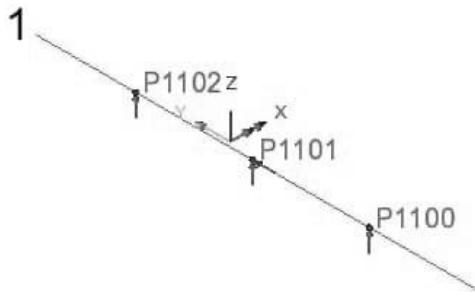
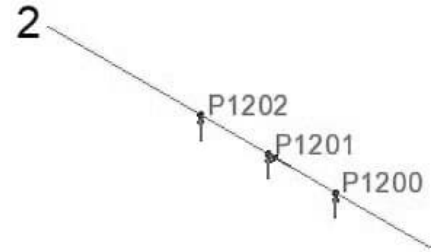


Casting stage 8 - Transversal beams UK (TB-UK):



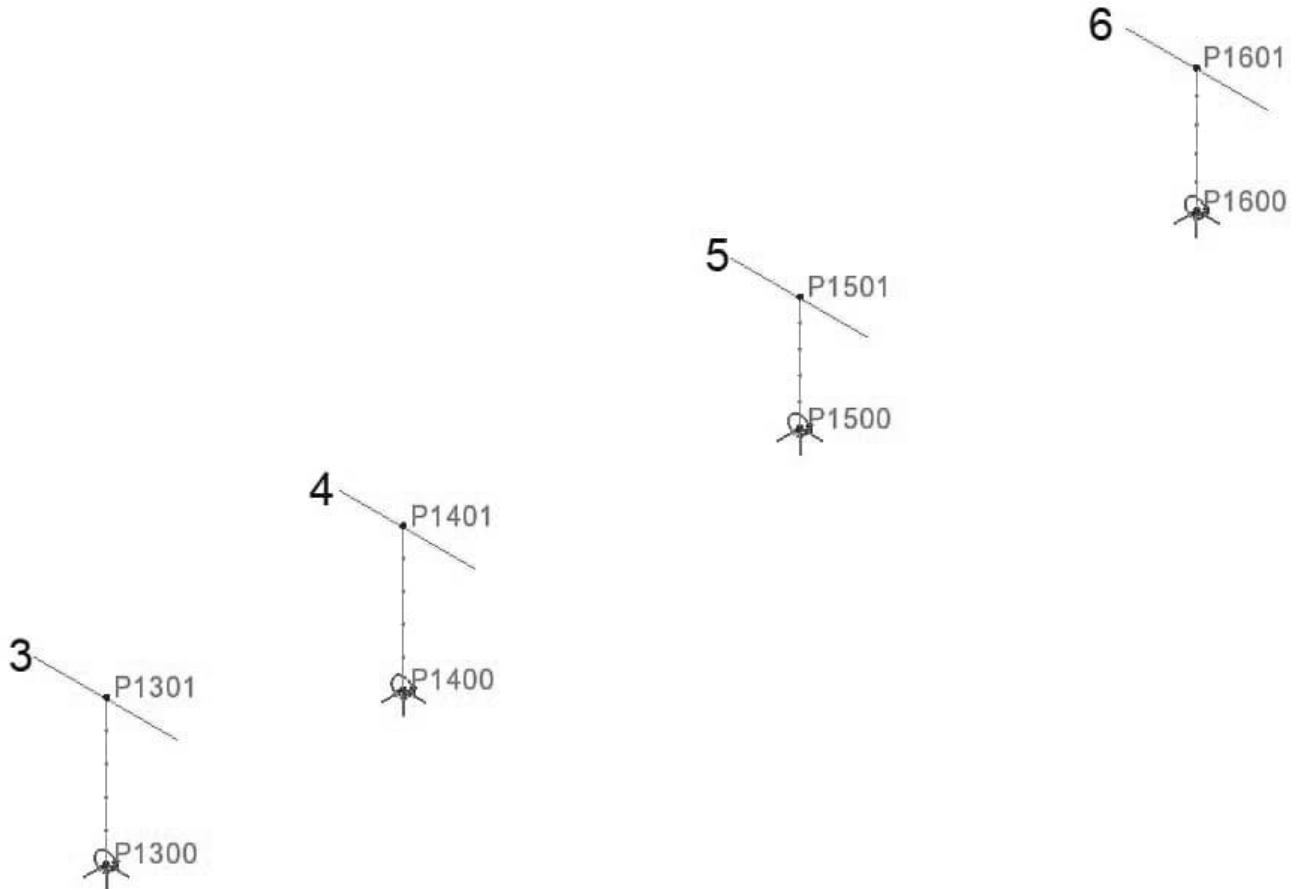
	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:18
		Date :	Created :

Supernodes & Bearings.: Supports 1-2



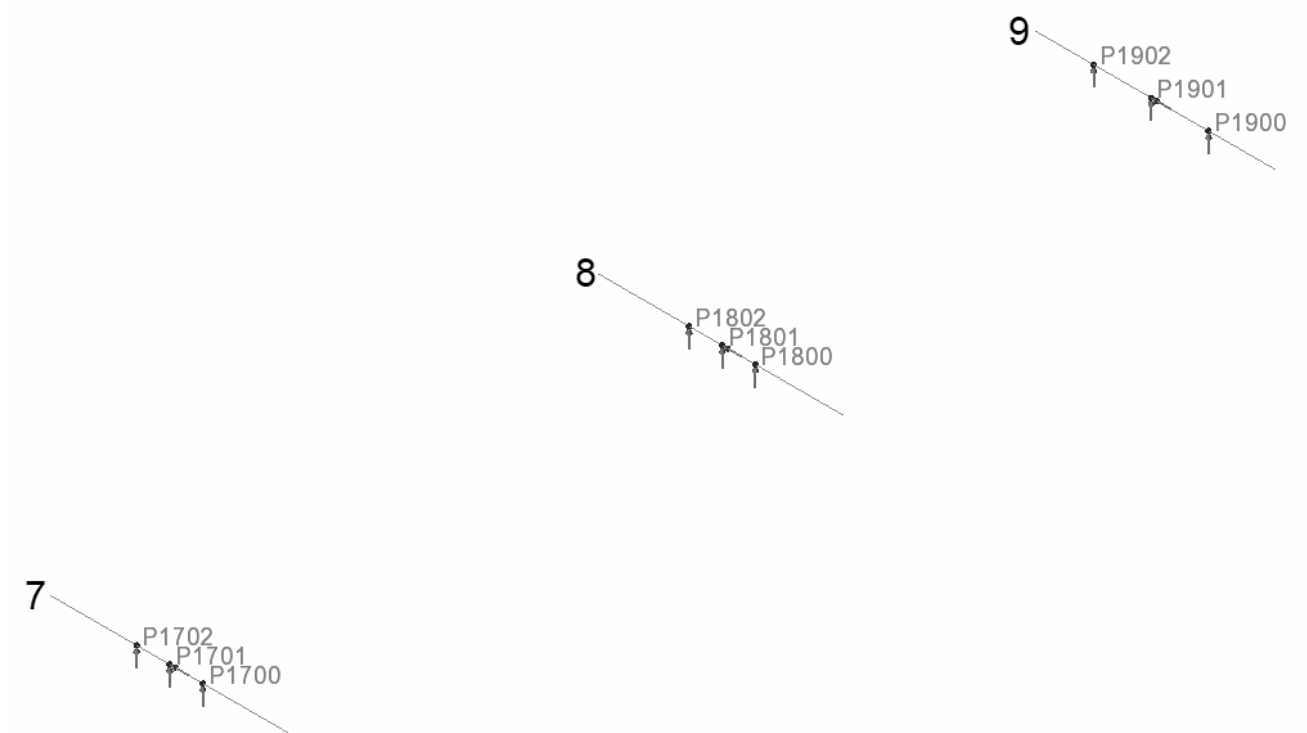
	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:19
	Pretensioned slab bridge: hollow deck	Date :	Created :

Columns: Supports 3-6



	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:20
		Date :	Created :

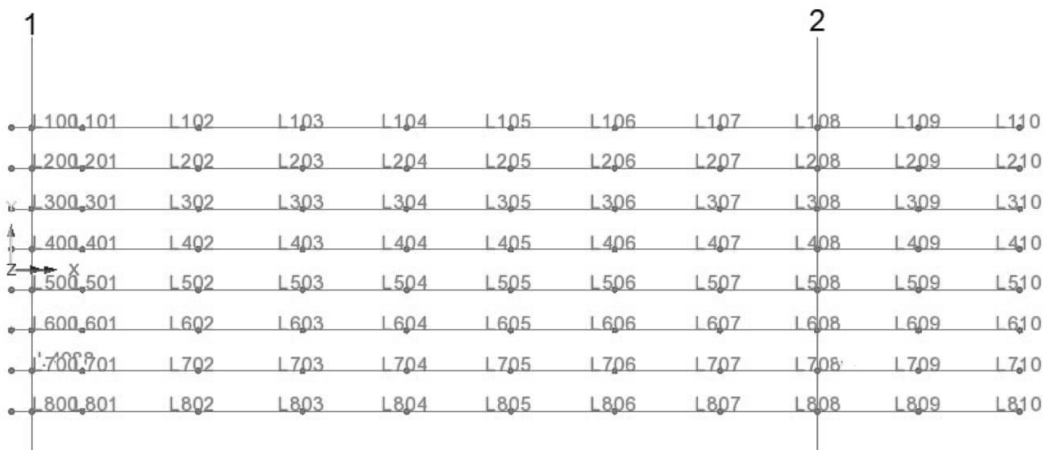
Supernodes & Bearings.: Supports 7-9



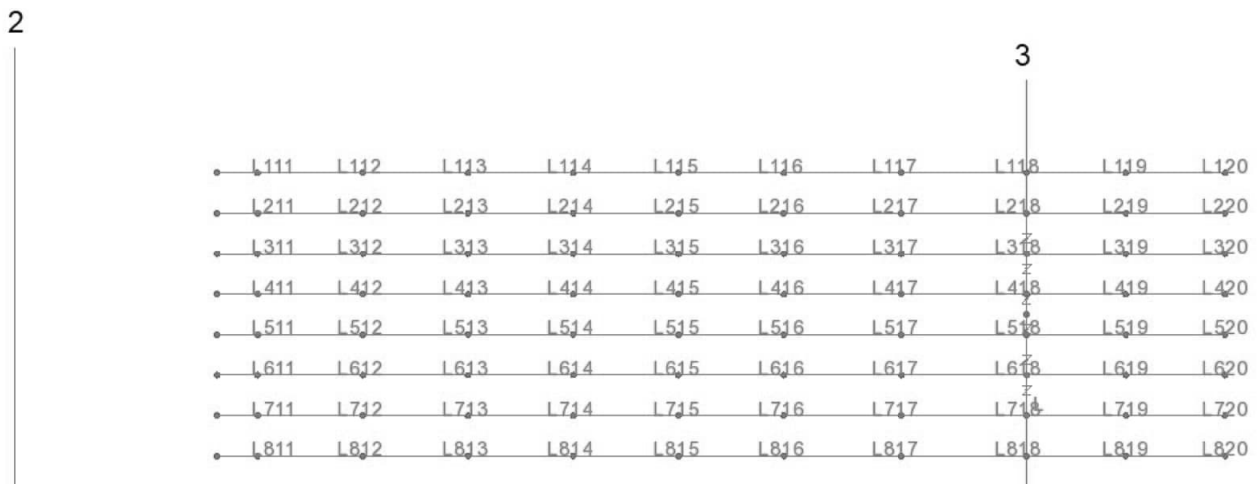
	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:21
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.2.1.2 Geometry : LINES

Casting stage 1 - Longitudinal beams (LB):

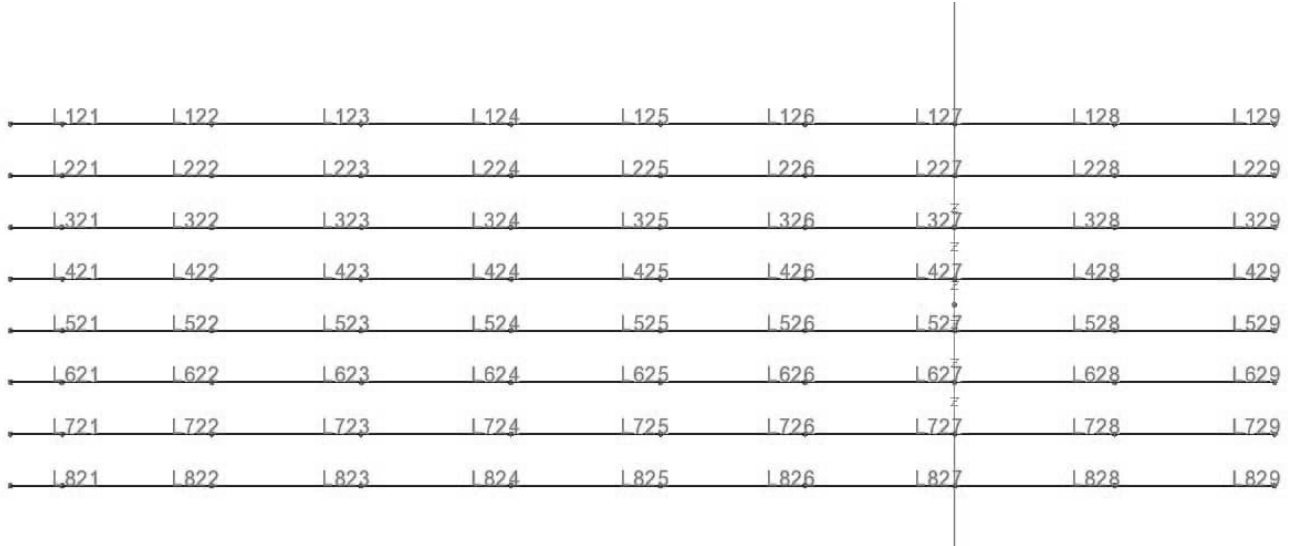


Casting stage2 - Longitudinal beams (LB):

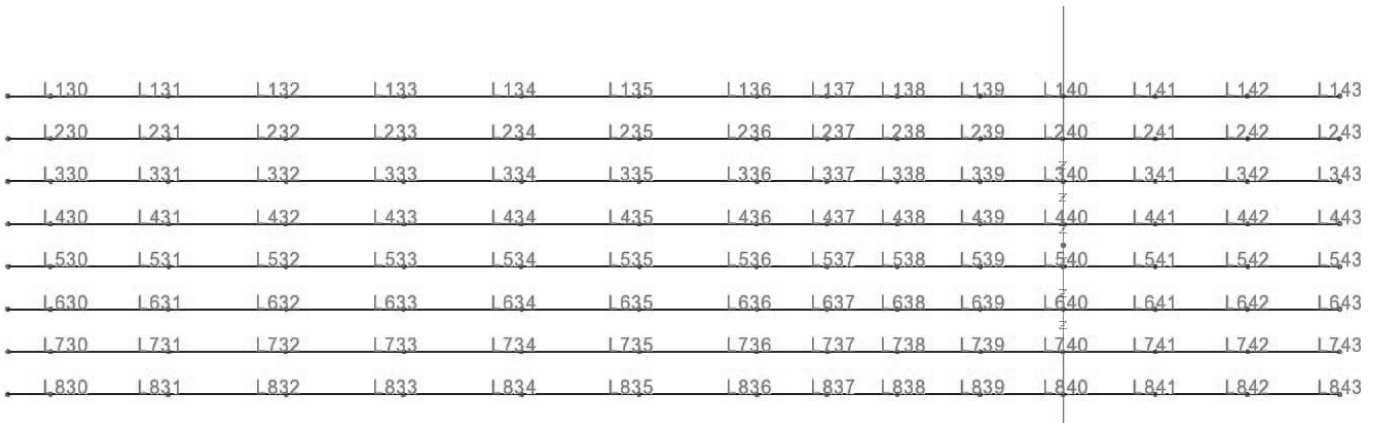


	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:22
		Date :	Created :

Casting stage 3 - Longitudinal beams (LB):

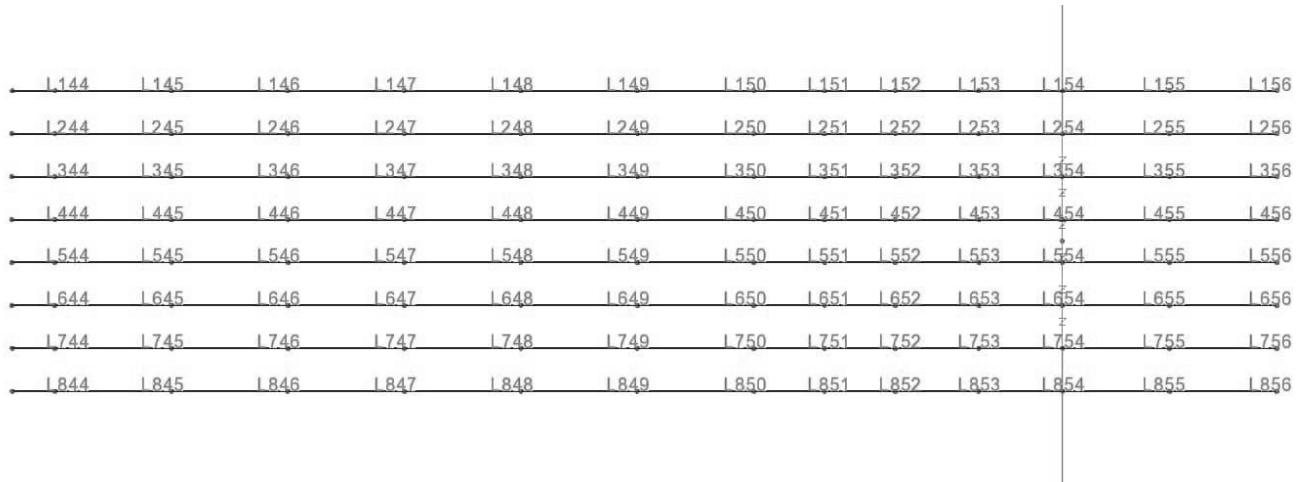


Casting stage 4 - Longitudinal beams (LB):

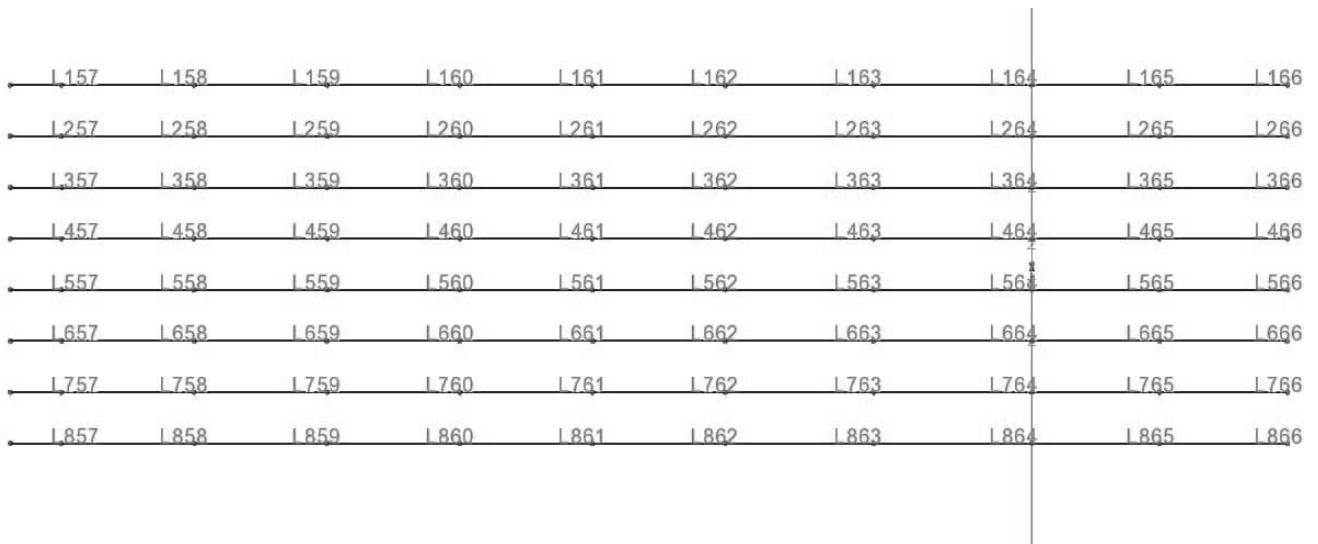


	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:23
		Date :	Created :

Casting stage 5 - Longitudinal beams (LB):

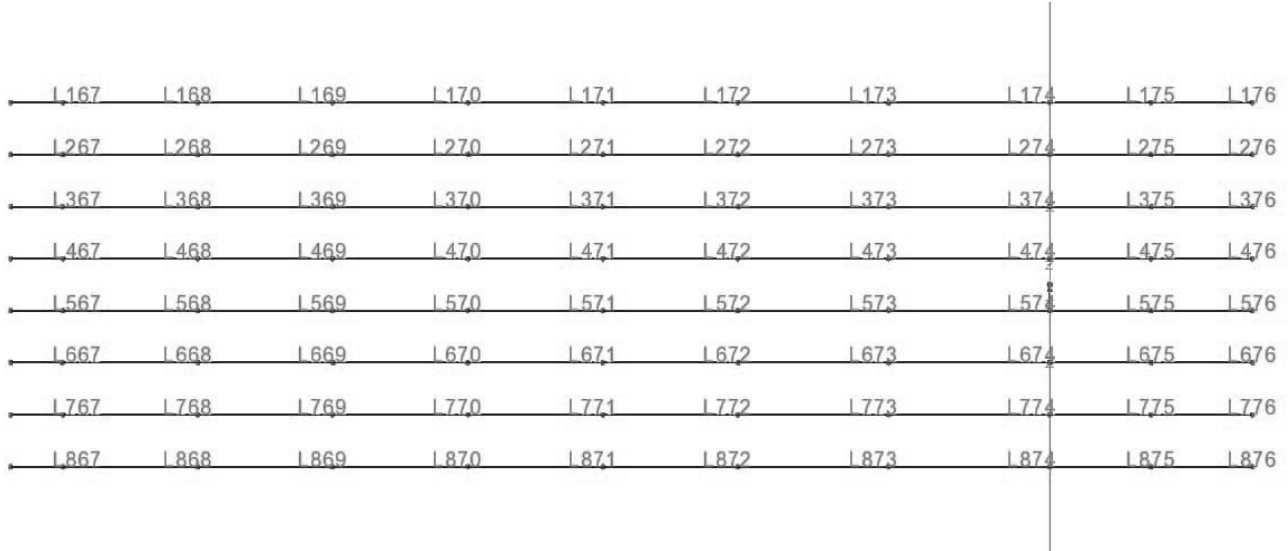


Casting stage 6 - Longitudinal beams (LB):



	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:24
		Date :	Created :

Casting stage 7 - Longitudinal beams (LB):

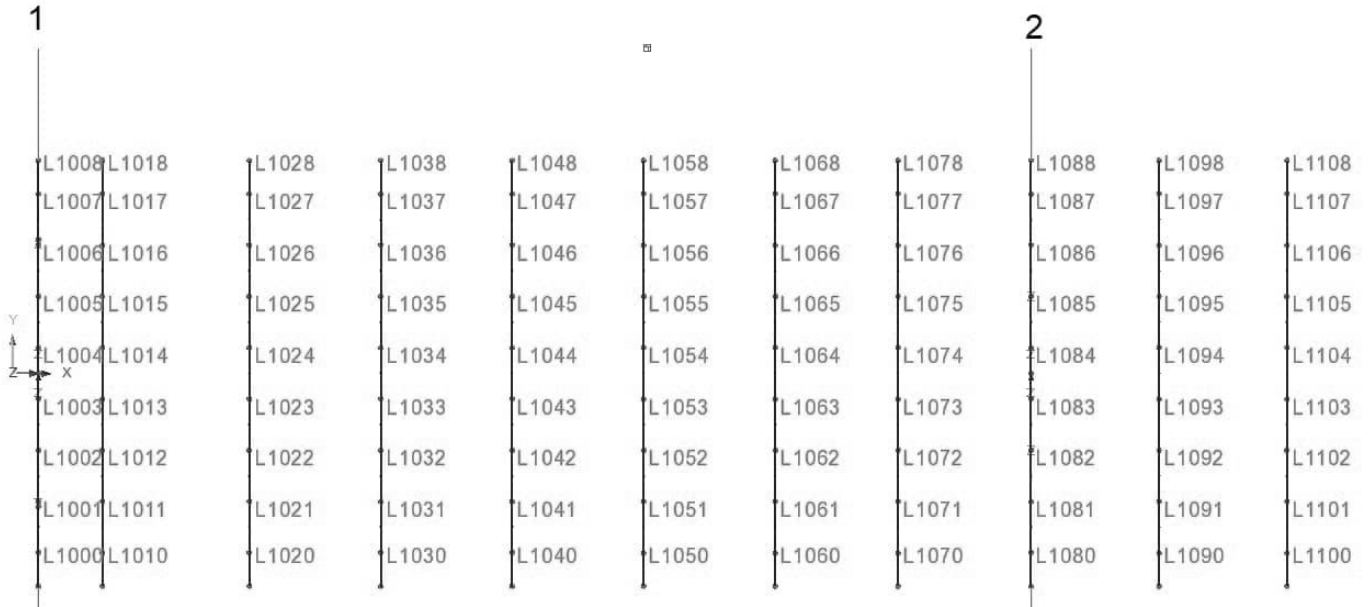


Casting stage 8 - Longitudinal beams (LB):

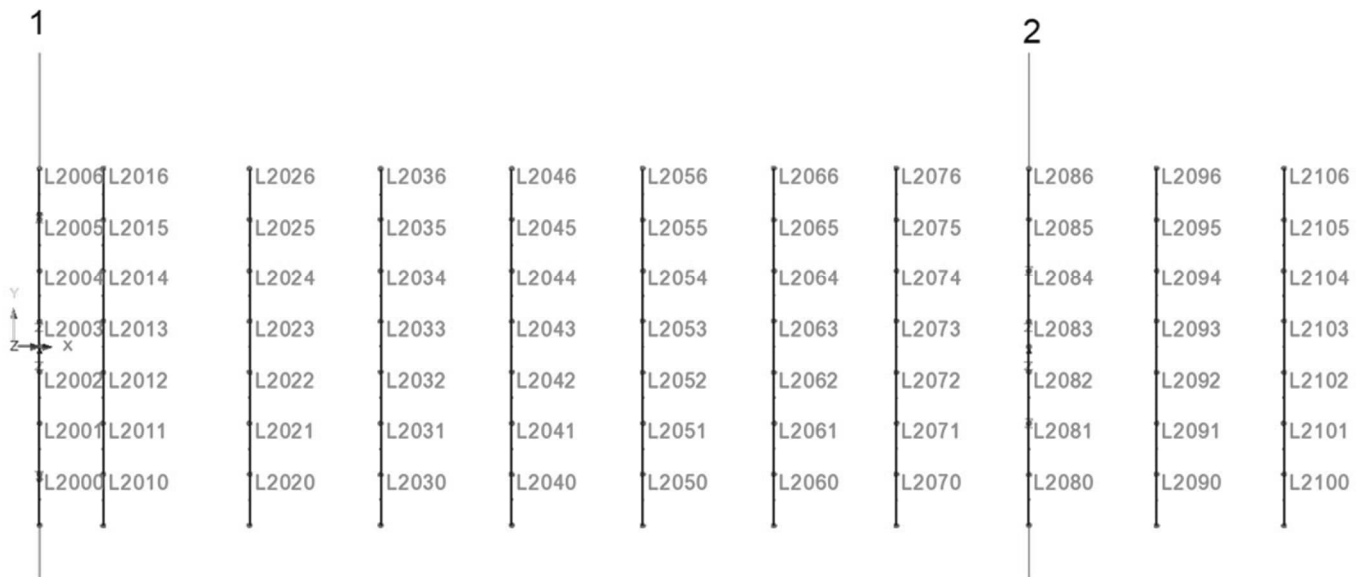


	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:25
	Pretensioned slab bridge: hollow deck	Date :	Created :

Casting stage 1 - Transversal beams OK (TB-OK) & Edge beams (EB):

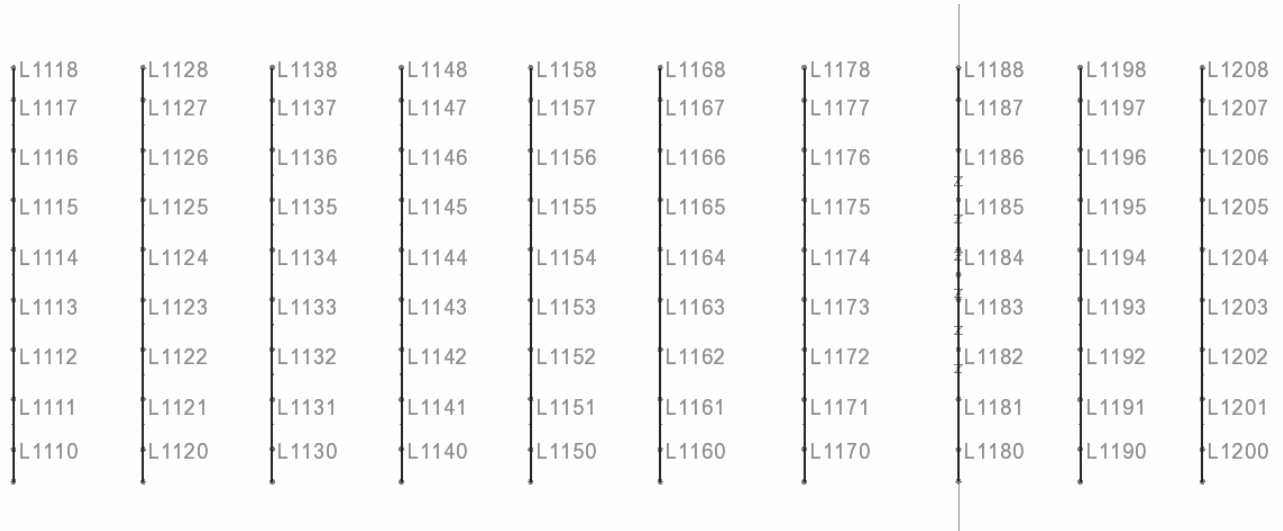


Casting stage 1 - Transversal beams UK (TB-UK):

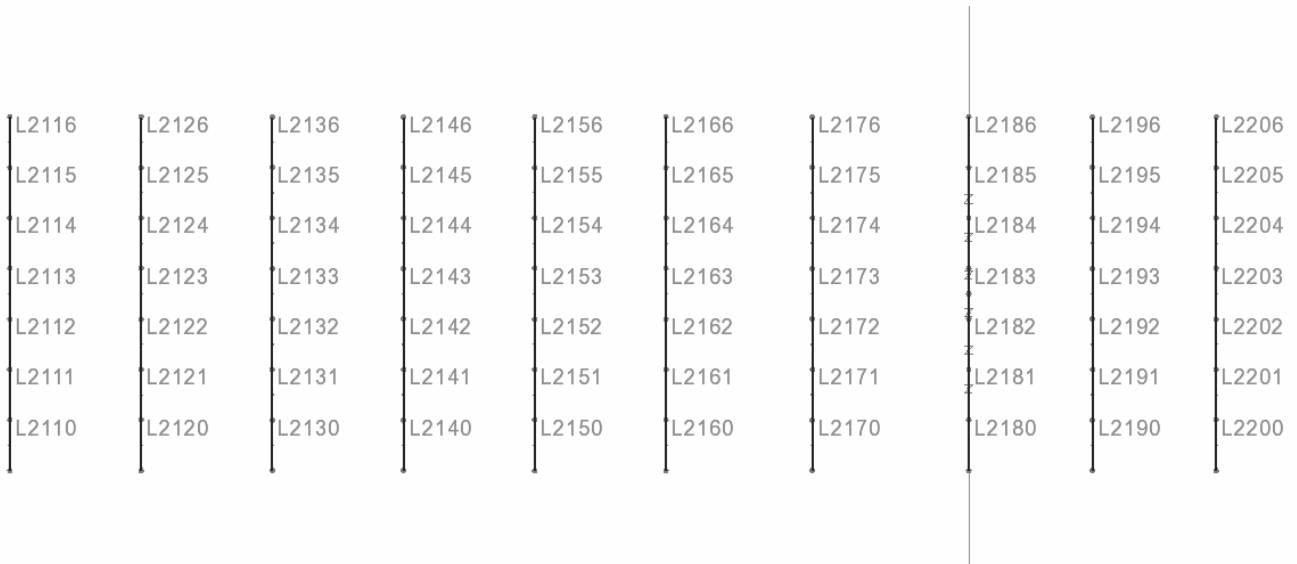


	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:26
	Pretensioned slab bridge: hollow deck	Date :	Created :

Casting stage 2 - Transversal beams OK (TB-OK) & Edge beams (EB):

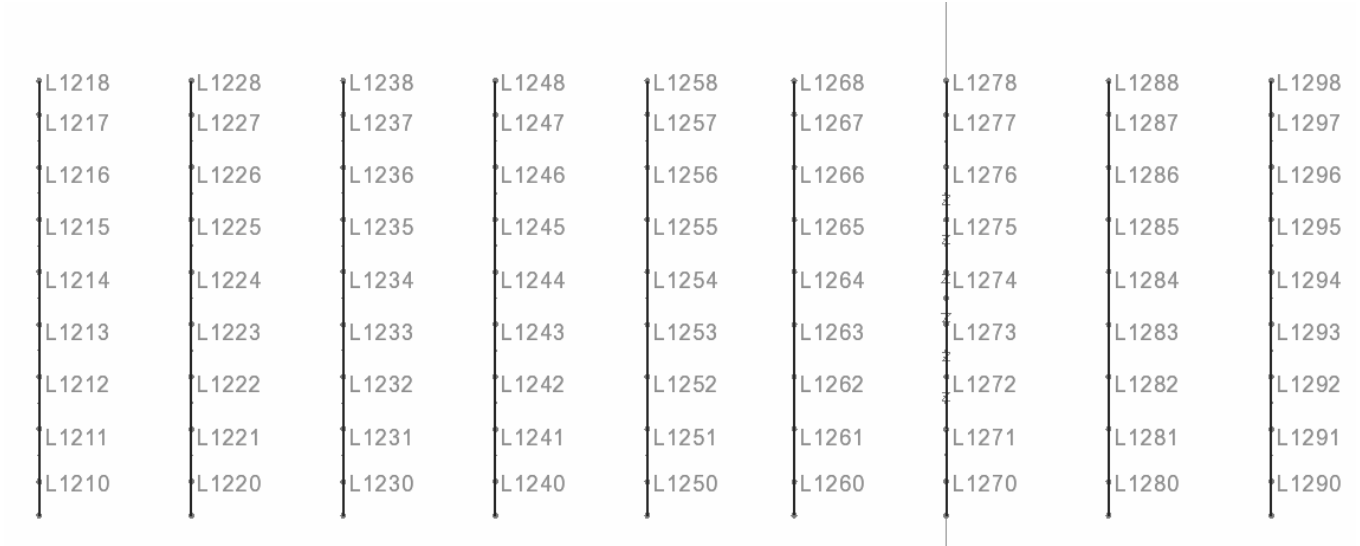


Casting stage 2 - Transversal beams UK (TB-UK):

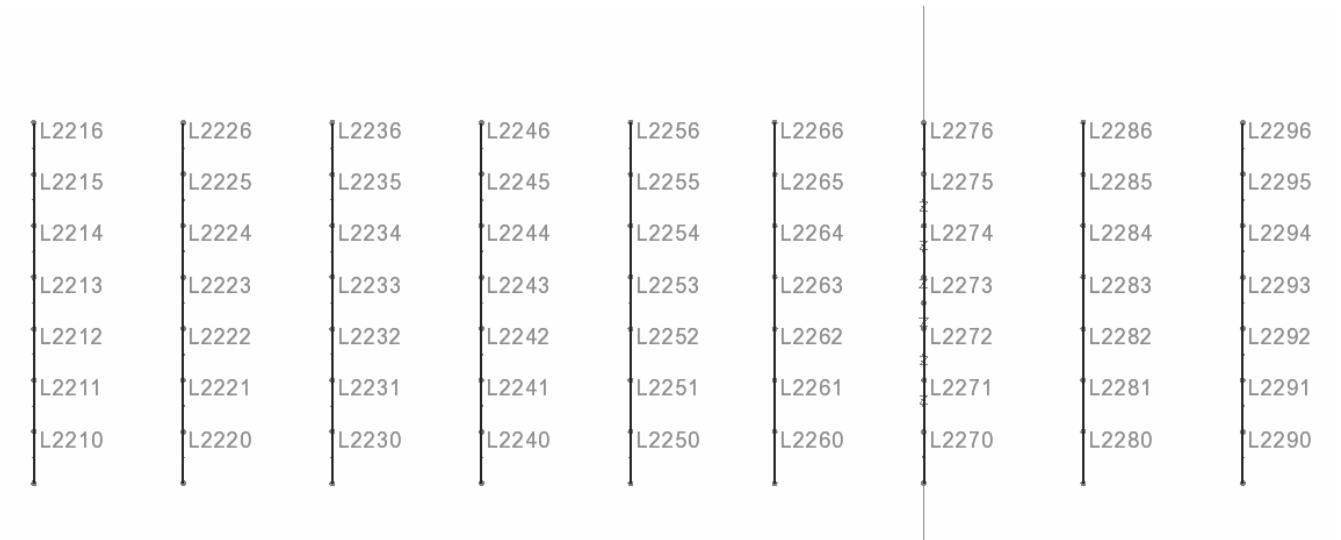


	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:27
		Date :	Created :

Casting stage 3 - Transversal beams OK (TB-OK) & Edge beams (EB):



Casting stage 3 - Transversal beams UK (TB-UK):



	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:28
		Date :	Created :

Casting stage 4 - Transversal beams OK (TB-OK) & Edge beams (EB):

L1308	L1318	L1328	L1338	L1348	L1358	L1368	L1378	L1388	L1398	L1408	L1418	L1428	L1438
L1307	L1317	L1327	L1337	L1347	L1357	L1367	L1377	L1387	L1397	L1407	L1417	L1427	L1437
L1306	L1316	L1326	L1336	L1346	L1356	L1366	L1376	L1386	L1396	L1406	L1416	L1426	L1436
L1305	L1315	L1325	L1335	L1345	L1355	L1365	L1375	L1385	L1395	L1405	L1415	L1425	L1435
L1304	L1314	L1324	L1334	L1344	L1354	L1364	L1374	L1384	L1394	L1404	L1414	L1424	L1434
L1303	L1313	L1323	L1333	L1343	L1353	L1363	L1373	L1383	L1393	L1403	L1413	L1423	L1433
L1302	L1312	L1322	L1332	L1342	L1352	L1362	L1372	L1382	L1392	L1402	L1412	L1422	L1432
L1301	L1311	L1321	L1331	L1341	L1351	L1361	L1371	L1381	L1391	L1401	L1411	L1421	L1431
L1300	L1310	L1320	L1330	L1340	L1350	L1360	L1370	L1380	L1390	L1400	L1410	L1420	L1430

Casting stage 4 - Transversal beams UK (TB-UK):

L2306	L2316	L2326	L2336	L2346	L2356	L2366	L2376	L2386	L2396	L2406	L2416	L2426	L2436
L2305	L2315	L2325	L2335	L2345	L2355	L2365	L2375	L2385	L2395	L2405	L2415	L2425	L2435
L2304	L2314	L2324	L2334	L2344	L2354	L2364	L2374	L2384	L2394	L2404	L2414	L2424	L2434
L2303	L2313	L2323	L2333	L2343	L2353	L2363	L2373	L2383	L2393	L2403	L2413	L2423	L2433
L2302	L2312	L2322	L2332	L2342	L2352	L2362	L2372	L2382	L2392	L2402	L2412	L2422	L2432
L2301	L2311	L2321	L2331	L2341	L2351	L2361	L2371	L2381	L2391	L2401	L2411	L2421	L2431
L2300	L2310	L2320	L2330	L2340	L2350	L2360	L2370	L2380	L2390	L2400	L2410	L2420	L2430

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:29
		Date :	Created :

Casting stage 5 - Transversal beams OK (TB-OK) & Edge beams (EB):

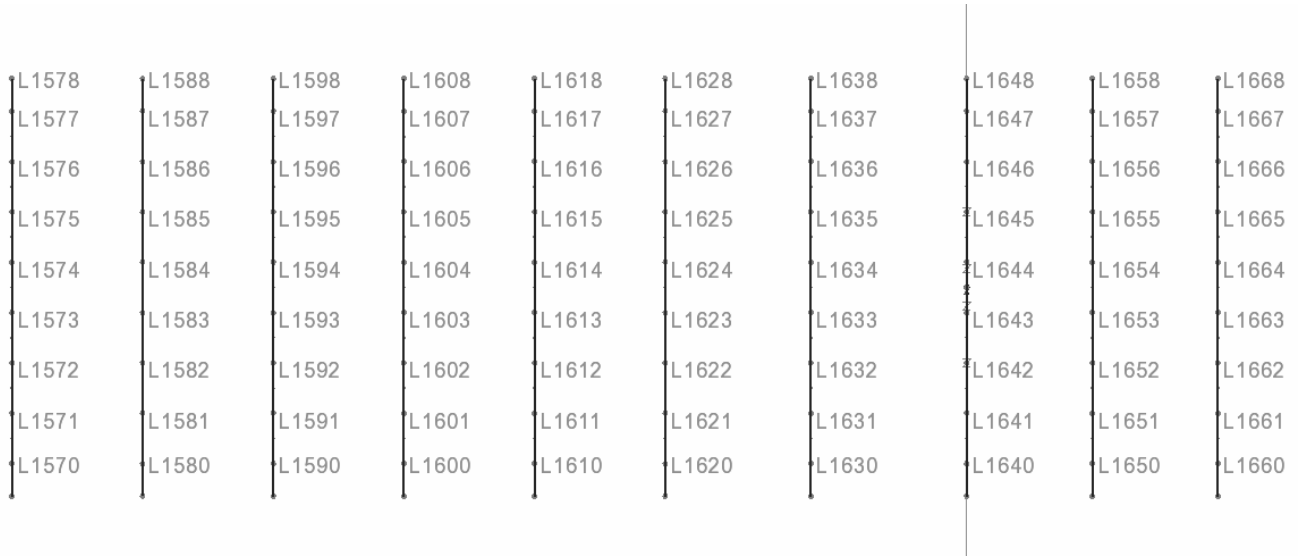
L1448	L1458	L1468	L1478	L1488	L1498	L1508	L1518	L1528	L1538	L1548	L1558	L1568
L1447	L1457	L1467	L1477	L1487	L1497	L1507	L1517	L1527	L1537	L1547	L1557	L1567
L1446	L1456	L1466	L1476	L1486	L1496	L1506	L1516	L1526	L1536	L1546	L1556	L1566
L1445	L1455	L1465	L1475	L1485	L1495	L1505	L1515	L1525	L1535	L1545	L1555	L1565
L1444	L1454	L1464	L1474	L1484	L1494	L1504	L1514	L1524	L1534	L1544	L1554	L1564
L1443	L1453	L1463	L1473	L1483	L1493	L1503	L1513	L1523	L1533	L1543	L1553	L1563
L1442	L1452	L1462	L1472	L1482	L1492	L1502	L1512	L1522	L1532	L1542	L1552	L1562
L1441	L1451	L1461	L1471	L1481	L1491	L1501	L1511	L1521	L1531	L1541	L1551	L1561
L1440	L1450	L1460	L1470	L1480	L1490	L1500	L1510	L1520	L1530	L1540	L1550	L1560

Casting stage 5 - Transversal beams UK (TB-UK):

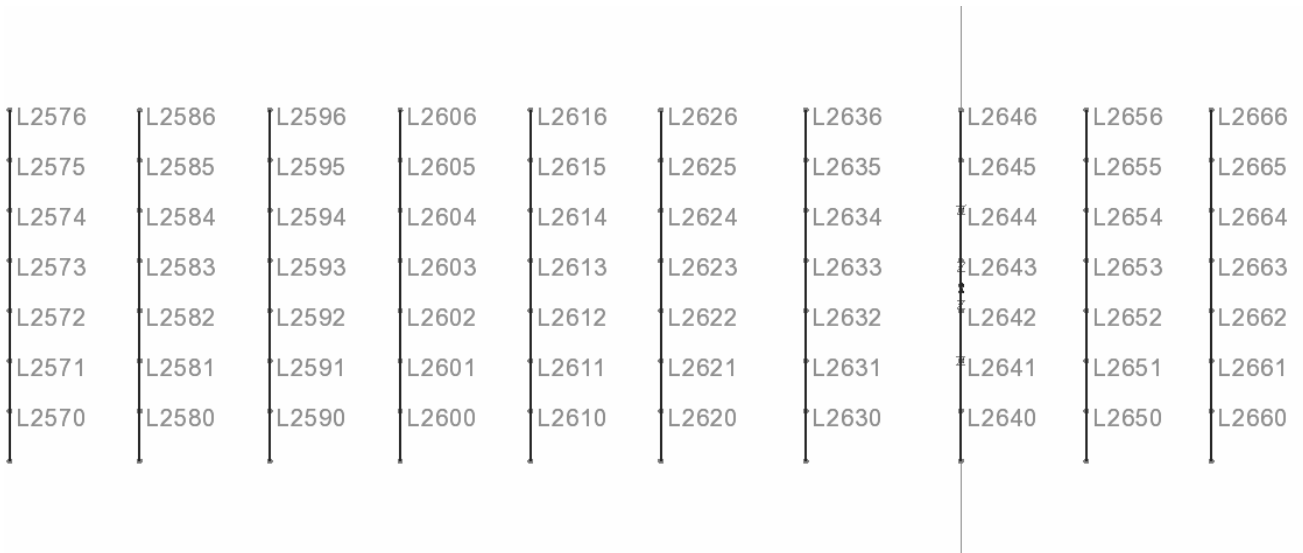
L2446	L2456	L2466	L2476	L2486	L2496	L2506	L2516	L2526	L2536	L2546	L2556	L2566
L2445	L2455	L2465	L2475	L2485	L2495	L2505	L2515	L2525	L2535	L2545	L2555	L2565
L2444	L2454	L2464	L2474	L2484	L2494	L2504	L2514	L2524	L2534	L2544	L2554	L2564
L2443	L2453	L2463	L2473	L2483	L2493	L2503	L2513	L2523	L2533	L2543	L2553	L2563
L2442	L2452	L2462	L2472	L2482	L2492	L2502	L2512	L2522	L2532	L2542	L2552	L2562
L2441	L2451	L2461	L2471	L2481	L2491	L2501	L2511	L2521	L2531	L2541	L2551	L2561
L2440	L2450	L2460	L2470	L2480	L2490	L2500	L2510	L2520	L2530	L2540	L2550	L2560

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:30
	Pretensioned slab bridge: hollow deck	Date :	Created :

Casting stage 6 - Transversal beams OK (TB-OK) & Edge beams (EB):



Casting stage 6 - Transversal beams UK (TB-UK):

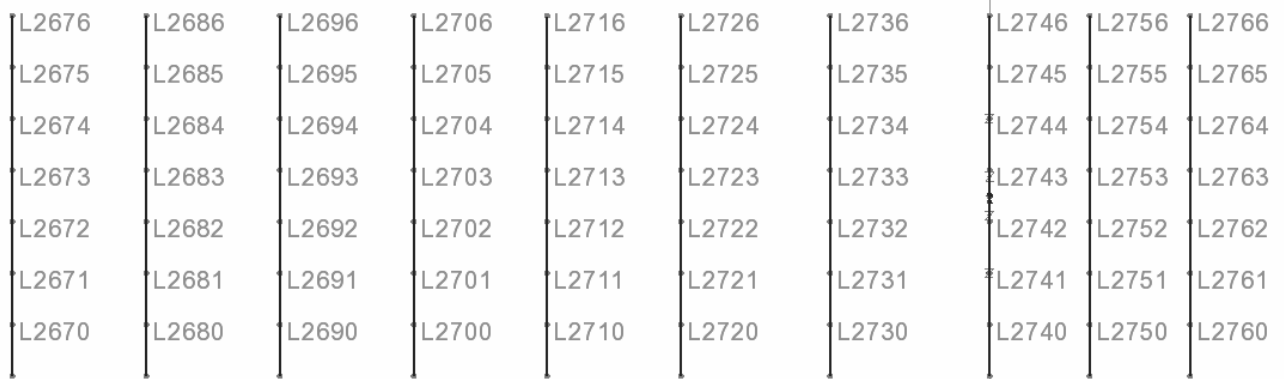


	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:31
		Date :	Created :

Casting stage 7 - Transversal beams OK (TB-OK) & Edge beams (EB):

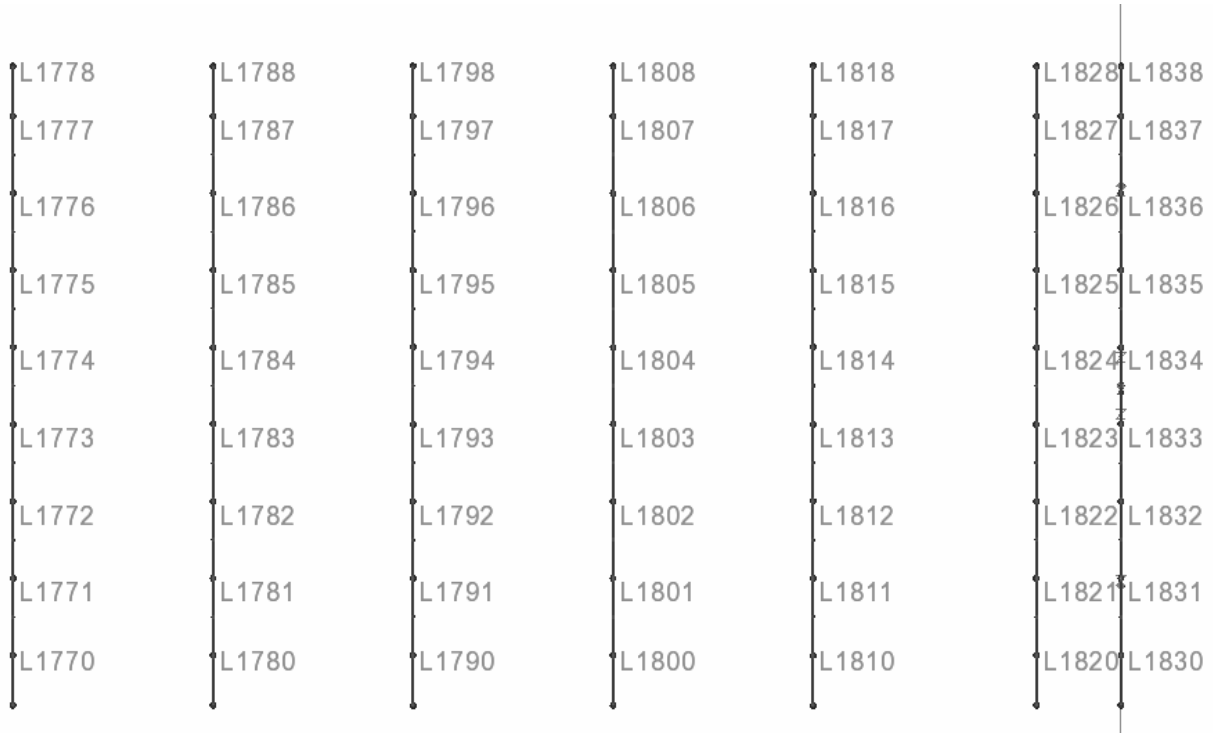


Casting stage 7 - Transversal beams UK (TB-UK):

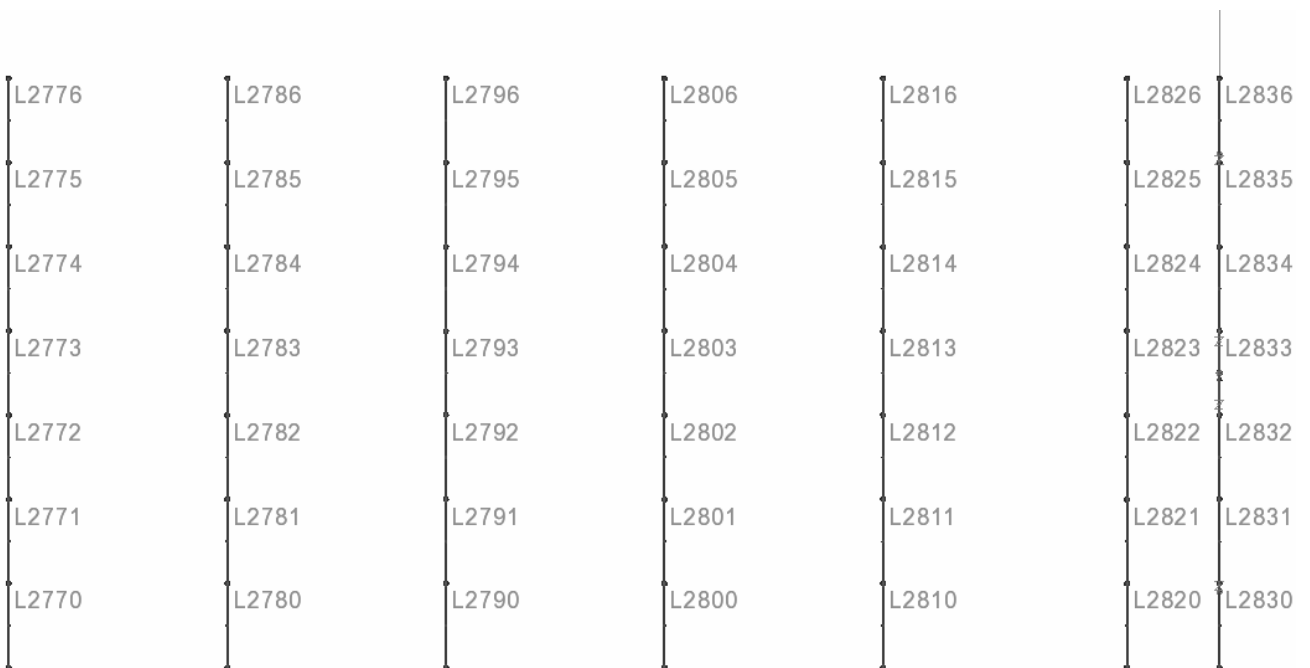


	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:32
	Pretensioned slab bridge: hollow deck	Date :	Created :

Casting stage 8 - Transversal beams OK (TB-OK) & Edge beams (EB):

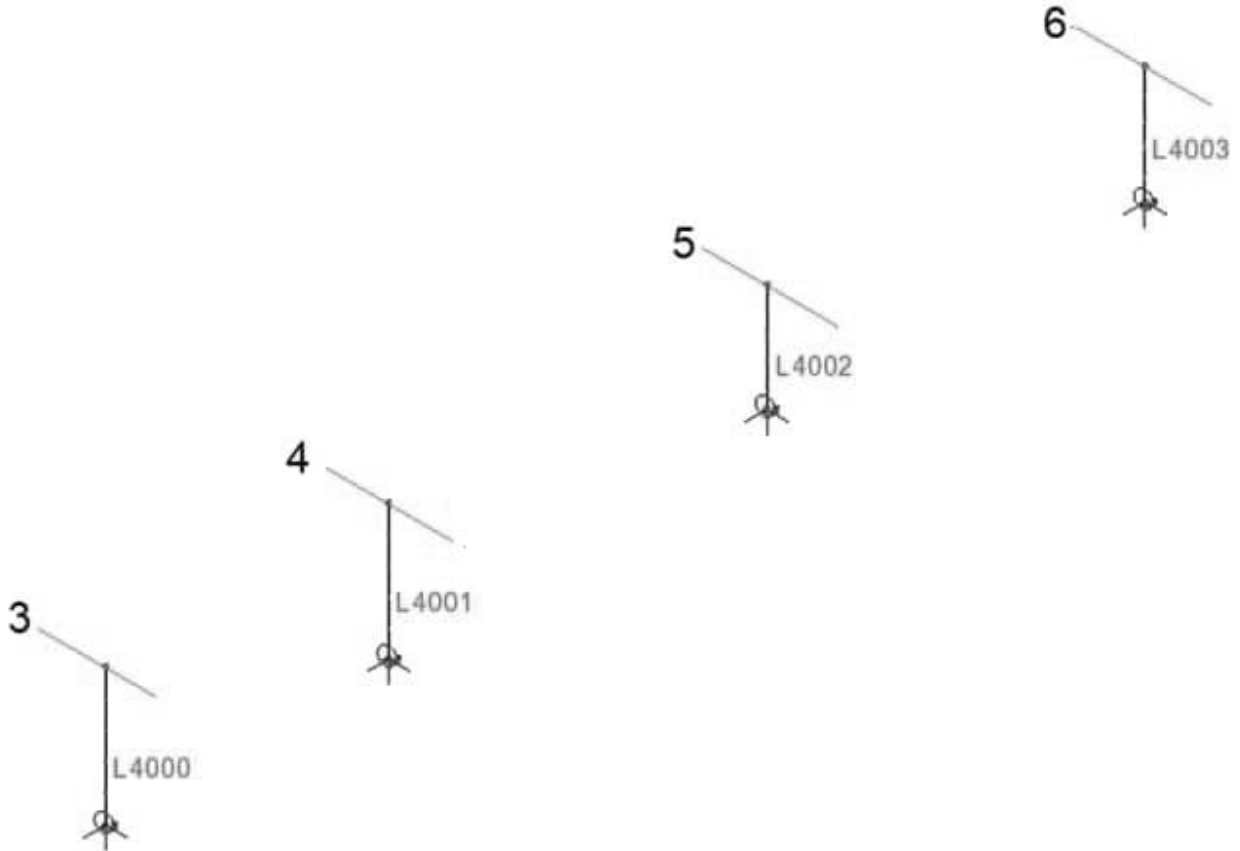


Casting stage 8 - Transversal beams UK (TB-UK):



	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:33
		Date :	Created :

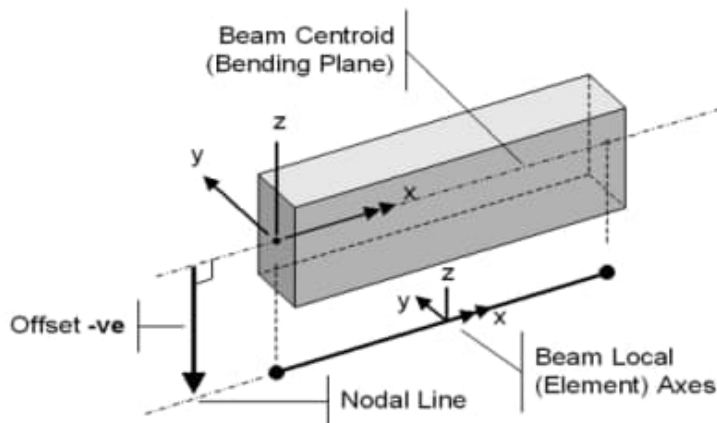
Columns: Supports 3-6



	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:34
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3 CROSS SECTION PROPERTIES

Principal sketch of geometry associated to 3D beam ("Thick beam" / BMS3) elements are seen below.



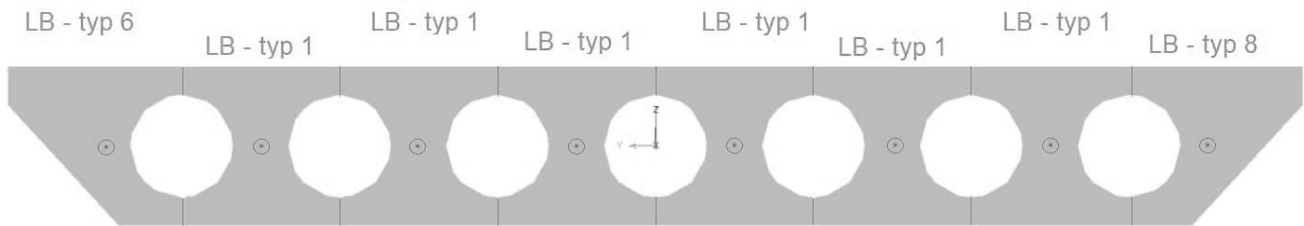
	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:35
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.1 Longitudinal beams (LB)

There are a total of 8 different types according to the reporting below.

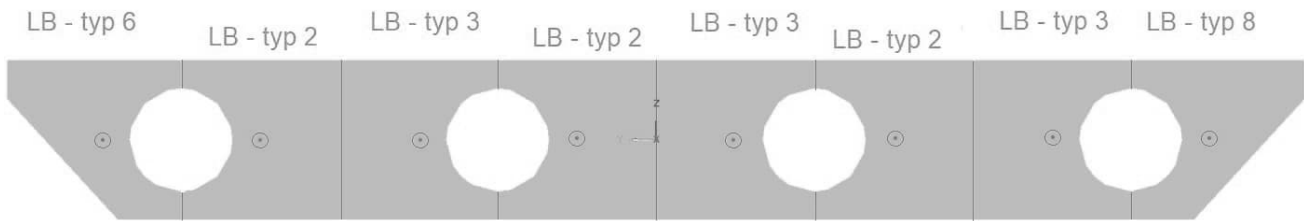
The main beams are defined with a cross-section labeled “Arbitrary Section.” Cross-section constants are determined using the function “*Section Property Calculator.*”

In order to avoid torsion in the beam, a fictitious torsional stiffness corresponding to $K_v = 10^{-6} \text{ m}^4$ is manually introduced.



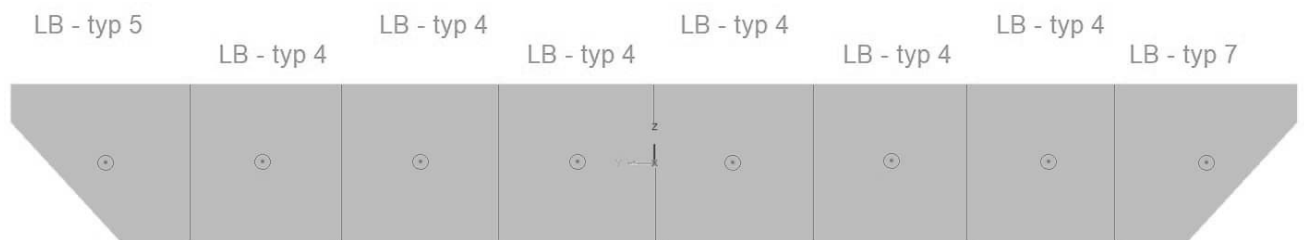
TYPE SECTION 1

Cross section with 8 void tubes.



TYPE SECTION 2

Cross section with 4 void tubes.

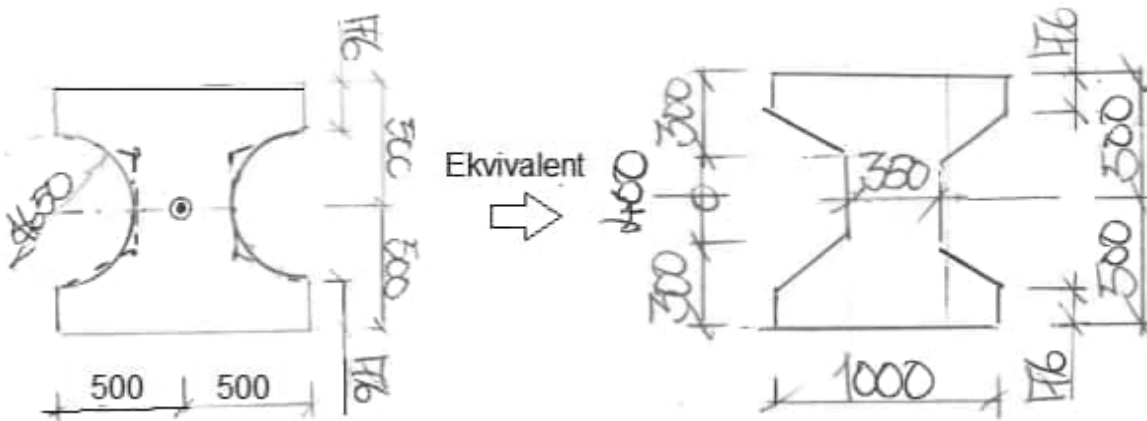


TYPE SECTION 3

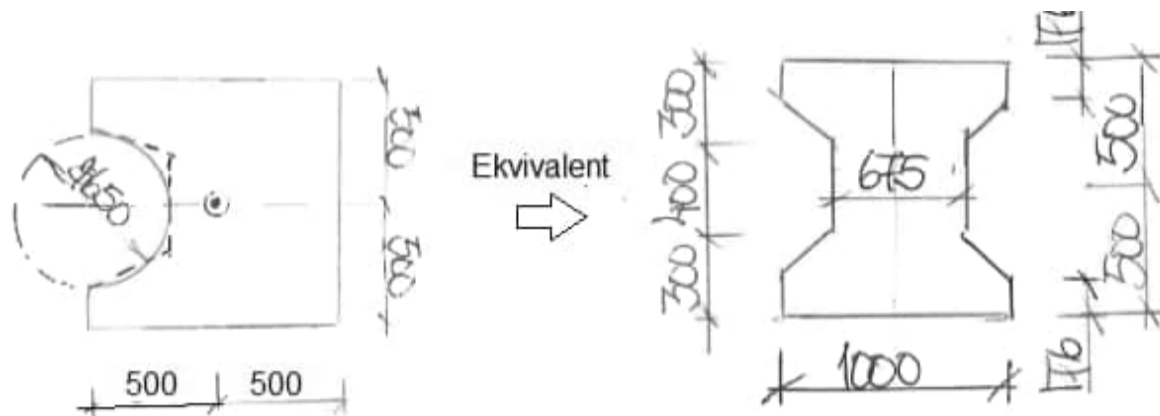
Massive cross section.

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:36
	Pretensioned slab bridge: hollow deck	Date :	Created :

The geometry of these beams is presented below. In the check of resistance, however, simplified equivalent cross sections are applied.

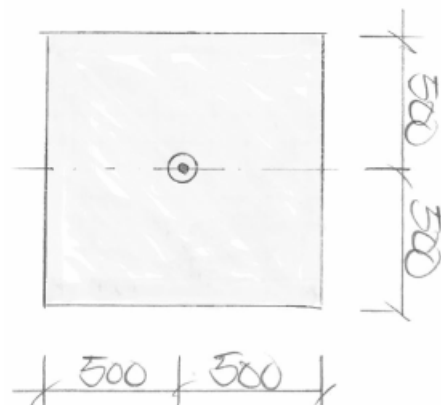


LB – type 1



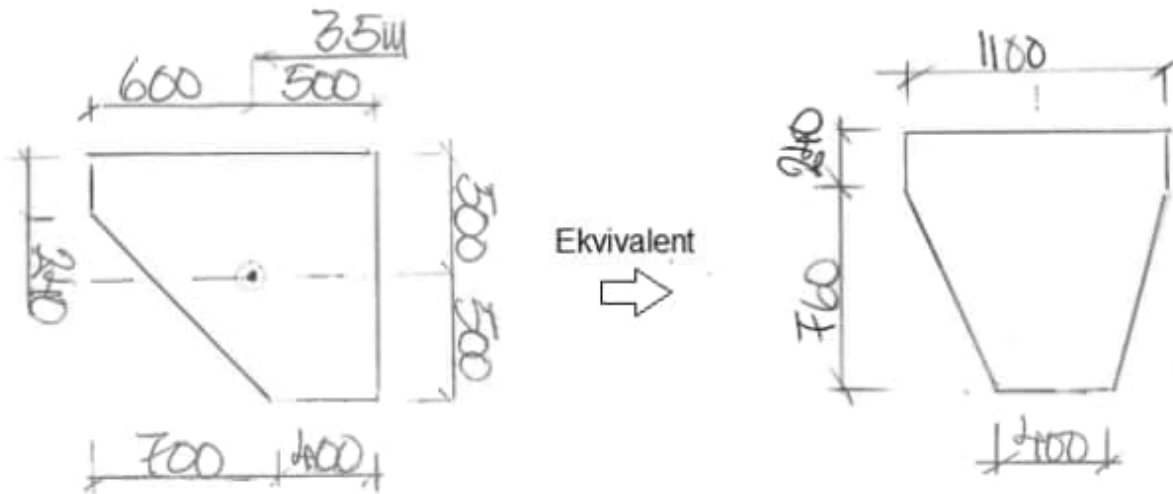
LB – type 2

Measurements same for LB – typ 3



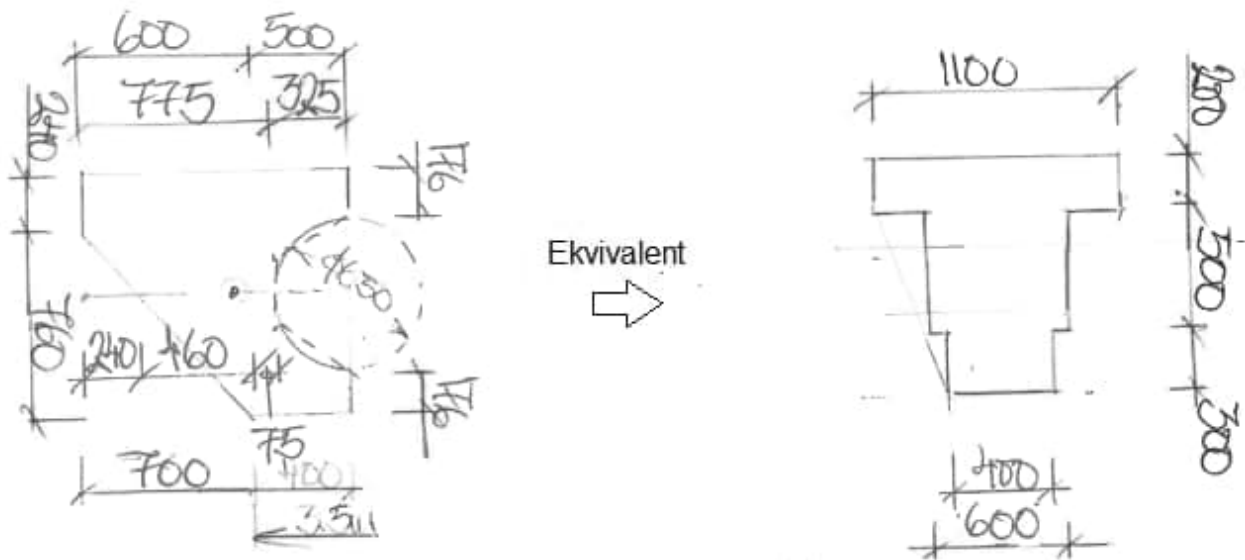
LB – type 4

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:37
	Pretensioned slab bridge: hollow deck	Date :	Created :



LB – type 5

Measurements same as LB – typ 7

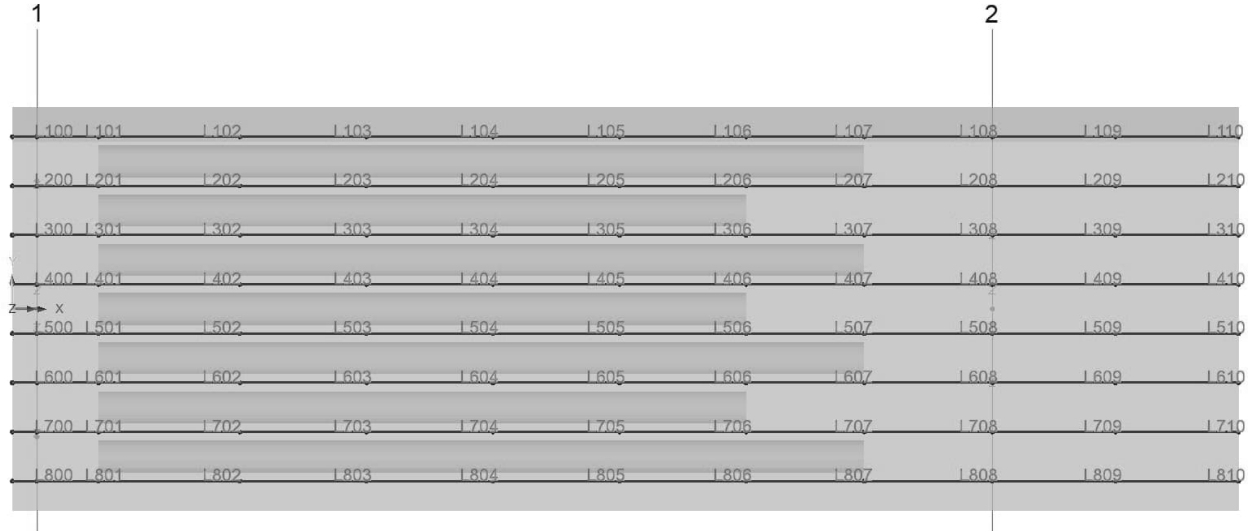


LB – type 6

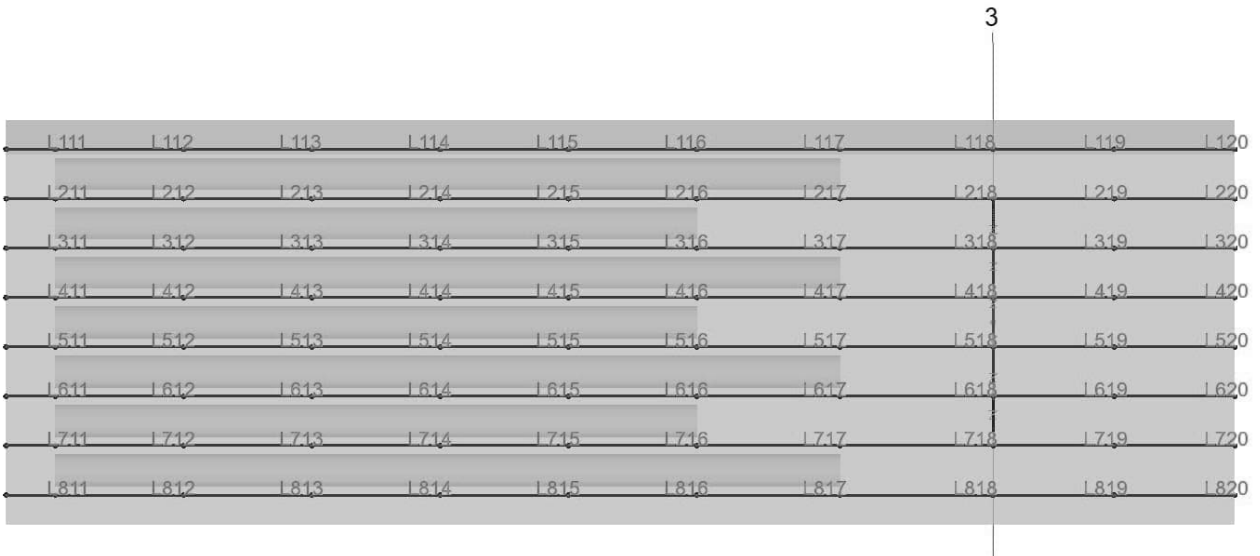
Measurements as LB – type 8

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:38
	Pretensioned slab bridge: hollow deck	Date :	Created :

Casting stage 1 - Longitudinal beams (LB):



Casting stage 2 - Longitudinal beams (LB):



	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:39
	Pretensioned slab bridge: hollow deck	Date :	Created :

Casting stage 3 - Longitudinal beams (LB):

4

1.121	1.122	1.123	1.124	1.125	1.126	1.127	1.128	1.129
1.221	1.222	1.223	1.224	1.225	1.226	1.227	1.228	1.229
1.321	1.322	1.323	1.324	1.325	1.326	1.327	1.328	1.329
1.421	1.422	1.423	1.424	1.425	1.426	1.427	1.428	1.429
1.521	1.522	1.523	1.524	1.525	1.526	1.527	1.528	1.529
1.621	1.622	1.623	1.624	1.625	1.626	1.627	1.628	1.629
1.721	1.722	1.723	1.724	1.725	1.726	1.727	1.728	1.729
1.821	1.822	1.823	1.824	1.825	1.826	1.827	1.828	1.829

Casting stage 4 - Longitudinal beams (LB):

5

1.130	1.131	1.132	1.133	1.134	1.135	1.136	1.137	1.138	1.139	1.140	1.141	1.142	1.143
1.230	1.231	1.232	1.233	1.234	1.235	1.236	1.237	1.238	1.239	1.240	1.241	1.242	1.243
1.330	1.331	1.332	1.333	1.334	1.335	1.336	1.337	1.338	1.339	1.340	1.341	1.342	1.343
1.430	1.431	1.432	1.433	1.434	1.435	1.436	1.437	1.438	1.439	1.440	1.441	1.442	1.443
1.530	1.531	1.532	1.533	1.534	1.535	1.536	1.537	1.538	1.539	1.540	1.541	1.542	1.543
1.630	1.631	1.632	1.633	1.634	1.635	1.636	1.637	1.638	1.639	1.640	1.641	1.642	1.643
1.730	1.731	1.732	1.733	1.734	1.735	1.736	1.737	1.738	1.739	1.740	1.741	1.742	1.743
1.830	1.831	1.832	1.833	1.834	1.835	1.836	1.837	1.838	1.839	1.840	1.841	1.842	1.843

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:40
		Date :	Created :

Casting stage 5 - Longitudinal beams (LB):

6

L144	L145	L146	L147	L148	L149	L150	L151	L152	L153	L154	L155	L156
L244	L245	L246	L247	L248	L249	L250	L251	L252	L253	L254	L255	L256
L344	L345	L346	L347	L348	L349	L350	L351	L352	L353	L354	L355	L356
L444	L445	L446	L447	L448	L449	L450	L451	L452	L453	L454	L455	L456
L544	L545	L546	L547	L548	L549	L550	L551	L552	L553	L554	L555	L556
L644	L645	L646	L647	L648	L649	L650	L651	L652	L653	L654	L655	L656
L744	L745	L746	L747	L748	L749	L750	L751	L752	L753	L754	L755	L756
L844	L845	L846	L847	L848	L849	L850	L851	L852	L853	L854	L855	L856

Casting stage 6 - Longitudinal beams (LB):

7

L157	L158	L159	L160	L161	L162	L163	L164	L165	L166
L257	L258	L259	L260	L261	L262	L263	L264	L265	L266
L357	L358	L359	L360	L361	L362	L363	L364	L365	L366
L457	L458	L459	L460	L461	L462	L463	L464	L465	L466
L557	L558	L559	L560	L561	L562	L563	L564	L565	L566
L657	L658	L659	L660	L661	L662	L663	L664	L665	L666
L757	L758	L759	L760	L761	L762	L763	L764	L765	L766
L857	L858	L859	L860	L861	L862	L863	L864	L865	L866

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:41
		Date :	Created :

Casting stage 7 - Longitudinal beams (LB):

8

1.167	1.168	1.169	1.170	1.171	1.172	1.173	1.174	1.175	1.176
1.267	1.268	1.269	1.270	1.271	1.272	1.273	1.274	1.275	1.276
1.367	1.368	1.369	1.370	1.371	1.372	1.373	1.374	1.375	1.376
1.467	1.468	1.469	1.470	1.471	1.472	1.473	1.474	1.475	1.476
1.567	1.568	1.569	1.570	1.571	1.572	1.573	1.574	1.575	1.576
1.667	1.668	1.669	1.670	1.671	1.672	1.673	1.674	1.675	1.676
1.767	1.768	1.769	1.770	1.771	1.772	1.773	1.774	1.775	1.776
1.867	1.868	1.869	1.870	1.871	1.872	1.873	1.874	1.875	1.876

Casting stage 8 - Longitudinal beams (LB):

9

1.177	1.178	1.179	1.180	1.181	1.182	1.183	1.184
1.277	1.278	1.279	1.280	1.281	1.282	1.283	1.284
1.377	1.378	1.379	1.380	1.381	1.382	1.383	1.384
1.477	1.478	1.479	1.480	1.481	1.482	1.483	1.484
1.577	1.578	1.579	1.580	1.581	1.582	1.583	1.584
1.677	1.678	1.679	1.680	1.681	1.682	1.683	1.684
1.777	1.778	1.779	1.780	1.781	1.782	1.783	1.784
1.877	1.878	1.879	1.880	1.881	1.882	1.883	1.884

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:42
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.1.1 LB – Type 1

Punkt	y	z
A1	-0.500	0.500
A2	0.500	0.500
A3	0.500	-0.500
A4	-0.500	-0.500
A5	0.175	0
-	m	m

Punkt	y	z
A6	-0.175	0
A7	0.500	0.325
A8	-0.500	0.325
A9	0.500	-0.325
A10	-0.500	-0.325
-		

Analysis category: 3D

Definition

From library / calculator
 Rotation about centroid: 0
 Mirrored about axis: None

Enter properties
 Usage: 3D Thick Beam (Any beam)

Reinforcement (only used for RC design checks): None

ez origin: Centroid, ey origin: Same as e:

Property	Value
Cross sectional area (A)	0.66817
Second moment of area about y axis (Iyy)	0.0745729
Second moment of area about z axis (Izz)	0.0373876
Product moment of area (Iyz)	-62.5131E-15
Torsional constant (J)	1,0E-6
Effective shear area in y direction (Asy)	0.544981
Effective shear area in z direction (Asz)	0.353281
Eccentricity in y direction (ey)	0.0
Eccentricity in z direction (ez)	0.0

Visualise... Tapering >> Section details...

Name: LB - Typ 1 (5)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:43
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.1.2 LB – Type 2

Punkt	y	z
A1	-0.428	0.500
A2	0.572	0.500
A3	0.572	-0.500
A4	-0.428	-0.500
-	m	m

Punkt	y	z
A5	0.572	0.325
A6	0.572	-0.325
A7	0.247	0
-	m	m

Analysis category: 3D

Definition

From library / calculator
Rotation about centroid: 0
Mirrored about axis: None

Enter properties
Usage: 3D Thick Beam (Any beam)

Reinforcement (only used for RC design checks): None

ez origin: Centroid ey origin: Same as e:

	Value
Cross sectional area (A)	0,834085
Second moment of area about y axis (Iyy)	0,078953
Second moment of area about z axis (Izz)	0,0560347
Product moment of area (Iyz)	2,06602E-12
Torsional constant (J)	1,0E-6
Effective shear area in y direction (Asy)	0,691516
Effective shear area in z direction (Asz)	0,558568
Eccentricity in y direction (ey)	0,072
Eccentricity in z direction (ez)	0,0

Buttons: Visualise... Tapering >> Section details...

Arbitrary Sections

6:LB - Typ 2

Name: LB - Typ 2 (6)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:44
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.1.3 LB – Type 3

Punkt	y	z
A1	-0.572	0.500
A2	0.428	0.500
A3	0.428	-0.500
A4	-0.572	-0.500
-	m	m

Punkt	y	z
A5	-0.572	0.325
A6	-0.572	-0.325
A7	-0.247	0
-	m	m

Analysis category: 3D

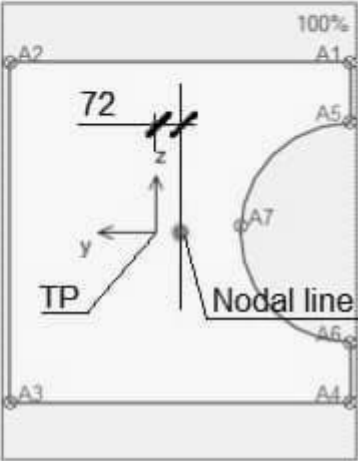
Definition

From library / calculator
 Rotation about centroid: 0
 Mirrored about axis: None

Enter properties
 Usage: 3D Thick Beam (Any beam)

Reinforcement (only used for RC design checks): None

ez origin: Centroid, ey origin: Same as e.



	Value
Cross sectional area (A)	0.834085
Second moment of area about y axis (Iyy)	0.0789532
Second moment of area about z axis (Izz)	0.056035
Product moment of area (Iyz)	-0.551257E-12
Torsional constant (J)	1.0E-6
Effective shear area in y direction (Asy)	0.691558
Effective shear area in z direction (Asz)	0.55857
Eccentricity in y direction (ey)	-0.072
Eccentricity in z direction (ez)	0.0

Buttons: Visualise..., Tapering >>, Section details...

Name: LB - Typ 3 (7)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:45
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.1.4 LB – Type 4

Punkt	y	z
S1	-0.500	0.500
S2	0.500	0.500
S3	0.500	-0.500
S4	-0.500	-0.500
-	m	m

Analysis category: 3D

Definition

From library / calculator
 Rotation about centroid: 0
 Mirrored about axis: None

Enter properties
 Usage: 3D Thick Beam (Any beam)

Reinforcement (only used for RC design checks): None

ez origin: Centroid | ey origin: Same as e:

	Value
Cross sectional area (A)	1,0
Second moment of area about y axis (Iyy)	0,0833333
Second moment of area about z axis (Izz)	0,0833333
Product moment of area (Iyz)	0,0
Torsional constant (J)	1,0E-6
Effective shear area in y direction (Asy)	0,833423
Effective shear area in z direction (Asz)	0,833423
Eccentricity in y direction (ey)	0,0
Eccentricity in z direction (ez)	0,0

Buttons: Visualise..., Tapering >>, Section details...

Name: LB - Typ 4 (45)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:46
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.1.5 LB – Type 5

Punkt	y	z
A1	-0.449	0.421
A2	0.651	0.421
A3	-0.049	-0.579
A4	-0.449	-0.579
A5	0.651	0.181
-	m	m

Analysis category: 3D

Definition

From library / calculator

Rotation about centroid: 0 °

Mirrored about axis: None

Enter properties

Usage: 3D Thick Beam (Any beam)

Arbitrary Sections: 8:LB - Typ 5

Reinforcement (only used for RC design checks): None

ez origin: Centroid, ey origin: Same as e:

Property	Value
Cross sectional area (A)	0,834
Second moment of area about y axis (Iyy)	0,0617844
Second moment of area about z axis (Izz)	0,0684942
Product moment of area (Iyz)	0,0234736
Torsional constant (J)	1,0E-6
Effective shear area in y direction (Asy)	0,658068
Effective shear area in z direction (Asz)	0,650074
Eccentricity in y direction (ey)	0,051
Eccentricity in z direction (ez)	-0,079

Buttons: Visualise..., Tapering >>, Section details...

Name: LB - Typ 5 (9)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:47
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.1.6 LB – Type 6

Punkt	y	z
A1	-0.526	0.402
A2	0.574	0.402
A3	-0.126	-0.598
A4	-0.526	-0.598
-	m	m

Punkt	y	z
A5	0.574	0.162
A6	-0.526	0.227
A7	-0.526	-0.423
-	m	m

Analysis category: 3D

Definition

From library / calculator

Rotation about centroid: 0

Mirrored about axis: None

Enter properties

Usage: 3D Thick Beam (Any beam)

Reinforcement (only used for RC design checks): None

ez origin: Centroid | ey origin: Same as e:

Cross sectional area (A)	0,668086
Second moment of area about y axis (Iyy)	0,0561226
Second moment of area about z axis (Izz)	0,0472308
Product moment of area (Iyz)	0,0184055
Torsional constant (J)	1,0E-6
Effective shear area in y direction (Asy)	0,50467
Effective shear area in z direction (Asz)	0,365593
Eccentricity in y direction (ey)	-0,026
Eccentricity in z direction (ez)	-0,098

Buttons: Visualise... | Tapering >> | Section details...

EU Sections

HE Shapes (EN53-62)

HE 1000 M

Value
0,668086
0,0561226
0,0472308
0,0184055
1,0E-6
0,50467
0,365593
-0,026
-0,098

Name: LB - Typ 6 (10)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:48
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.1.7 LB – Type 7

Punkt	y	Z
A1	-0.449	0.421
A2	0.651	0.421
A3	-0.049	-0.579
A4	-0.449	-0.579
A5	0.651	0.181
-	m	m

Analysis category: 3D

Definition

From library / calculator
 Rotation about centroid: 0 °
 Mirrored about axis: None

Enter properties
 Usage: 3D Thick Beam (Any beam)

Arbitrary Sections

11:LB - Typ 7

Reinforcement (only used for RC design checks): None

ez origin: Centroid, ey origin: Same as e.

	Value
Cross sectional area (A)	0.834
Second moment of area about y axis (Iyy)	0.0617844
Second moment of area about z axis (Izz)	0.0684942
Product moment of area (Iyz)	-0.0234736
Torsional constant (J)	1.0E-6
Effective shear area in y direction (Asy)	0.658068
Effective shear area in z direction (Asz)	0.650074
Eccentricity in y direction (ey)	-0.051
Eccentricity in z direction (ez)	-0.079

Visualise... Tapering >> Section details...

Name: LB - Typ 7 (11)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:49
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.1.8 LB – Type 8

Punkt	y	z
A1	-0.526	0.402
A2	0.574	0.402
A3	-0.126	-0.598
A4	-0.526	-0.598
-	m	m

Punkt	y	z
A5	0.574	0.162
A6	-0.526	0.227
A7	-0.526	-0.423
-	m	m

Analysis category: 3D

Definition

From library / calculator
 Rotate about centroid: 0
 Mirrored about axis: None

Enter properties
 Usage: 3D Thick Beam (Any beam)

Reinforcement (only used for RC design checks): None

ez origin: Centroid ey origin: Same as e:

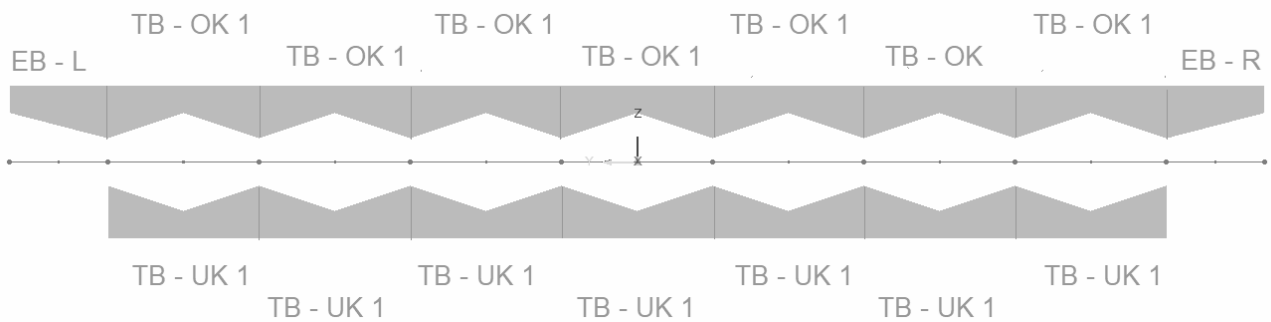
Property	Value
Cross sectional area (A)	0.668086
Second moment of area about y axis (Iyy)	0.0561226
Second moment of area about z axis (Izz)	0.0472308
Product moment of area (Iyz)	-0.0184055
Torsional constant (J)	1.0E-6
Effective shear area in y direction (Asy)	0.504675
Effective shear area in z direction (Asz)	0.365593
Eccentricity in y direction (ey)	0.026
Eccentricity in z direction (ez)	-0.098

Name: LB - Typ 8 (12)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:50
	Pretensioned slab bridge: hollow deck	Date :	Created :

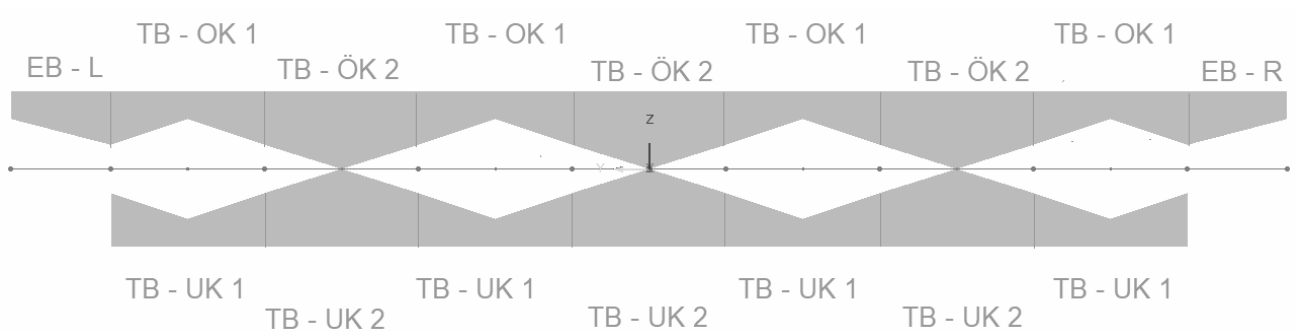
2.3.2 Transversal beams (TB)

There are a total of 8 different types according to the reporting below.



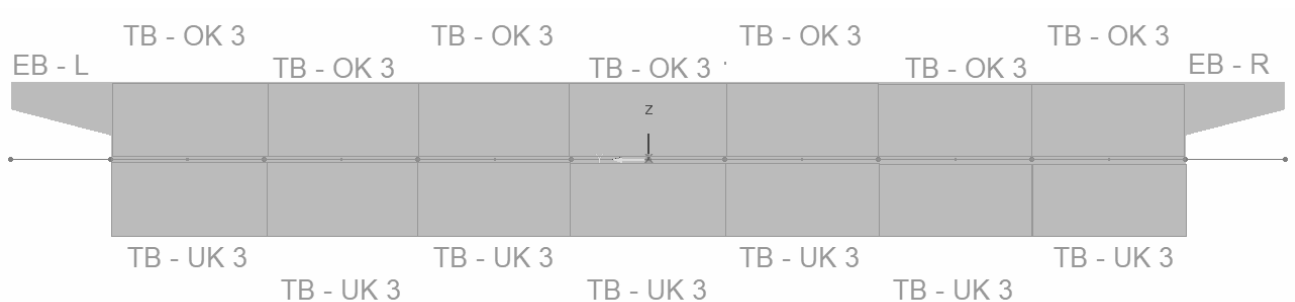
TYPE SECTION 1

Cross section with 8 void tubes.



TYPE SECTION 2

Cross section with 4 void tubes.

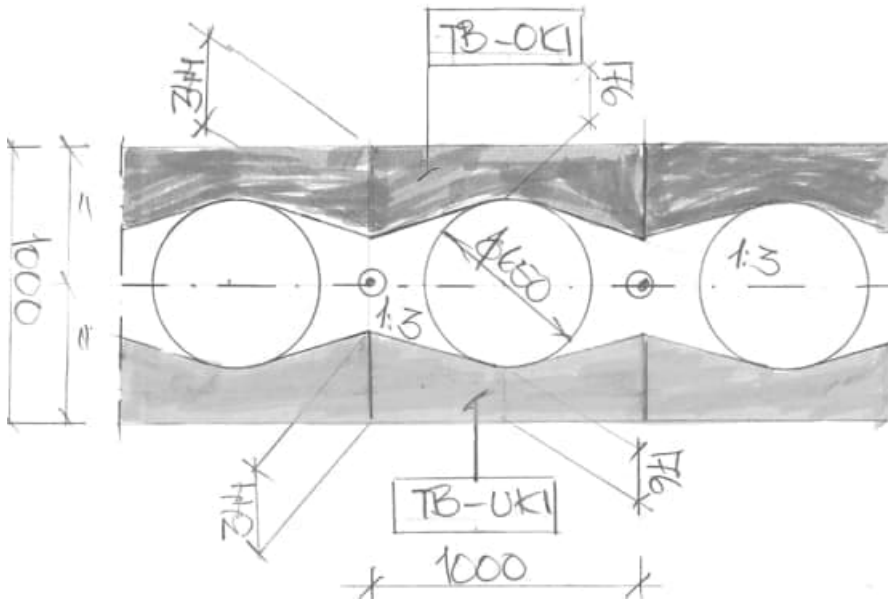


TYPE SECTION 3

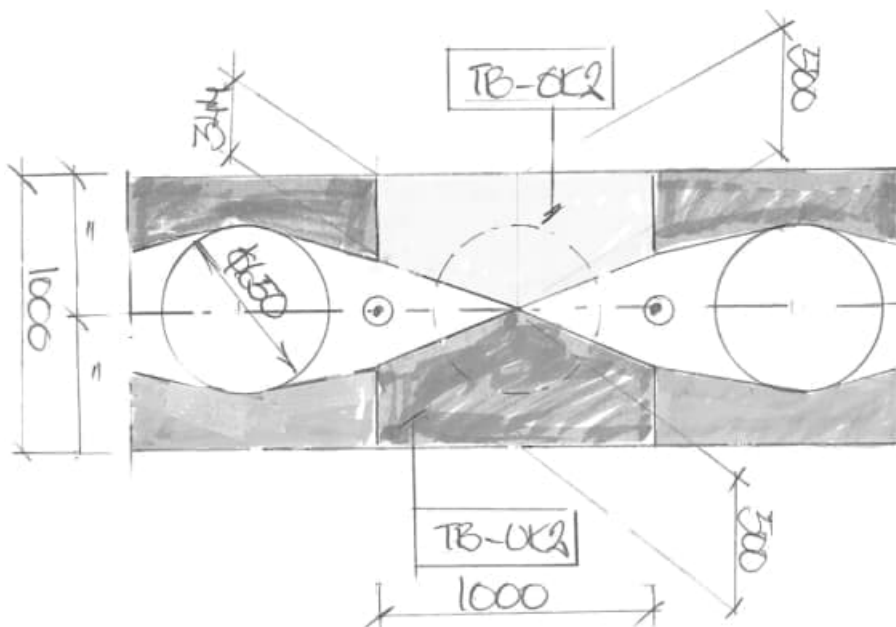
Massive cross section.

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:51
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.2.1 Thickness transversal beams

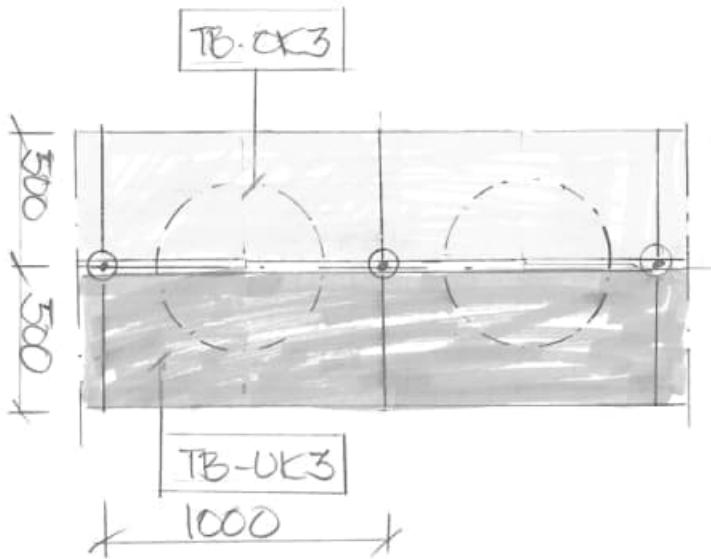


TB - OK 1 & TB - UK 1

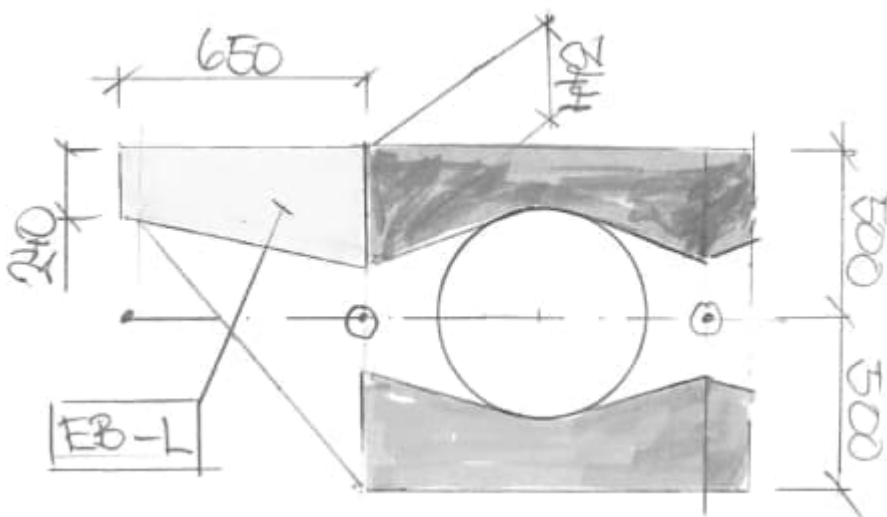


TB - OK 2 & TB - UK 2

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:52
	Pretensioned slab bridge: hollow deck	Date :	Created :



TB - OK 3 & TB - UK 3



EB - L

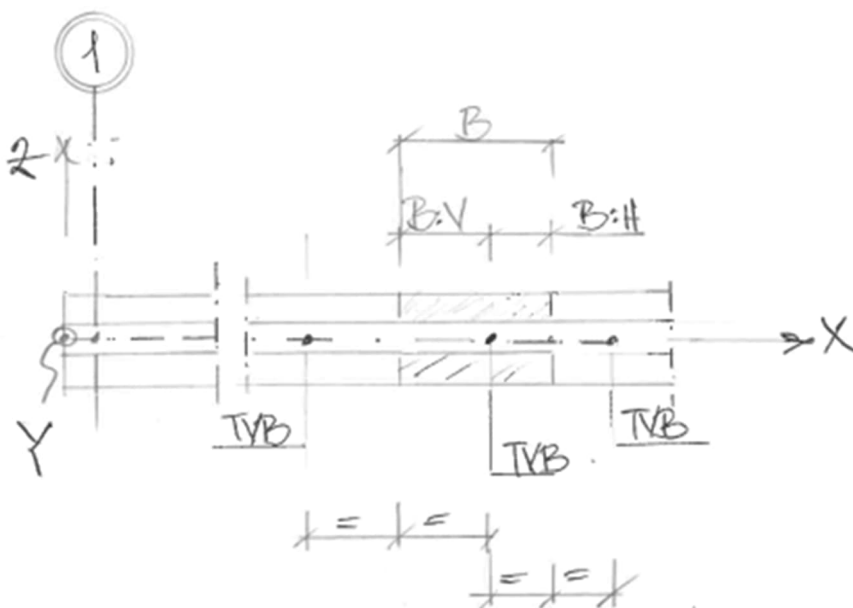
Mått gäller även EB - R

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:53
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.2.2 Width transversal beams

The fictitious transverse beams have different widths depending on the distance at which they are located from each other.

A review of how the total width (denoted "B:TOT") is distributed for each transverse beam. A simplified width is then chosen (denoted "Selected B"). In total, 5 different simplified widths are applied for the fictitious transverse beams (B = 1.0 m; B = 1.50 m; B = 2.0 m; B = 2.5 m; B = 3.0 m).



	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:54
		Date :	Created :

Casting stage 1:

X	B:V	B:H	B:TOT	TVB	Remark
0	x	x	x	No	Bridge end
0,50	0,500	0,625	1,13	Yes	Support 1
1,75	0,625	1,435	2,06	Yes	-
4,62	1,435	1,285	2,72	Yes	-
7,19	1,285	1,285	2,57	Yes	-
9,76	1,285	1,285	2,57	Yes	-
12,33	1,285	1,285	2,57	Yes	-
14,90	1,285	1,300	2,59	Yes	-
17,50	1,300	1,200	2,50	Yes	-
19,90	1,200	1,250	2,45	Yes	Support 2
22,40	1,250	1,250	2,50	Yes	-
24,90	1,250	0,500	1,75	Yes	Casting joint
m	m	m	m		-

→

Chosen B	Section type
x	x
1,0	3
2,0	3
2,5	1
2,5	1
2,5	1
2,5	1
2,5	1
2,5	2
2,5	3
2,5	3
2,0	3
m	-

Casting stage 2:

X	B:V	B:H	B:TOT	TVB	Remark
24,90	x	x	x	No	Casting joint
25,90	0,500	1,300	1,80	Yes	Support 2
28,50	1,300	1,300	2,60	Yes	-
31,10	1,300	1,300	2,60	Yes	-
33,70	1,300	1,300	2,60	Yes	-
36,30	1,300	1,300	2,60	Yes	-
38,90	1,300	1,450	2,75	Yes	-
41,80	1,450	1,550	3,00	Yes	-
44,90	1,550	1,225	2,78	Yes	Support 3
47,35	1,225	1,225	2,45	Yes	-
49,80	1,225	0,500	1,73	Yes	Casting joint
m	m	m	m	-	-

→

Chosen B	Section type
x	x
2,0	1
2,5	1
2,5	1
2,5	1
2,5	1
2,5	1
3,0	2
3,0	3
2,5	3
1,5	3
m	-

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:55
		Date :	Created :

Casting stage 3:

X	B:V	B:H	B:TOT	TVB	Remark
49,80	x	x	x	No	Casting joint
50,80	0,500	1,450	1,95	Yes	-
53,70	1,450	1,450	2,90	Yes	-
56,60	1,450	1,450	2,90	Yes	-
59,50	1,450	1,450	2,90	Yes	-
62,40	1,450	1,400	2,85	Yes	-
65,20	1,400	1,450	2,85	Yes	-
68,10	1,450	1,550	3,00	Yes	Support 4
71,20	1,550	1,550	3,10	Yes	-
74,30	1,550	0,400	1,95	Yes	Casting joint
m	m	m	m	-	-

Chosen B	Section type
x	x
2,0	1
3,0	1
3,0	1
3,0	1
3,0	1
3,0	2
3,0	3
3,0	3
2,0	3
m	-

→

Casting stage 4:

X	B:V	B:H	B:TOT	TVB	Remark
74,30	x	x	x	No	Casting joint
75,30	0,500	1,385	1,89	Yes	-
78,07	1,385	1,380	2,77	Yes	-
80,83	1,380	1,385	2,77	Yes	-
83,60	1,385	1,385	2,77	Yes	-
86,37	1,385	1,380	2,77	Yes	-
89,13	1,380	1,385	2,77	Yes	-
91,90	1,385	0,825	2,21	Yes	-
93,55	0,825	0,825	1,65	Yes	-
95,20	0,825	0,975	1,80	Yes	-
97,15	0,975	0,975	1,95	Yes	-
99,10	0,975	1,085	2,06	Yes	Support 5
101,27	1,085	1,080	2,17	Yes	-
103,43	1,080	1,085	2,17	Yes	-
105,60	1,085	0,500	1,58	Yes	Casting stage
m	m	m	m	-	-

Chosen B	Section type
x	x
2,0	1
3,0	1
3,0	1
3,0	1
3,0	1
3,0	1
2,0	1
1,5	2
2,0	2
2,0	3
2,0	3
2,0	3
1,5	3
m	-

→

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:56
	Pretensioned slab bridge: hollow deck	Date :	Created :

Casting stage 5:

X	B:V	B:H	B:TOT	TVB	Remark
105,60	x	x	x	No	Casting stage
106,60	0,500	1,360	1,86	Yes	-
109,32	1,360	1,355	2,72	Yes	-
112,03	1,355	1,360	2,72	Yes	-
114,75	1,360	1,360	2,72	Yes	-
117,47	1,360	1,355	2,72	Yes	-
120,18	1,355	1,360	2,72	Yes	-
122,90	1,360	0,825	2,19	Yes	-
124,55	0,825	0,825	1,65	Yes	-
126,20	0,825	0,975	1,80	Yes	-
128,15	0,975	0,975	1,95	Yes	-
130,10	0,975	1,250	2,22	Yes	Support 6
132,60	1,250	1,250	2,50	Yes	-
135,10	1,250	0,500	1,75	Yes	Casting stage
m	m	m	m	-	-

Chosen B	Section type
x	x
2,0	1
3,0	1
3,0	1
3,0	1
3,0	1
3,0	1
2,0	1
1,5	2
2,0	2
2,0	3
2,0	3
2,5	3
1,5	3
m	-

Casting stage 6:

X	B:V	B:H	B:TOT	TVB	Remark
135,10	x	x	x	No	Casting stage
136,10	0,500	1,300	1,80	Yes	-
138,70	1,300	1,300	2,60	Yes	-
141,30	1,300	1,300	2,60	Yes	-
143,90	1,300	1,300	2,60	Yes	-
146,50	1,300	1,300	2,60	Yes	-
149,10	1,300	1,450	2,75	Yes	-
152,00	1,450	1,550	3,00	Yes	-
155,10	1,550	1,250	2,80	Yes	Support 7
157,60	1,250	1,250	2,50	Yes	-
160,10	1,250	0,500	1,75	Yes	Casting stage
m	m	m	m	-	-

Chosen B	Section type
x	x
2,0	1
2,5	1
2,5	1
2,5	1
2,5	1
3,0	1
3,0	2
3,0	3
2,5	3
1,5	3
m	-

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:57
		Date :	Created :

Casting stage 7:

X	B:V	B:H	B:TOT	TVB	Remark
160,10	x	x	x	No	Casting stage
161,10	0,500	1,300	1,80	Yes	-
163,70	1,300	1,300	2,60	Yes	-
166,30	1,300	1,300	2,60	Yes	-
168,90	1,300	1,300	2,60	Yes	-
171,50	1,300	1,300	2,60	Yes	-
174,10	1,300	1,450	2,75	Yes	-
177,00	1,450	1,550	3,00	Yes	-
180,10	1,550	0,975	2,53	Yes	Support 8
182,05	0,975	0,975	1,95	Yes	-
184,00	0,975	0,550	1,52	Yes	Casting stage
m	m	m	m	-	-

Chosen B	Section type
x	x
2,0	1
2,5	1
2,5	1
2,5	1
2,5	1
3,0	1
3,0	2
2,5	3
2,0	3
1,5	3
m	-

→

Casting stage 8:

X	B:V	B:H	B:TOT	TVB	Remark
184,00	x	x	x	No	Casting stage
185,10	0,550	1,300	1,85	Yes	-
187,70	1,300	1,300	2,60	Yes	-
190,30	1,300	1,300	2,60	Yes	-
192,90	1,300	1,300	2,60	Yes	-
195,50	1,300	1,450	2,75	Yes	-
198,40	1,450	0,550	2,00	Yes	-
199,50	0,550	0,500	1,05	Yes	Support 9
200,00	x	x	x	No	Broände
m	m	m	m	-	-

Chosen B	Section type
x	x
2,0	1
2,5	1
2,5	1
2,5	1
2,5	1
2,0	1
1,0	3
x	x
m	-

→

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:58
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.2.3 Defintion transversal beams

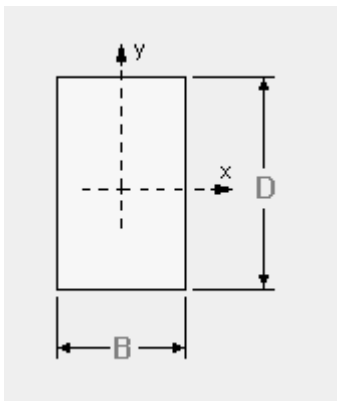
The occurring fictitious beams are both of even thickness and tapered.

The tapered beams are designated as "Multiple Varying Section".

These are either tapered with two break points (designated "2 sections") or three break points (designated "sections").

Determination of cross-sectional constants is carried out by the "Section property calculator". In this case, only solid rectangular cross-sections occur (designated "RSS" or "Rectangular Solid Section").

The rectangular cross-sections are defined by thickness (designated "D") and width (designated "B").



	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:59
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.2.1 TB – OK1

This transversal beam is designated 'Multiple varying: 3 sections' with geometry as below.

TB – OK 1_1500:

Section	D	B	Section
1	0.344	1.500	RSS D = 0.344 B = 1.5
2	0.176	1.500	RSS D = 0.176 B = 1.5
3	0.344	1.500	RSS D = 0.344 B = 1.5
-	m	m	-

Eccentricity in z direction (ez): -0.412 m

Multiple Varying Section ×

Analysis category: 3D

Specify shape interpolation
 Symmetric section

Distance interpretation:
 Scaled to fit each line individually
 Along reference path: Centerline

	Section	Shape Interpolation	Distance	
1	1,50 X 0,344 (RSS D=0,344 B=1,5)	Start	0,0	Edit...
2	1,50 x 0,176 (RSS D=0,176 B=1,5)	Linear	0,5	Insert
3	1,50 X 0,344 (RSS D=0,344 B=1,5)	Linear	1,0	Delete

Flip

Alignment:
Vertical: Top to top (ey origin: Same as ez)
Horizontal: Centre to centre (ez origin: Centroid)
Align all sections to section: 2
Interpolation of properties: Use Section Calculator

Name: TB - OK 1_1500 (2)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:60
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB – OK 1_2000:

Section	D	B	Section
1	0.344	2.000	RSS D = 0.344 B = 2.0
2	0.176	2.000	RSS D = 0.176 B = 2.0
3	0.344	2.000	RSS D = 0.500 B = 2.0
-	m	m	-

Eccentricity in z direction (ez): -0.412 m

Multiple Varying Section ×

Analysis category: 3D

Specify shape interpolation
 Symmetric section

Distance interpretation:
 Scaled to fit each line individually
 Along reference path: Centerline

	Section	Shape Interpolation	Distance
1	2.00 X 0.344 (RSS D=0.344 B=2)	Start	0.0
2	2.00 x 0.176 (RSS D=0.176 B=2)	Linear	0.5
3	2.00 X 0.344 (RSS D=0.344 B=2)	Linear	1.0

Buttons: Edit..., Insert, Delete, Flip

Alignment:
Vertical: Top to top (ey origin: Same as ez)
Horizontal: Centre to centre (ez origin: Centroid)
Align all sections to section: 2
Interpolation of properties: Use Section Calculator

Section 1-1 Section 2-2 Section 3-3

Name: TB - OK 1_2000 (3)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:61
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB – OK 1_2500:

Section	D	B	Section
1	0.344	2.500	RSS D = 0.344 B = 2.5
2	0.176	2.500	RSS D = 0.176 B = 2.5
3	0.344	2.500	RSS D = 0.344 B = 2.5
-	m	m	-

Eccentricity in z direction (ez): -0.412 m

Multiple Varying Section



Analysis category

Specify shape interpolation
 Symmetric section

Distance interpretation

Scaled to fit each line individually
 Along reference path

	Section	Shape Interpolation	Distance
1	2.50 X 0.344 (RSS D=0.344 B=2.5)	Start	0.0
2	2.50 x 0.176 (RSS D=0.176 B=2.5)	Linear	0.5
3	2.50 X 0.344 (RSS D=0.344 B=2.5)	Linear	1.0

Alignment

Vertical ey origin Align all sections to section

Horizontal ez origin Interpolation of properties

Section 1-1
Section 2-2
Section 3-3

Name (4)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:62
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB - OK 1_3000:

Section	D	B	Section
1	0.344	3.000	RSS D = 0.344 B = 3.0
2	0.176	3.000	RSS D = 0.176 B = 3.0
3	0.344	3.000	RSS D = 0.344 B = 3.0
-	m	m	-

Eccentricity in z direction (ez): -0.412 m

Multiple Varying Section ✕

Analysis category:

Specify shape interpolation
 Symmetric section

Distance interpretation:
 Scaled to fit each line individually
 Along reference path

	Section	Shape Interpolation	Distance
1	3,00 X 0,344 (RSS D=0,344 B=3)	Start	0,0
2	3,00 x 0,176 (RSS D=0,176 B=3)	Linear	0,5
3	3,00 X 0,344 (RSS D=0,344 B=3)	Linear	1,0

Alignment:
Vertical: ey origin:
Horizontal: ez origin:

Align all sections to section:
Interpolation of properties:

Name: (5)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:63
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.2.2 TB – OK2

This transversal beam is designated 'Multiple varying: 3 sections' with geometry as below.

TB – OK 2_1500:

Section	D	B	Section
1	0.344	1.500	RSS D = 0.344 B = 1.5
2	0.500	1.500	RSS D = 0.500 B = 1.5
3	0.344	1.500	RSS D = 0.344 B = 1.5
-	m	m	-

Eccentricity in z direction (ez): -0.250 m

Multiple Varying Section ✕

Analysis category:

Specify shape interpolation

Symmetric section

Distance interpretation

Scaled to fit each line individually

Along reference path

	Section	Shape Interpolation	Distance	
1	1,50 X 0,344 (RSS D=0,344 B=1,5)	Start	0,0	Edit...
2	1,50 x 0,50 (RSS D=0,5 B=1,5)	Linear	0,5	Insert
3	1,50 X 0,344 (RSS D=0,344 B=1,5)	Linear	1,0	Delete

Alignment

Vertical: ey origin:

Horizontal: ez origin:

Align all sections to section:

Interpolation of properties:

Section 1-1
Section 2-2
Section 3-3

Name: (19)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:64
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB – OK 2_2000:

Section	D	B	Section
1	0.344	2.000	RSS D = 0.344 B = 2.0
2	0.500	2.000	RSS D = 0.500 B = 2.0
3	0.344	2.000	RSS D = 0.344 B = 2.0
-	m	m	-

Eccentricity in z direction (ez): -0.250 m

Multiple Varying Section
✕

Analysis category

Specify shape interpolation

Symmetric section

Distance interpretation

Scaled to fit each line individually

Along reference path

	Section	Shape Interpolation	Distance
1	2.00 X 0.344 (RSS D=0.344 B=2)	Start	0.0
2	2.00 x 0.50 (RSS D=0.5 B=2)	Linear	0.5
3	2.00 X 0.344 (RSS D=0.344 B=2)	Linear	1.0

Alignment

Vertical ey origin

Horizontal ez origin

Align all sections to section

Interpolation of properties

The diagram shows a cross-section of a bridge deck with three sections labeled 1, 2, and 3. Section 1 is at the left end, section 2 is in the middle, and section 3 is at the right end. The deck is wider at section 2 and narrower at sections 1 and 3. Below the diagram are three boxes representing the cross-sections: Section 1-1, Section 2-2, and Section 3-3.

Name (20)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:65
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB - OK 2_2500:

Section	D	B	Section
1	0.344	2.500	RSS D = 0.344 B = 2.5
2	0.500	2.500	RSS D = 0.500 B = 2.5
3	0.344	2.500	RSS D = 0.344 B = 2.5
-	m	m	-

Eccentricity in z direction (ez): -0.250 m

Multiple Varying Section ×

Analysis category: 3D

Specify shape interpolation
 Symmetric section

Distance interpretation:
 Scaled to fit each line individually
 Along reference path: Centerline

	Section	Shape Interpolation	Distance
1	2,50 X 0,344 (RSS D=0,344 B=2,5)	Start	0,0
2	2,50 x 0,50 (RSS D=0,5 B=2,5)	Linear	0,5
3	2,00 X 0,344 (RSS D=0,344 B=2)	Linear	1,0

Buttons: Edit... Insert Delete Flip

Alignment:
Vertical: Top to top ey origin: Same as ez Align all sections to section: 2
Horizontal: Centre to centre ez origin: Centroid Interpolation of properties: Use Section Calculator

Section 1-1 Section 2-2 Section 3-3

Name: TB - OK 2_2500 (21)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:66
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB - OK 2_3000:

Section	D	B	Section
1	0.344	3.000	RSS D = 0.344 B = 3.0
2	0.500	3.000	RSS D = 0.500 B = 3.0
3	0.344	3.000	RSS D = 0.344 B = 3.0
-	m	m	-

Eccentricity in z direction (ez): -0.250 m

Multiple Varying Section ✕

Analysis category: 3D

Specify shape interpolation
 Symmetric section

Distance interpretation:
 Scaled to fit each line individually
 Along reference path: Centerline

	Section	Shape Interpolation	Distance
1	3,00 X 0,344 (RSS D=0,344 B=3)	Start	0,0
2	3,00 x 0,50 (RSS D=0,5 B=3)	Linear	0,5
3	1,00 x 0,344 (RSS D=0,344 B=1)	Linear	1,0

Buttons: Edit... Insert Delete Flip

Alignment:
Vertical: Top to top ey origin: Same as ez Align all sections to section: 2
Horizontal: Centre to centre ez origin: Centroid Interpolation of properties: Use Section Calculator

Section 1-1 Section 2-2 Section 3-3

Name: TB - OK 2_3000 (22)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:67
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.2.3 TB – OK3

This transversal beam is designated 'Multiple varying: 2 sections' with geometry as below.

TB – OK 3_1000:

Section	D	B	Section
1	0.500	1.000	RSS D = 0.500 B = 1.0
2	0.500	1.000	RSS D = 0.500 B = 1.0
-	m	m	-

Eccentricity in z direction (ez): -0.250 m

Multiple Varying Section ✕

Analysis category: 3D

Specify shape interpolation
 Symmetric section

Distance interpretation:
 Scaled to fit each line individually
 Along reference path: Centerline

	Section	Shape Interpolation	Distance
1	1,00 x 0,50 (RSS D=0,5 B=1)	Start	0,0
2	1,00 x 0,50 (RSS D=0,5 B=1)	Linear	1,0

Alignment:
Vertical: Top to top (ey origin: Same as ez)
Horizontal: Centre to centre (ez origin: Centroid)
Align all sections to section: 2
Interpolation of properties: Use Section Calculator

Name: TB - OK 3_1000 (23)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:68
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB – OK 3_1500:

Section	D	B	Section
1	0.500	1.500	RSS D = 0.500 B = 1.5
2	0.500	1.500	RSS D = 0.500 B = 1.5
-	m	m	-

Eccentricity in z direction (ez): -0.250 m

Multiple Varying Section ✕

Analysis category

Specify shape interpolation

Symmetric section

Distance interpretation

Scaled to fit each line individually

Along reference path

	Section	Shape Interpolation	Distance	
1	1,50 x 0,50 (RSS D=0,5 B=1,5)	Start	0,0	Edit...
2	1,50 x 0,50 (RSS D=0,5 B=1,5)	Linear	1,0	Insert
				Delete
				Flip

Alignment

Vertical ey origin

Horizontal ez origin

Align all sections to section

Interpolation of properties

Name (24)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:69
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB – OK 3_2000:

Section	D	B	Section
1	0.500	2.000	RSS D = 0.500 B = 2.0
2	0.500	2.000	RSS D = 0.500 B = 2.0
-	m	m	-

Eccentricity in z direction (ez): -0.250 m

Multiple Varying Section ×

Analysis category:

Specify shape interpolation
 Symmetric section

Distance interpretation:
 Scaled to fit each line individually
 Along reference path:

	Section	Shape Interpolation	Distance
1	2.00 x 0.50 (RSS D=0.5 B=2)	Start	0.0
2	2.00 x 0.50 (RSS D=0.5 B=2)	Linear	1.0

Alignment:
Vertical: ey origin:
Horizontal: ez origin:

Align all sections to section:
Interpolation of properties:

1 100% 2

1 2

Section 1-1 Section 2-2

Name: (25)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:70
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB - OK 3_2500:

Section	D	B	Section
1	0.500	2.500	RSS D = 0.500 B = 2.5
2	0.500	2.500	RSS D = 0.500 B = 2.5
-	m	m	-

Eccentricity in z direction (ez): -0.250 m

Multiple Varying Section
✕

Analysis category

Specify shape interpolation

Symmetric section

Distance interpretation

Scaled to fit each line individually

Along reference path

	Section	Shape Interpolation	Distance	Edit...
1	2.50 x 0.50 (RSS D=0.5 B=2.5)	Start	0.0	Insert
2	2.50 x 0.50 (RSS D=0.5 B=2.5)	Linear	1.0	Delete

Flip

Alignment

Vertical ey origin

Horizontal ez origin

Align all sections to section

Interpolation of properties

Section 1-1
Section 2-2

Name (26)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:71
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB – OK 3_3000:

Section	D	B	Section
1	0.500	3.000	RSS D = 0.500 B = 3.0
2	0.500	3.000	RSS D = 0.500 B = 3.0
-	m	m	-

Eccentricity in z direction (ez): -0.250 m

Multiple Varying Section
✕

Analysis category

Specify shape interpolation

Symmetric section

Distance interpretation

Scaled to fit each line individually

Along reference path

	Section	Shape Interpolation	Distance
1	3,00 x 0,50 (RSS D=0,5 B=3)	Start	0,0
2	3,00 x 0,50 (RSS D=0,5 B=3)	Linear	1,0

Edit...

Insert

Delete

Flip

Alignment

Vertical ey origin

Horizontal ez origin

Align all sections to section

Interpolation of properties

Name (27)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:72
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.2.4 TB – UK1

This transversal beam is designated 'Multiple varying: 3 sections' with geometry as below.

TB – UK 1_1500:

Section	D	B	Section
1	0.344	1.500	RSS D = 0.344 B = 1.5
2	0.176	1.500	RSS D = 0.176 B = 1.5
3	0.344	1.500	RSS D = 0.500 B = 1.5
-	m	m	-

Eccentricity in z direction (ez): +0.412 m

Multiple Varying Section ✕

Analysis category:

Specify shape interpolation
 Symmetric section

Distance interpretation:
 Scaled to fit each line individually
 Along reference path

	Section	Shape Interpolation	Distance
1	1,50 X 0,344 (RSS D=0,344 B=1,5)	Start	0,0
2	1,50 x 0,176 (RSS D=0,176 B=1,5)	Linear	0,5
3	1,50 X 0,344 (RSS D=0,344 B=1,5)	Linear	1,0

Alignment:
Vertical: ey origin:
Horizontal: ez origin:
Align all sections to section:
Interpolation of properties:

Name: (29)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:73
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB – UK 1_2000:

Section	D	B	Section
1	0.344	2.000	RSS D = 0.344 B = 2.0
2	0.176	2.000	RSS D = 0.176 B = 2.0
3	0.344	2.000	RSS D = 0.500 B = 2.0
-	m	m	-

Eccentricity in z direction (ez): +0.412 m

Multiple Varying Section ✕

Analysis category: 3D

Specify shape interpolation
 Symmetric section

Distance interpretation:
 Scaled to fit each line individually
 Along reference path: Centerline

	Section	Shape Interpolation	Distance
1	2.00 X 0.344 (RSS D=0.344 B=2)	Start	0.0
2	2.00 x 0.176 (RSS D=0.176 B=2)	Linear	0.5
3	2.00 X 0.344 (RSS D=0.344 B=2)	Linear	1.0

Alignment:
Vertical: Bottom to bottom, ey origin: Same as ez
Horizontal: Centre to centre, ez origin: Centroid
Align all sections to section: 2
Interpolation of properties: Use Section Calculator

Section 1-1 Section 2-2 Section 3-3

Name: TB - UK 1_2000 (30)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:74
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB – UK 1_2500:

Section	D	B	Section
1	0.344	2.500	RSS D = 0.344 B = 2.5
2	0.176	2.500	RSS D = 0.176 B = 2.5
3	0.344	2.500	RSS D = 0.500 B = 2.5
-	m	m	-

Eccentricity in z direction (ez): +0.412 m

Multiple Varying Section ✕

Analysis category:

Specify shape interpolation
 Symmetric section

Distance interpretation

Scaled to fit each line individually
 Along reference path

	Section	Shape Interpolation	Distance
1	2,50 X 0,344 (RSS D=0,344 B=2,5)	Start	0,0
2	2,50 x 0,176 (RSS D=0,176 B=2,5)	Linear	0,5
3	2,50 X 0,344 (RSS D=0,344 B=2,5)	Linear	1,0

Alignment

Vertical: ey origin:
Horizontal: ez origin:

Align all sections to section:
Interpolation of properties:

The diagram illustrates a trapezoidal cross-section of a bridge deck. It is divided into three sections: Section 1 (left), Section 2 (middle), and Section 3 (right). Section 2 is the narrowest part, while Sections 1 and 3 are wider. A vertical dashed line marks the center of Section 2. Below the main diagram, three smaller diagrams show the cross-sections at different points: Section 1-1, Section 2-2, and Section 3-3.

Name: (new)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:75
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB – UK 1_3000:

Section	D	B	Section
1	0.344	3.000	RSS D = 0.344 B = 3.0
2	0.176	3.000	RSS D = 0.176 B = 3.0
3	0.344	3.000	RSS D = 0.500 B = 3.0
-	m	m	-

Eccentricity in z direction (ez): +0.412 m

Multiple Varying Section



Analysis category

Specify shape interpolation
 Symmetric section

Distance interpretation

Scaled to fit each line individually
 Along reference path

	Section	Shape Interpolation	Distance
1	3,00 X 0,344 (RSS D=0,344 B=3)	Start	0,0
2	3,00 x 0,176 (RSS D=0,176 B=3)	Linear	0,5
3	3,00 X 0,344 (RSS D=0,344 B=3)	Linear	1,0

Alignment

Vertical ey origin

Horizontal ez origin

Align all sections to section

Interpolation of properties

Section 1-1
Section 2-2
Section 3-3

Name (32)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:76
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.2.5 TB – UK2

This transversal beam is designated 'Multiple varying: 3 sections' with geometry as below.

TB – UK 2_1500:

Section	D	B	Section
1	0.344	1.500	RSS D = 0.344 B = 1.5
2	0.500	1.500	RSS D = 0.500 B = 1.5
3	0.344	1.500	RSS D = 0.344 B = 1.5
-	m	m	-

Eccentricity in z direction (ez): +0.250 m

Multiple Varying Section
✕

Analysis category

Specify shape interpolation

Symmetric section

Distance interpretation

Scaled to fit each line individually

Along reference path

	Section	Shape Interpolation	Distance
1	1,50 X 0,344 (RSS D=0,344 B=1,5)	Start	0,0
2	1,50 x 0,50 (RSS D=0,5 B=1,5)	Linear	0,5
3	1,50 X 0,344 (RSS D=0,344 B=1,5)	Linear	1,0

Alignment

Vertical ey origin

Horizontal ez origin

Align all sections to section

Interpolation of properties

Section 1-1
Section 2-2
Section 3-3

Name (34)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:77
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB – UK 2_2000:

Section	D	B	Section
1	0.344	2.000	RSS D = 0.344 B = 2.0
2	0.500	2.000	RSS D = 0.500 B = 2.0
3	0.344	2.000	RSS D = 0.344 B = 2.0
-	m	m	-

Eccentricity in z direction (ez): +0.250 m

Multiple Varying Section



Analysis category:

Specify shape interpolation
 Symmetric section

Distance interpretation:
 Scaled to fit each line individually
 Along reference path:

	Section	Shape Interpolation	Distance
1	2.00 X 0.344 (RSS D=0.344 B=2)	Start	0.0
2	2.00 x 0.50 (RSS D=0.5 B=2)	Linear	0.5
3	2.00 X 0.344 (RSS D=0.344 B=2)	Linear	1.0

Alignment:
Vertical: ey origin:
Horizontal: ez origin:

Align all sections to section:
Interpolation of properties:

Name: (35)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:78
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB – UK 2_2500:

Section	D	B	Section
1	0.344	2.500	RSS D = 0.344 B = 2.5
2	0.500	2.500	RSS D = 0.500 B = 2.5
3	0.344	2.500	RSS D = 0.344 B = 2.5
-	m	m	-

Eccentricity in z direction (ez): +0.250 m

Multiple Varying Section ✕

Analysis category: 3D

Specify shape interpolation
 Symmetric section

Distance interpretation:
 Scaled to fit each line individually
 Along reference path: Centerline

	Section	Shape Interpolation	Distance
1	2,50 X 0,344 (RSS D=0,344 B=2,5)	Start	0,0
2	2,50 x 0,50 (RSS D=0,5 B=2,5)	Linear	0,5
3	2,50 X 0,344 (RSS D=0,344 B=2,5)	Linear	1,0

Buttons: Edit..., Insert, Delete, Flip

Alignment:
Vertical: Bottom to bottom, ey origin: Same as ez
Horizontal: Centre to centre, ez origin: Centroid
Align all sections to section: 2
Interpolation of properties: Use Section Calculator

100%

Section 1-1 Section 2-2 Section 3-3

Name: TB - UK 2_2500 (24)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:79
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB – UK 2_3000:

Section	D	B	Section
1	0.344	3.000	RSS D = 0.344 B = 3.0
2	0.500	3.000	RSS D = 0.500 B = 3.0
3	0.344	3.000	RSS D = 0.344 B = 3.0
-	m	m	-

Eccentricity in z direction (ez): +0.250 m

Multiple Varying Section ×

Analysis category:

Specify shape interpolation

Symmetric section

Distance interpretation

Scaled to fit each line individually

Along reference path Centerline

	Section	Shape Interpolation	Distance	Edit...
1	3,00 X 0,344 (RSS D=0,344 B=3)	Start	0,0	Insert
2	3,00 x 0,50 (RSS D=0,5 B=3)	Linear	0,5	Delete
3	3,00 X 0,344 (RSS D=0,344 B=3)	Linear	1,0	Flip

Alignment

Vertical: Bottom to bottom ey origin: Same as ez

Horizontal: Centre to centre ez origin: Centroid

Align all sections to section: 2

Interpolation of properties: Use Section Calculato

Name: TB - UK 2_3000 (37)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:80
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.2.6 TB – UK3

This transversal beam is designated 'Multiple varying: 2 sections' with geometry as below.

TB – UK 3_1000:

Section	D	B	Section
1	0.500	1.000	RSS D = 0.500 B = 1.0
2	0.500	1.000	RSS D = 0.500 B = 1.0
-	m	m	-

Eccentricity in z direction (ez): +0.25 m

Multiple Varying Section
✕

Analysis category

Specify shape interpolation

Symmetric section

Distance interpretation

Scaled to fit each line individually

Along reference path Centerline

	Section	Shape Interpolation	Distance
1	1,00 x 0,50 (RSS D=0,5 B=1)	Start	0,0
2	1,00 x 0,50 (RSS D=0,5 B=1)	Linear	1,0

Edit...

Insert

Delete

Flip

Alignment

Vertical Individual eccentricitie ey origin Same as ez

Horizontal Centre to centre ez origin Centroid

Align all sections to section 2

Interpolation of properties Use Section Calculato

The diagram shows a horizontal beam with two sections, labeled 1 and 2. Section 1 is on the left and Section 2 is on the right. Below the beam, two cross-sections are shown: Section 1-1 on the left and Section 2-2 on the right. The beam is labeled with '1' at the left end and '2' at the right end. A '100%' scale indicator is present at the top right of the beam diagram.

Name TB - UK 3_1000 (38)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:81
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB – UK 3_1500:

Section	D	B	Section
1	0.500	1.500	RSS D = 0.500 B = 1.5
2	0.500	1.500	RSS D = 0.500 B = 1.5
-	m	m	-

Eccentricity in z direction (ez): +0.25 m

Multiple Varying Section ×

Analysis category:

Specify shape interpolation
 Symmetric section

Distance interpretation:
 Scaled to fit each line individually
 Along reference path

	Section	Shape Interpolation	Distance
1	1,50 x 0,50 (RSS D=0,5 B=1,5)	Start	0,0
2	1,50 x 0,50 (RSS D=0,5 B=1,5)	Linear	1,0

Alignment:
Vertical: ey origin:
Horizontal: ez origin:

Align all sections to section:
Interpolation of properties:

1 100% 2

Section 1-1 Section 2-2

Name: (39)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:82
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB – UK 3_2000:

Section	D	B	Section
1	0.500	2.000	RSS D = 0.500 B = 2.0
2	0.500	2.000	RSS D = 0.500 B = 2.0
-	m	m	-

Eccentricity in z direction (ez): +0.25 m

Multiple Varying Section



Analysis category

Specify shape interpolation

Symmetric section

Distance interpretation

Scaled to fit each line individually

Along reference path

	Section	Shape Interpolation	Distance	
1	2,00 x 0,50 (RSS D=0,5 B=2)	Start	0,0	Edit...
2	2,00 x 0,50 (RSS D=0,5 B=2)	Linear	1,0	Insert
				Delete
				Flip

Alignment

Vertical ey origin

Horizontal ez origin

Align all sections to section

Interpolation of properties

Section 1-1 Section 2-2

Name (40)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:83
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB – UK 3_2500:

Section	D	B	Section
1	0.500	2.500	RSS D = 0.500 B = 2.5
2	0.500	2.500	RSS D = 0.500 B = 2.5
-	m	m	-

Eccentricity in z direction (ez): +0.25 m

Multiple Varying Section
✕

Analysis category

Specify shape interpolation

Symmetric section

Distance interpretation

Scaled to fit each line individually

Along reference path

	Section	Shape Interpolation	Distance
1	2.50 x 0.50 (RSS D=0.5 B=2.5)	Start	0.0
2	2.50 x 0.50 (RSS D=0.5 B=2.5)	Linear	1.0

Alignment

Vertical ey origin

Horizontal ez origin

Align all sections to section

Interpolation of properties

Name (41)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:84
	Pretensioned slab bridge: hollow deck	Date :	Created :

TB – UK 3_3000:

Section	D	B	Section
1	0.500	3.000	RSS D = 0.500 B = 3.0
2	0.500	3.000	RSS D = 0.500 B = 3.0
-	m	m	-

Multiple Varying Section



Analysis category

Specify shape interpolation

Symmetric section

Distance interpretation

Scaled to fit each line individually

Along reference path

	Section	Shape Interpolation	Distance
1	3,00 x 0,50 (RSS D=0,5 B=3)	Start	0,0
2	3,00 x 0,50 (RSS D=0,5 B=3)	Linear	1,0

Alignment

Vertical ey origin

Horizontal ez origin

Align all sections to section

Interpolation of properties

Name (42)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:85
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.2.7 EB – L

This transversal beam is designated 'Multiple varying: 2 sections' with geometry as below.

EB – L_1000:

Section	D	B	Section
1	0.344	1.000	RSS D = 0.344 B = 1.0
2	0.176	1.000	RSS D = 0.176 B = 1.0
-	m	m	-

Eccentricity in z direction (ez): -0.412 m

Multiple Varying Section ✕

Analysis category: 3D

Specify shape interpolation
 Symmetric section

Distance interpretation:
 Scaled to fit each line individually
 Along reference path: Centerline

	Section	Shape Interpolation	Distance
1	1.00 x 0.344 (RSS D=0.344 B=1)	Start	0.0
2	1.00 x 0.176 (RSS D=0.176 B=1)	Linear	0.65

Alignment:
Vertical: Top to top | ey origin: Same as ez
Horizontal: Centre to centre | ez origin: Centroid
Align all sections to section: 2
Interpolation of properties: Use Section Calculator

Name: EB - L_1500 (new)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:86
	Pretensioned slab bridge: hollow deck	Date :	Created :

EB - L_1500:

Section	D	B	Section
1	0.344	1.500	RSS D = 0.344 B = 1.5
2	0.176	1.500	RSS D = 0.176 B = 1.5
-	m	m	-

Eccentricity in z direction (ez): -0.412 m

Multiple Varying Section ✕

Analysis category: 3D

Specify shape interpolation
 Symmetric section

Distance interpretation:
 Scaled to fit each line individually
 Along reference path: Centerline

	Section	Shape Interpolation	Distance
1	1.50 X 0.344 (RSS D=0.344 B=1.5)	Start	0.0
2	1.50 x 0.176 (RSS D=0.176 B=1.5)	Linear	0.65

Buttons: Edit... Insert Delete Flip

Alignment:
Vertical: Top to top (ey origin: Same as ez)
Horizontal: Centre to centre (ez origin: Centroid)
Align all sections to section: 2
Interpolation of properties: Use Section Calculator

Name: EB - L_1500 (new)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:87
	Pretensioned slab bridge: hollow deck	Date :	Created :

EB - L_2000:

Section	D	B	Section
1	0.344	2.000	RSS D = 0.344 B = 2.0
2	0.176	2.000	RSS D = 0.176 B = 2.0
-	m	m	-

Eccentricity in z direction (ez): -0.412 m

Multiple Varying Section ✕

Analysis category:

Specify shape interpolation

Symmetric section

Distance interpretation

Scaled to fit each line individually

Along reference path

	Section	Shape Interpolation	Distance	Edit...
1	2.00 x 0.344 (RSS D=0.344 B=2)	Start	0.0	Insert
2	2.00 x 0.176 (RSS D=0.176 B=2)	Linear	0.65	Delete

Flip

Alignment

Vertical: ey origin:

Horizontal: ez origin:

Align all sections to section:

Interpolation of properties:

Name: (43)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:88
	Pretensioned slab bridge: hollow deck	Date :	Created :

EB - L_2500:

Section	D	B	Section
1	0.344	2.500	RSS D = 0.344 B = 2.5
2	0.176	2.500	RSS D = 0.176 B = 2.5
-	m	m	-

Eccentricity in z direction (ez): -0.412 m

Multiple Varying Section ✕

Analysis category:

Specify shape interpolation

Symmetric section

Distance interpretation

Scaled to fit each line individually

Along reference path:

	Section	Shape Interpolation	Distance	Edit...
1	2.50 X 0,344 (RSS D=0,344 B=2.5)	Start	0,0	Insert
2	2.50 x 0,176 (RSS D=0,176 B=2.5)	Linear	0,65	Delete

Alignment

Vertical: ey origin:

Horizontal: ez origin:

Align all sections to section:

Interpolation of properties:

Name: (44)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:89
	Pretensioned slab bridge: hollow deck	Date :	Created :

EB - L_3000:

Section	D	B	Section
1	0.344	3.000	RSS D = 0.344 B = 3.0
2	0.176	3.000	RSS D = 0.176 B = 3.0
-	m	m	-

Eccentricity in z direction (ez): -0.412 m

Multiple Varying Section ×

Analysis category

Specify shape interpolation

Symmetric section

Distance interpretation

Scaled to fit each line individually

Along reference path

	Section	Shape Interpolation	Distance	Edit...
1	3.00 X 0.344 (RSS D=0.344 B=3)	Start	0.0	Insert
2	3.00 x 0.176 (RSS D=0.176 B=3)	Linear	0.65	Delete

Flip

Alignment

Vertical ey origin

Horizontal ez origin

Align all sections to section

Interpolation of properties

Name (45)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:90
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.2.8 EB – R

This transversal beam is designated 'Multiple varying: 2 sections' with geometry as below.

EB – L_1000:

Section	D	B	Section
1	0.176	1.000	RSS D = 0.176 B = 1.0
2	0.344	1.000	RSS D = 0.344 B = 1.0
-	m	m	-

Eccentricity in z direction (ez): -0.412 m

Multiple Varying Section
✕

Analysis category:

Specify shape interpolation

Symmetric section

Distance interpretation

Scaled to fit each line individually

Along reference path

	Section	Shape Interpolation	Distance
1	1,00 x 0,176 (RSS D=0,176 B=1)	Start	0,0
2	1,00 x 0,344 (RSS D=0,344 B=1)	Linear	0,65

Alignment

Vertical: ey origin:

Horizontal: ez origin:

Align all sections to section:

Interpolation of properties:

Section 1-1 Section 2-2

Name: (46)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:91
	Pretensioned slab bridge: hollow deck	Date :	Created :

EB – R_1500:

Section	D	B	Section
1	0.176	1.500	RSS D = 0.176 B = 1.5
2	0.344	1.500	RSS D = 0.344 B = 1.5
-	m	m	-

Eccentricity in z direction (ez): -0.412 m

Multiple Varying Section



Analysis category:

Specify shape interpolation

Symmetric section

Distance interpretation

Scaled to fit each line individually

Along reference path

	Section	Shape Interpolation	Distance
1	1,50 x 0,176 (RSS D=0,176 B=1,5)	Start	0,0
2	1,50 X 0,344 (RSS D=0,344 B=1,5)	Linear	0,65

Alignment

Vertical: ey origin:

Horizontal: ez origin:

Align all sections to section:

Interpolation of properties:

Section 1-1 Section 2-2

Name: (47)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:92
	Pretensioned slab bridge: hollow deck	Date :	Created :

EB - R_2000:

Section	D	B	Section
1	0.176	2.000	RSS D = 0.176 B = 2.0
2	0.344	2.000	RSS D = 0.344 B = 2.0
-	m	m	-

Eccentricity in z direction (ez): -0.412 m

Multiple Varying Section

Analysis category
Distance interpretation

Specify shape interpolation
 Symmetric section

Scaled to fit each line individually
 Along reference path Centerline

	Section	Shape Interpolation	Distance	Edit...
1	2.00 x 0.176 (RSS D=0.176 B=2)	Start	0.0	Insert
2	2.00 X 0.344 (RSS D=0.344 B=2)	Linear	0.65	Delete

Flip

Alignment

Vertical Top to top ey origin Same as ez Align all sections to section 2

Horizontal Centre to centre ez origin Centroid Interpolation of properties Use Section Calculato

Section 1-1
Section 2-2

Name EB - R_2000 (48)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:93
	Pretensioned slab bridge: hollow deck	Date :	Created :

EB - R_2500:

Section	D	B	Section
1	0.176	2.500	RSS D = 0.176 B = 2.5
2	0.344	2.500	RSS D = 0.344 B = 2.5
-	m	m	-

Eccentricity in z direction (ez): -0.412 m

Multiple Varying Section
✕

Analysis category:

Specify shape interpolation

Symmetric section

Distance interpretation

Scaled to fit each line individually

Along reference path

	Section	Shape Interpolation	Distance	Edit...
1	2.50 x 0.176 (RSS D=0.176 B=2.5)	Start	0,0	Insert
2	2.50 x 0.344 (RSS D=0.344 B=2.5)	Linear	0,65	Delete

Alignment

Vertical: ey origin:

Horizontal: ez origin:

Align all sections to section:

Interpolation of properties:

Name: (49)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:94
	Pretensioned slab bridge: hollow deck	Date :	Created :

EB - R_3000:

Section	D	B	Section
1	0.176	3.000	RSS D = 0.176 B = 3.0
2	0.344	3.000	RSS D = 0.344 B = 3.0
-	m	m	-

Eccentricity in z direction (ez): -0.412 m

Multiple Varying Section



Analysis category:

Specify shape interpolation
 Symmetric section

Distance interpretation
 Scaled to fit each line individually
 Along reference path

	Section	Shape Interpolation	Distance
1	3,00 x 0,176 (RSS D=0,176 B=3)	Start	0,0
2	3,00 X 0,344 (RSS D=0,344 B=3)	Linear	0,65

Edit...
Insert
Delete
Flip

Alignment
Vertical: ey origin:
Horizontal: ez origin:

Align all sections to section:
Interpolation of properties:

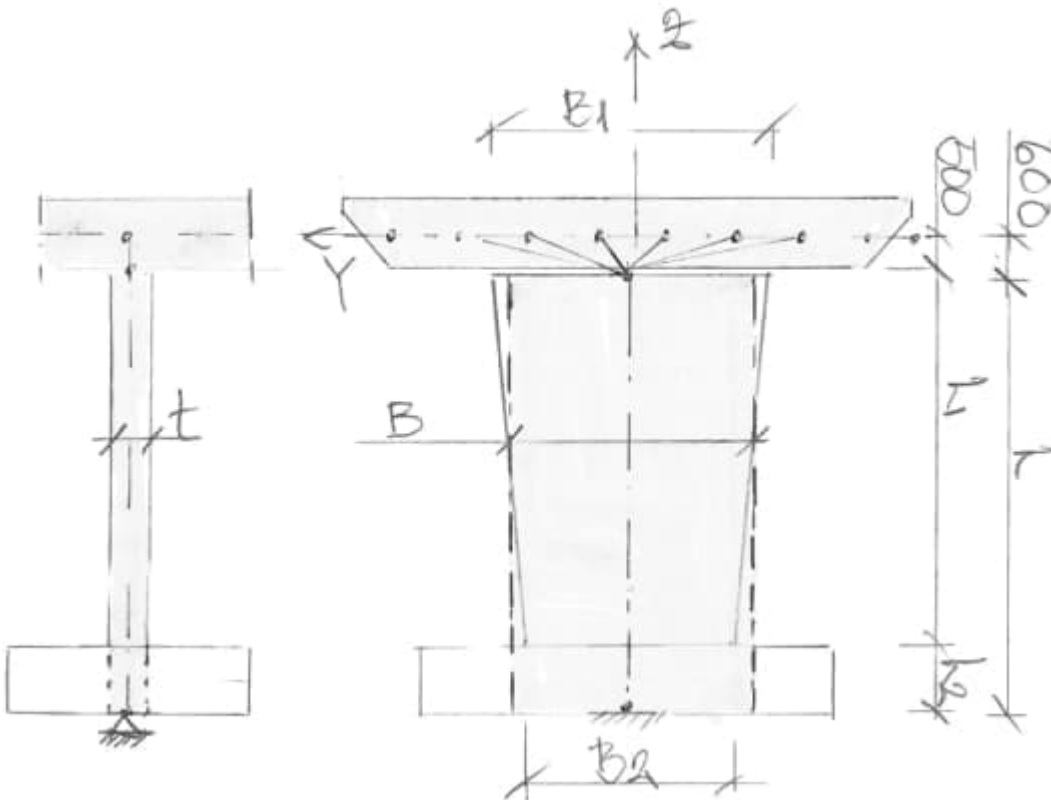
Name: (50)

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:95
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.3.3 Column (CL)

There are a total of 4 pillars belonging to Support 3-6. These have varying lengths, but they are modeled with a constant simplified geometry B x L x t as shown below. This simplification is considered possible because the pillars have significant slenderness in the length direction. The existing boundary conditions also contribute to this.

B	L	t
3.90	12.67	0.60
3.90	11.48	0.60
3.90	9.32	0.60
3.90	10.08	0.60
m	m	m



Simplified cross section.

Section	D	B	Section
4	0.600	3.900	RSS D = 0.6 B = 3.9
-	m	m	-

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:96
	Pretensioned slab bridge: hollow deck	Date :	Created :

Geometric Line



Analysis category

Definition

From library / calculator

Rotation about centroid °

Mirrored about axis

Enter properties

Usage

Parametric Sections

Rectangular Sections

100%

Reinforcement (only used for RC design checks)

ez origin ey origin

	Value
Cross sectional area (A)	2,34
Second moment of area about y axis (Iyy)	0,0702
Second moment of area about z axis (Izz)	2,96595
Product moment of area (Iyz)	0,0
Torsional constant (J)	0,253592
Effective shear area in y direction (Asy)	1,95003
Effective shear area in z direction (Asz)	1,95125
Eccentricity in y direction (ey)	0,0
Eccentricity in z direction (ez)	0,0

Visualise... Tapering >> Section details...

Name (17)

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:97
		Date :	Created :

2.4 MATERIAL

According to common calculation practice, prestressed structural elements shall be given higher stiffness than non-prestressed ones. In the calculation, non-prestressed structural elements are assumed to be cracked, which results in reduced stiffness. In the calculation, the E-modulus for non-prestressed structural elements is reduced to $0.6E_{ck} = 20400 \text{ MPa}$.

The longitudinal beams (LB) are modeled as uncracked and with weight.

Other beams are modeled as cracked and weightless.

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:98
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.4.1 Material longitudinal beams (uncracked)

Isotropic

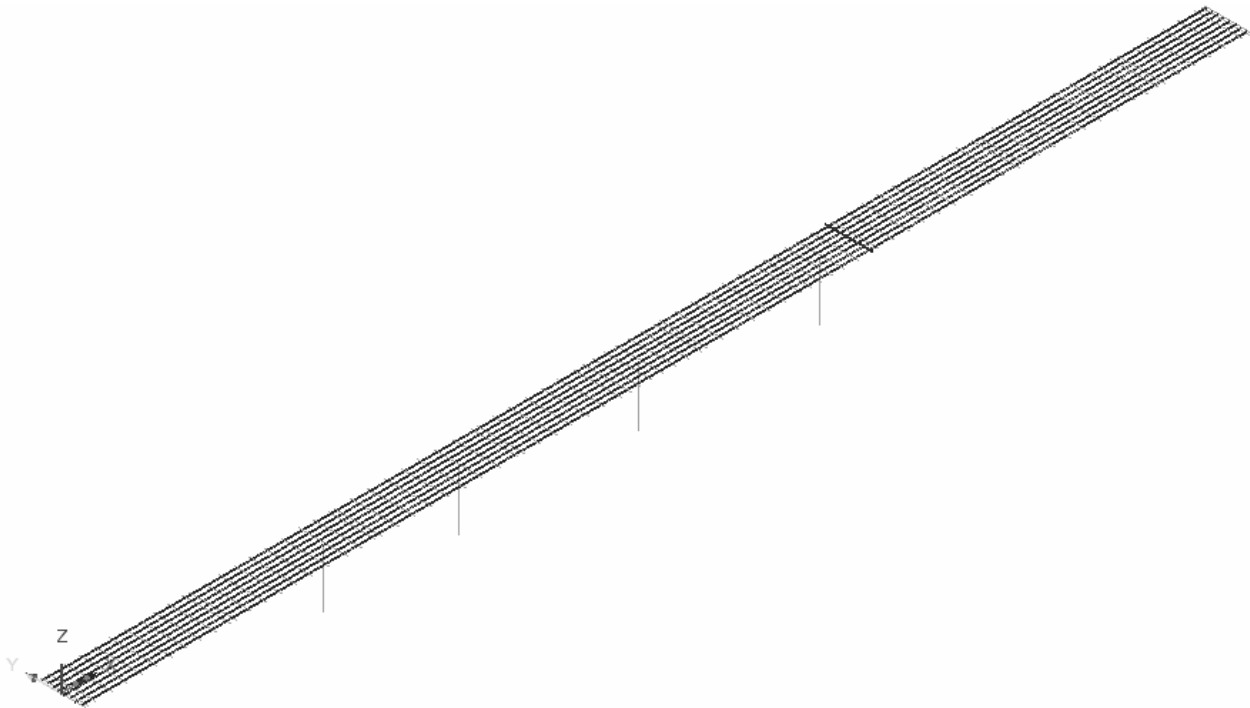
Plastic
 Creep
 Damage
 Shrinkage
 Viscous
 Two phase
 Ko Initialisation

Elastic

Dynamic properties
 Thermal expansion

	Value
Young's modulus	34.0E6
Poisson's ratio	0.2
Mass density	2.4
Coefficient of thermal expansion	10.0E-6

Name (4)



	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:99
	Pretensioned slab bridge: hollow deck	Date :	Created :

2.4.2 Material transversal beams (cracked)

Isotropic

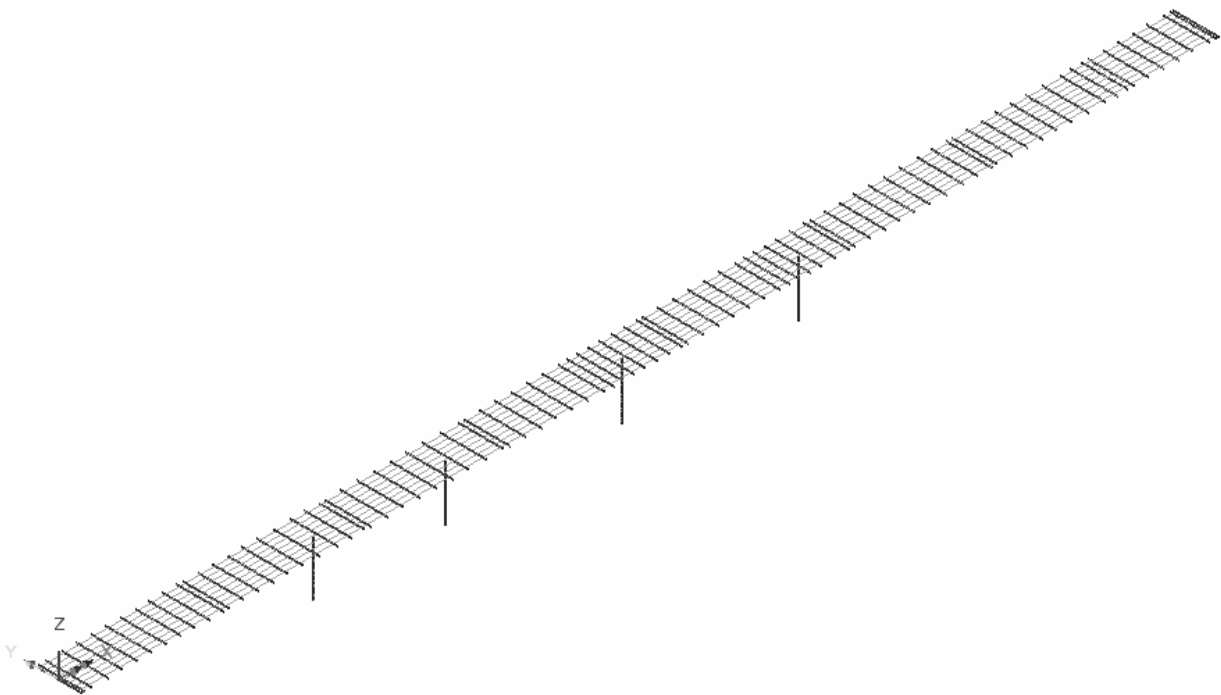
Plastic
 Creep
 Damage
 Shrinkage
 Viscous
 Two phase
 Ko Initialisation

Elastic

Dynamic properties
 Thermal expansion

	Value
Young's modulus	20,42E6
Poisson's ratio	0,2
Mass density	1,0E-3
Coefficient of thermal expansion	10,0E-6

Name (5)



	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:100
	Pretensioned slab bridge: hollow deck	Date :	Created :

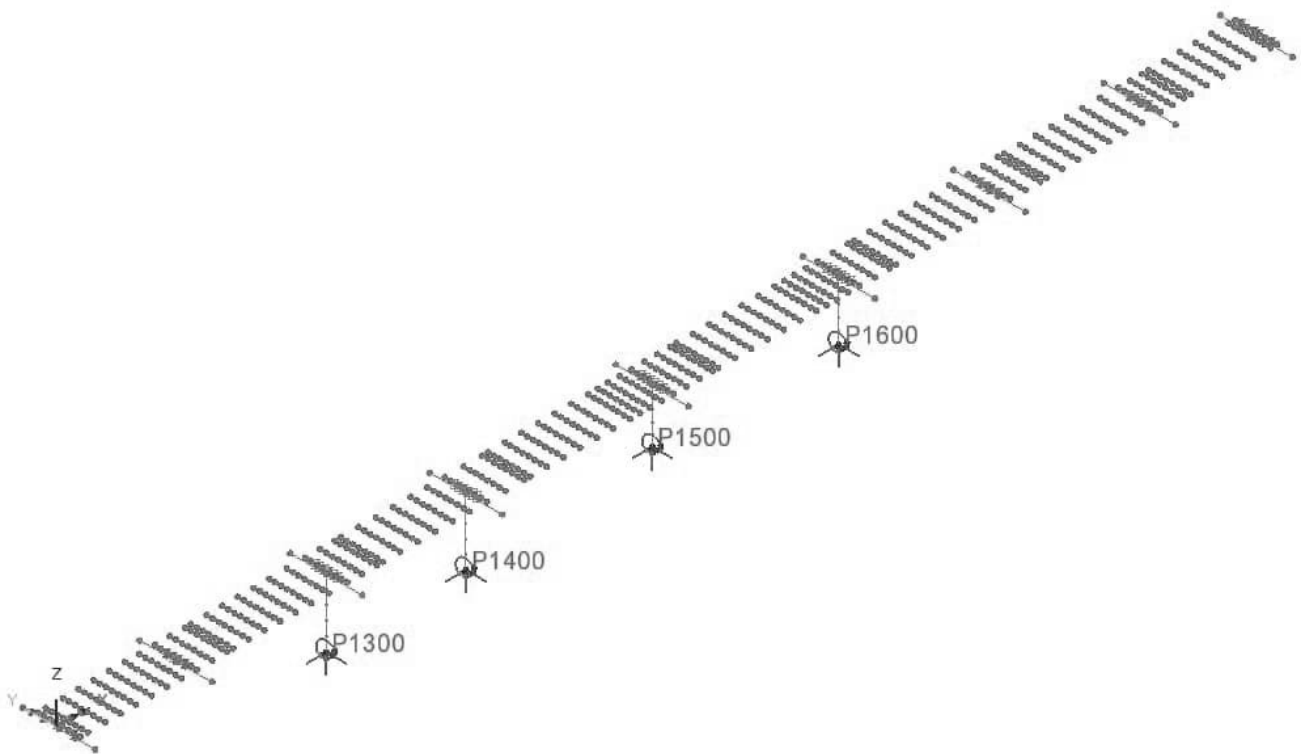
2.5 BOUNDARY CONDITIONS

2.5.1 Foundation

Support 3-6 är modellerad med *Point Supports*.

The boundary conditions in these “super-nodes” are modelled according to global coordinate system as shown in sketch.

Support	Point	Direction	TX	TY	TZ	RX	RY	RZ
3	P1300	Global	Fixed	Fixed	Fixed	Fixed	Free	Free
4	P1400	Global	Fixed	Fixed	Fixed	Fixed	Free	Free
5	P1500	Global	Fixed	Fixed	Fixed	Fixed	Free	Free
6	P1600	Global	Fixed	Fixed	Fixed	Fixed	Free	Free
-	-	-	kN/m	kN/m	kN/m	kNm/rad	kNm/rad	kNm/rad

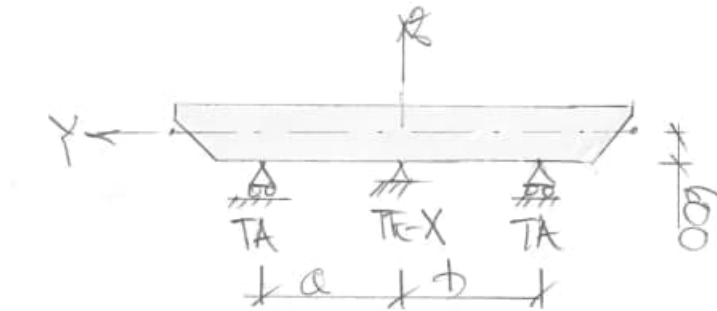


Overview

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:101
		Date :	Created :

2.5.2 Bearings

Bearings at support 1, 2, 7, 8 and 9 are modeled with *Point Supports*. A total of 3 are present at each support with appearance as shown below.



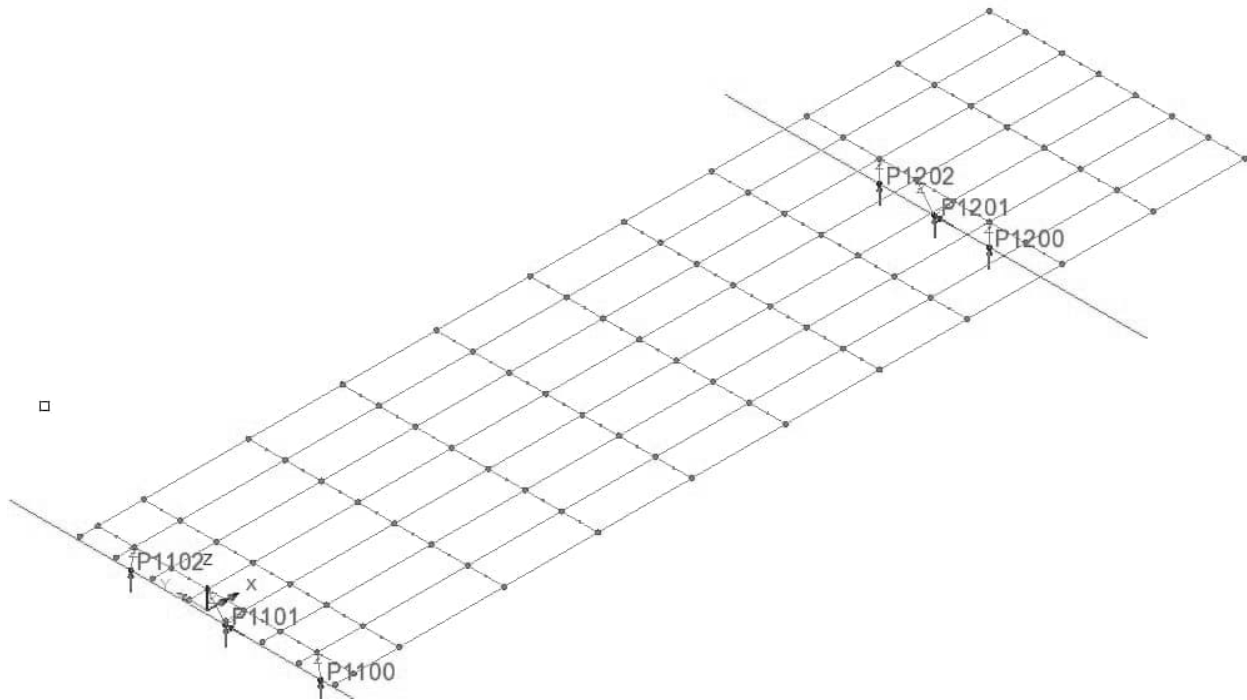
Support	a	b
1	2600	2600
2	1500	1500
7	1500	1500
8	1500	1500
9	2600	2600
-	mm	mm

These layers are modeled in the global coordinate system with boundary conditions as described below.

Bearing	Direction	TX	TY	TZ	RX	RY	RZ
TA	Global	Free	Free	Fixed	Free	Free	Free
TE-X	Global	Free	Fixed	Fixed	Free	Free	Free
-	-	kN/m	kN/m	kN/m	kNm/rad	kNm/rad	kNm/rad

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:102
		Date :	Created :

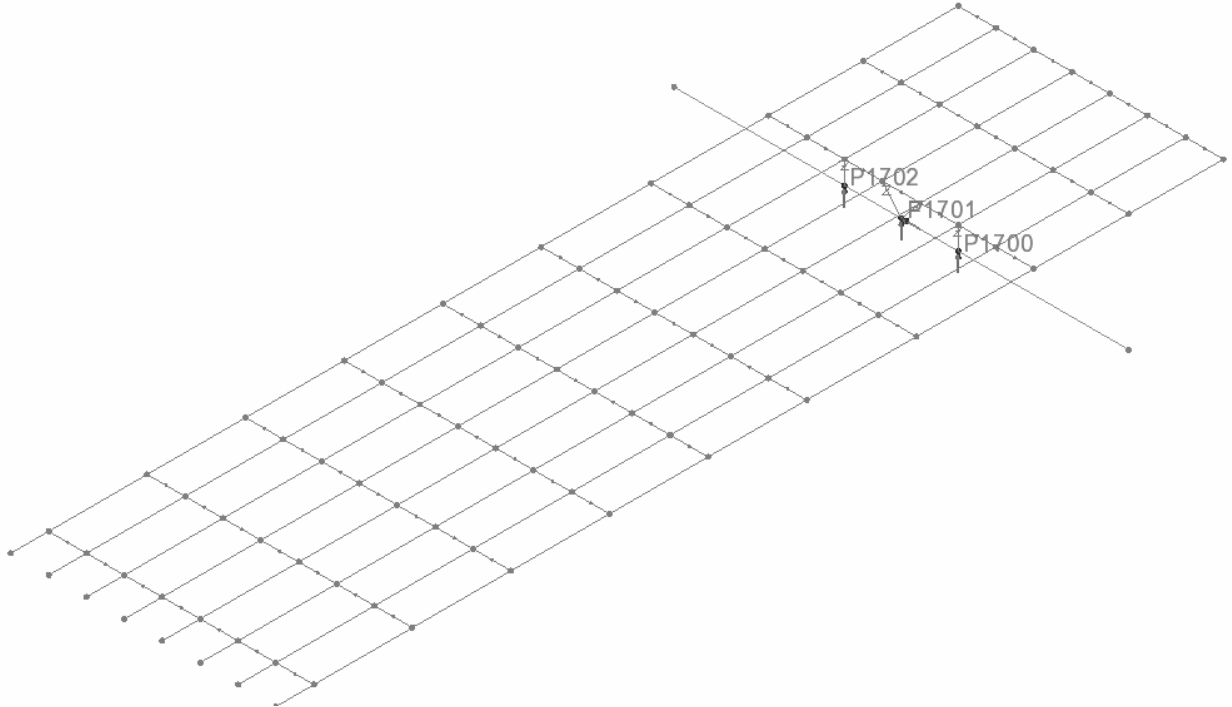
Overview of bearings at casting stage 1:
Support 1 & 2



Support	Typ	Point
1	TA	P1100
1	TE-X	P1101
1	TA	P1102
2	TA	P1200
2	TE-X	P1201
2	TA	P1202

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:103
		Date :	Created :

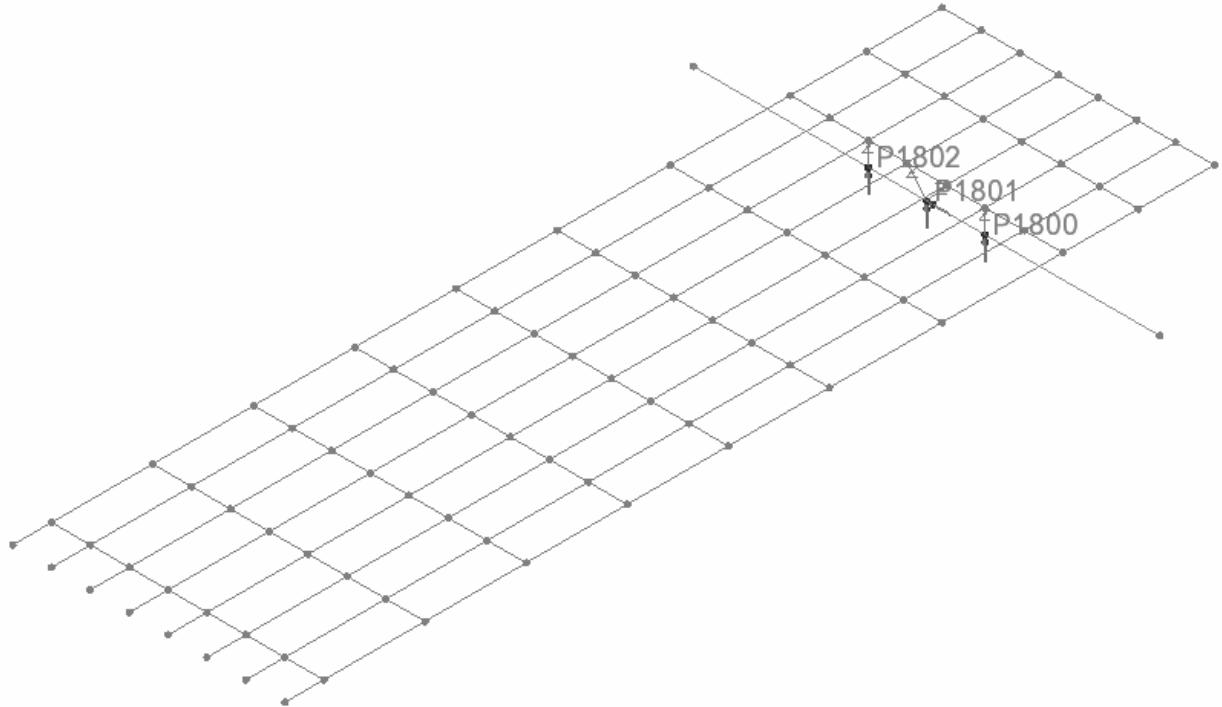
Overview of bearings at casting stage 6:
Support 7



Support	Typ	Point
7	TA	P1700
7	TE-X	P1701
7	TA	P1702

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:104
		Date :	Created :

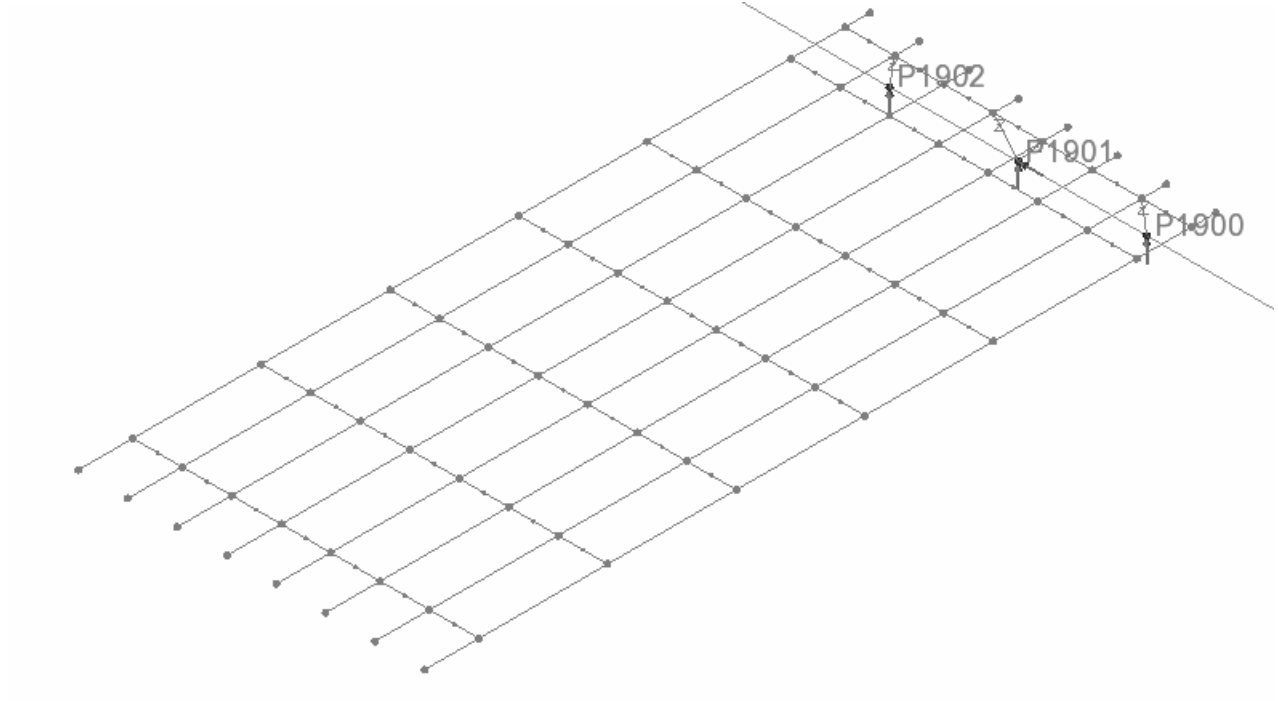
Overview of bearings at casting stage 7:
Support 8



Support	Typ	Point
8	TA	P1800
8	TE-X	P1801
8	TA	P1802

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:105
		Date :	Created :

Overview of bearings at casting stage 8:
Support 9



Support	Typ	Point
9	TA	P1900
9	TE-X	P1901
9	TA	P1902

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:106
		Date :	Created :

2.6 MESH

In the model, 3D beam elements (BMI21) and Joint elements (JSH4) are used. The latter are used to connect columns to the bridge deck at Support 3-6 to the bridge deck.

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:107
		Date :	Created :

2.6.1 Beam element (BMI21)

Longitudinal beams, transversal beams, and columns are modeled as 3D beam elements.

The beam elements are modeled with varying node division within each subarea according to the presentation below.

Name	Divisions	End release: Start	End release: End	Structure
Element 1	1	None	None	LB
Element 2	2	None	None	TB & EB
Element 5	5	None	None	Pelare

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:108
		Date :	Created :

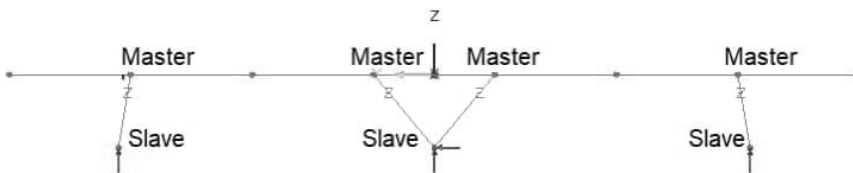
2.6.2 Joint element (JSH4): rigid link from bearing to longitudinal beams

Nodes for bearings are rigidly connected to the longitudinal girders (LB) of the bridge deck.

The controlling node is designated “Master” while the adapting node is designated “Slave”.

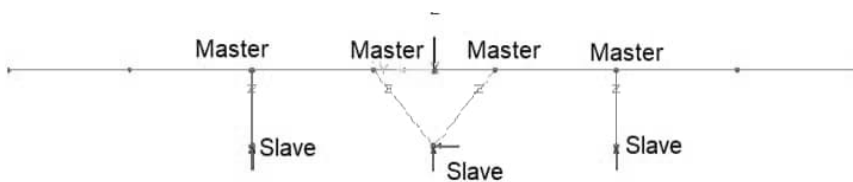
The properties of the Joint element (JSH4) are retrieved and specified in the node designated “Master”. All these nodes are assigned material properties designated “Joint material” in the table below.

Name	u	v	w	THx	THy	Thz
“Joint material”	Fixed	Fixed	Fixed	Free	Free	Free
-	kN/m	kN/m	kN/m	kNm/rad	kNm/rad	kNm/rad



Rigid link at end supports

Support 1 and 9



Rigid link intermediate supports

Support 2, 7 and 8

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:109
		Date :	Created :

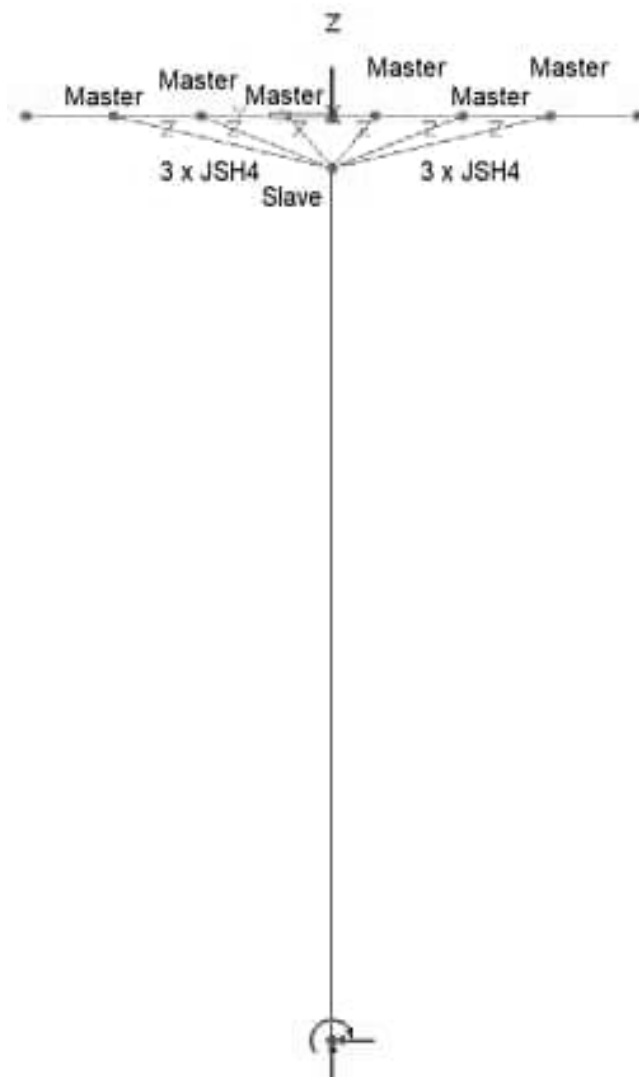
2.6.3 Joint element (JSH4): rigid link from column to transversal beams

Nodes for bearings are rigidly connected to the transverse beams of the bridge deck TB-UK.

The controlling node is designated "Master" while the adapting node is designated "Slave".

The properties of the Joint element (JSH4) are retrieved/indicated in the node designated "Master". All of these nodes are assigned material properties designated "Joint material" in the table below.

Name	u	v	w	THx	THy	Thz
"Joint material"	Fixed	Fixed	Fixed	Free	Free	Free
-	kN/m	kN/m	kN/m	kNm/rad	kNm/rad	kNm/rad



Ridig connection intermeditate supports Support 3-6

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:110
		Date :	Created :

2.7 STAGED CONSTRUCTION

There are a total of 8 construction stages.

The geometric model is the same for these systems, however, it is allowed that boundary conditions, material properties, cross-section constants, and loads vary between the different static systems.

Analysis 9 is referred to as "Base Analysis" and corresponds to the static system in the operational phase. The other analyses are based on this one.

Nr	Analysis	Stage
1	1	I
2	2	II
3	3	III
4	4	IV
5	5	V
6	6	VI
7	7	VII
8	8	VIII
9	9 *	Driftskede

* = "Definition of base analysis"

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:111
	Pretensioned slab bridge: hollow deck	Date :	Created :

The redistribution occurs so that the static system that exists in the "construction stage" transitions to that which exists for the continuous static system present in the "operational stage". The simplified method according to SS-EN 1992-2 section KK.7 is used to study the impact of staged construction.

For the check, it has been assumed that there are 2 months (60 days) between the time (t_0) of casting stage until the formwork removal of the adjoining casting stage (t_c).

$$S(t) \approx \sum_{i=1}^8 S_{0,i} + \left(S_c - \sum_{i=1}^8 S_{0,i} \right) \cdot \frac{\varphi(t) - \varphi(60days)}{1 + 0.8 \cdot \varphi(t)}$$

S_c : forces static system operational stage

$S_{0,i}$: forces static system during construction stages

$$\varphi(60days) = 0.4$$

$$\varphi(120 years) = 1.4$$

$$S(120years) \approx \sum_{i=1}^8 S_{0,i} + \left(S_c - \sum_{i=1}^8 S_{0,i} \right) \cdot \frac{1.4 - 0.4}{1 + 0.8 \cdot 1.4} = \sum_{i=1}^8 S_{0,i} + 0.47 \cdot \left(S_c - \sum_{i=1}^8 S_{0,i} \right)$$

M_c : static system "operational stage" (Analysis 9)

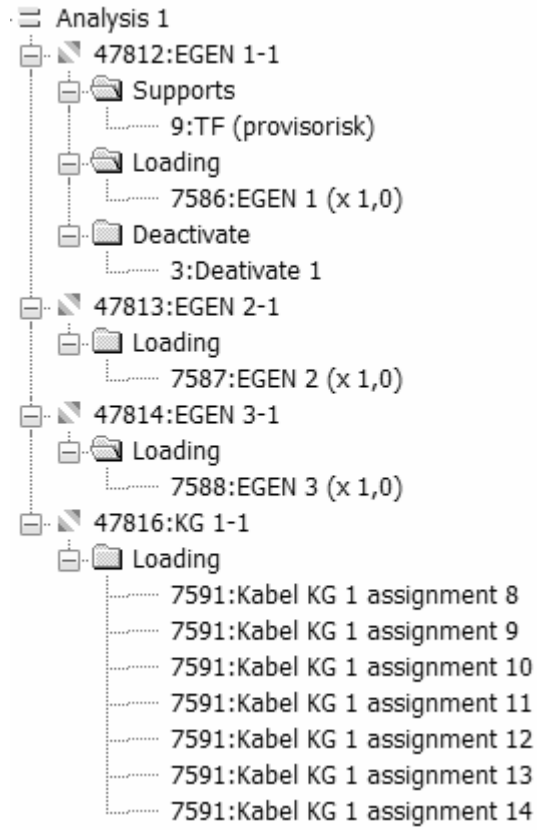
M_0 : static system "construction stage" (Analysis 1-8)

$$\rightarrow M(t = 120years) = 0.47 M_c + 0.53 M_0$$

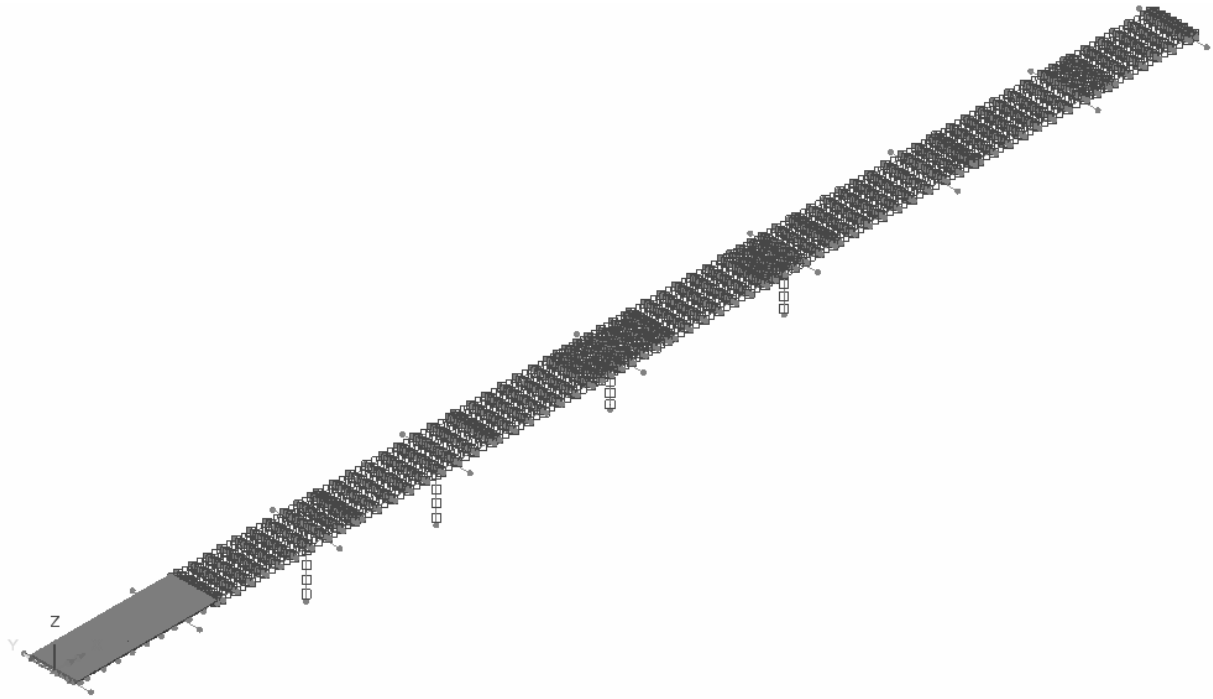
	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:112
		Date :	Created :

Analysis 1:

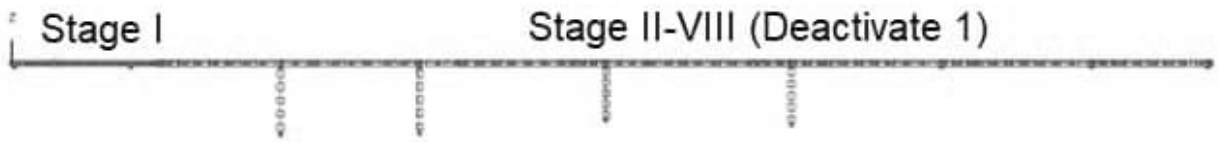
(Only STAGE I is "active" while STAGE II-VIII are "deactive")



	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:113
		Date :	Created :



OVERVIEW

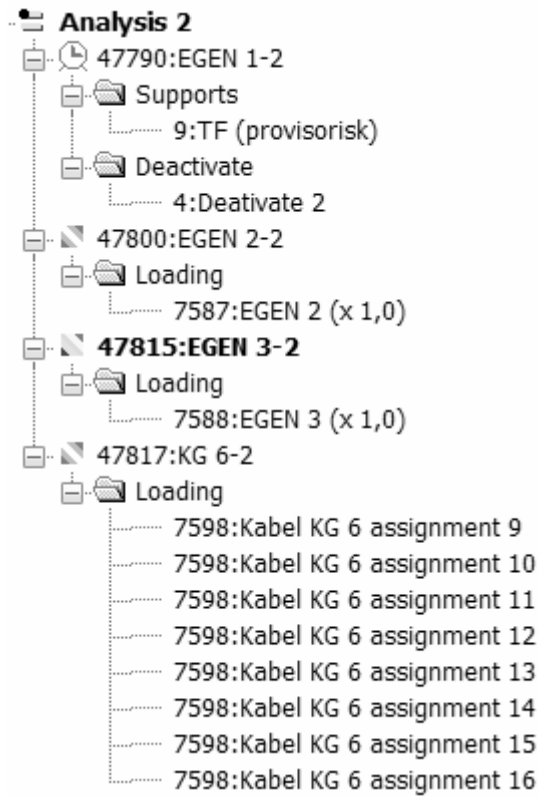


ELEVATION

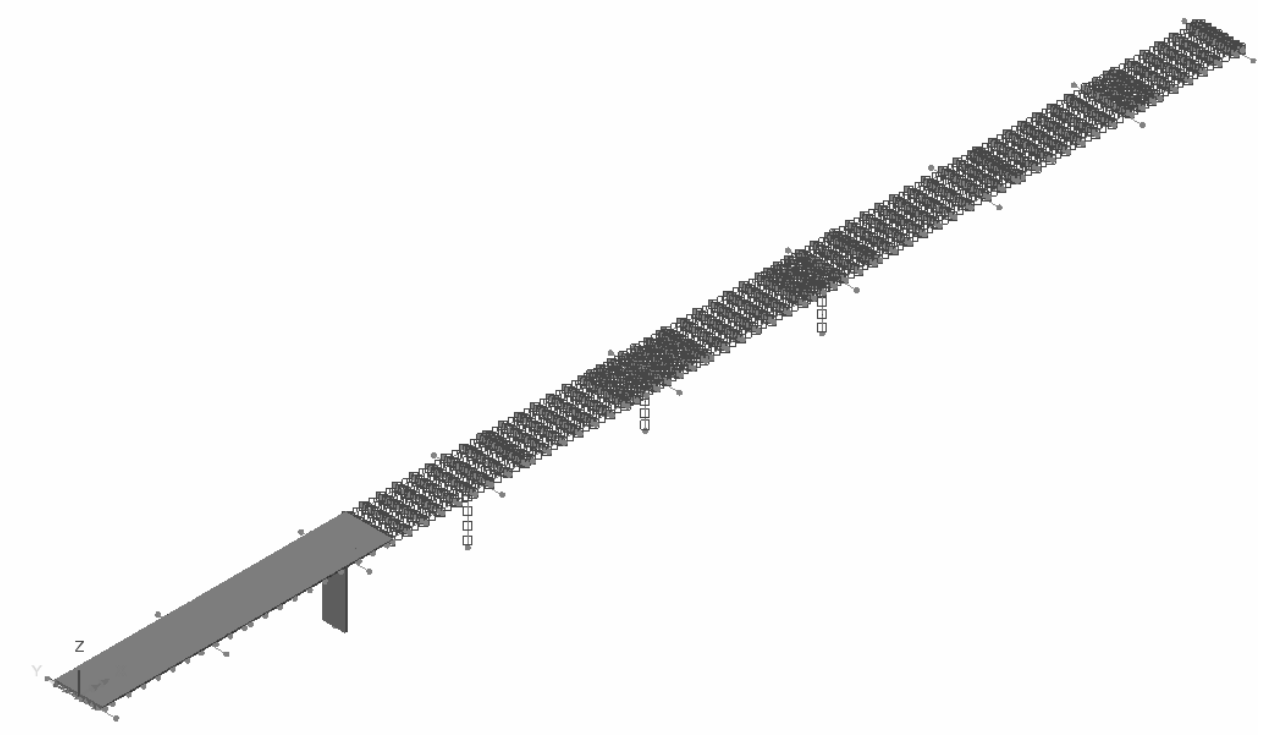
	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:114
		Date :	Created :

Analysis 2:

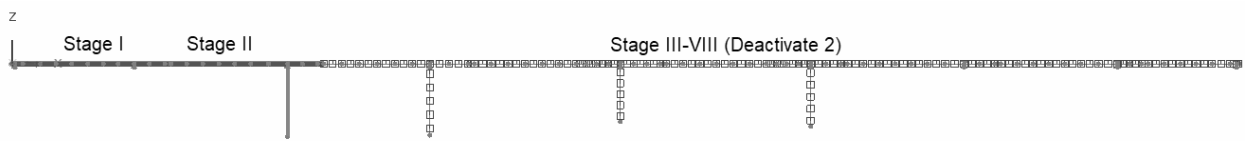
(Only STAGE I-II is "active" while STAGE III-VIII are "deactive")



	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:115
		Date :	Created :



OVERVIEW

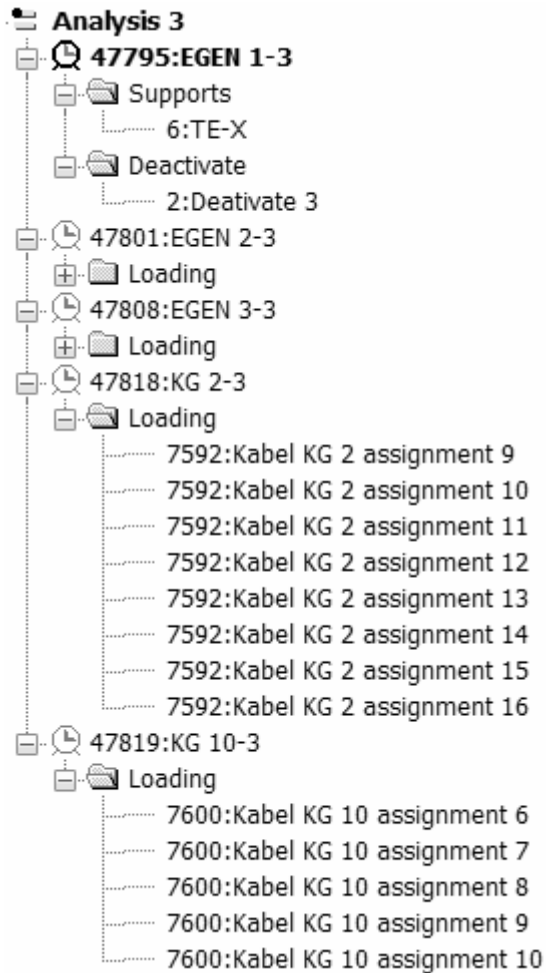


ELEVATION

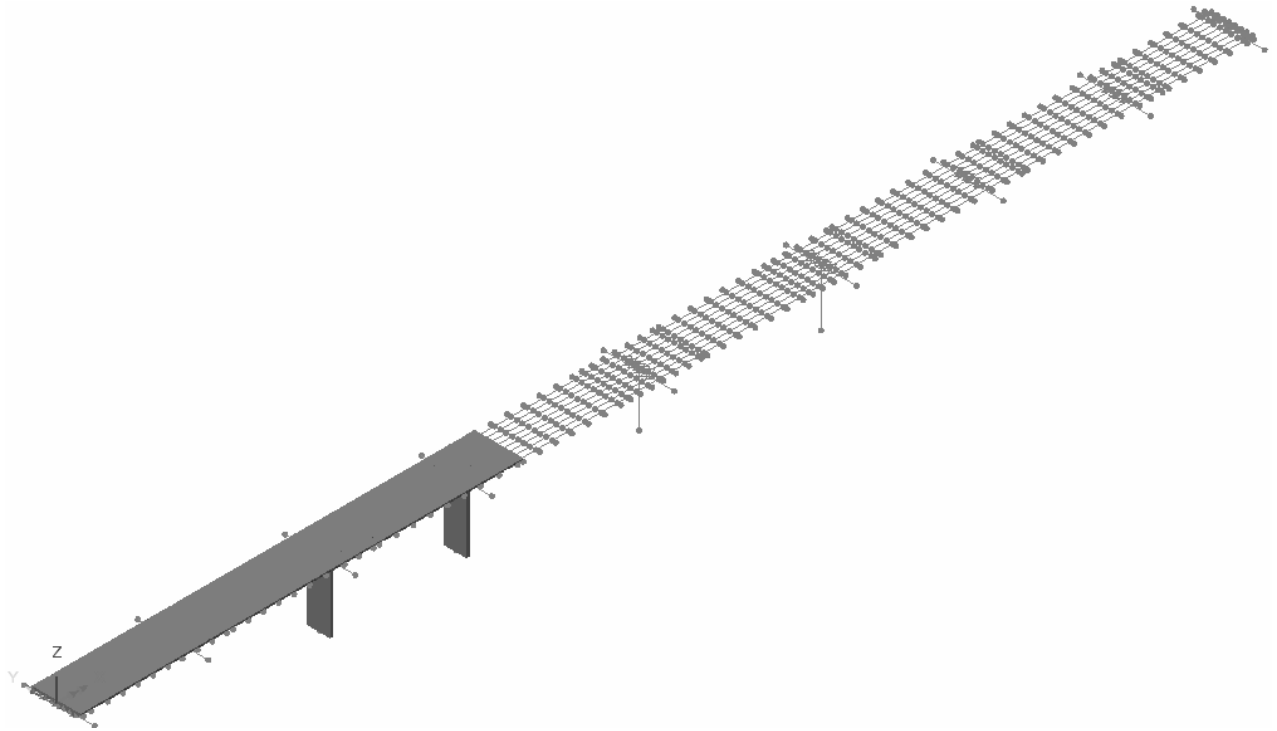
	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:116
	Pretensioned slab bridge: hollow deck	Date :	Created :

Analysis 3:

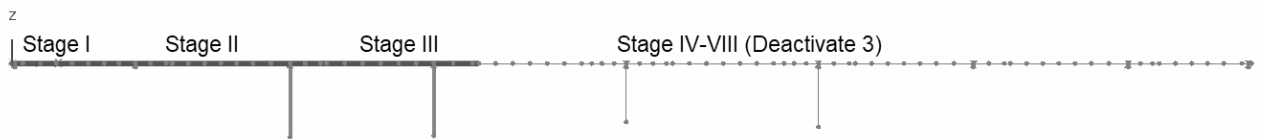
(Only STAGE I-III is "active" while STAGE IV-VIII are "deactive")



	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:117
		Date :	Created :



OVERVIEW

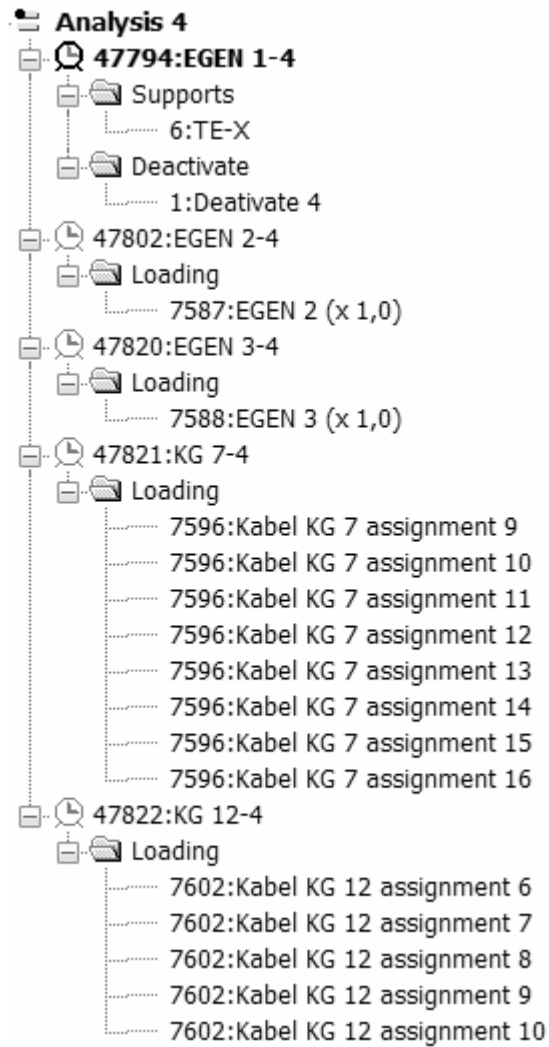


ELEVATION

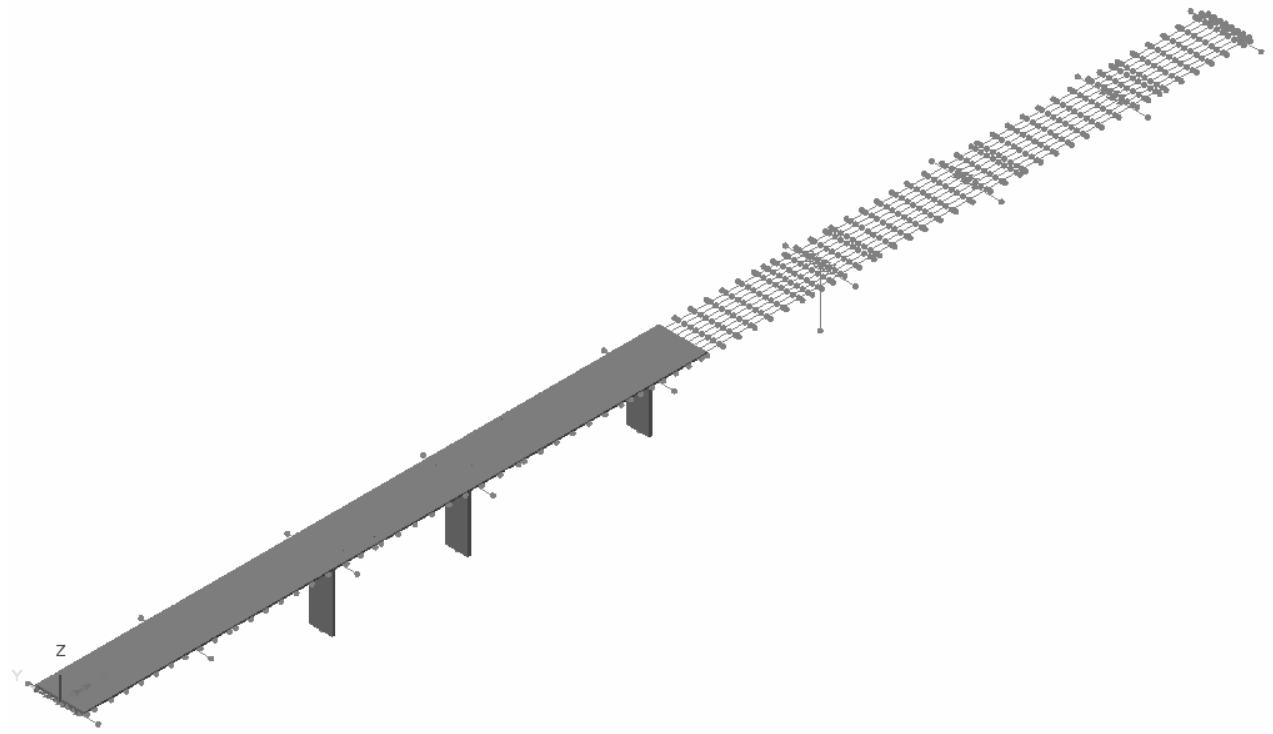
	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:118
	Pretensioned slab bridge: hollow deck	Date :	Created :

Analysis 4:

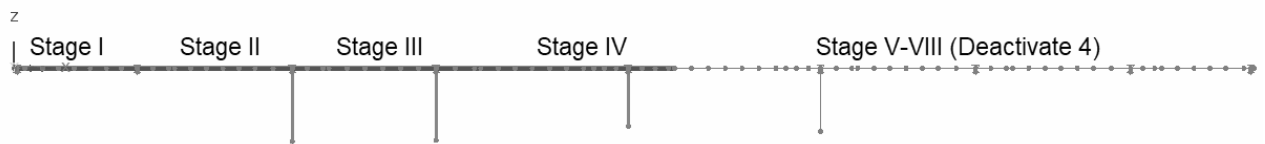
(Only STAGE I-IV is "active" while STAGE V-VIII are "deactive")



	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:119
		Date :	Created :



OVERVIEW

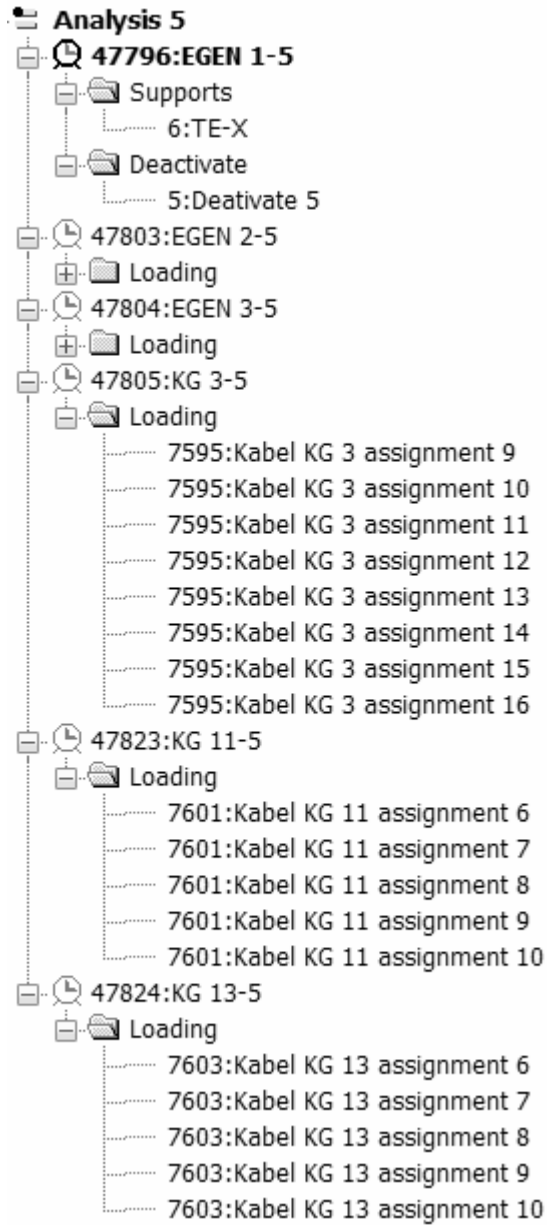


ELEVATION

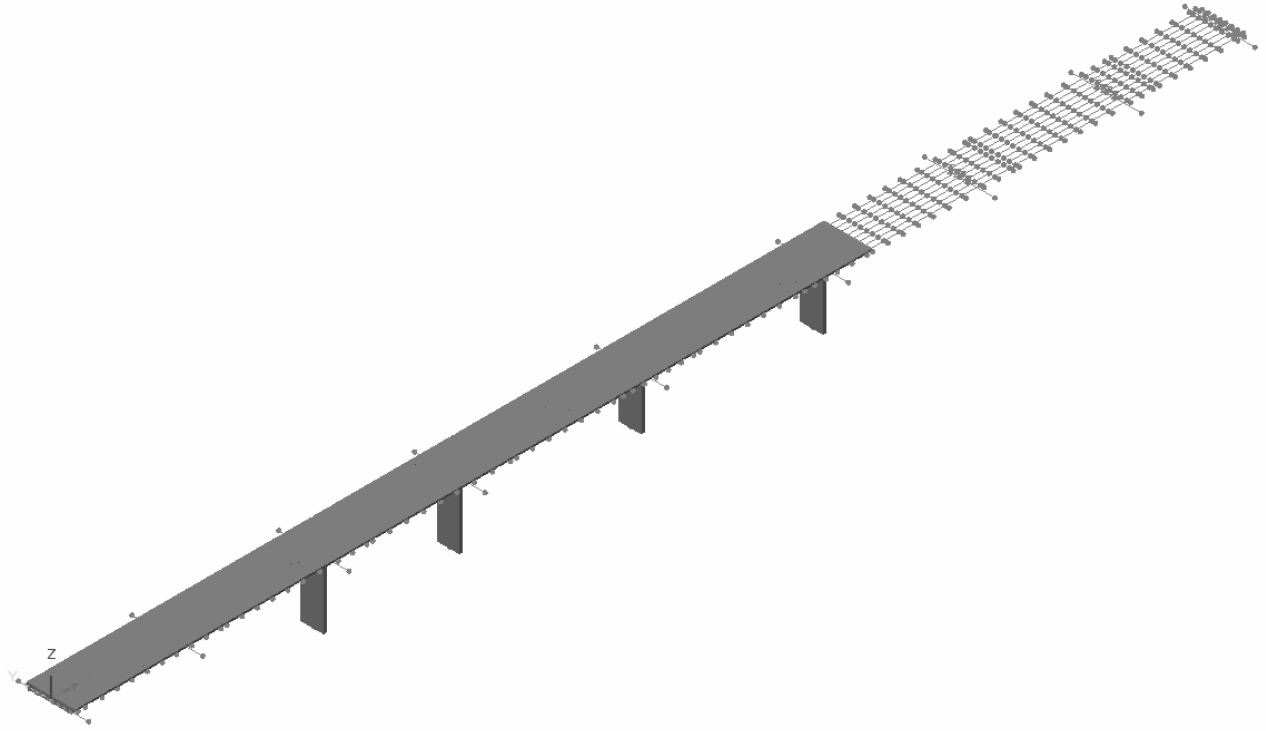
	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A2:120
	Pretensioned slab bridge: hollow deck	Date :	Created :

Analysis 5:

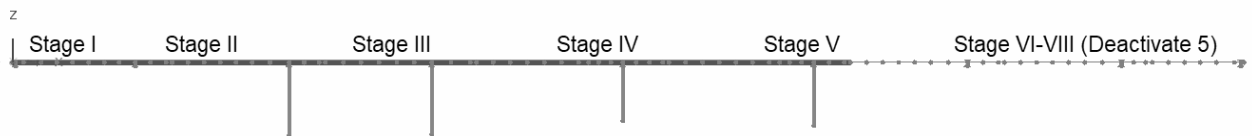
(Only STAGE I-V is "active" while STAGE VI-VIII are "deactive")



	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:121
		Date :	Created :



OVERVIEW

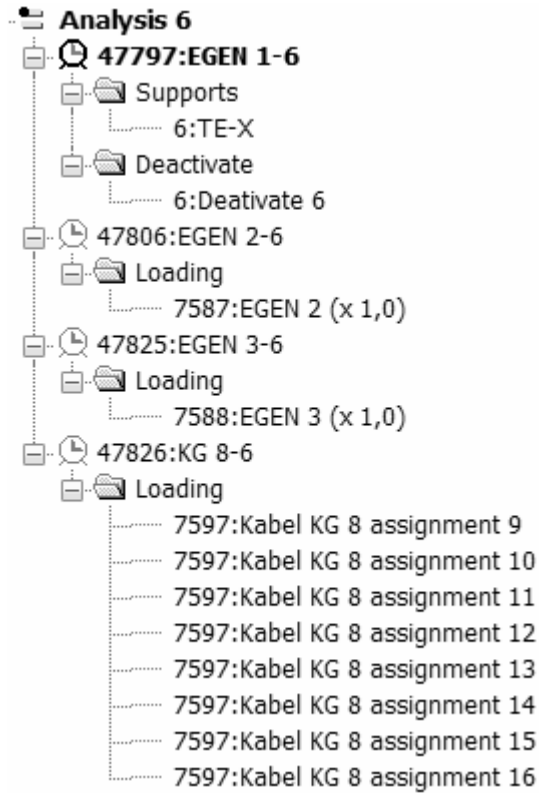


ELEVATION

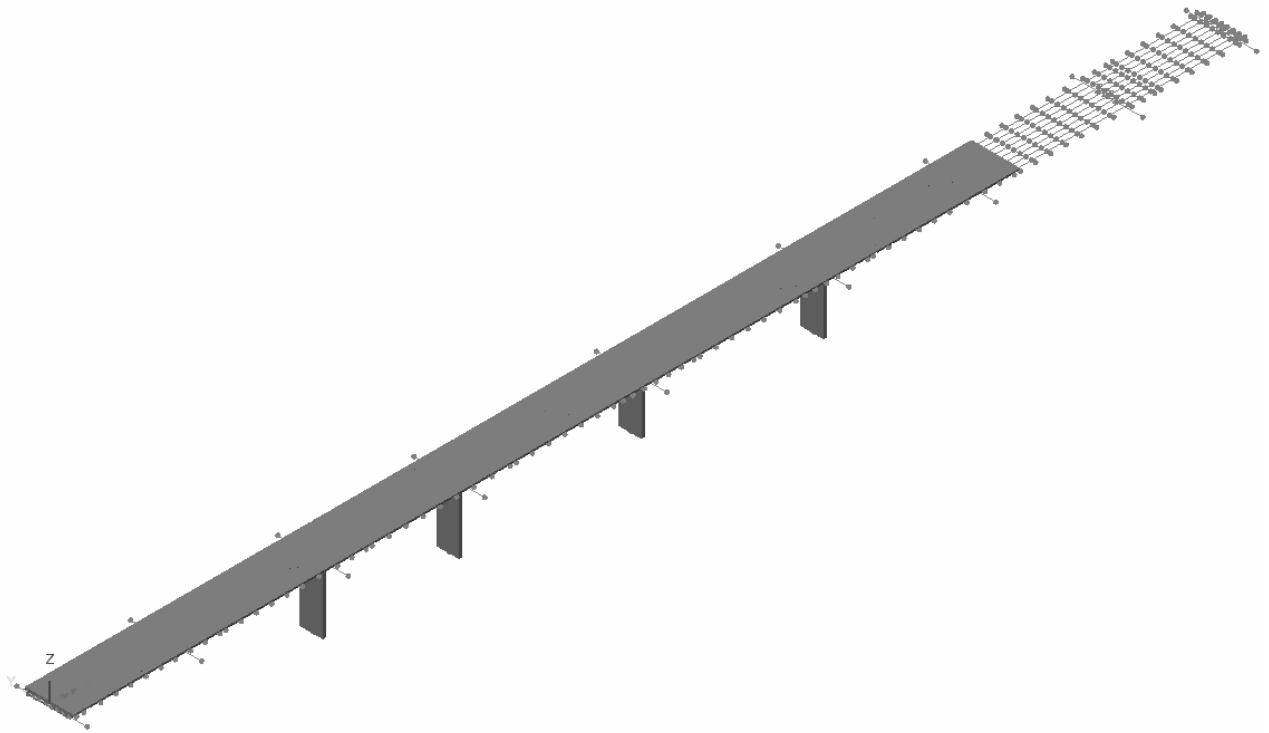
	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:122
		Date :	Created :

Analysis 6:

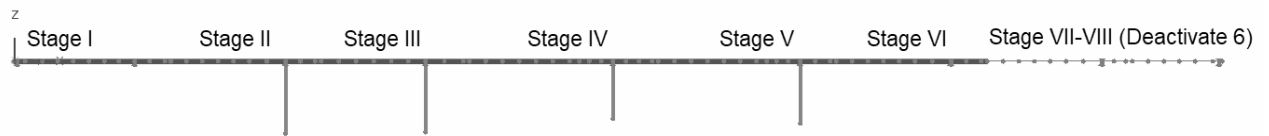
(Only STAGE I-VI is "active" while STAGE VII-VIII are "deactive")



	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:123
		Date :	Created :



OVERVIEW



ELEVATION

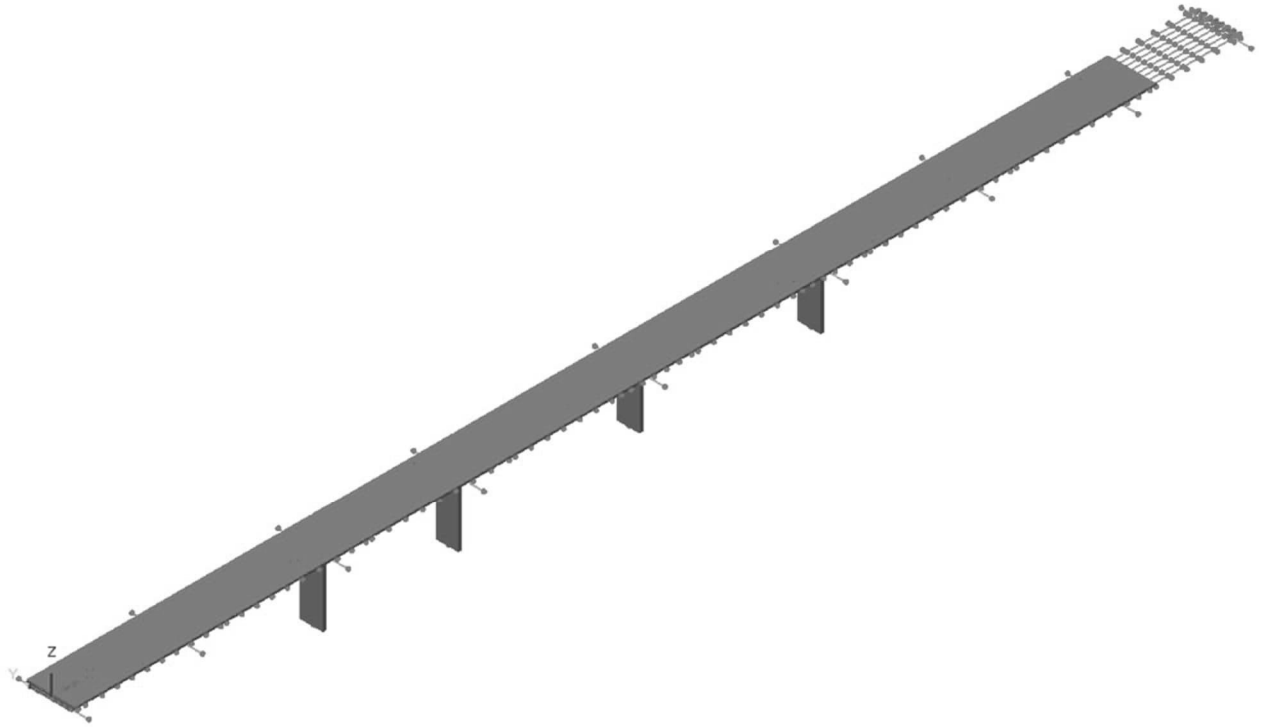
	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:124
		Date :	Created :

Analysis 7:

(Only STAGE I-VII is "active" while STAGE VIII is "deactive")

- **Analysis 7**
 - [-] 🔍 47798:EGEN 1-7
 - [-] 📁 Supports
 - 6:TE-X
 - [-] 📁 Deactivate
 - 7:Deativate 7
 - [-] 🕒 47807:EGEN 2-7
 - [-] 📁 Loading
 - 7587:EGEN 2 (x 1,0)
 - [-] 🕒 47827:EGEN 3-7
 - [-] 📁 Loading
 - 7588:EGEN 3 (x 1,0)
 - [-] 🕒 47828:KG 4-7
 - [-] 📁 Loading
 - 7593:Kabel KG 4 assignment 9
 - 7593:Kabel KG 4 assignment 10
 - 7593:Kabel KG 4 assignment 11
 - 7593:Kabel KG 4 assignment 12
 - 7593:Kabel KG 4 assignment 13
 - 7593:Kabel KG 4 assignment 14
 - 7593:Kabel KG 4 assignment 15
 - 7593:Kabel KG 4 assignment 16

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:125
		Date :	Created :



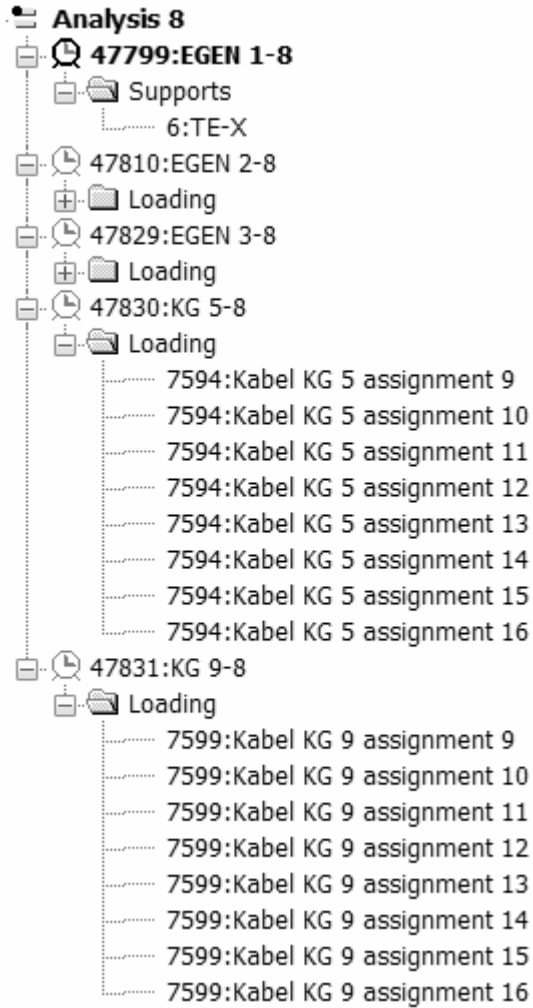
OVERVIEW



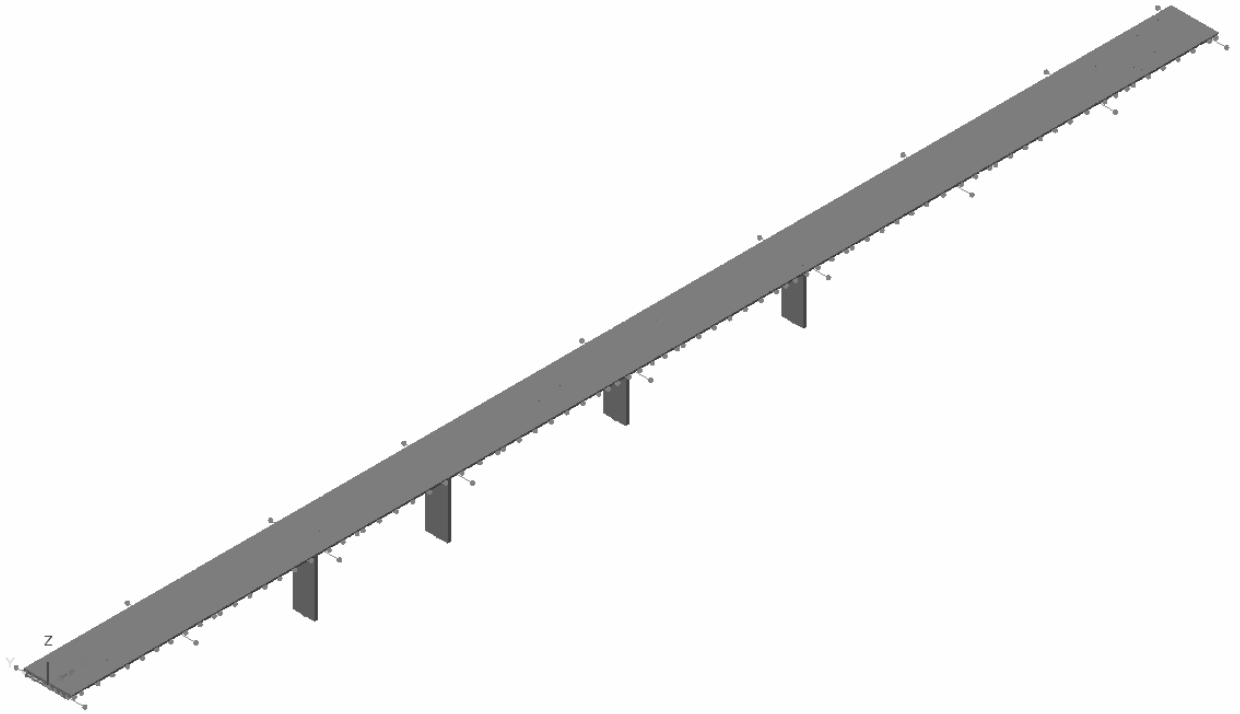
ELEVATION

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:126
		Date :	Created :

Analysis 8:
(All stages are "active")



	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:127
		Date :	Created :



OVERVIEW



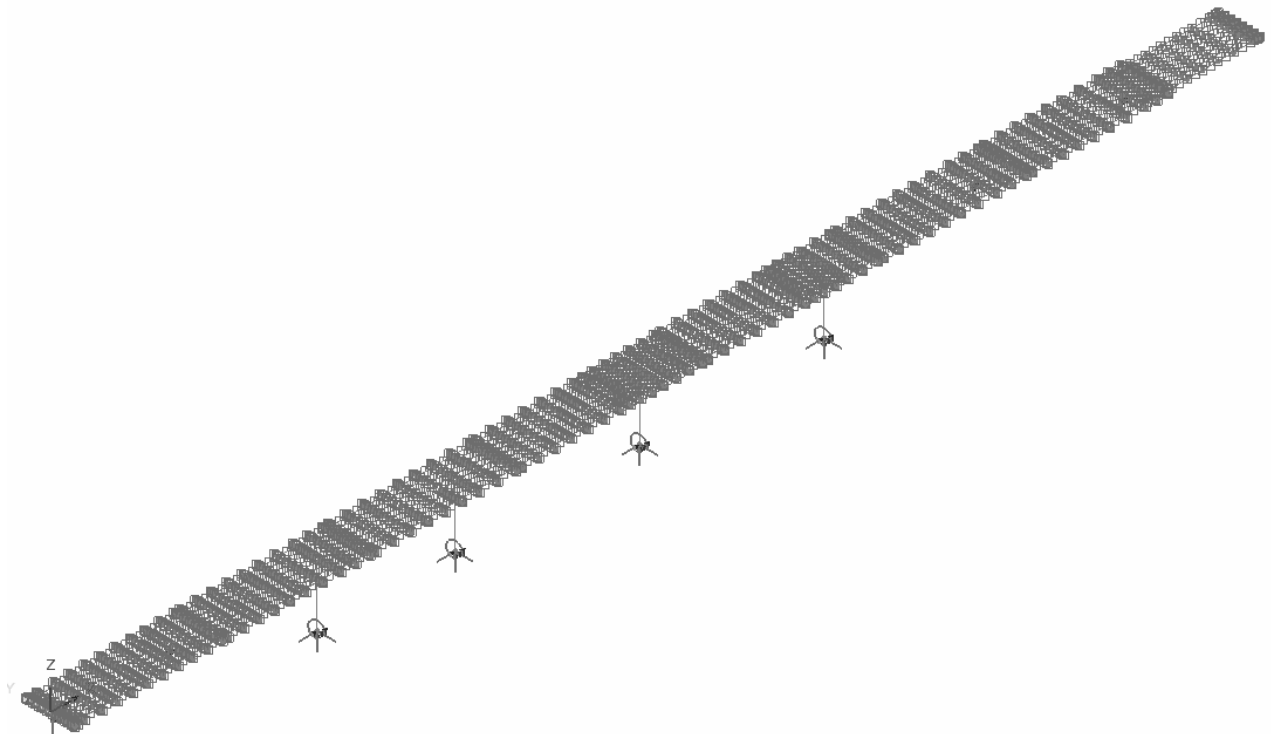
ELEVATION

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A2:128
		Date :	Created :

2.8 SEARCH AREA

Discrete load can be applied to structure as geometrical load areas. These areas are termed Search Area.

In this case, a Search Area is defined for longitudinal beams (LB) and transversal beams at the top (TB-OK).



Search area : Deck
All LB and TB-OK

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:1
		Date :	Created :

3. LOADS

3.1	DEAD WEIGHT	page 3:2-7
3.2	SURFACING	page 3:8
3.3	CREEP	page 3:9-10
3.4	SHRINKAGE	page 3:11-
3.5	TRAFFIC	page 3:12-29
3.6	BRAKING LOAD	page 3:30-32
3.7	TEMPERATUR	page 3:33
3.8	PRESTRESS	page 3:34-95
3.9	LOAD COMBINATIONS	page 3:96-107

Not all loads are considered. Only the above are appied.

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:2
		Date :	Created :

3.1 DEAD WEIGHT

$$\gamma_c = 25 \cdot \frac{kN}{m^3} \quad : \text{betong}$$

3.1.1 Load bridge deck excl. edge beam

The loads belonging to the bridge deck, excluding edge beams, are introduced as line loads along the longitudinal beams (LB).

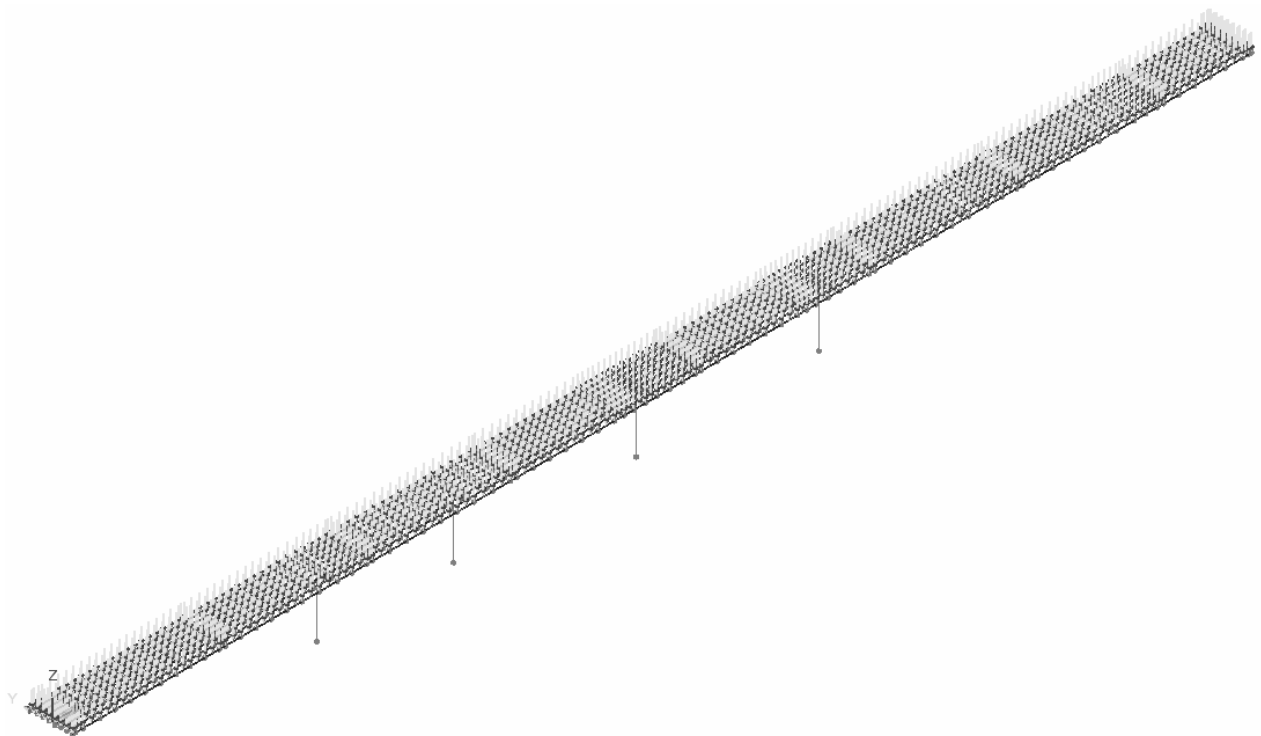
Load : EGEN 1

Structural loading : Body force

Linear acceleration in Z direction (a_z) : $-10 \frac{m}{s^2}$

Load case : EGEN 1

Loading assignment: Assign to lines (LB 1-8)



Overview 3D

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:3
	Pretensioned slab bridge: hollow deck	Date :	Created :

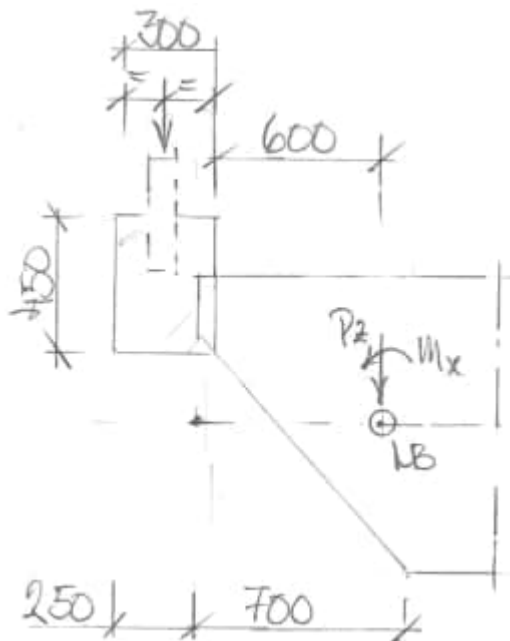
3.1.2 Edge beam + railing: left side

The load belonging to the edge beam including the railing is applied as a line load along the longitudinal beam (LB 1) nearest the left side. The effect of eccentric load placement is accounted for by applying an equivalent line moment.

$$p_{railing} = 0.5 \frac{kN}{m}$$

$$\rightarrow p_z = p_{railing} + p_{EB} = 0.5 \frac{kN}{m} + 0.45m \cdot 0.30m \cdot 24 \frac{kN}{m^3} = -4 \frac{kN}{m}$$

$$\rightarrow m_x = p_z \cdot (0.6m + 0.15m) = -3 \frac{kNm}{m}$$



	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:4
		Date :	Created :

Load : EGEN 2

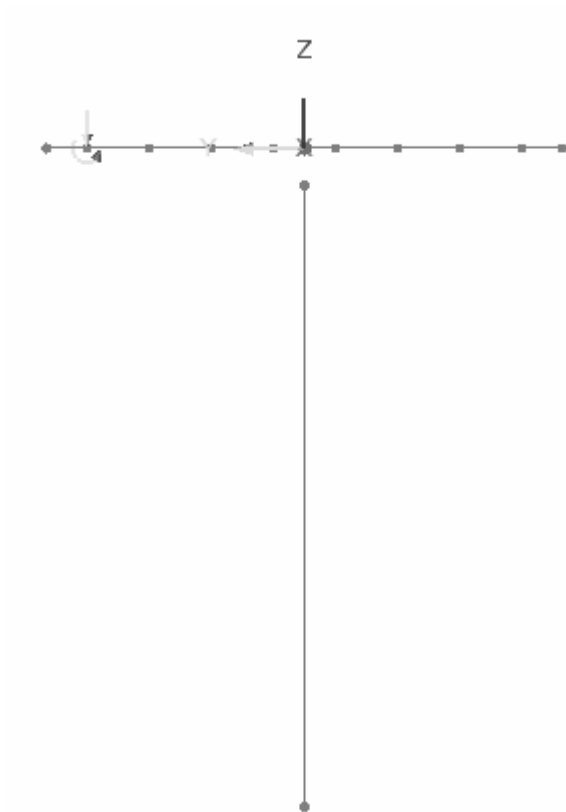
Structural loading : Global distributed

Load Z direction: -4 kN/m

Moment about X axis: -3 kN/m

Load case : EGEN 2

Loading assignment: Assign to lines (LB 1)



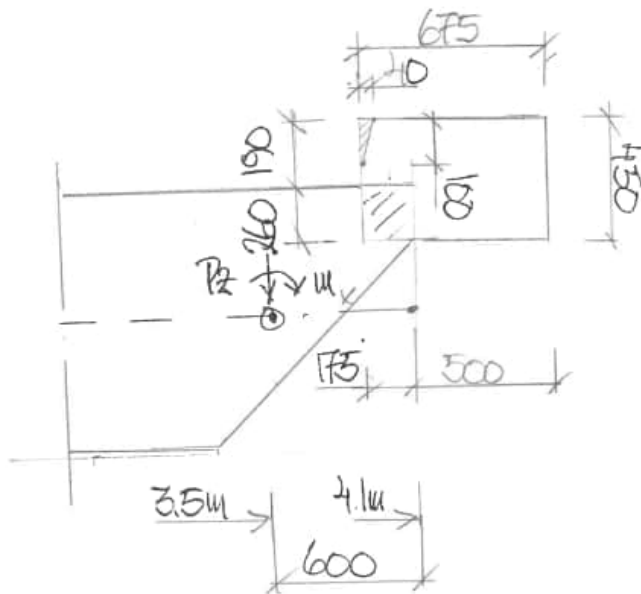
	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:5
	Pretensioned slab bridge: hollow deck	Date :	Created :

3.1.3 Edge beam: right side

The load belonging to the edge beam including the railing is applied as a line load along the longitudinal beam (LB 8) nearest the right side. The effect of eccentric load placement is accounted for by applying an equivalent line moment.

$$\rightarrow p_z = p_{KB} = (0.675m \cdot 0.45m - 0.175m \cdot 0.26m - 0.02m \cdot 0.10m) \cdot 24 \frac{kN}{m^3} = -6 \frac{kN}{m} \left(-4 \frac{kN}{m} \right)$$

$$\rightarrow m_x = -p_z \cdot (0.6m + 0.25m) = 5 \frac{kNm}{m} \left(3 \frac{kNm}{m} \right)$$



	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:6
		Date :	Created :

Load: EGEN.3

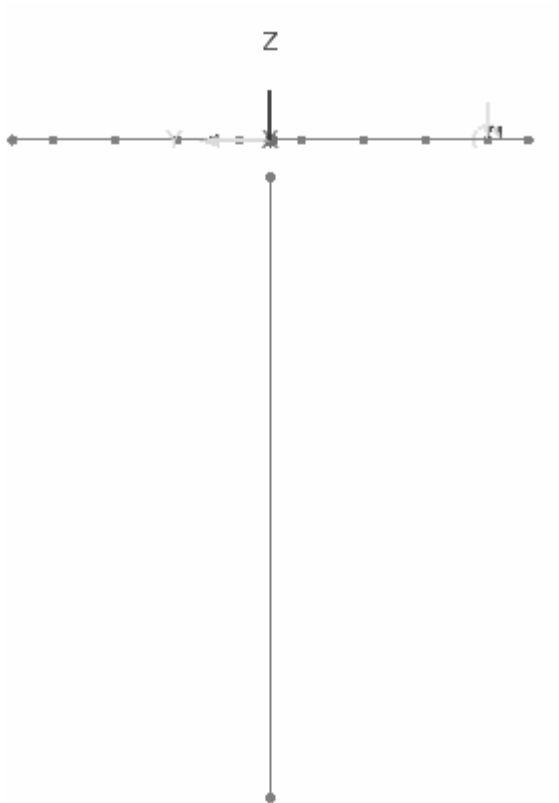
Structural loading : Global distributed

Load Z direction: -4 kN/m

Moment about X axis: +3 kN/m

Load case : EGEN 3

Loading assignment: Assign to lines (LB 8)



	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:7
		Date :	Created :

3.1.4 Load combinations

Load combination basis EGEN-E:
(Static system "Analysis 1" → "Analysis 8")

Load case	Factor
EGEN 1-1	1.00
EGEN 2-1	1.00
EGEN 3-1	1.00
EGEN 1-2	1.00
EGEN 2-2	1.00
EGEN 3-2	1.00
EGEN 1-3	1.00
EGEN 2-3	1.00
EGEN 3-3	1.00
EGEN 1-4	1.00
EGEN 2-4	1.00
EGEN 3-4	1.00
EGEN 1-5	1.00
EGEN 2-5	1.00
EGEN 3-5	1.00
EGEN 1-6	1.00
EGEN 2-6	1.00
EGEN 3-6	1.00
EGEN 1-7	1.00
EGEN 2-7	1.00
EGEN 3-7	1.00
EGEN 1-8	1.00
EGEN 2-8	1.00
EGEN 3-8	1.00

Basic load combination EGEN-C:
(Static system "Analysis 9")

Load case	Factor
EGEN 1	1.00
EGEN 2	1.00
EGEN 3	1.00

Basic load combination EGEN-:

Load case	Factor
EGEN-E	0.51
EGEN-C	0.49

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:8
		Date :	Created :

3.2 SURFACING

Thickness pavement with a thickness of 90 mm is considered.

$$q_{belagg} = \gamma_{belagg} \cdot t = 22 \frac{kN}{m^3} \cdot 0.09m = 1.8kPa \rightarrow p_z = q_{belagg} \cdot b = 1.8kPa \cdot 1m = 1.8 \frac{kN}{m}$$

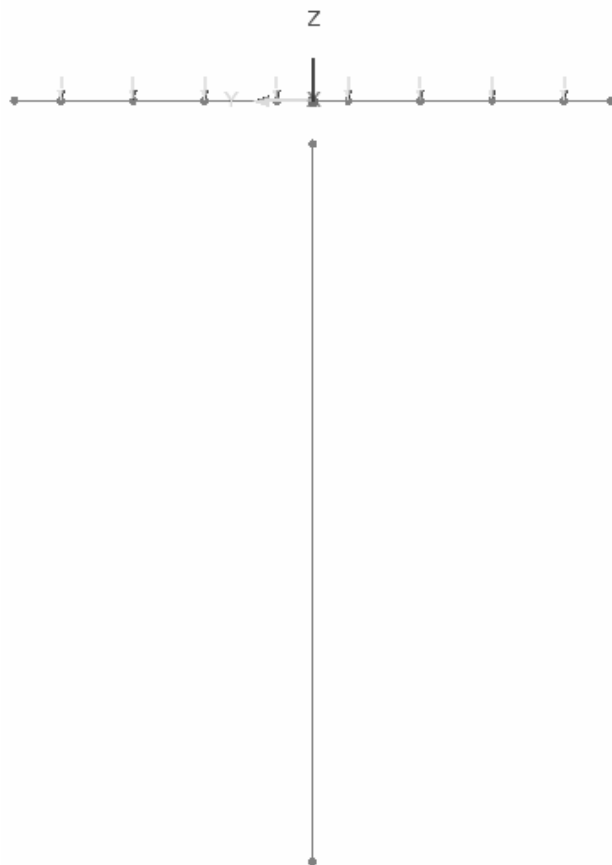
Load : SURFACE

Structural loading : Global distributed

Load Z direction: -1.8 kN/m

Load case : BELAGG

Loading assignment: Assign to lines



	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:9
		Date :	Created :

3.3 CREEP

Total creep is determined according to SS-EN 1992-1-1 §3.1.4 and TRVINFRA-00227 section 7.1.6.4 for RH 80% at time t_1 .

Time for first loading (= time when formwork was removed) is termed t_0 .

$$t_0 = 5 \text{ days}$$

$$t_2 = 120 \text{ years}$$

Bridge consists of parts with different thicknesses as seen below.

The bridge beam has different widths at top and bottom. When determining creep, the average value is applied.

$$b = \frac{6.8m + 8.2m}{2} = 7.5 \text{ m}$$

Bridge deck (t = 1.0 m; b = 7.5 m):

$$\phi(t_1 = 5 \text{ days}, t_0) = 0.40$$

$$\phi(t_2 = 120 \text{ år}, t_0) = 1.40$$

$$\varepsilon_{cc}(t_1, t_0) = \phi(t_1, t_0) \cdot \frac{\sigma_c}{E_c}$$

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:10
		Date :	Created :

To study the effect concrete stiffness according to SS-EN 1992-1-1 5.8.7 creep values seen below are used.

Load cases	ϕ
Permanent	1.4
Variable excluding temperature	0
Temperature	0.3*

* = According to Swedish work practice

$$E_{system} = \frac{E_{cm}}{1 + \phi}$$

Instead of adjusting E-modulus the load coefficients are adjusted.

$$f_{Shrinkage} = \frac{1}{1 + \phi_{ef}} = \frac{1}{1 + 1.4} = 0.42$$

$$f_{Temp} = \frac{1}{1 + \phi_{ef}} = \frac{1}{1 + 0.3} = 0.77$$

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:11
		Date :	Created :

3.4 SHRINKAGE

Total shrinkage according to SS-EN 1992-1-1 §3.1.4 and TRVINFRA-00227 section 7.1.6.4 for RH 80% at time t_2 .

Determination of load effect from shrinkage should consider the reduced concrete stiffness from creep.

$$t_s = 0 \text{ days}$$

$$t_2 = 120 \text{ years}$$

The bridge beam has different widths at top and bottom. When determining the crystal, the average value is applied.

$$b = \frac{6.8m + 8.2m}{2} = 7.5 \text{ m}$$

Superstructure:

Shrinkage $\epsilon_{cs} = 0.023\%$ is applied to all construction parts for safety. The movement corresponds to that which occurs due to an imaginary temperature load $\therefore T = -23^\circ\text{C}$.

Remark

The existing static model causes negligible restraint forces to be considered as arising from shrinkage. This means that the load case is not introduced in the static model, but it is considered when determining long-term losses in prestressing reinforcement in the serviceability limit state.

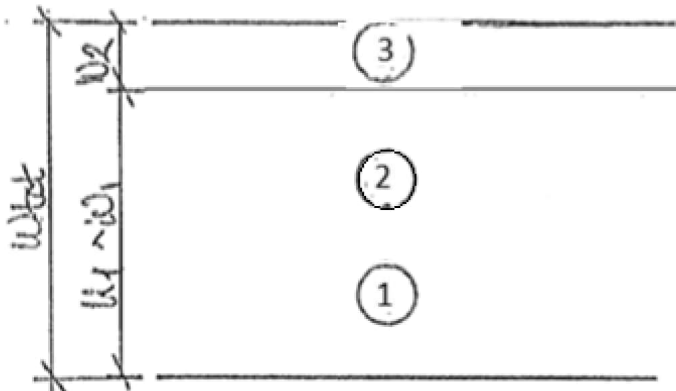
	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:12
	Pretensioned slab bridge: hollow deck	Date :	Created :

3.5 TRAFFIC

Evaluation of vertical traffic is performed for LM 1 and LM 2 according to SS-EN 1991-2 section 4.3.

Evaluation will also be performed EG A/B = 180kN/300 kN according to TRVFS 2011:12 chapter 6 point 3§.

3.5.1 Indelning av körbana i lastfält



Total traffic width : $w_{tot} = 8.0 m$

Number of traffic lanes : $n_1 = \text{Integer} \left[\frac{w_{tot}}{3.0m} \right] = 2 \text{ lanes}$

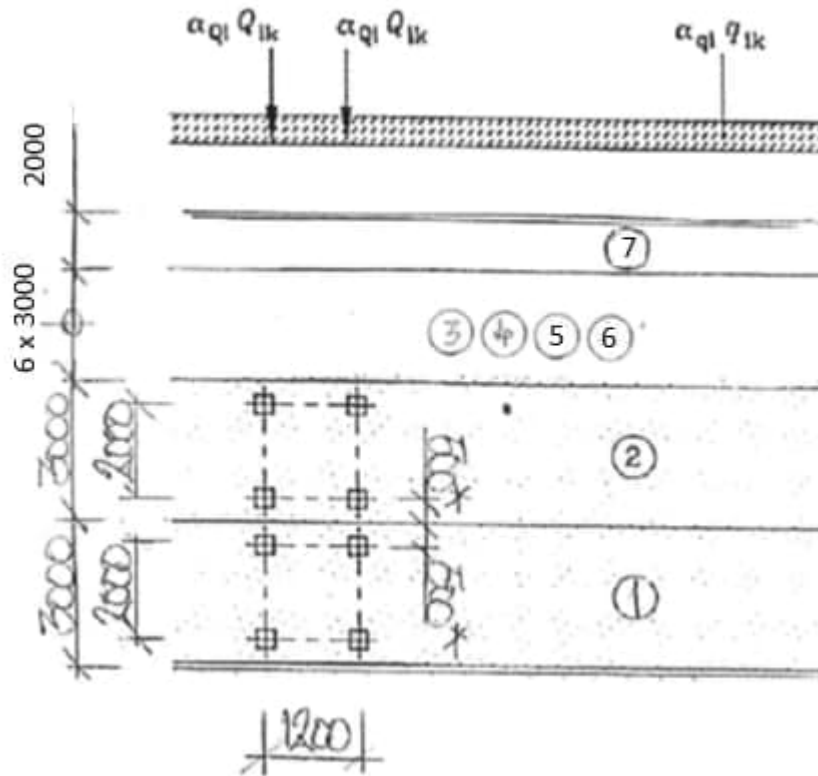
Full traffic width : $w_1 = 3.0m$

Remaining width : $w_2 = 2.0m$

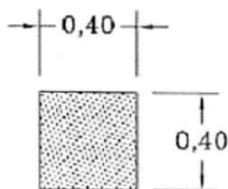
	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:13
	Pretensioned slab bridge: hollow deck	Date :	Created :

3.5.2 Load model 1 (LM 1)

Characteristic values according to SS-EN 1991-2 §4.3.2.



* = When studying local effects 250 mm is to be assumed.



	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:14
		Date :	Created :

Axle loads:

α_Q : national adaptation factor according to TRVFS 2011:12 table 7.1

$Q'_k = \alpha_Q \cdot Q_k$: characteristic value including national adaptation factor

Traffic lane	Q_k	α_Q	Q'_k	Remark
1	300	0,9	270	LM1- 2 x 270 kN
2	200	0,9	180	LM1- 2 x 180 kN
3	100	0	0	No load
-	kN	-	kN	-

Surface loads:

α_q : national adaptation factor according to TRVFS 2011:12 table 7.1

$q'_k = \alpha_q \cdot q_k$: characteristic value including national adaptation factor

Traffic lane	q_k	α_q	q'_k
1	9.0	0.8	7.2
2-3	2.5	1.0	2.5
-	kPa	-	kPa

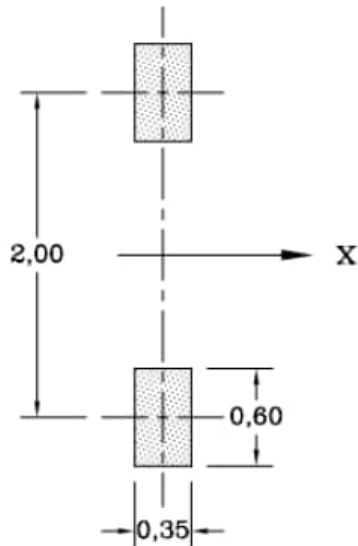
Remark

Evaluation is performed using Vehicle Load Optimisation (VLO), see section 3.7.4.

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:15
		Date :	Created :

3.5.3 Load model 2 (LM 2)

Characteristic vertical load according to SS-EN 1991-2 §4.3.3.



$\beta_Q = \alpha_Q = 0.90$: national adaptation factor

$Q_k = 400 \text{ kN}$: characteristic value

$Q'_k = \beta_k \cdot Q_k = 360 \text{ kN}$: characteristic value including national adaptation factor

Tire pressure

TSFS Chapter 11 Section 4 states that the same contact surface as LM 1 may be used.

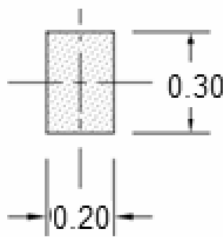
	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:16
		Date :	Created :

3.5.4 Load model EG A/B

Calculation is performed using traffic load EG A/B = 180 kN/300 kN excluding dynamic factor.

Traffic load EG A/B are applied to two traffic lanes. Traffic on first lane is multiplied by 1.00 while second lane is multiplied 0.80.

The center distance between the wheel pressures is 2.0 meters according to TSFS chapter 11 §2.



Wheel pressure

$\epsilon_{dyn} = 25 \%$: dynamic factor ^{1.)}

$A' = A \cdot (1 + \epsilon_{dyn}) = 180 \text{ kN} \cdot (1 + 0.25) = 225 \text{ kN}$: single load including dynamic factor

$B' = B \cdot (1 + \epsilon_{dyn}) = 300 \text{ kN} \cdot (1 + 0.25) = 375 \text{ kN}$: tandem load including dynamic factor

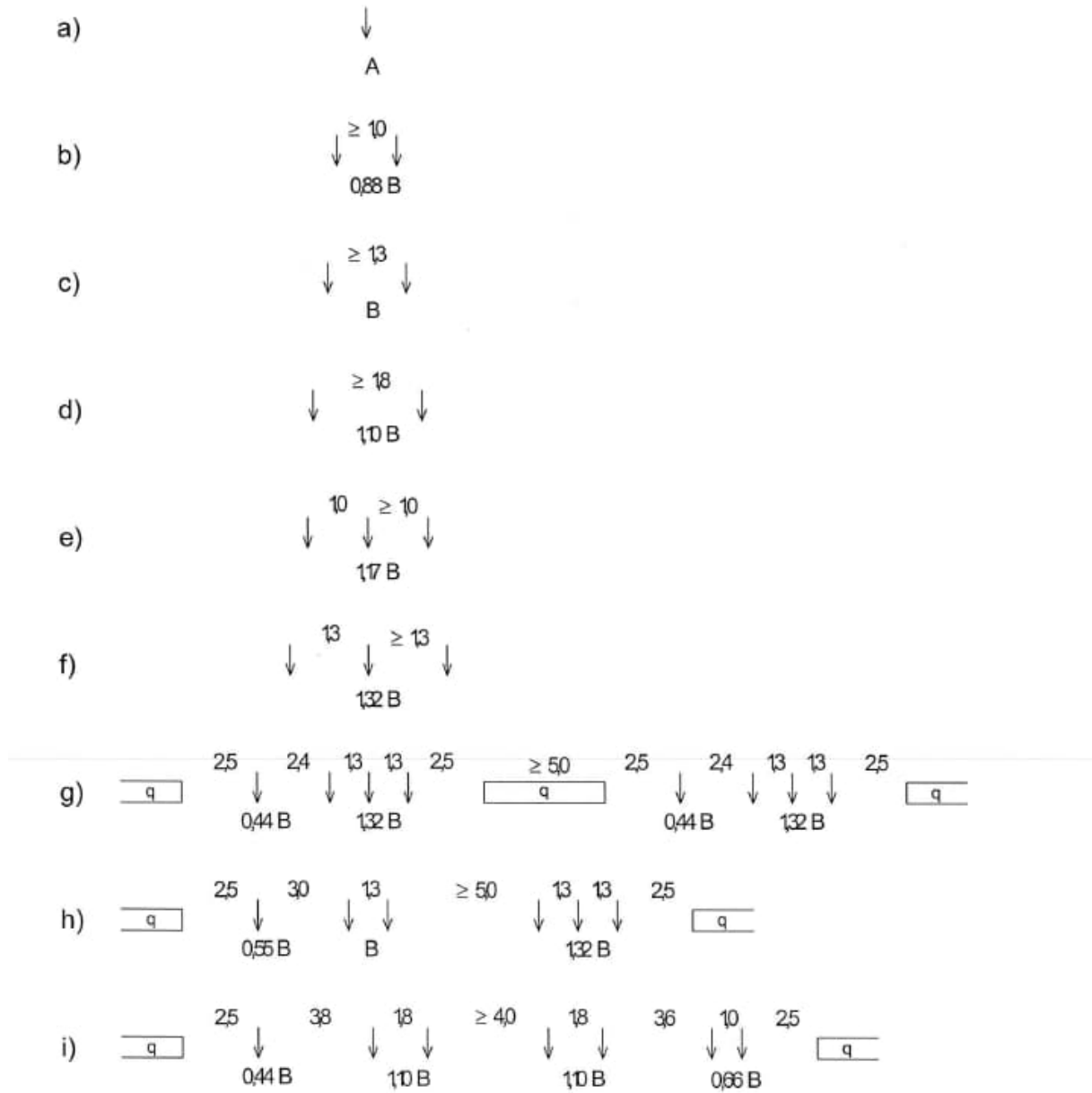
$p = 5 \frac{\text{kN}}{\text{m}}$: surface load

Footnote:

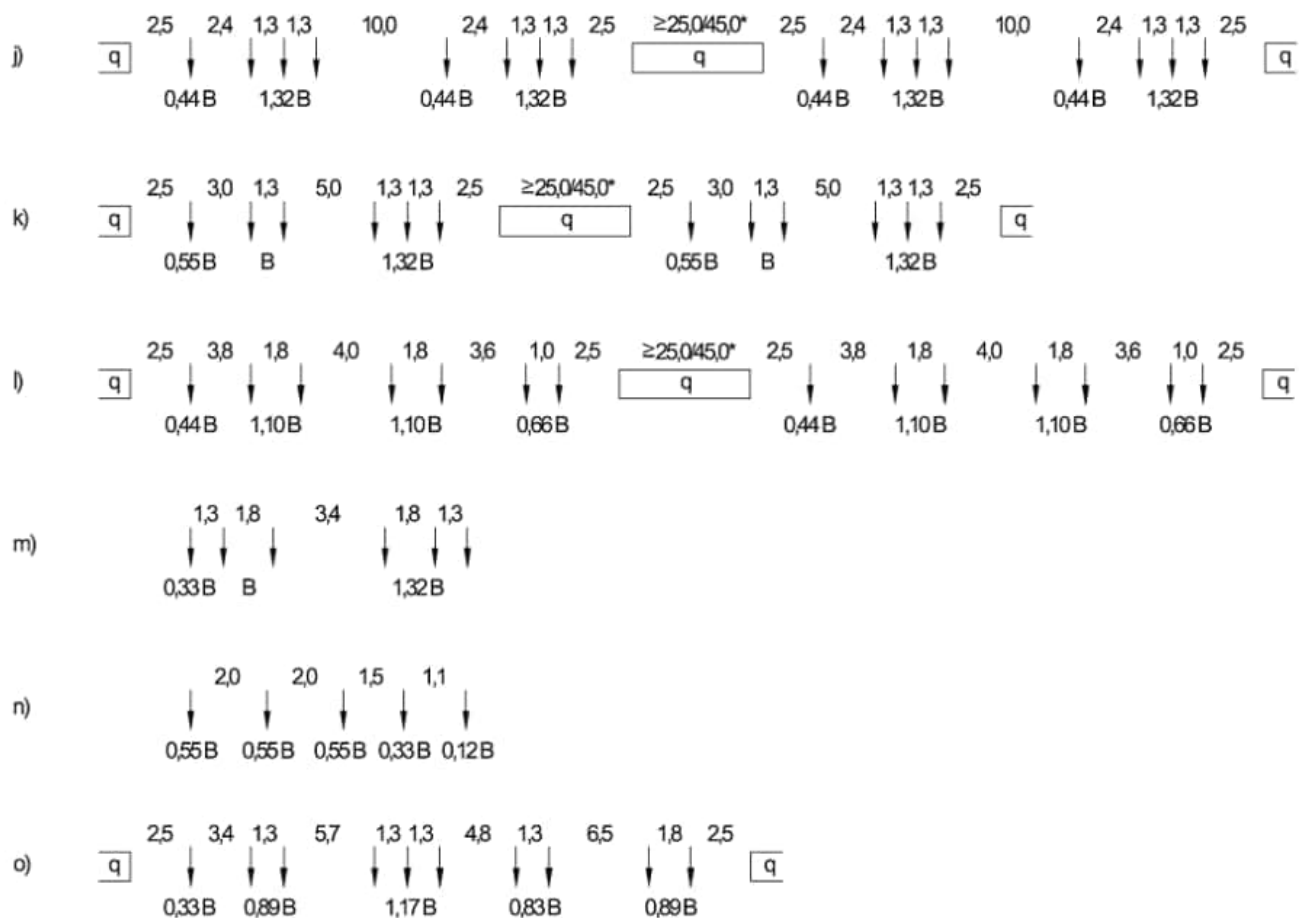
^{1.)} TRVINFRA-00227 table 7.1-5 section 4.2.1(1) states apply 25 % ..

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:17
	Pretensioned slab bridge: hollow deck	Date :	Created :

Graphic presentation of common vehicle types:
(Vehicle types according to TRVINFRA-00331 Appendix 1)



	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:18
	Pretensioned slab bridge: hollow deck	Date :	Created :



Note:

Evaluation is carried out with the script Vehicle Load Optimization (VLO), see sections 3.5.3 and 3.5.4.

Since there is no motorway, * = 45 m is applied according to TRVINFRA-00331 section 8.3.2.2.1 for vehicle types j, k, and l.

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:19
		Date :	Created :

3.5.5 Vehicle Load Optimization (VLO)

3.5.5.1 Influence components

Influence surfaces are created using *Direct Method Influence Envelope*. This is done by applying *Influence components* seen below.

Inf1 – Reactions :

The screenshot shows the 'Direct Method Influence Envelope' dialog box. The 'Entity' is set to 'Reaction' and the 'Direction' is 'Nodal' with a value of '0.0'. A list of influence components is shown on the right, with 'Standard' checked and 'FZ' selected. The 'Include coincident effects' checkbox is checked. The 'Name' field contains 'Inf1 - Reaction' and a count of '(1)' is shown next to it.

Inf2 – Beam (Fz):

The screenshot shows the 'Direct Method Influence Envelope' dialog box. The 'Entity' is set to 'Force/Moment - Thick 3D Beam' and the 'Direction' is 'Element local' with a value of '0.0'. A list of influence components is shown on the right, with 'Standard' checked and 'Fz' selected. The 'Include coincident effects' checkbox is checked. The 'Name' field contains 'Inf2 - Beam (Fz)' and a count of '(2)' is shown next to it.

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:20
		Date :	Created :

Inf3 – Beam (My):

Direct Method Influence Envelope ✕

Entity: Force/Moment - Thick 3D Beam

Direction: Element local 0.0

Standard

- Fx
- Fy
- Fz
- Mx
- My
- Mz

Include coincident effects

Name: Inf3 - Beam (My) (3)

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:21
		Date :	Created :

Influence surfaces :

Search area: Superstructure

Definition type: Grid

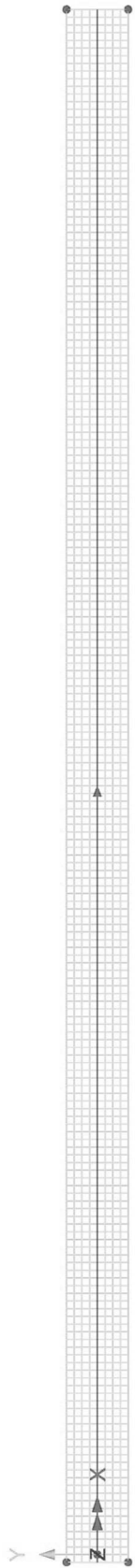
Path: Centerline

Transverse width: 8.0 m

Longitudinal spacing: 0.5 m

Transversal spacing: 0.5 m

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:22
		Date :	Created :



PLAN

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:23
		Date :	Created :

Vehicle load optimisation options:

Loading options

Country: Sweden Optional code settings...

Design code: EN1991-2 Sweden 2011 Optional loading parameters...

Solution process

View onerous effects table Set influence surfaces...

Create loading patterns Define carriageways...

All chosen influences
 Most onerous

Create envelopes

By design case
 By influence and design case

Vehicle longitudinal incremental movement: 0.50 m

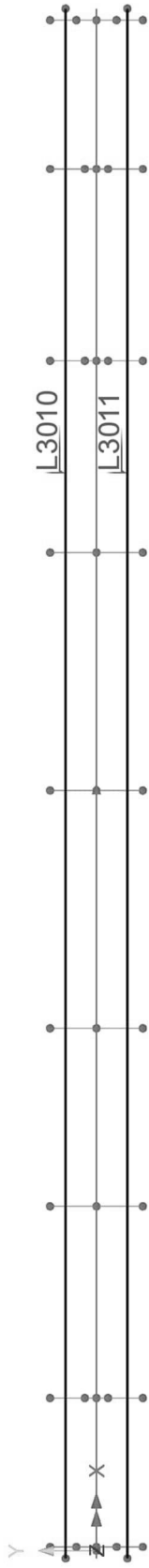
Vehicle transverse incremental movement: 0.50 m

Vehicle direction: both

Definition of carriageway (kerbs): L3010 & L3011

Influence surfaces: Include all (positive & negative)

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:24
		Date :	Created :



PLAN

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:25
		Date :	Created :

3.5.5.2 Envelope : LM 1

Load model 1 (LM1) defined in SS-EN 1991-2 section 4.3.2.

The screenshot shows the 'EN1991-2 Sweden 2011' configuration window. It is divided into two main sections: 'Representative values required' and 'Load groups to include'.
 In the 'Representative values required' section, the 'Characteristic' option is selected with a checked checkbox. Other options like 'Combination (psi0)', 'Frequent (psi1)', 'Infrequent (psi1,infq)', and 'Quasi-permanent (psi2)' are unselected.
 In the 'Load groups to include' section, 'Group 1a - LM1' is selected with a checked checkbox. Other groups (1b, 4, 5) and the 'Complementary load model' are unselected. The 'Dynamic amplification (additional)' is set to 20%. The 'Vehicle(s)' field for both Group 1a and Group 5 is set to 'None'. The 'Include associated LM1' checkbox is unselected. The 'Output for each load group' checkbox is also unselected.

3.5.5.3 Envelope : LM 2

Load model 2 (LM2) defined in SS-EN 1991-2 section 4.3.3.

The screenshot shows the 'EN1991-2 Sweden 2011' configuration window for Load Model 2. The 'Representative values required' section is identical to the previous screenshot, with 'Characteristic' selected.
 In the 'Load groups to include' section, 'Group 1b - LM2' is selected with a checked checkbox. Other groups (1a, 4, 5) and the 'Complementary load model' are unselected. The 'Dynamic amplification (additional)' is set to 20%. The 'Vehicle(s)' field for both Group 1b and Group 5 is set to 'None'. The 'Include associated LM1' checkbox is unselected. The 'Output for each load group' checkbox is also unselected.

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:26
		Date :	Created :

3.7.5.4 Envelope : EG A

EG A is defined as complementary load model with options seen below.

Representative values required

- Characteristic
- Combination (psi0)
- Frequent (psi1)
- Infrequent (psi1, infq)
- Quasi-permanent (psi2)

Load groups to include

- Group 1a - LM1
- Group 4 - LM4
- Complementary load model
- Dynamic amplification (additional) 25 %
- Vehicle(s) Type a
- Group 5 - LM3
- Vehicle(s) None
- Include associated LM1

Dynamic amplification (additional): 25 %

Vehicle selection: Type a

3.5.5.5 Envelope : EG B

EG B is defined as complementary load model with options seen below.

Representative values required

- Characteristic
- Combination (psi0)
- Frequent (psi1)
- Infrequent (psi1, infq)
- Quasi-permanent (psi2)

Load groups to include

- Group 1a - LM1
- Group 4 - LM4
- Complementary load model
- Dynamic amplification (additional) 25 %
- Vehicle(s) Type g, Type h, Type i, Type o
- Group 5 - LM3
- Vehicle(s) None
- Include associated LM1

Dynamic amplification (additional): 25 %

Vehicle selection: Type b → o

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:27
		Date :	Created :

3.5.5.6 Combined traffic load (TRAFIK)

There are a total 4 different traffic loads termed LM 1, LM2, EG A and EG B.

The envelope is used to identify the most onerous load effect.

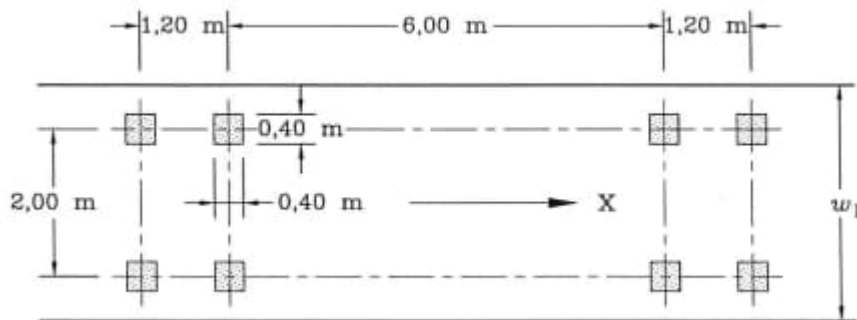
Envelope TRAFIK :

Envelope
LM 1
LM 2
EG A
EG B

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:28
		Date :	Created :

3.5.5.7 Fatigue model

Fatigue model 3 (UTM3) defined in SS-EN 1991-2 section 4.6.4. The load is defined in Group 5 (special vehicle) in present version of software.



$Q_k = 120 \text{ kN}$

: characteristic value including nation adaptation factors.

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:29
	Pretensioned slab bridge: hollow deck	Date :	Created :

The load definition:

The load UTM3 is defined as a special vehicle in "load group 5".

Representative values required

Characteristic

Combination (psi0)

Frequent (psi1)

Infrequent (psi1,infq)

Quasi-permanent (psi2)

Load groups to include

Group 1a - LM1

Group 4 - LM4

Complementary load model

Dynamic amplification (additional) %

Vehicle(s) ...

Group 5

Vehicle(s) ...

Include associated LM1

Point ✕

Analysis category

Arbitrary

Grid x
y

Untransformed load direction

X Y

Z Surface normal

XYZ global

XYZ transformable

Projection vector

Project in load direction

X component

Y component

Z component

	X	Y	Z	Load
1	-4.2	1.00	10	-60
2	-4.2	-1.00	10	-60
3	-3.0	1.00	10	-60
4	-3.0	-1.00	10	-60
5	3.0	1.00	10	-60
6	3.0	-1.00	10	-60
7	4.2	1.00	10	-60
8	4.2	-1.00	10	-60

Name ▼ ▲ (new)

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:30
		Date :	Created :

3.6 BRAKING LAOD

Load acts at level of surfacing.

Braking load is defined by SS-EN 1991-2 §4.4.1.

Load acts at level of surfacing.

$$L = 19.1 \text{ m} + 25.0 \text{ m} + 23.2 \text{ m} + 31.0 \text{ m} + 31.0 \text{ m} + 25.0 \text{ m} + 25.0 \text{ m} + 19.1 \text{ m} = 198.4 \text{ m}$$

Load modell LM 1 :

$$Q_{lk} = 0.6\alpha_{Q1} \cdot (2Q_{ik}) + 0.1\alpha_{q1} \cdot q_{1k} \cdot w_1 \cdot L$$

$$180 \text{ kN} \cdot \alpha_{Q1} \leq Q_{lk} \leq 900 \text{ kN}$$

$$Q_{broms} = 0.6 \cdot (2 \cdot 270 \text{ kN}) + 0.1 \cdot 7.2 \text{ kPa} \cdot 3.0 \text{ m} \cdot 198.4 \text{ m} = 324 \text{ kN} + 429 \text{ kN} = 753 \text{ kN}$$

Load model EG B = 300 kN (see TSFS chapter 11. §2) :

Vehicle j.) is the heaviest with $\sum Q_{EG B} = 7.04B$.

$$Q_{lk} = 0.35 \cdot \sum Q_{EG B} + 0.1 \cdot p \cdot L_q$$

$$Q_{lk} \leq 500 \text{ kN}$$

$$Q_{broms} = 0.35 \cdot 7.04 \cdot 300 \text{ kN} + 0.1 \cdot 5 \frac{\text{kN}}{\text{m}} \cdot (198.4 \text{ m} - 50.0 \text{ m}) = 739 \text{ kN} + 74 \text{ kN} = 813 \text{ kN}$$

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:31
		Date :	Created :

Load definition in static model:

The load case is distributed from support 4-6 along longitudinal beams (LB 3 → LB 6).

Distance from support 4 to support 6 is $L = 62 \text{ m}$.

$$p_x = \frac{1}{4} \cdot \frac{Q_{broms}}{L} = \frac{813 \text{ kN}}{4 \cdot 62.0 \text{ m}} = 3.3 \frac{\text{kN}}{\text{m}}$$

$$m_y = p_x \cdot (0.50 \text{ m} + t_{bel}) = 3.3 \frac{\text{kN}}{\text{m}} \cdot (0.5 \text{ m} + 0.09 \text{ m}) = 1.9 \frac{\text{kN}}{\text{m}}$$

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:32
		Date :	Created :

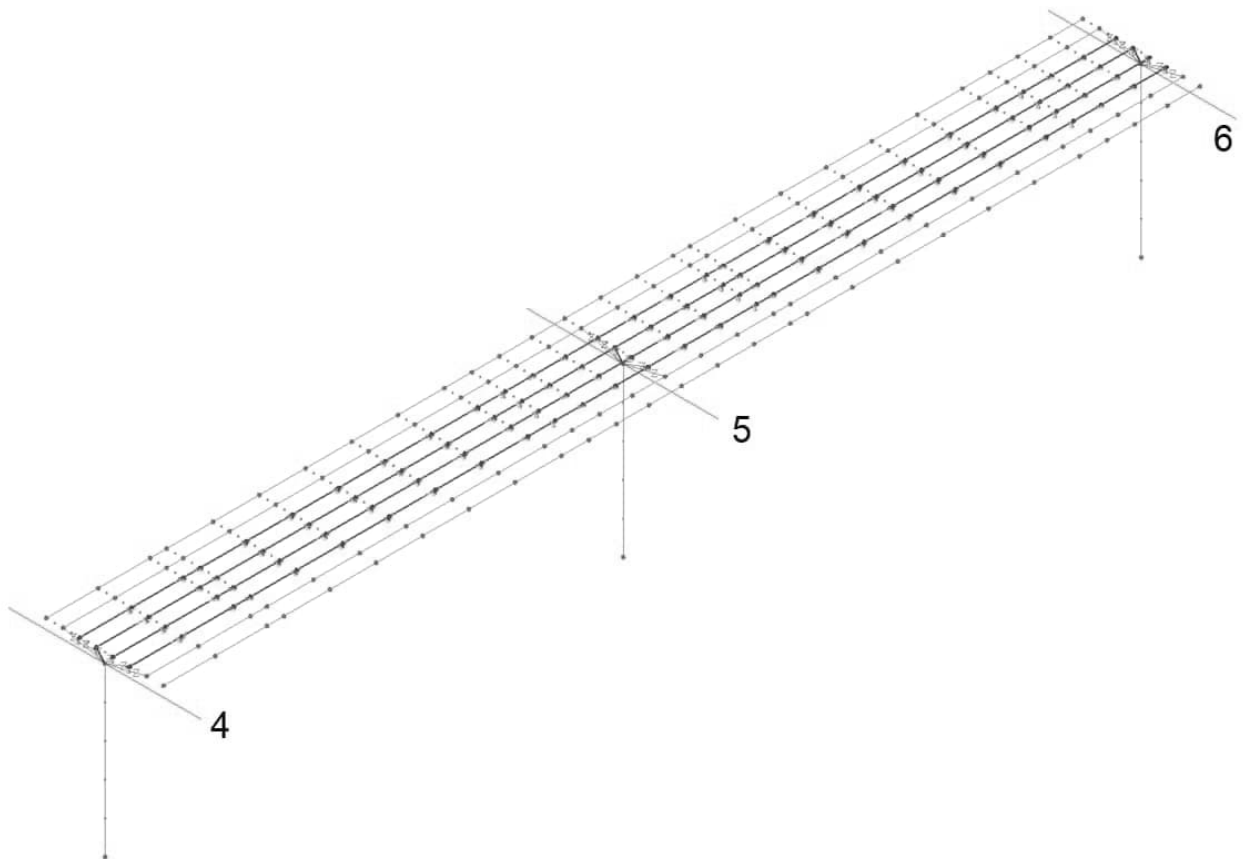
Load case : BROMS+

Structural loading : Global distributed

Load X direction: +3.3 kN/m

Moment about Y axis: +1.9 kNm/m

Loading assignment: Assign to lines



	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:33
		Date :	Created :

3.7 TEMPERATURE

The effect of temperature shall be considered in the serviceability limit state according to SS-EN 1992-1-1 §2.3.1.2.

Location: Bollnäs → $T_0 (-) = -22^{\circ}\text{C}$

Maximum temperature: $T_+ = +25^{\circ}\text{C}$

Minimum temperature: $T_- = T_0 (-) = -38^{\circ}\text{C}$

Inspection shows that the effect of uneven temperature change does not need to be considered.

The static system causes only movement due to uniform temperature change in the longitudinal direction.

No restraint forces are considered to occur, thus load case is ignored in static model.

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:34
		Date :	Created :

3.8 PRESTRESS

Analysis of pre tensioned cable is studied at times : t_0 (5 days), t_1 (30 days) and t_2 (120 years).

Initial prestress loss at time t_0 is only due to friction.

Determination of time loses (η_t) is made in separate program. Preliminary analysis will use losses seen below.

Time	η_t	Load combination	Load case
t_0	0 %	PT-T0	1.00 x PT-T0
t_1	6 %	PT-T1	0.95 x PT-T0
t_2	16 %	PT-T2	0.85 x PT-T0

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:35
		Date :	Created :

3.8.1 General

Vid bestämning av uppspanningsförluster tillämpas $\mu = 0.25$ och $k = 0.0030$.
Materialegenskaper enligt nedan tillämpas vid bärighetsberäkning.

Material VSL 12 ϕ 13:

$$f_{p0.2k} = 1600MPa \quad : \text{ stress at elongation } 0.2 \%$$

$$f_{pk} = 1800MPa \quad : \text{ ultimate stress}$$

$$E_{sk} = 200GPa \quad : \text{ E-modulus}$$

$$A_p = 12 \cdot 93mm^2 = 1110mm^2 \quad : \text{ cabel area}$$

$$F_u = 1110mm^2 \cdot 1800MPa = 2000kN \quad : \text{ ultimate load}$$

Slip during locking:

4 mm

Permissible stress before locking :

See SS-EN 1992-1-1 section 5.10.2.1

$$\sigma_{p,max}^{före} = 1260MPa \rightarrow P_{före} = 1260MPa \cdot 1110mm^2 = 1399kN$$

Permissible stress after locking :

See SS-EN 1992-1-1 section 5.10.3

$$\sigma_{p,max}^{efter} = 1170MPa \rightarrow P_{efter} = 1170MPa \cdot 1110mm^2 = 1299kN$$

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:36
		Date :	Created :

Prestress force and slip are applied at active anchors according to the presentation below.

Tendon



Analysis category

Property
1:VSL 12-13

	Value
Prestress force	1399

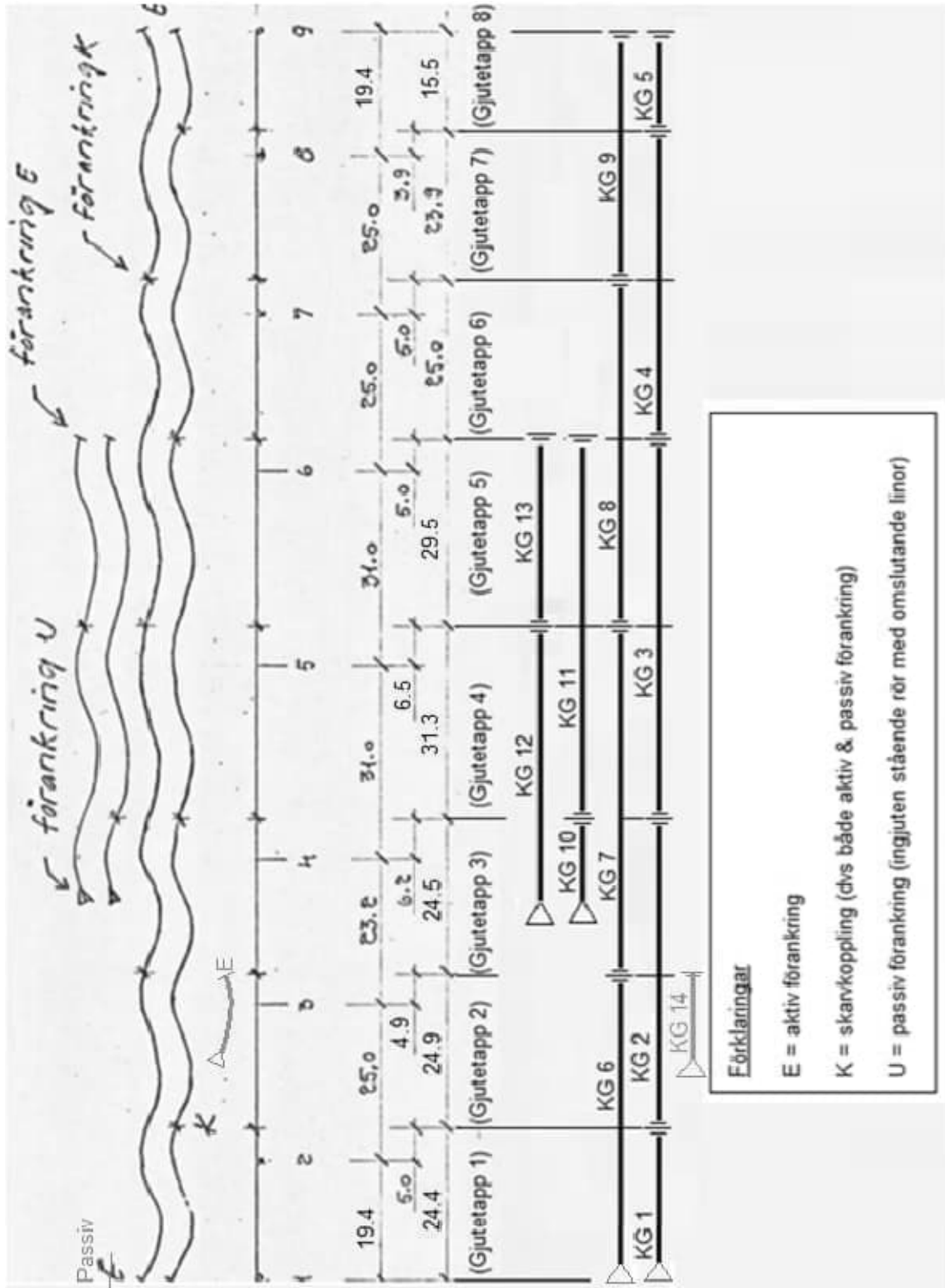
Jacking

	Value
Angle	0.0
Slip	0.004

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:37
	Pretensioned slab bridge: hollow deck	Date :	Created :

3.8.2 Cabel position: theoretical

Overview of cable routing for all cast stages according to the figure below.



ELEVATION

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:38
		Date :	Created :

Cabel positions:

Nr.	KG1	KG2		KG3		KG4		KG5
1	112	212	312	412	512	612	712	812
2	132	232	332	432	532	632	732	832
3	141	241	341	441	541	641	741	841
4	151	251	351	451	551	651	751	851
5	162	262	362	462	562	662	762	862
6	171	271	371	471	571	671	771	871
7	181	281	381	481	581	681	781	881
8	182	282	382	482	582	682	782	882

Nr.	KG 6		KG 7		KG 8		KG 9	
9	111	211	311	411	511	611	711	811
10	121	221	321	421	521	621	721	821
11	122	222	322	422	522	622	722	822
12	131	231	331	431	531	631	731	831
13	142	242	342	442	542	642	742	842
14	152	252	352	452	552	652	752	852
15	161	261	361	461	561	661	761	861
16	172	272	372	472	572	672	772	872

Nr.	KG 10	KG 11	
17	313	413	513
18	333	433	533
19	353	453	553
20	363	463	563
21	383	483	583

Nr.	KG 12		KG 13		KG 14
22	323	423	523	623	223
23	334	434	534	634	253
24	343	443	543	643	273
25	364	464	564	664	-
26	373	473	573	673	-

Explanations:

y(+) : distance from center of individual cable to bottom of beam

y_{med} (+) : distance from center of average location of cabel group to bottom of beam

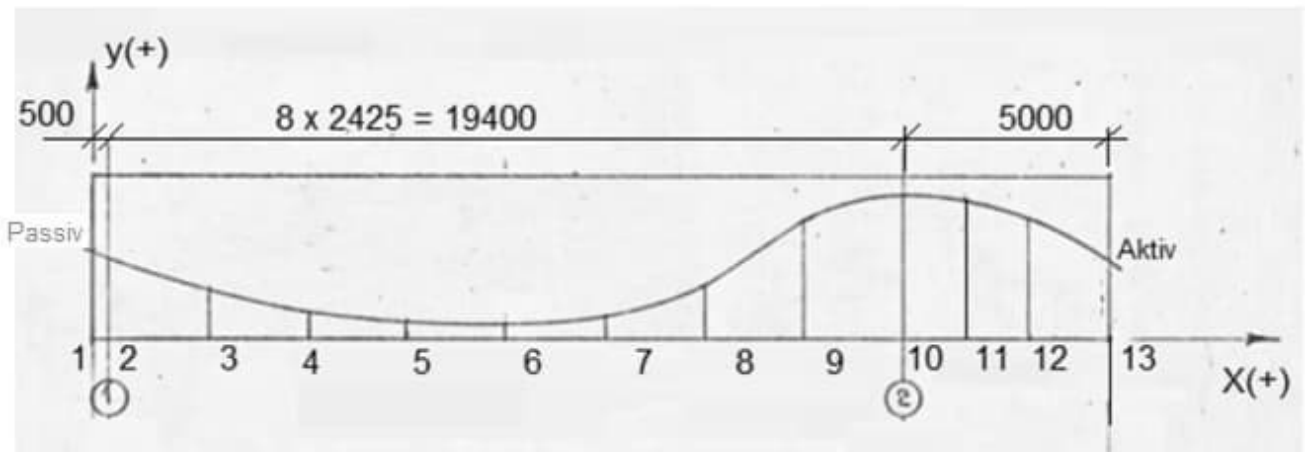
	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:39
		Date :	Created :

Casting stage 1: KG 1 – 8 cables

Stöd	L	ΔL	Nr	X(+)	x(+)	K 112		K 132		K 141		y _{med} (+)
						K 182	K 162	K 151	K 171	K 181		
-	0,500	-	1	0,200	0	810	660	360	210	529		
1:V		-	2	0,500	0,300	761	633	363	235	514		
1:H	19,400	2,425	2	0,500	0	761	633	363	235	514		
-		-	-	1,712	1,212	565	525	375	335	455		
-		2,425	3	2,925	2,425	435	435	365	365	400		
-		2,425	4	5,350	4,850	300	300	300	300	300		
-		2,425	5	7,775	7,275	220	220	220	220	220		
-		2,425	6	10,200	9,700	200	200	0	200	200		
-		2,425	7	12,625	12,125	270	270	270	270	270		
-		2,425	8	15,050	14,550	400	400	400	400	400		
-		2,425	9	17,475	16,975	660	660	660	660	660		
2:V		2,425	10	19,900	19,400	890	890	890	890	890		
2:H	5,000	-	10	19,900	0	890	890	890	890	890		
-		1,562	11	21,462	1,562	840	840	740	740	790		
-		1,563	12	23,025	3,125	750	750	550	550	650		
-		1,875	13	24,900	5,000	630	630	330	330	480		
-	m	m	-	m	m	mm	mm	mm	mm	mm		

Manual verification:

$$y_{med}(+) = \frac{761mm \cdot 2 + 633mm \cdot 2 + 363mm \cdot 3 + 235mm \cdot 1}{8} = 514mm$$



ELEVATION

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:40
		Date :	Created :

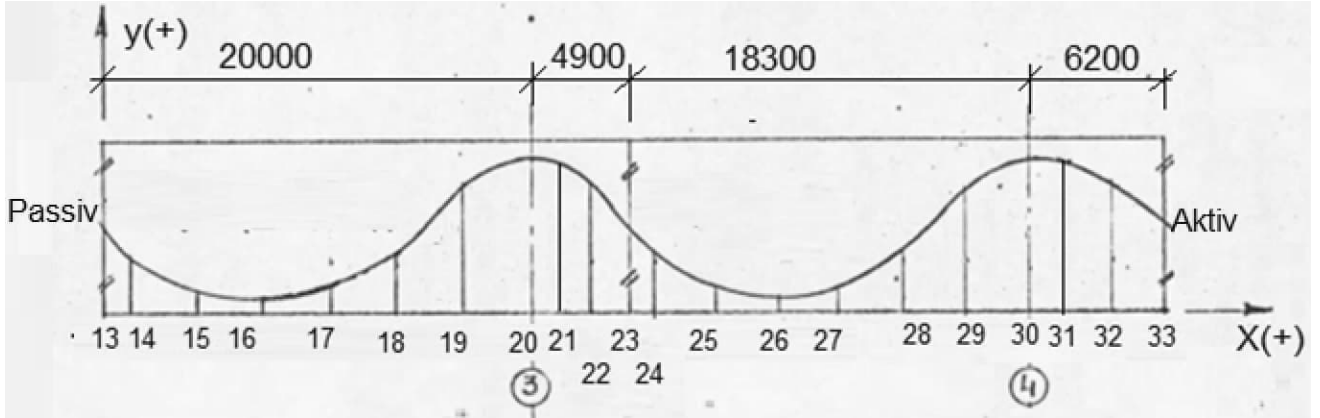
Casting stage → 3: KG 2 – 8 cables

Stöd	L	ΔL	Nr	X(+)	x(+)	K 212/312	y(+)	K 241/341	y(+)	K 281/381	y _{med} (+)
						K 232/332		K 251/351		K 262/362	
-	20,000	-	13	24,900	0	630	330	330	330	480	
-		1,250	14	26,150	1,250	505	235	235	235	370	
-		3,125	15	29,275	4,375	170	170	170	170	170	
-		3,125	16	32,400	7,500	90	90	90	90	90	
-		3,125	17	35,525	10,625	170	170	170	170	170	
-		3,125	18	38,650	13,750	380	380	380	380	380	
-		3,125	19	41,775	16,875	650	650	650	650	650	
3:V		3,125	20	44,900	20,000	860	840	840	840	850	
3:H	4,900	-	20	44,900	0	860	840	840	840	850	
-		1,450	21	46,350	1,450	810	650	650	650	730	
-		1,450	22	47,800	2,900	750	450	450	450	600	
-		2,000	23	49,800	4,900	570	270	270	270	420	
-	18,300	-	23	49,800	0	570	270	270	270	420	
-		0,900	24	50,700	0,900	440	240	240	240	340	
-		2,900	25	53,600	3,800	210	190	190	190	200	
-		2,900	26	56,500	6,700	150	150	150	150	150	
-		2,900	27	59,400	9,600	250	250	250	250	250	
-		2,900	28	62,300	12,500	500	500	500	500	500	
-		2,900	29	65,200	15,400	770	770	770	770	770	
4:V		2,900	30	68,100	18,300	910	910	910	910	910	
4:H	6,200	-	30	68,100	0	910	910	910	910	910	
-		1,937	31	70,037	1,937	850	850	850	850	850	
-		1,938	32	71,975	3,875	740	740	685	733		
-		2,325	33	74,300	6,200	600	600	475	584		
-	m	m	-	m	m	mm	mm	mm	mm		

Manual verification:

$$y_{med}(+) = \frac{600mm \cdot 4 + 600mm \cdot 3 + 475mm \cdot 1}{8} = 584mm$$

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:41
	Pretensioned slab bridge: hollow deck	Date :	Created :



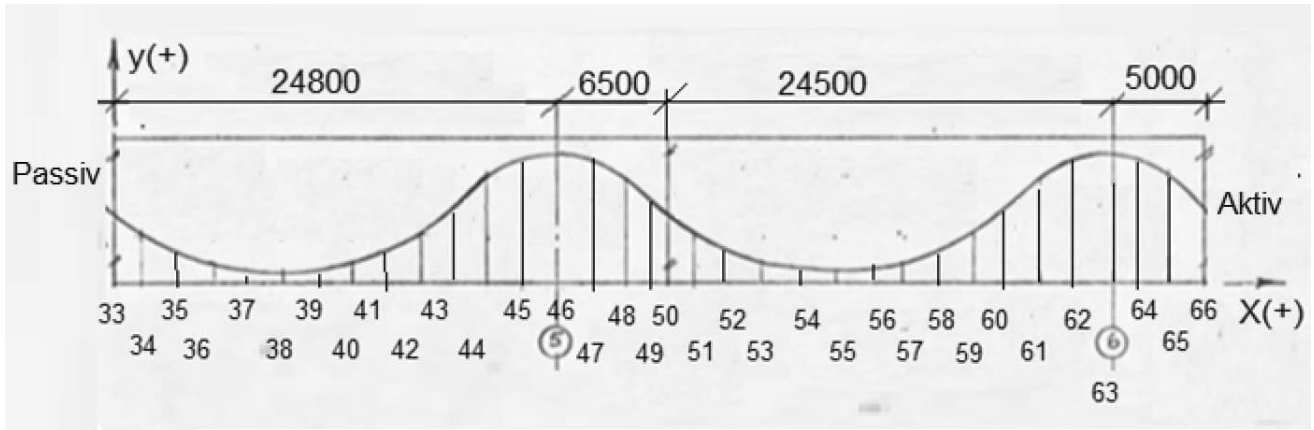
ELEVATION

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:42
		Date :	Created :

Casting stage 4 → 5: KG 3 – 8 cables

Stöd	L	ΔL	Nr	X(+)	x(+)	K 441/541	y(+)	y(+)	y(+)	y _{med} (+)
						K 432/532				
-	24,800	-	33	74,300	0	600	600	475	584	
-		1,550	34	75,850	1,550	520	450	380	485	
-		1,938	35	77,788	3,488	420	260	300	365	
-		1,938	36	79,725	5,425	325	250	130	282	
-		1,938	37	81,663	7,363	245	110	220	208	
-		1,938	38	83,600	9,300	185	80	185	159	
-		1,938	39	85,538	11,238	185	80	185	159	
-		1,938	40	87,475	13,175	210	150	210	195	
-		1,938	41	89,413	15,113	290	285	290	289	
-		1,938	42	91,350	17,050	430	430	430	430	
-		1,938	43	93,288	18,988	550	550	550	550	
-		1,938	44	95,225	20,925	670	670	670	670	
-		1,938	45	97,163	22,863	810	810	810	810	
5:V		1,938	46	99,100	24,800	900	900	900	900	
5:H		6,500	-	46	99,100	0	900	900	900	900
-	1,937		47	101,037	1,937	820	820	820	820	
-	1,938		48	102,975	3,875	720	720	670	714	
-	1,937		49	104,912	5,812	620	620	500	605	
-	0,688		50	105,600	6,500	585	585	460	569	
-	24,500	-	50	105,600	0	585	585	460	569	
-		1,250	51	106,850	1,250	515	475	475	500	
-		1,938	52	108,788	3,188	380	280	280	343	
-		1,938	53	110,725	5,125	265	100	100	203	
-		1,938	54	112,663	7,063	210	80	80	161	
-		1,938	55	114,600	9,000	185	80	185	159	
-		1,938	56	116,538	10,938	240	110	240	208	
-		1,938	57	118,475	12,875	295	140	295	256	
-		1,938	58	120,413	14,813	350	230	350	320	
-		1,938	59	122,350	16,750	440	380	440	425	
-		1,938	60	124,288	18,688	550	550	550	550	
-		1,938	61	126,225	20,625	670	670	670	670	
-		1,938	62	128,163	22,563	785	785	785	785	
6:V	1,938	63	130,100	24,500	880	880	880	880		
6:H	5,000	-	63	130,100	0	880	880	880	880	
-		1,562	64	131,662	1,562	870	870	870	870	
-		1,563	65	133,225	3,125	870	870	870	870	
-		1,875	66	135,100	5,000	760	760	680	750	
-	m	m	-	m	m	mm	mm	mm	mm	

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:43
	Pretensioned slab bridge: hollow deck	Date :	Created :



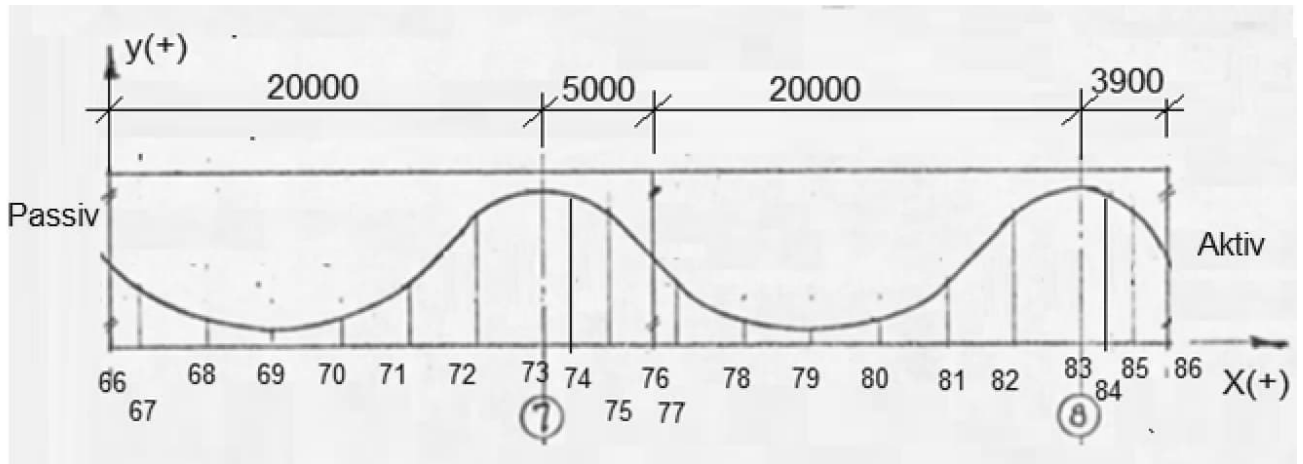
ELEVATION

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:44
		Date :	Created :

Casting stage 6 → 7: KG 4 – 8 cables

Stöd	L	ΔL	Nr	X(+)	x(+)	K 612/712	y(+)	y(+)	y(+)	y _{med} (+)
						K 632/732 K 662/762 K 682/782				
-	20,000	-	66	135,100	0	760	760	680	750	
-		1,250	67	136,350	1,250	555	555	460	543	
-		3,125	68	139,475	4,375	250	250	250	250	
-		3,125	69	142,600	7,500	150	150	150	150	
-		3,125	70	145,725	10,625	200	200	200	200	
-		3,125	71	148,850	13,750	340	340	340	340	
-		3,125	72	151,975	16,875	600	600	600	600	
7:V		3,125	73	155,100	20,000	870	870	870	870	
7:H	5,000	-	73	155,100	0	870	870	870	870	
-		1,562	74	156,662	1,562	740	855	855	798	
-		1,563	75	158,225	3,125	510	790	790	650	
-		1,875	76	160,100	5,000	340	640	640	490	
-	20,000	-	76	160,100	0	340	640	640	490	
-		1,250	77	161,350	1,250	270	490	490	380	
-		3,125	78	164,475	4,375	170	170	170	170	
-		3,125	79	167,600	7,500	90	90	90	90	
-		3,125	80	170,725	10,625	170	170	170	170	
-		3,125	81	173,850	13,750	370	370	370	370	
-		3,125	82	176,975	16,875	650	650	650	650	
8:V		3,125	83	180,100	20,000	850	850	850	850	
8:H	3,900	-	83	180,100	0	850	850	850	850	
-		1,218	84	181,318	1,218	850	750	750	800	
-		1,219	85	182,537	2,437	810	510	510	660	
-		1,463	86	184,000	3,900	655	355	355	505	
-	m	m	-	m	m	mm	mm	mm	mm	

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:45
	Pretensioned slab bridge: hollow deck	Date :	Created :

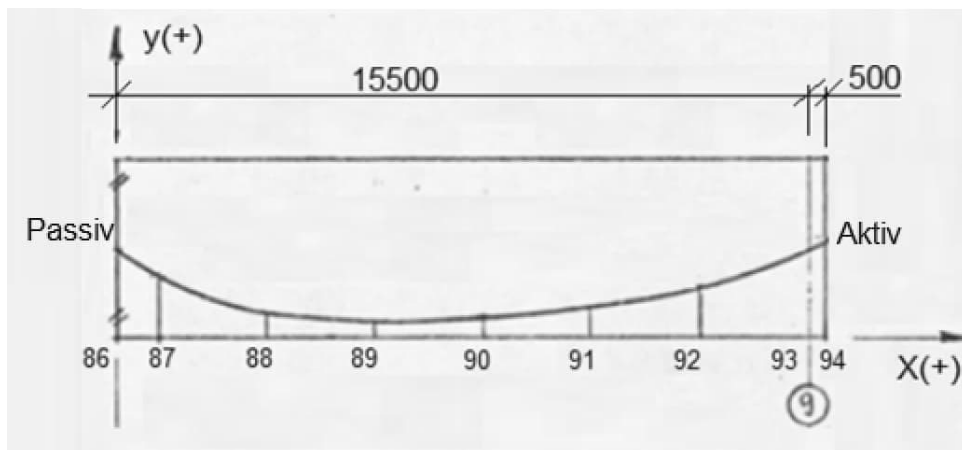


ELEVATION

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:46
		Date :	Created :

Casting stage 8: KG 5 – 8 cables

Stöd	L	ΔL	Nr	X(+)	x(+)	K 812	y(+)	y(+)	y(+)	$y_{med}(+)$
						K 832				
						K 862	K 871			
						K 882				
-	15,500	-	86	184,000	0	655	355	355	355	505
-		0,975	87	184,975	0,975	475	325	325	325	400
-		2,421	88	187,396	3,396	275	265	265	265	270
-		2,421	89	189,817	5,817	200	200	200	200	200
-		2,421	90	192,237	8,237	220	220	220	220	220
-		2,421	91	194,658	10,658	300	300	300	300	300
-		2,421	92	197,079	13,079	400	400	400	400	400
9:V		2,421	93	199,500	15,500	630	380	380	380	505
9:H	0,500	-	93	199,500	0	630	380	380	380	505
		0,300	94	199,800	0,300	660	360	360	360	510
-	m	m	-	m	m	mm	mm	mm	mm	mm



ELEVATION

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:47
		Date :	Created :

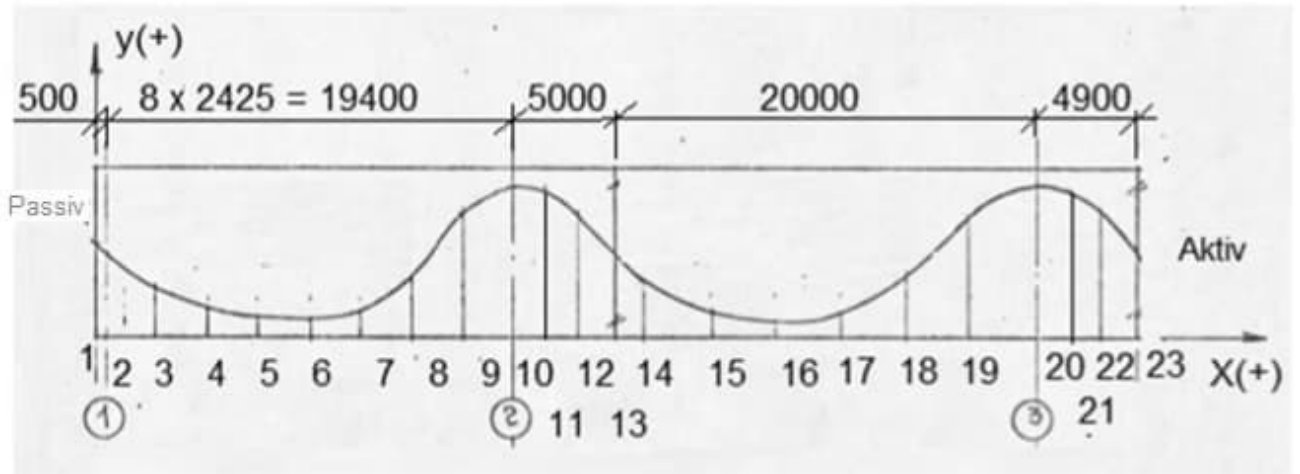
Casting stage 1 → 2: KG 6 – 8 cables

Stöd	L	ΔL	Nr	X(+)	x(+)	K 122/222	y(+)	K 142/242	y(+)	K 152/252	y(+)	K 172/272	y(+)	K 121/221	y(+)	K 131/231	y(+)	K 161/261	y(+)	K 111/211	y(+)	y _{med} (+)	
						K 161/261		K 111/211															
-	0,500	-	1	0,200	0	660	360	210	491														
1:V		-	2	0,500	0,300	633	363	235	482														
1:H	19,400	2,425	2	0,500	0	633	363	235	482														
-		-	-	1,712	1,212	525	375	335	445														
-		2,425	3	2,925	2,425	435	365	365	400														
-		2,425	4	5,350	4,850	300	300	300	300														
-		2,425	5	7,775	7,275	220	220	220	220														
-		2,425	6	10,200	9,700	200	200	200	200														
-		2,425	7	12,625	12,125	270	270	270	270														
-		2,425	8	15,050	14,550	400	400	400	400														
-		2,425	9	17,475	16,975	660	660	660	660														
2:V		2,425	10	19,900	19,400	890	890	890	890														
2:H	5,000	-	10	19,900	0	890	890	890	890														
-		1,562	11	21,462	1,562	840	740	740	790														
-		1,563	12	23,025	3,125	750	550	550	650														
-		1,875	13	24,900	5,000	630	330	330	480														
-	20,000	-	13	24,900	0	630	330	330	480														
-		1,250	14	26,150	1,250	505	235	235	370														
-		3,125	15	29,275	4,375	170	170	170	170														
-		3,125	16	32,400	7,500	90	90	90	90														
-		3,125	17	35,525	10,625	170	170	170	170														
-		3,125	18	38,650	13,750	380	380	380	380														
-		3,125	19	41,775	16,875	650	650	650	650														
3:V		3,125	20	44,900	20,000	860	840	840	850														
3:H	4,900	-	20	44,900	0	860	840	840	850														
-		1,450	21	46,350	1,450	810	650	650	730														
-		1,450	22	47,800	2,900	750	450	450	600														
-		2,000	23	49,800	4,900	570	270	270	420														
-	m	m	-	m	m	mm	mm	mm	mm														

Manual verification:

$$y_{med}(+) = \frac{810mm \cdot 4 + 650mm \cdot 3 + 650mm \cdot 1}{8} = 730mm$$

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:48
	Pretensioned slab bridge: hollow deck	Date :	Created :



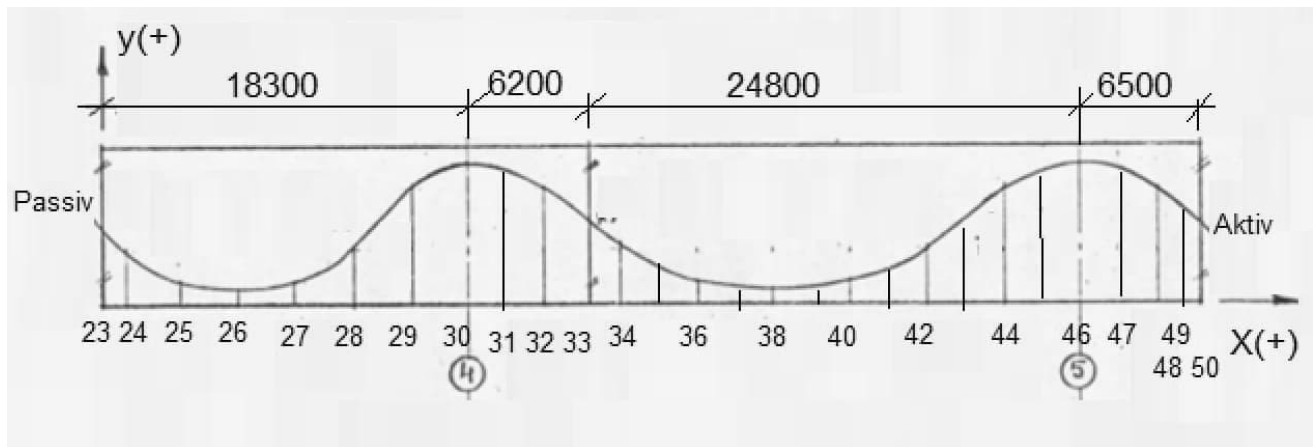
ELEVATION

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:49
		Date :	Created :

Casting stage 3 → 4: KG 7 – 8 cables

Stöd	L	ΔL	Nr	X(+)	x(+)	y(+)	y(+)	y(+)	y _{med} (+)
-	18,300	-	23	49,800	0	570	270	270	420
-		0,900	24	50,700	0,900	440	240	240	340
-		2,900	25	53,600	3,800	210	190	190	200
-		2,900	26	56,500	6,700	150	150	150	150
-		2,900	27	59,400	9,600	250	250	250	250
-		2,900	28	62,300	12,500	500	500	500	500
-		2,900	29	65,200	15,400	770	770	770	770
4:V		2,900	30	68,100	18,300	910	910	910	910
4:H	6,200	-	30	68,100	0	910	910	910	910
-		1,937	31	70,037	1,937	850	850	850	850
-		1,938	32	71,975	3,875	740	740	685	733
-		2,325	33	74,300	6,200	600	600	475	584
-	24,800	-	33	74,300	0	600	600	475	584
-		1,550	34	75,850	1,550	450	520	380	468
-		1,938	35	77,788	3,488	260	460	300	340
-		1,938	36	79,725	5,425	130	325	250	218
-		1,938	37	81,663	7,363	110	245	220	174
-		1,938	38	83,600	9,300	80	185	185	133
-		1,938	39	85,538	11,238	80	185	185	133
-		1,938	40	87,475	13,175	150	210	210	180
-		1,938	41	89,413	15,113	285	290	290	288
-		1,938	42	91,350	17,050	430	430	430	430
-		1,938	43	93,288	18,988	550	550	550	550
-		1,938	44	95,225	20,925	670	670	670	670
-		1,938	45	97,163	22,863	810	810	810	810
5:V			1,938	46	99,100	24,800	900	900	900
5:H	6,500	-	46	99,100	0	900	900	900	900
-		1,937	47	101,037	1,937	820	820	820	820
-		1,938	48	102,975	3,875	720	720	670	714
-		1,937	49	104,912	5,812	620	620	500	605
-		0,688	50	105,600	6,500	585	585	460	569
-	m	m	-	m	m	mm	mm	mm	mm

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:50
		Date :	Created :



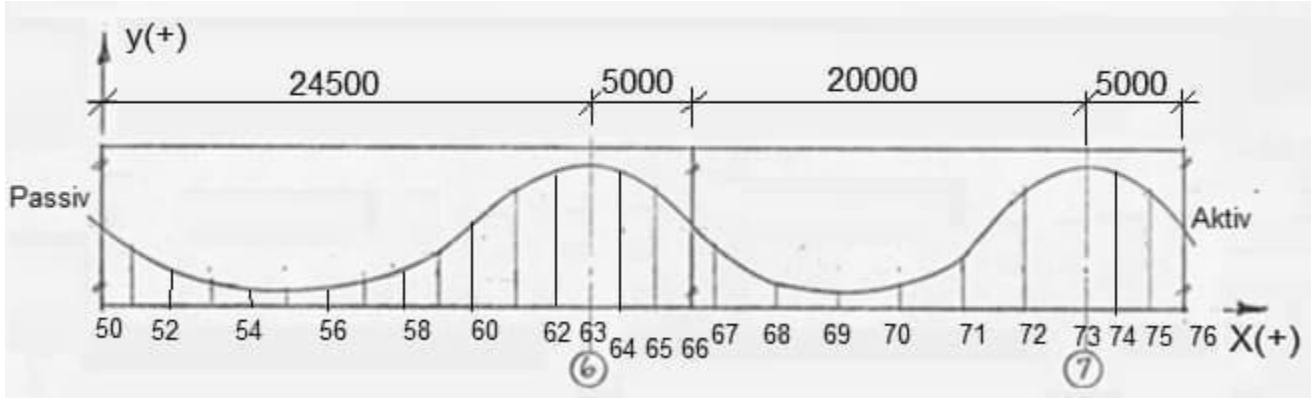
ELEVATION

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:51
		Date :	Created :

Casting stage 5 → 6: KG 8 – 8 cables

Stöd	L	ΔL	Nr	X(+)	x(+)	K 522/622	y(+)	K 531/631	y(+)	y _{med} (+)
						K 542/642		K 552/652		
-	24,500	-	50	105,600	0	585	585	585	460	569
-		1,250	51	106,850	1,250	475	515	515	380	478
-		1,938	52	108,788	3,188	280	380	380	260	315
-		1,938	53	110,725	5,125	100	265	265	190	173
-		1,938	54	112,663	7,063	80	210	210	190	143
-		1,938	55	114,600	9,000	80	185	185	185	133
-		1,938	56	116,538	10,938	110	240	240	240	175
-		1,938	57	118,475	12,875	140	295	295	295	218
-		1,938	58	120,413	14,813	230	350	350	350	290
-		1,938	59	122,350	16,750	380	440	440	440	410
-		1,938	60	124,288	18,688	550	550	550	550	550
-		1,938	61	126,225	20,625	670	670	670	670	670
-		1,938	62	128,163	22,563	785	785	785	785	785
6:V		1,938	63	130,100	24,500	880	880	880	880	880
6:H	5,000	-	63	130,100	0	880	880	880	880	880
-		1,562	64	131,662	1,562	870	870	870	870	870
-		1,563	65	133,225	3,125	845	845	800	845	834
-		1,875	66	135,100	5,000	680	760	605	680	671
-	20,000	-	66	135,100	0	680	760	605	680	671
-		1,250	67	136,350	1,250	450	555	440	450	461
-		3,125	68	139,475	4,375	250	250	250	250	250
-		3,125	69	142,600	7,500	150	150	150	150	150
-		3,125	70	145,725	10,625	200	200	200	200	200
-		3,125	71	148,850	13,750	340	340	340	340	340
-		3,125	72	151,975	16,875	600	600	600	600	600
7:V		3,125	73	155,100	20,000	870	870	870	870	870
7:H	5,000	-	73	155,100	0	870	870	870	870	870
-		1,562	74	156,662	1,562	740	855	855	855	798
-		1,563	75	158,225	3,125	510	790	790	790	650
-		1,875	76	160,100	5,000	340	640	640	640	490
-	m	m	-	m	m	mm	mm	mm	mm	mm

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:52
	Pretensioned slab bridge: hollow deck	Date :	Created :



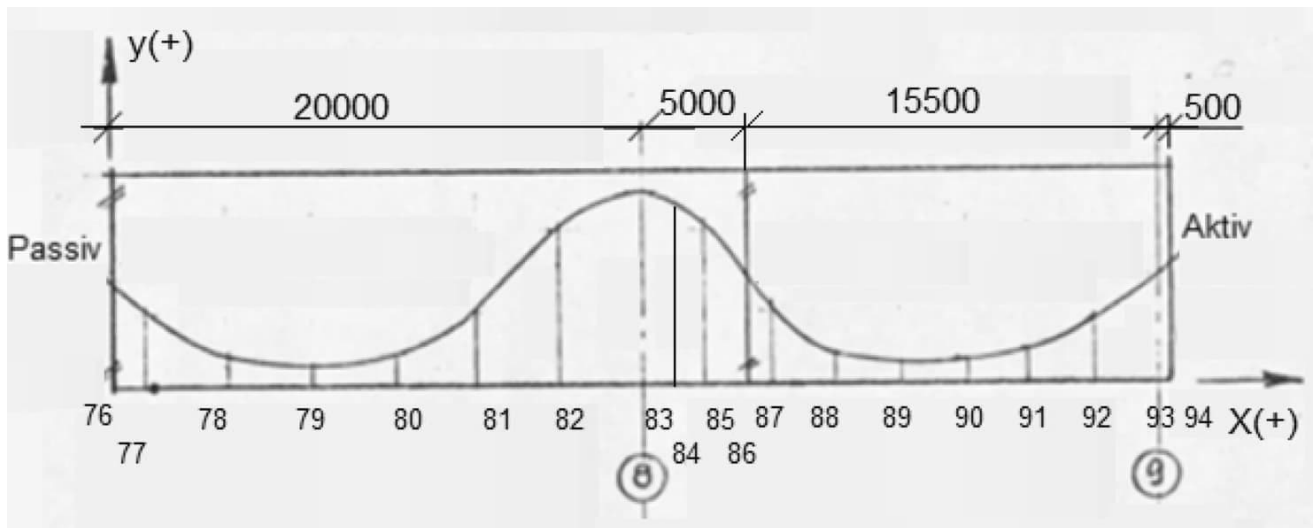
ELEVATION

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:53
		Date :	Created :

Casting stage 7 → 8: KG 9 – 8 cables

Stöd	L	ΔL	Nr	X(+)	x(+)	K 722/822	K 742/842	K 752/852	K 772/872	K 721/821	K 731/831	K 761/861	K 711/811	y _{med} (+)
						y(+)	y(+)	y(+)	y(+)					
-	20,000	-	76	160,100	0	340	640	640	640	490	490	490	490	490
-		1,250	77	161,350	1,250	270	490	490	490	380	380	380	380	380
-		3,125	78	164,475	4,375	170	170	170	170	170	170	170	170	170
-		3,125	79	167,600	7,500	90	90	90	90	90	90	90	90	90
-		3,125	80	170,725	10,625	170	170	170	170	170	170	170	170	170
-		3,125	81	173,850	13,750	370	370	370	370	370	370	370	370	370
-		3,125	82	176,975	16,875	650	650	650	650	650	650	650	650	650
8:V		3,125	83	180,100	20,000	850	850	850	850	850	850	850	850	850
8:H	3,900	-	83	180,100	0	850	850	850	850	850	850	850	850	850
-		1,218	84	181,318	1,218	850	750	750	750	800	800	800	800	800
-		1,219	85	182,537	2,437	810	510	510	510	660	660	660	660	660
-		1,463	86	184,000	3,900	655	355	355	355	505	505	505	505	505
-	15,500	-	86	184,000	0	655	355	355	355	505	505	505	505	505
-		0,975	87	184,975	0,975	475	325	325	325	400	400	400	400	400
-		2,421	88	187,396	3,396	275	265	265	265	270	270	270	270	270
-		2,421	89	189,817	5,817	200	200	200	200	200	200	200	200	200
-		2,421	90	192,237	8,237	220	220	220	220	220	220	220	220	220
-		2,421	91	194,658	10,658	300	300	300	300	300	300	300	300	300
-		2,421	92	197,079	13,079	400	400	400	400	400	400	400	400	400
9:V		2,421	93	199,500	15,500	620	380	380	380	500	500	500	500	500
9:H	0,500	-	93	199,500	0	620	380	380	380	500	500	500	500	500
-		0,300	94	199,800	0,300	660	360	360	360	510	510	510	510	510
-	m	m	-	m	m	mm	mm	mm	mm	mm	mm	mm	mm	mm

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:54
	Pretensioned slab bridge: hollow deck	Date :	Created :



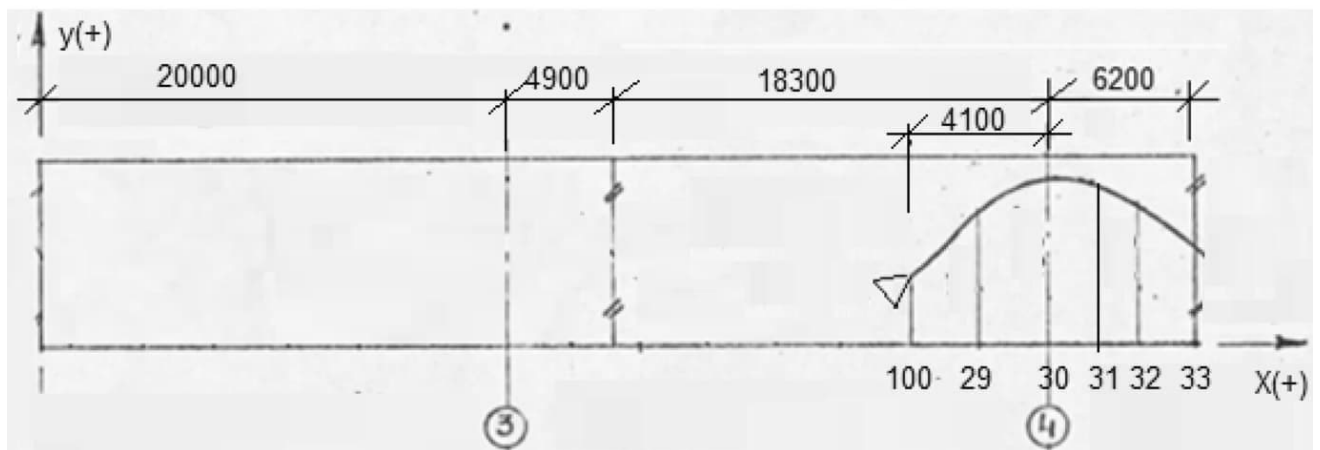
ELEVATION

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:55
		Date :	Created :

Casting stage 3: KG 10 – 5 cables

K 313
K 333
K 353
K 363
K 383

Stöd	L	ΔL	Nr	X(+)	x(+)	y(+)	y _{med} (+)
-	18,300	-	23	49,800	0	x	-
-		0,900	24	50,700	0,900	x	-
-		2,900	25	53,600	3,800	x	-
-		2,900	26	56,500	6,700	x	-
-		2,900	27	59,400	9,600	x	-
-		2,900	28	62,300	12,500	x	-
-		1,700	100	64,000	14,200	450	450
-		1,200	29	65,200	15,400	665	665
4:V		2,900	30	68,100	18,300	805	805
4:H	6,200	-	30	68,100	0	805	805
-		1,937	31	70,037	1,937	680	680
-		1,938	32	71,975	3,875	440	440
-		2,325	33	74,300	6,200	300	300
-	m	m	-	m	m	mm	mm



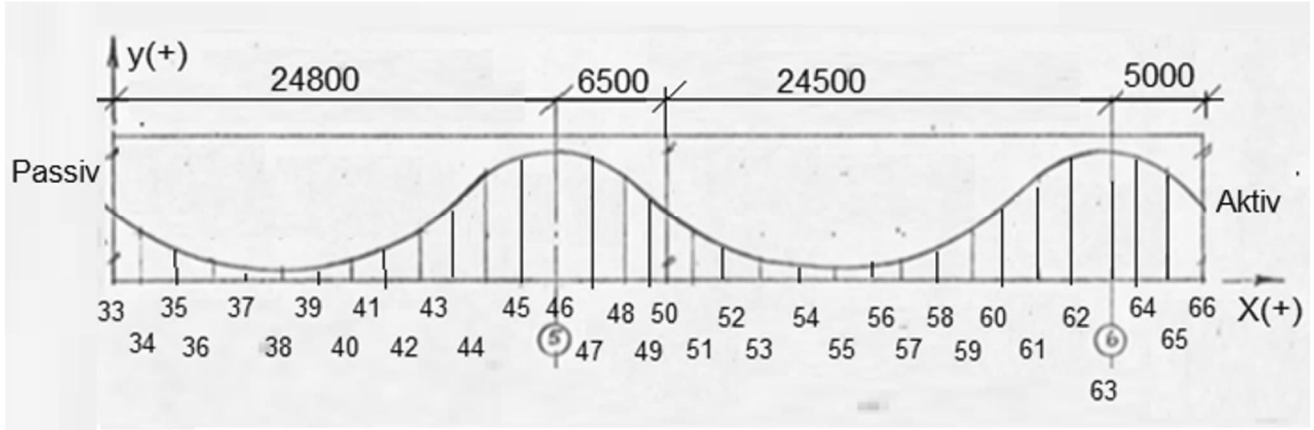
	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:56
	Pretensioned slab bridge: hollow deck	Date :	Created :

Casting stage 4-5: KG 11 – 5 cables

K 413/513
K 433/533
K 453/543
K 463/563
K 483/583

Stöd	L	ΔL	Nr	X(+)	x(+)	y(+)	y _{med} (+)
-	24,800	-	33	74,300	0	300	300
-		1,550	34	75,850	1,550	230	230
-		1,938	35	77,788	3,488	170	170
-		1,938	36	79,725	5,425	130	130
-		1,938	37	81,663	7,363	110	110
-		1,938	38	83,600	9,300	80	80
-		1,938	39	85,538	11,238	80	80
-		1,938	40	87,475	13,175	90	90
-		1,938	41	89,413	15,113	145	145
-		1,938	42	91,350	17,050	275	275
-		1,938	43	93,288	18,988	410	410
-		1,938	44	95,225	20,925	540	540
-		1,938	45	97,163	22,863	670	670
5:V		1,938	46	99,100	24,800	795	795
5:H	6,500	-	46	99,100	0	795	795
-		1,937	47	101,037	1,937	650	650
-		1,938	48	102,975	3,875	470	470
-		1,937	49	104,912	5,812	330	330
-		0,688	50	105,600	6,500	285	285
-	24,500	-	50	105,600	0	285	285
-		1,250	51	106,850	1,250	215	215
-		1,938	52	108,788	3,188	150	150
-		1,938	53	110,725	5,125	80	80
-		1,938	54	112,663	7,063	80	80
-		1,938	55	114,600	9,000	80	80
-		1,938	56	116,538	10,938	110	110
-		1,938	57	118,475	12,875	140	140
-		1,938	58	120,413	14,813	210	210
-		1,938	59	122,350	16,750	320	320
-		1,938	60	124,288	18,688	420	420
-		1,938	61	126,225	20,625	540	540
-		1,938	62	128,163	22,563	655	655
6:V		1,938	63	130,100	24,500	750	750
6:H	5,000	-	63	130,100	0	750	750
-		1,562	64	131,662	1,562	680	680
-		1,563	65	133,225	3,125	555	555
-		1,875	66	135,100	5,000	410	410
-	m	m	-	m	m	mm	mm

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:57
	Pretensioned slab bridge: hollow deck	Date :	Created :



ELEVATION

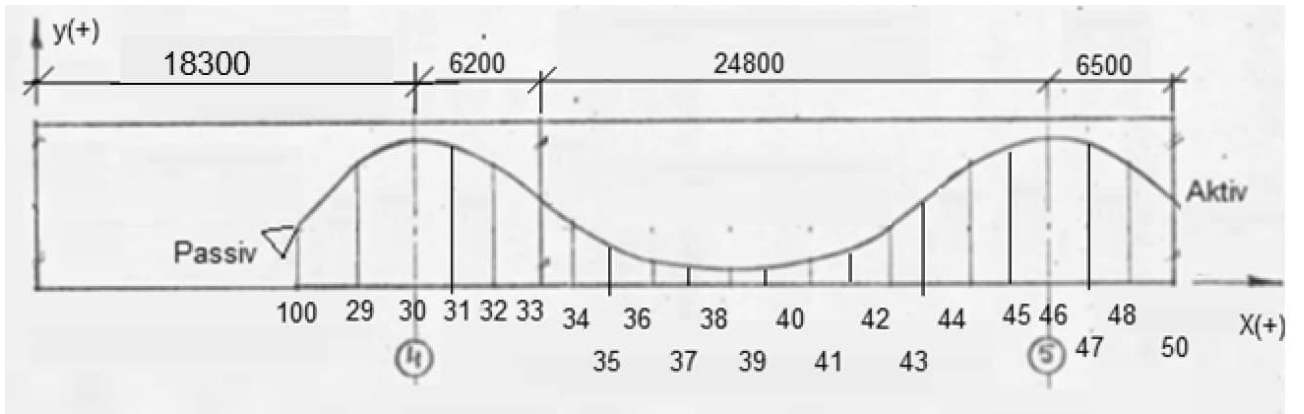
	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:58
		Date :	Created :

Casting stage 3 → 4: KG 12 – 5 cables

K 323/423
K 334/434
K 343/443
K 364/464
K 373/473

Stöd	L	ΔL	Nr	X(+)	x(+)	y(+)	y _{med} (+)
-	18,300	-	23	49,800	0	x	-
-		0,900	24	50,700	0,900	x	-
-		2,900	25	53,600	3,800	x	-
-		2,900	26	56,500	6,700	x	-
-		2,900	27	59,400	9,600	x	-
-		2,900	28	62,300	12,500	x	-
-		1,700	100	64,000	14,200	450	450
-		1,200	29	65,200	15,400	665	665
4:V		2,900	30	68,100	18,300	805	805
4:H	6,200	-	30	68,100	0	805	805
-		1,937	31	70,037	1,937	680	680
-		1,938	32	71,975	3,875	440	440
-		2,325	33	74,300	6,200	300	300
-	24,800	-	33	74,300	0	300	300
-		1,550	34	75,850	1,550	230	230
-		1,938	35	77,788	3,488	170	170
-		1,938	36	79,725	5,425	130	130
-		1,938	37	81,663	7,363	110	110
-		1,938	38	83,600	9,300	80	80
-		1,938	39	85,538	11,238	80	80
-		1,938	40	87,475	13,175	90	90
-		1,938	41	89,413	15,113	145	145
-		1,938	42	91,350	17,050	275	275
-		1,938	43	93,288	18,988	410	410
-		1,938	44	95,225	20,925	540	540
-		1,938	45	97,163	22,863	670	670
5:V		1,938	46	99,100	24,800	795	795
5:H	6,500	-	46	99,100	0	795	795
-		1,937	47	101,037	1,937	650	650
-		1,938	48	102,975	3,875	470	470
-		1,937	49	104,912	5,812	330	330
-		0,688	50	105,600	6,500	285	285
-	m	m	-	m	m	mm	mm

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:59
		Date :	Created :



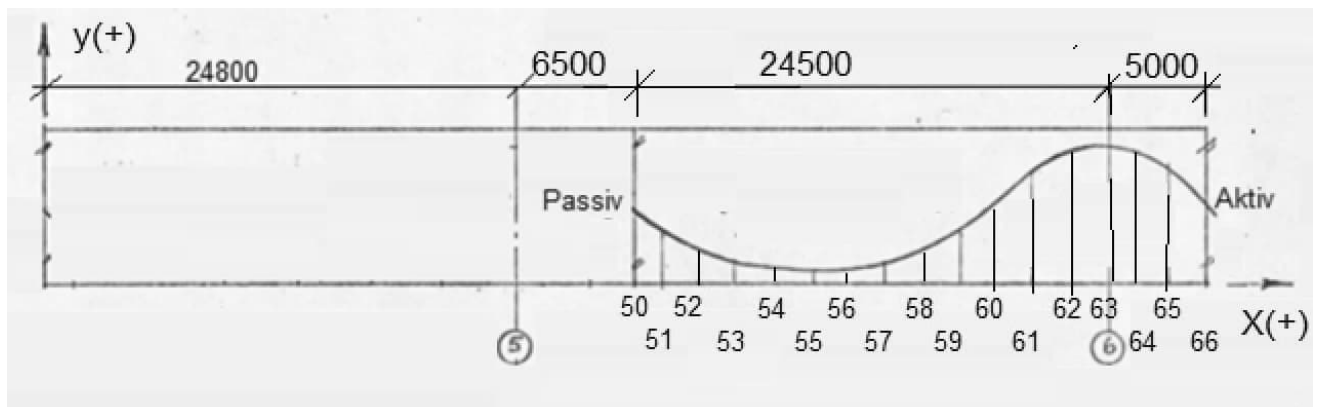
ELEVATION

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:60
		Date :	Created :

Casting stage 5: KG 13 – 5 cables

K 523/623
K 534/634
K 543/643
K 564/664
K 573/673

Stöd	L	ΔL	Nr	X(+)	x(+)	y(+)	$y_{med}(+)$
-	24,500	-	50	105,600	0	285	285
-		1,250	51	106,850	1,250	215	215
-		1,938	52	108,788	3,188	150	150
-		1,938	53	110,725	5,125	80	80
-		1,938	54	112,663	7,063	80	80
-		1,938	55	114,600	9,000	80	80
-		1,938	56	116,538	10,938	110	110
-		1,938	57	118,475	12,875	140	140
-		1,938	58	120,413	14,813	210	210
-		1,938	59	122,350	16,750	320	320
-		1,938	60	124,288	18,688	420	420
-		1,938	61	126,225	20,625	540	540
-		1,938	62	128,163	22,563	655	655
6:V	1,938	63	130,100	24,500	750	750	
6:H	5,000	-	63	130,100	0	750	750
-		1,562	64	131,662	1,562	680	680
-		1,563	65	133,225	3,125	555	555
-		1,875	66	135,100	5,000	410	410
-	m	m	-	m	m	mm	mm

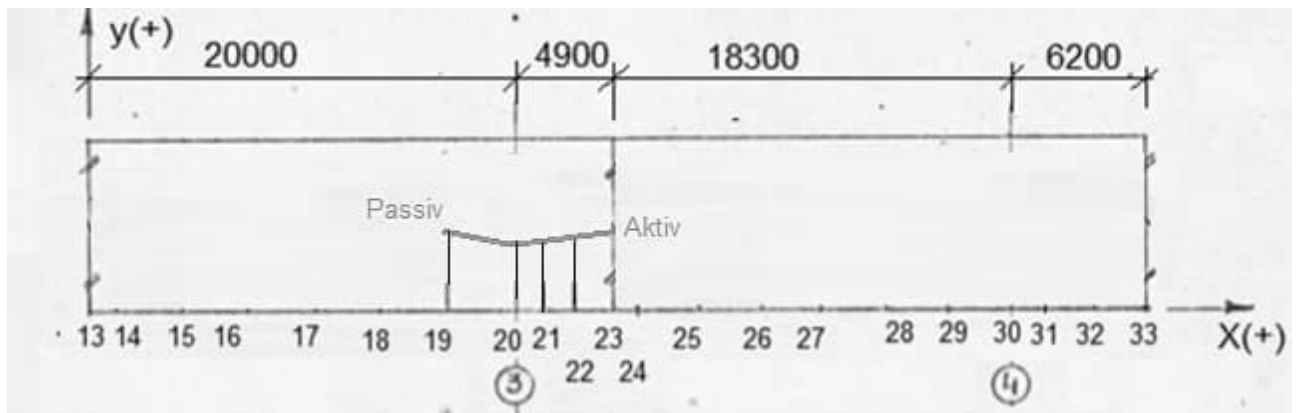


ELEVATION

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:61
		Date :	Created :

Casting stage 2 → 3: KG 14 – 3 cables

						K 223 K 253 K 273
Stöd	L	ΔL	Nr	X(+)	x(+)	y(+)
-		-	19	42,900	18,000	450
3:V		2,000	20	44,900	20,000	200
3:H	4,900	-	20	44,900	0	200
-		1,450	21	46,350	1,450	210
-		1,450	22	47,800	2,900	270
-		2,000	23	49,800	4,900	455
-	m	m	-	m	m	mm



ELEVATION

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:62
		Date :	Created :

3.8.3 Cabel position: static system

In the static model, tension cables VSL 12φ13 are introduced in the 8 longitudinal beams (LB 1-8) with the principal distribution as follows.

Span	LB 1	LB 2	LB 3	LB 4	LB 5	LB 6	LB 7	LB 8	Total
1	2	2	2	2	2	2	2	2	16
2	2 + 1 ^{1.)}	2	2	2	2 + 1 ^{1.)}	2	2	2 + 1 ^{1.)}	16 + 3 ^{1.)}
3	2 + 1 ^{1.)}	2	2	2	2 + 1 ^{1.)}	2	2	2 + 1 ^{1.)}	16 + 3 ^{1.)}
4	3	3	4	3	3	4	3	3	26
5	3	3	4	3	3	4	3	3	26
6	2	2	2	2	2	2	2	2	16
7	2	2	2	2	2	2	2	2	16
8	2	2	2	2	2	2	2	2	16
-	st	st	st	st	st	st	st	st	st

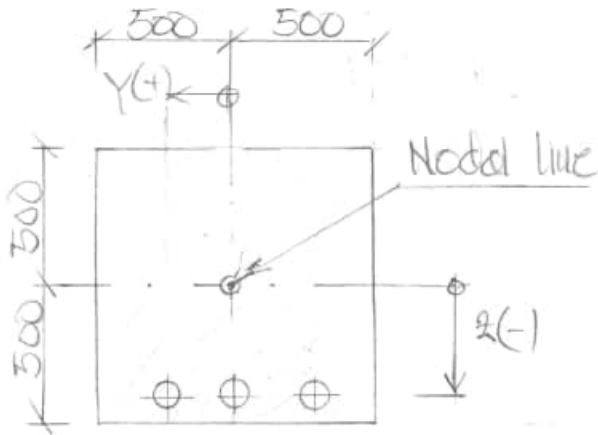
Cables are placed centrally sideways for each longitudinal beam, i.e., $y = 0$ m.
This simplification does not affect the center of gravity of the prestressing cables.

Notes

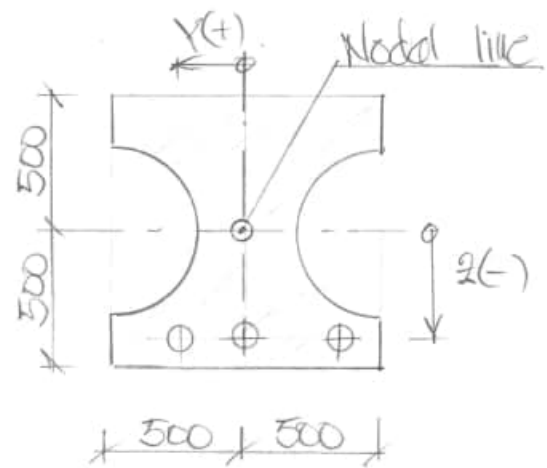
^{1.)} Local addition on each side of support 3 of KG 14.

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:63
	Pretensioned slab bridge: hollow deck	Date :	Created :

Cables are introduced into the different cross-section types as shown below.

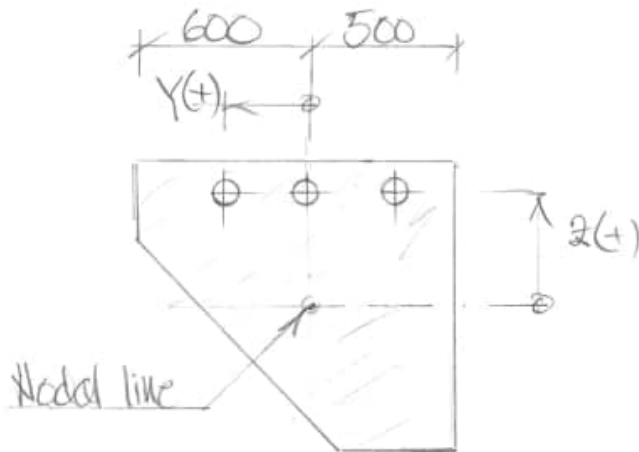


LB – type 4



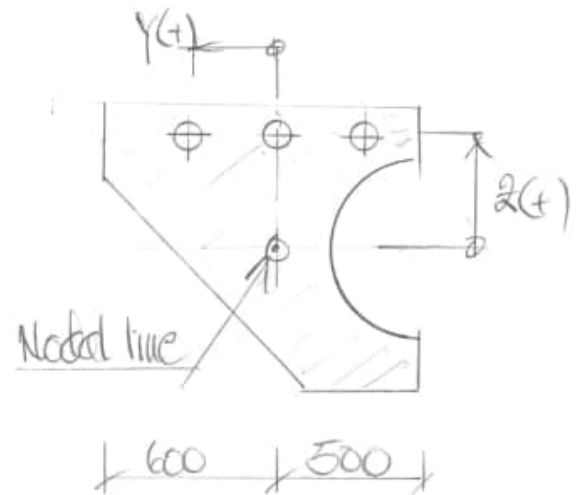
LB – type 1

Applies to type 2 & 3 also.



LB – type 5

Applies to type 7.



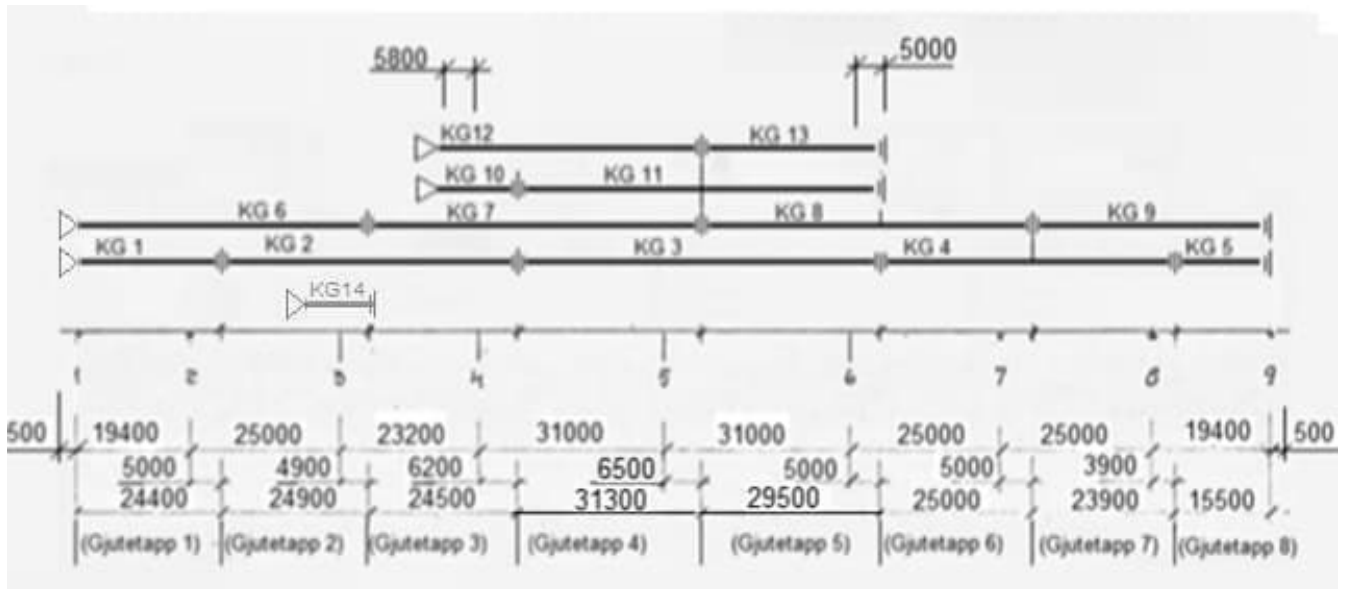
LB – type 6

Applies to type 8.

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:64
		Date :	Created :

3.8.4 Tendon loadcases

Below is shown how prestressing reinforcement is incorporated in the static model.



Summary input prestress:

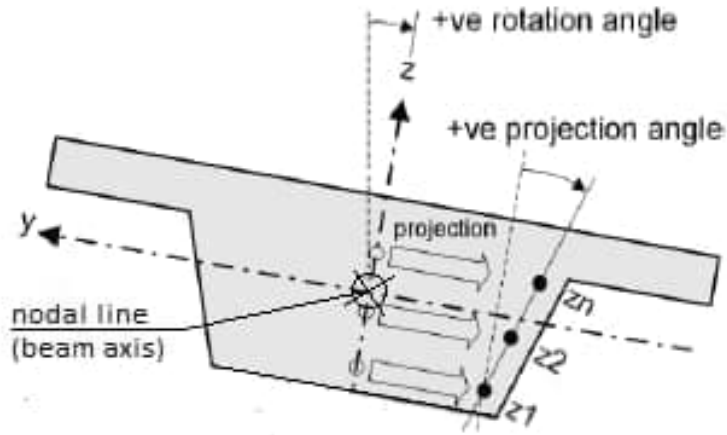
Tendon load	Area	Total cables	Slip	Left side	Right side	Max. prestress before	Min. prestress after	L
KG 1	1110	8	4	Passiv	Aktiv	1350	1299	24.7 ^{1.)}
KG 2	1110	8	4	Passiv	Aktiv	1350	1299	49.4
KG 3	1110	8	4	Passiv	Aktiv	1350	1299	60.8
KG 4	1110	8	4	Passiv	Aktiv	1350	1299	48.9
KG 5	1110	8	4	Passiv	Aktiv	1350	1299	15.8 ^{1.)}
KG 6	1110	8	4	Passiv	Aktiv	1350	1299	49.7 ^{1.)}
KG 7	1110	8	4	Passiv	Aktiv	1350	1299	55.8
KG 8	1110	8	4	Passiv	Aktiv	1350	1299	54.5
KG 9	1110	8	4	Passiv	Aktiv	1350	1299	39.7 ^{1.)}
KG 10	1110	5	4	Passiv	Aktiv	1350	1299	12.0
KG 11	1110	5	4	Passiv	Aktiv	1350	1299	60.8
KG 12	1110	5	4	Passiv	Aktiv	1350	1299	43.3
KG 13	1110	5	4	Passiv	Aktiv	1350	1299	29.5
KG 14	1110	3	4	Passiv	Aktiv	1350	1299	6.9
-	mm ²	-	mm	-	-	kN	kN	m

1.) Cable ends 0.2 m from end of bridge.

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:65
	Pretensioned slab bridge: hollow deck	Date :	Created :

3.8.4.1 Load definition

Profiles used in static modell, see page A3:46-52.



Principal sketch

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:66
		Date :	Created :

3.8.4.2 Tendon profile

Spread sheet input for KG 1:

x(+)	y(+)	z(+)	Remark
0	0,529	0,029	Passive anchorage
0,300	0,514	0,014	Support 1
1,512	0,455	-0,045	-
2,725	0,400	-0,100	-
5,150	0,300	-0,200	-
7,575	0,220	-0,280	-
10,000	0,200	-0,300	-
12,425	0,270	-0,230	-
14,850	0,400	-0,100	-
17,275	0,660	0,160	-
19,700	0,890	0,390	Support 2
21,262	0,790	0,290	-
22,825	0,650	0,150	-
24,700	0,480	-0,020	Active anchorage
m	m	m	-

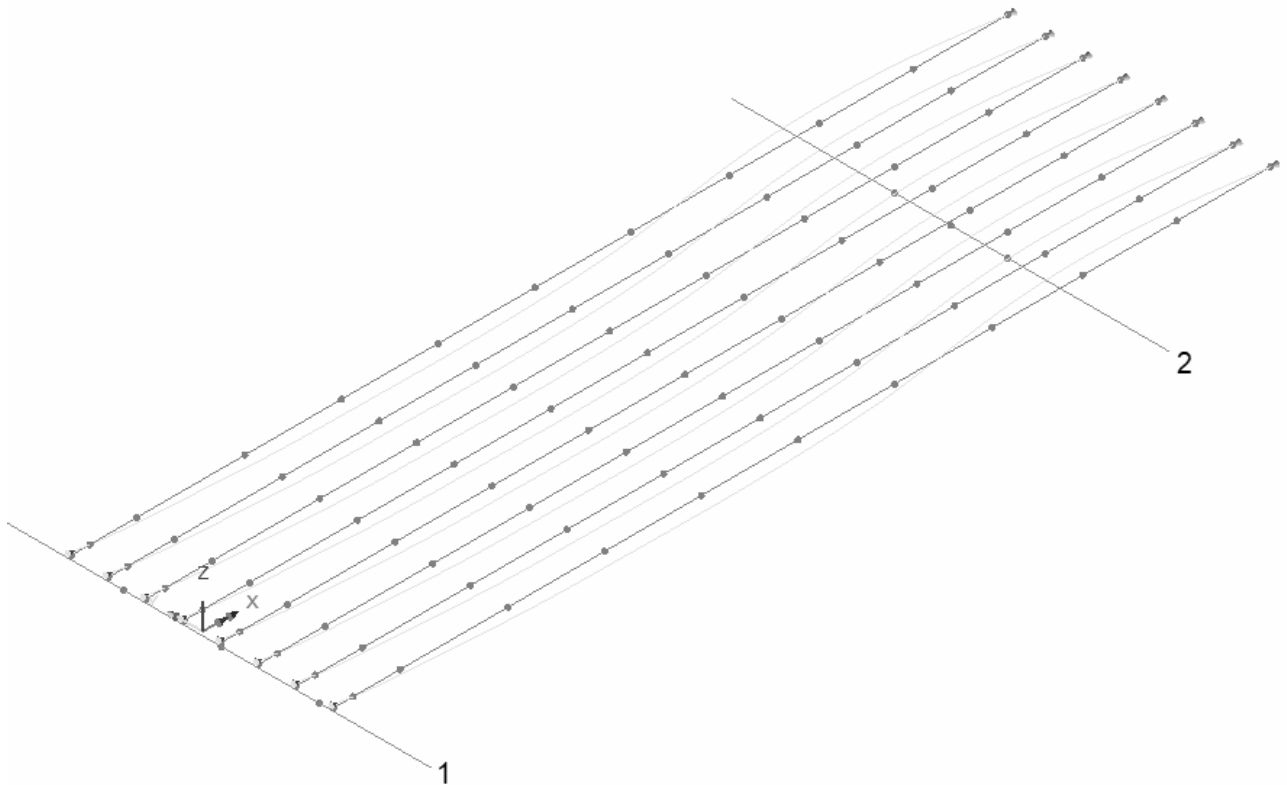
Offset distance from end 1 (start): 0.2 m

Jacking at end 1 (start): no
 Jacking at end 2 (end): yes



Elevation
 Visualizatiion

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:67
		Date :	Created :



3D-view
Visualization

Disitribution of cables above.

Beams	Number of cables	Designation
LB 1	1	"Assignment 1"
LB 2	1	"Assignment 2"
LB 3	1	"Assignment 3"
LB 4	1	"Assignment 4"
LB 5	1	"Assignment 5"
LB 6	1	"Assignment 6"
LB 7	1	"Assignment 7"
LB 8	1	"Assignment 8"
-	pcs	-

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:68
		Date :	Created :

Spread sheet input for KG 2:

x(+)	y(+)	z(+)	Remark
0	0,480	-0,020	Passive anchorage
1,250	0,370	-0,130	-
4,375	0,170	-0,330	-
7,500	0,090	-0,410	-
10,625	0,170	-0,330	-
13,750	0,380	-0,120	-
16,875	0,650	0,150	-
20,000	0,850	0,350	Support 3
21,450	0,730	0,230	-
22,900	0,600	0,100	-
24,900	0,420	-0,080	-
25,800	0,340	-0,160	-
28,700	0,200	-0,300	-
31,600	0,150	-0,350	-
34,500	0,250	-0,250	-
37,400	0,500	0,000	-
40,300	0,770	0,270	-
43,200	0,910	0,410	Support 4
45,137	0,850	0,350	-
47,075	0,733	0,233	-
49,400	0,584	0,084	Active anchorage
m	m	m	-

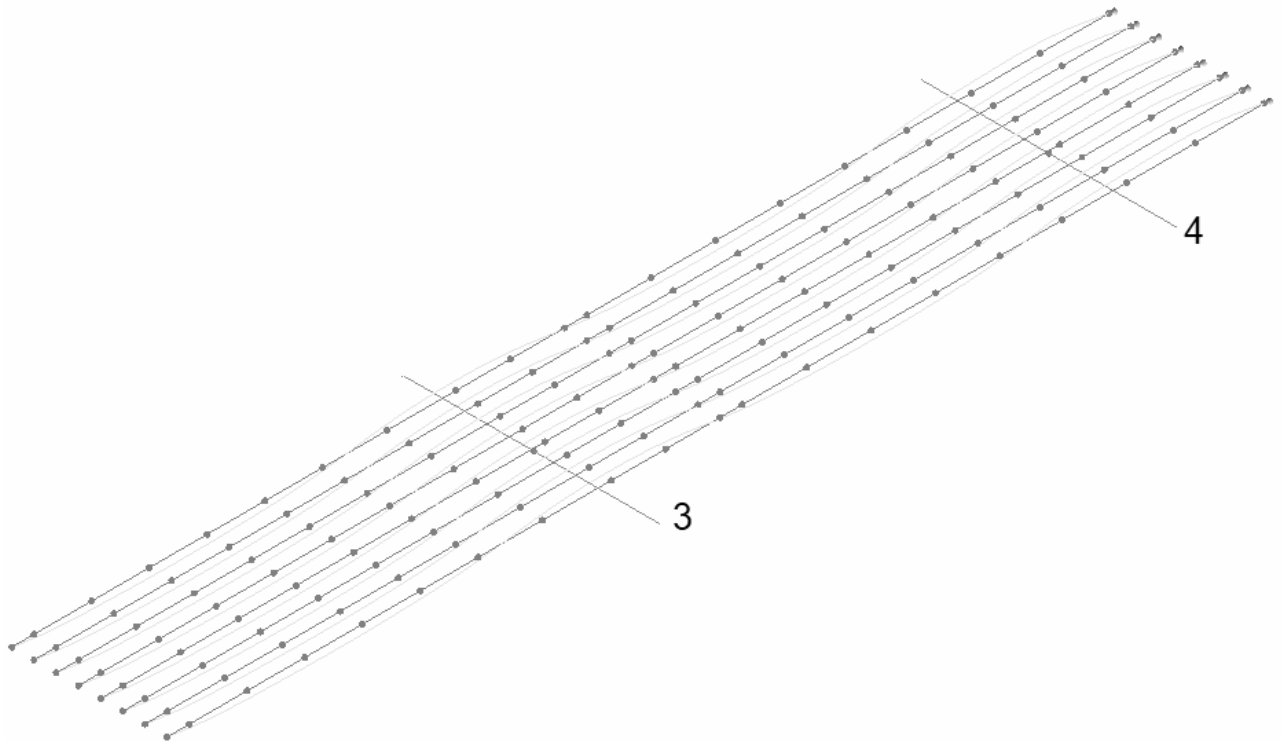
Offset distance from end 1 (start): 0 m

Jacking at end 1 (start): no
Jacking at end 2 (end): yes



Elevation

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:69
		Date :	Created :



3D-view

Disitribution of cables above.

Beams	Number of cables	Designation
LB 1	1	"Assignment 1"
LB 2	1	"Assignment 2"
LB 3	1	"Assignment 3"
LB 4	1	"Assignment 4"
LB 5	1	"Assignment 5"
LB 6	1	"Assignment 6"
LB 7	1	"Assignment 7"
LB 8	1	"Assignment 8"
-	pcs	-

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:70
		Date :	Created :

Spread sheet input for KG 3:

x(+)	y(+)	z(+)	Remark
0	0,584	0,084	Passive anchorage
1,550	0,485	-0,015	-
5,425	0,282	-0,218	-
9,300	0,159	-0,341	-
13,175	0,195	-0,305	-
17,050	0,430	-0,070	-
20,925	0,670	0,170	-
24,800	0,900	0,400	Support 5
28,675	0,714	0,214	-
32,550	0,500	0,000	-
36,425	0,203	-0,297	-
40,300	0,159	-0,341	-
44,175	0,256	-0,244	-
48,050	0,425	-0,075	-
51,925	0,670	0,170	-
55,800	0,880	0,380	Support 6
58,925	0,870	0,370	-
60,800	0,750	0,250	Active anchorage
m	m	m	-

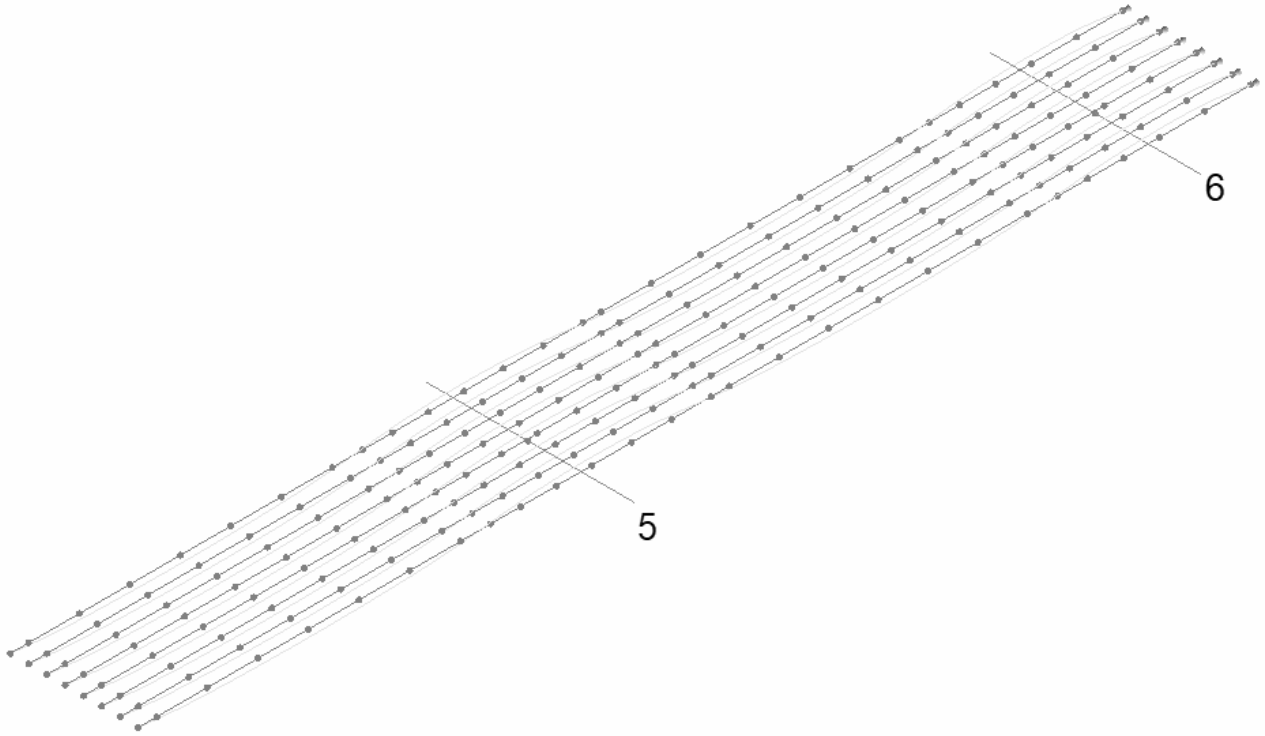
Offset distance from end 1 (start): 0 m

Jacking at end 1 (start): no
Jacking at end 2 (end): yes



Elevation

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:71
		Date :	Created :



3D-view

Disitribution of cables above.

Beams	Number of cables	Designation
LB 1	1	"Assignment 1"
LB 2	1	"Assignment 2"
LB 3	1	"Assignment 3"
LB 4	1	"Assignment 4"
LB 5	1	"Assignment 5"
LB 6	1	"Assignment 6"
LB 7	1	"Assignment 7"
LB 8	1	"Assignment 8"
-	pcs	-

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:72
		Date :	Created :

Spread sheet input for KG 4:

x(+)	y(+)	z(+)	Remark
0	0,750	0,250	Passive anchorage
1,250	0,543	0,043	= 2/8
4,375	0,250	-0,250	-
7,500	0,150	-0,350	-
10,625	0,200	-0,300	-
13,750	0,340	-0,160	-
16,875	0,600	0,100	-
20,000	0,870	0,370	Support 7
21,562	0,798	0,298	-
23,125	0,650	0,150	-
25,000	0,490	-0,010	-
26,250	0,380	-0,120	-
29,375	0,170	-0,330	-
32,500	0,090	-0,410	-
35,625	0,170	-0,330	-
38,750	0,370	-0,130	-
41,875	0,650	0,150	-
45,000	0,850	0,350	Support 8
46,218	0,800	0,300	-
47,437	0,660	0,160	-
48,900	0,505	0,005	Active anchorage

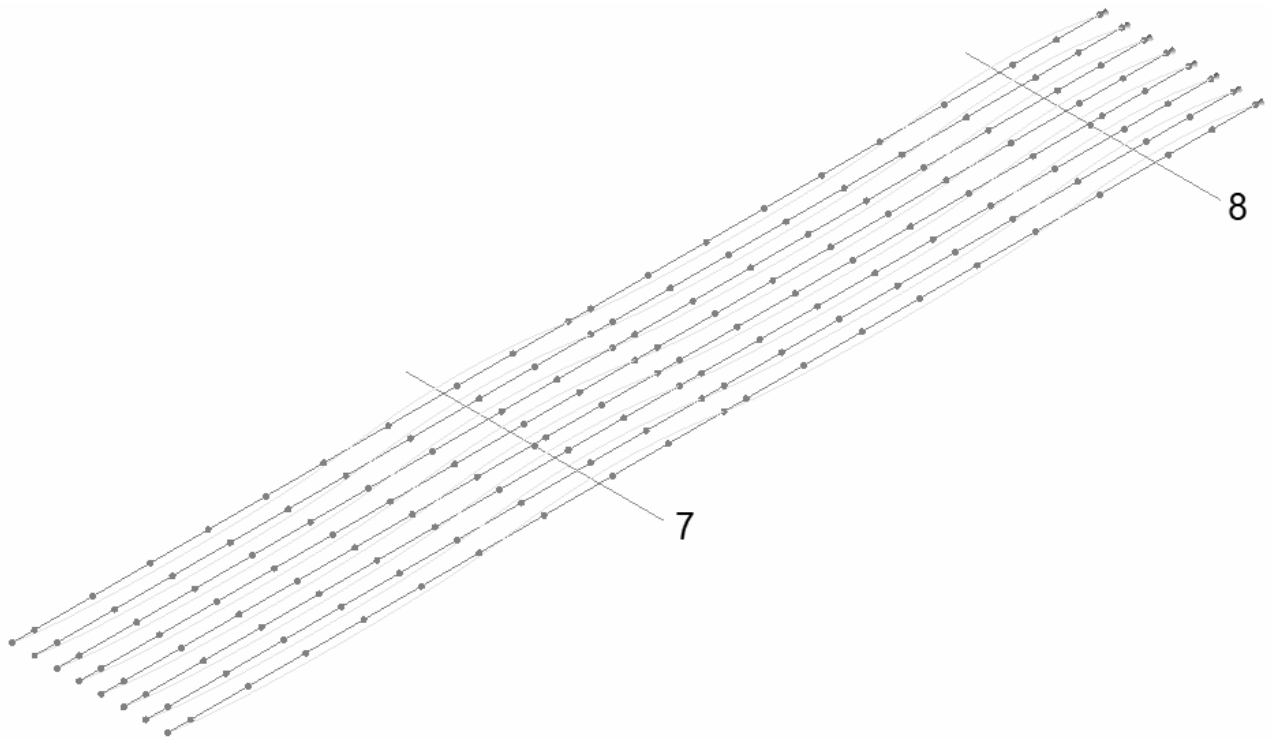
Offset distance from end 1 (start): 0 m

Jacking at end 1 (start): no
Jacking at end 2 (end): yes



Elevation

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:73
		Date :	Created :



3D-view

Disitribution of cables above.

Beams	Number of cables	Designation
LB 1	1	"Assignment 1"
LB 2	1	"Assignment 2"
LB 3	1	"Assignment 3"
LB 4	1	"Assignment 4"
LB 5	1	"Assignment 5"
LB 6	1	"Assignment 6"
LB 7	1	"Assignment 7"
LB 8	1	"Assignment 8"
-	pcs	-

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:74
		Date :	Created :

Spread sheet input for KG 5:

x(+)	y(+)		z(+)	Remark
0	0,505		0,005	Passive anchorage
0,975	0,400		-0,100	-
3,396	0,270		-0,230	-
5,817	0,200		-0,300	-
8,237	0,220		-0,280	-
10,658	0,300	→	-0,200	-
13,079	0,400		-0,100	-
15,500	0,505		0,005	Support 9
15,800	0,510		0,010	Active anchorage
m	m		m	-

Offset distance from end 1 (start): 0 m

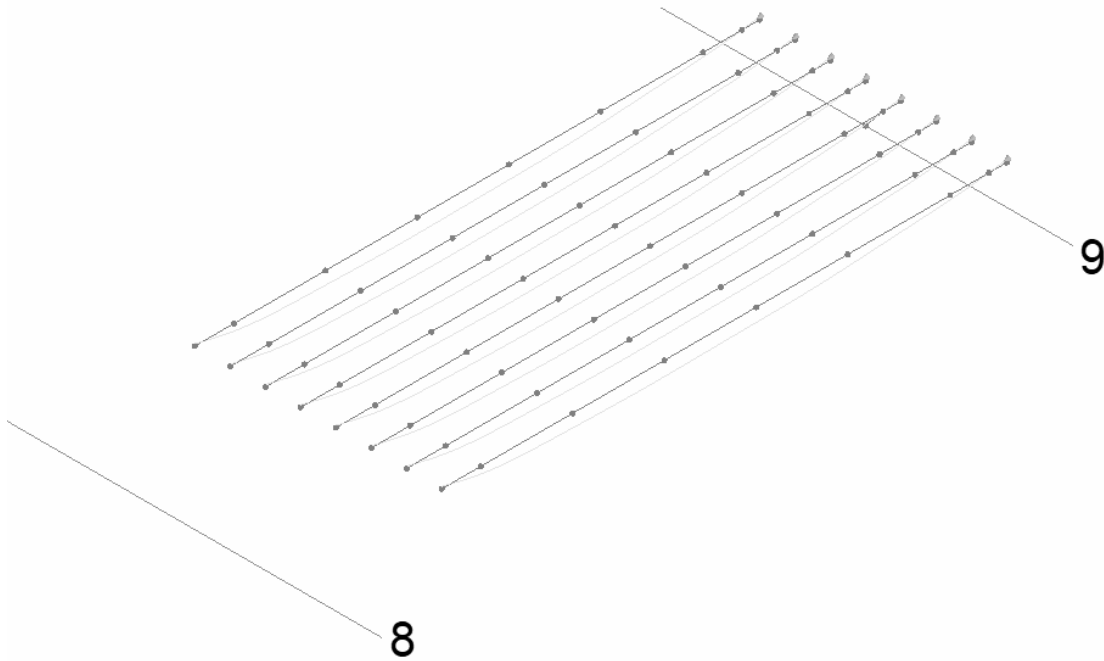
Jacking at end 1 (start): no

Jacking at end 2 (end): yes



Elevation

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:75
		Date :	Created :



3D-view

Disitribution of cables above.

Beam	No of cables
LB 1	1
LB 2	1
LB 3	1
LB 4	1
LB 5	1
LB 6	1
LB 7	1
LB 8	1
-	pcs

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:76
		Date :	Created :

Spread sheet input for KG 6:

x(+)	y(+)	z(+)	Remark
0	0,491	-0,009	Passive anchorage
0,300	0,482	-0,018	Support 1
1,512	0,445	-0,055	-
2,725	0,400	-0,100	-
5,150	0,300	-0,200	-
7,575	0,220	-0,280	-
10,000	0,200	-0,300	-
12,425	0,270	-0,230	-
14,850	0,400	-0,100	-
17,275	0,660	0,160	Support 2
19,700	0,890	0,390	-
21,262	0,790	0,290	-
22,825	0,650	0,150	-
24,700	0,480	-0,020	-
25,950	0,370	-0,130	-
29,075	0,170	-0,330	-
32,200	0,090	-0,410	-
35,325	0,170	-0,330	-
38,450	0,380	-0,120	-
41,575	0,650	0,150	-
44,700	0,850	0,350	Support 3
46,150	0,730	0,230	-
47,600	0,600	0,100	-
49,600	0,420	-0,080	Active anchorage
m	m	m	-

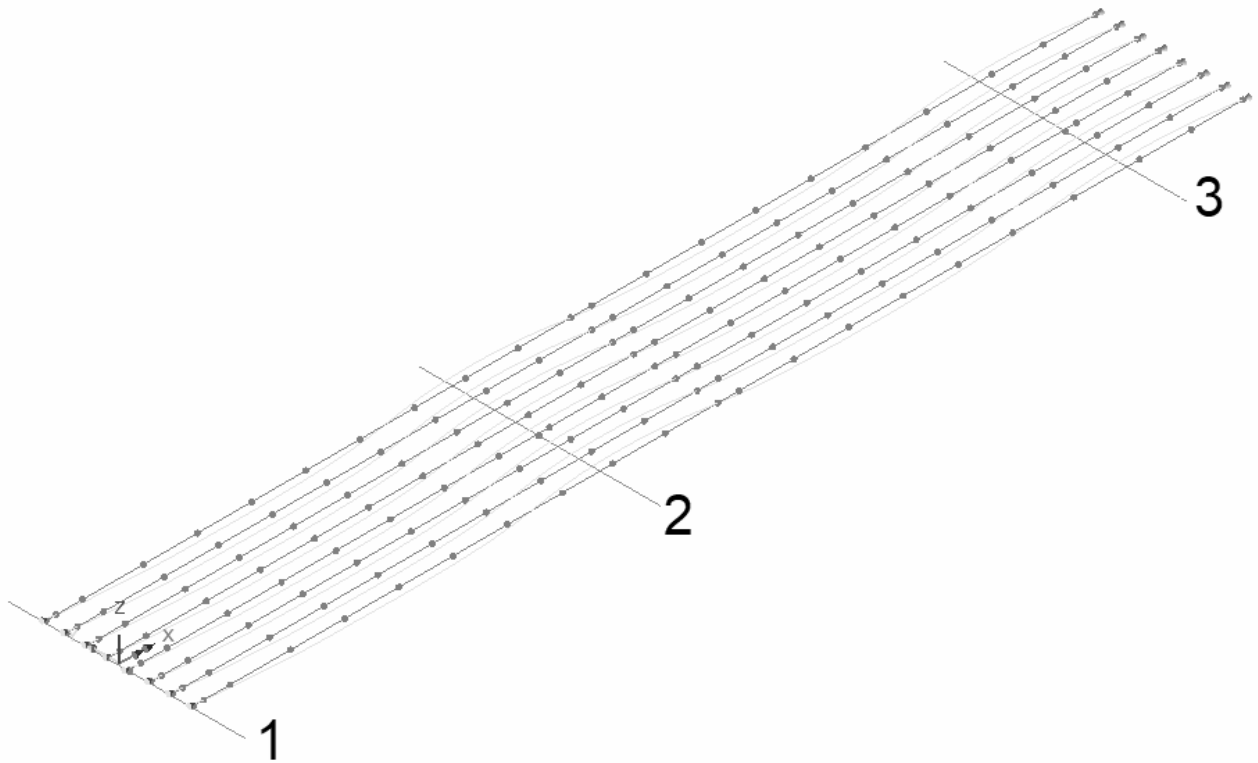
Offset distance from end 1 (start): 0.2 m

Jacking at end 1 (start): no
 Jacking at end 2 (end): yes



Elevation

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:77
		Date :	Created :



3D-view

Disitribution of cables above.

Beam	No of cables
LB 1	1
LB 2	1
LB 3	1
LB 4	1
LB 5	1
LB 6	1
LB 7	1
LB 8	1
-	pcs

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:78
		Date :	Created :

Spread sheet input for KG 7:

x(+)	y(+)	z(+)	Remark
0	0,420	-0,080	Passive anchorage
0,900	0,340	-0,160	-
3,800	0,200	-0,300	-
6,700	0,150	-0,350	-
9,600	0,250	-0,250	-
12,500	0,500	0	-
15,400	0,770	0,270	-
18,300	0,910	0,410	Support 4
22,175	0,733	0,233	-
26,050	0,468	-0,032	-
29,925	0,218	-0,282	-
33,800	0,133	-0,367	-
37,675	0,180	-0,320	-
39,613	0,288	-0,212	-
41,550	0,430	-0,070	-
45,425	0,670	0,170	-
49,300	0,900	0,400	Support 5
53,175	0,714	0,214	-
55,112	0,605	0,105	-
55,800	0,569	0,069	Active anchorage
m	m	m	-

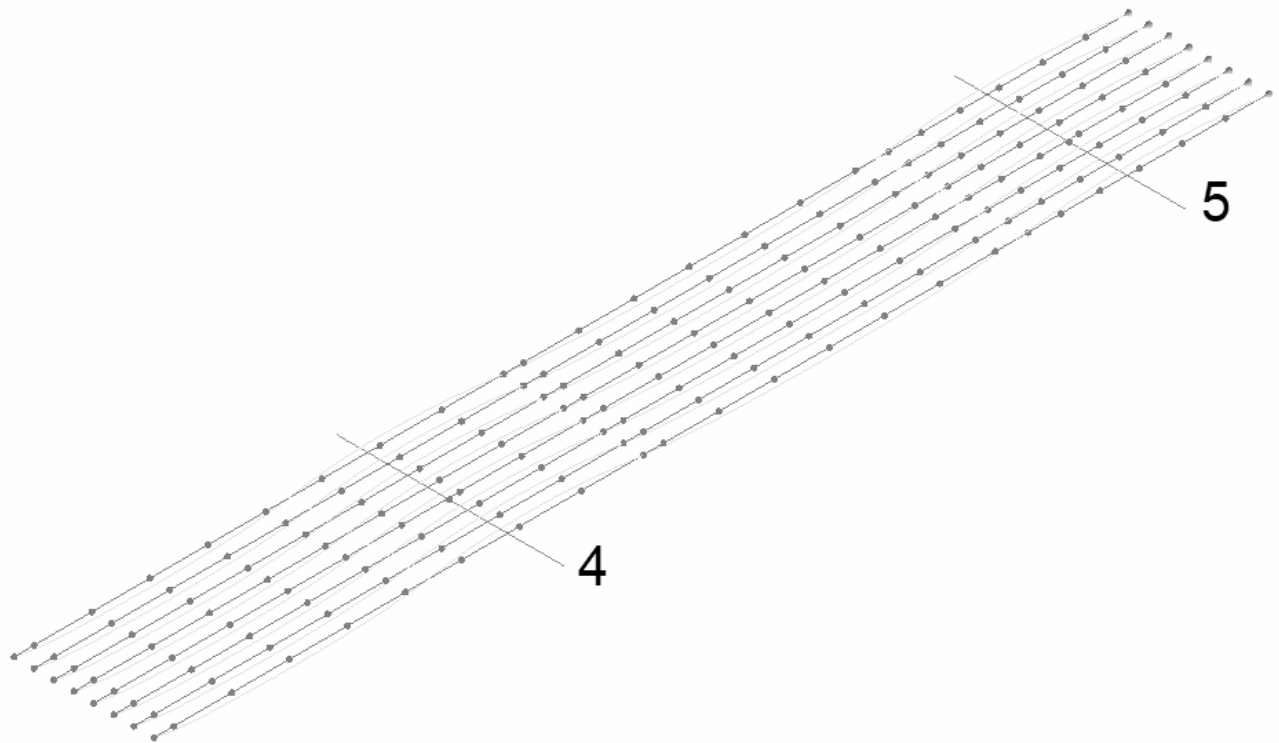
Offset distance from end 1 (start): 0 m

Jacking at end 1 (start): no
Jacking at end 2 (end): yes



Elevation

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:79
		Date :	Created :



3D-view

Disitribution of cables above.

Beams	Number of cables	Designation
LB 1	1	"Assignment 1"
LB 2	1	"Assignment 2"
LB 3	1	"Assignment 3"
LB 4	1	"Assignment 4"
LB 5	1	"Assignment 5"
LB 6	1	"Assignment 6"
LB 7	1	"Assignment 7"
LB 8	1	"Assignment 8"
-	pcs	-

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:80
		Date :	Created :

Spread sheet input for KG 8:

x(+)	y(+)		z(+)	Remark
0	0,569		0,069	Passive anchorage
1,250	0,478		-0,022	-
5,125	0,173		-0,327	-
9,000	0,133		-0,367	-
12,875	0,218		-0,282	-
16,750	0,410	→	-0,090	-
20,625	0,670		0,170	-
24,500	0,880		0,380	Support 6
27,625	0,834		0,334	-
30,750	0,461		-0,039	-
33,875	0,250		-0,250	-
37,000	0,150		-0,350	-
40,125	0,200		-0,300	-
43,250	0,340		-0,160	-
46,375	0,600		0,100	-
49,500	0,870		0,370	Support 7
52,625	0,650		0,150	-
54,500	0,490		-0,010	-
m	m		m	-

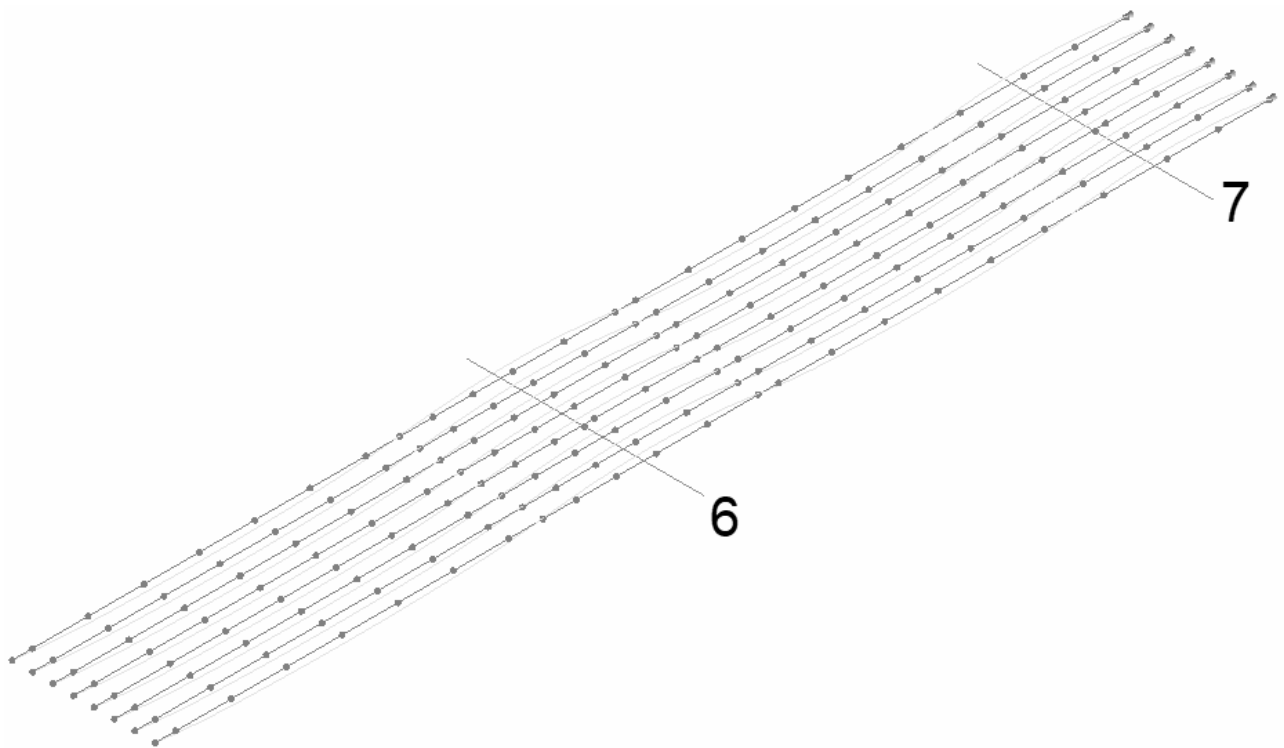
Offset distance from end 1 (start): 0 m

Jacking at end 1 (start): no
Jacking at end 2 (end): yes



Elevation

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:81
	Pretensioned slab bridge: hollow deck	Date :	Created :



3D-view

Disitribution of cables above.

Beams	Number of cables	Designation
LB 1	1	"Assignment 1"
LB 2	1	"Assignment 2"
LB 3	1	"Assignment 3"
LB 4	1	"Assignment 4"
LB 5	1	"Assignment 5"
LB 6	1	"Assignment 6"
LB 7	1	"Assignment 7"
LB 8	1	"Assignment 8"
-	pcs	-

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:82
		Date :	Created :

Spread sheet input for KG 9:

x(+)	y(+)	z(+)	Remark
0	0,490	-0,010	Passive anchorage
1,250	0,380	-0,120	-
4,375	0,170	-0,330	-
7,500	0,090	-0,410	-
10,625	0,170	-0,330	-
13,750	0,370	-0,130	-
16,875	0,650	0,150	-
20,000	0,850	0,350	Support 8
21,218	0,800	0,300	-
22,437	0,660	0,160	-
23,900	0,505	0,005	-
24,875	0,400	-0,100	-
27,296	0,270	-0,230	-
29,717	0,200	-0,300	-
32,137	0,220	-0,280	-
34,558	0,300	-0,200	-
36,979	0,400	-0,100	-
39,400	0,500	0	Support t9
39,700	0,510	0,010	Active anchorage
m	m	m	-

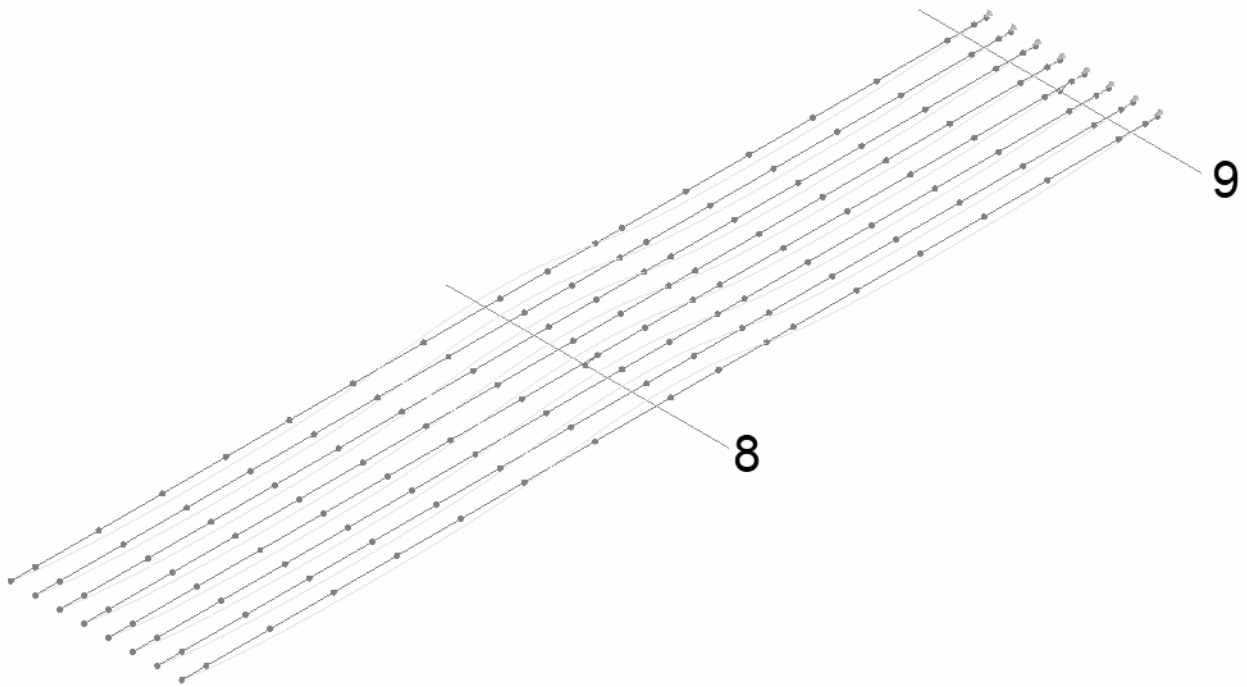
Offset distance from end 1 (start): 0 m

Jacking at end 1 (start): no
 Jacking at end 2 (end): yes



Elevation

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:83
		Date :	Created :



3D-view

Disitribution of cables above.

Beams	Number of cables	Designation
LB 1	1	"Assignment 1"
LB 2	1	"Assignment 2"
LB 3	1	"Assignment 3"
LB 4	1	"Assignment 4"
LB 5	1	"Assignment 5"
LB 6	1	"Assignment 6"
LB 7	1	"Assignment 7"
LB 8	1	"Assignment 8"
-	pcs	-

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:84
		Date :	Created :

Spread sheet input for KG 10:

x(+)	y(+)		z(+)	Remark
39,100	0,450		-0,050	Passive anchorage
40,300	0,665		0,165	-
43,200	0,805		0,305	Support 4
45,137	0,680	→	0,180	-
47,075	0,440		-0,060	-
49,400	0,300		-0,200	Active anchorage
m	m		m	-

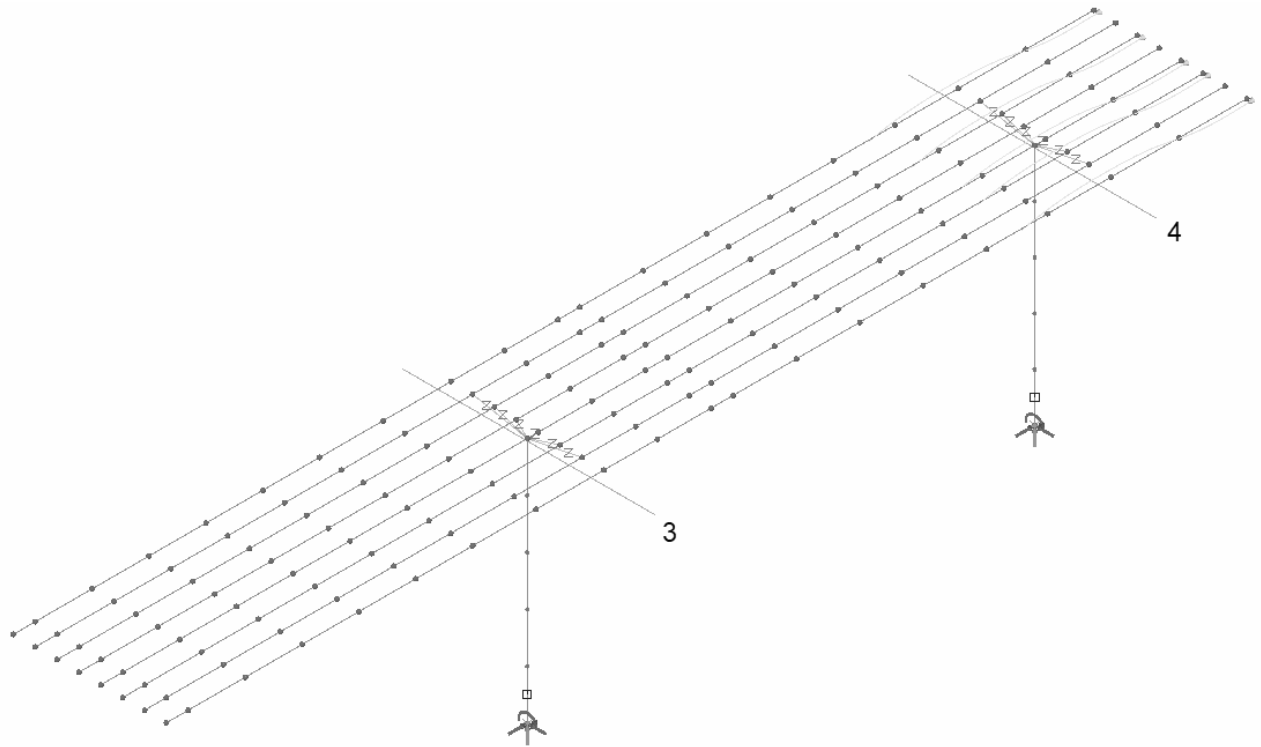
Offset distance from end 1 (start): 0 m

Jacking at end 1 (start): no
Jacking at end 2 (end): yes



Elevation

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:85
		Date :	Created :



3D-view

Disitribution of cables above.

Beams	Number of cables	Designation
LB 1	1	"Assignment 1"
LB 2	0	-
LB 3	1	"Assignment 2"
LB 4	0	-
LB 5	1	"Assignment 3"
LB 6	1	"Assignment 4"
LB 7	0	-
LB 8	1	"Assignment 5"
-	pcs	-

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:86
		Date :	Created :

Spread sheet input for KG 11:

x(+)	y(+)	z(+)	Remark
0	0,300	-0,200	Passive anchorage
1,550	0,230	-0,270	-
5,425	0,130	-0,370	-
9,300	0,080	-0,420	-
13,175	0,090	-0,410	-
17,050	0,275	-0,225	-
20,925	0,540	0,040	-
24,800	0,795	0,295	Support 5
28,675	0,470	-0,030	-
32,550	0,215	-0,285	-
36,425	0,080	-0,420	-
40,300	0,080	-0,420	-
44,175	0,140	-0,360	-
48,050	0,320	-0,180	-
51,925	0,540	0,040	-
55,800	0,750	0,250	Support 6
58,925	0,555	0,055	-
60,800	0,410	-0,090	Active anchorage
m	m	m	-

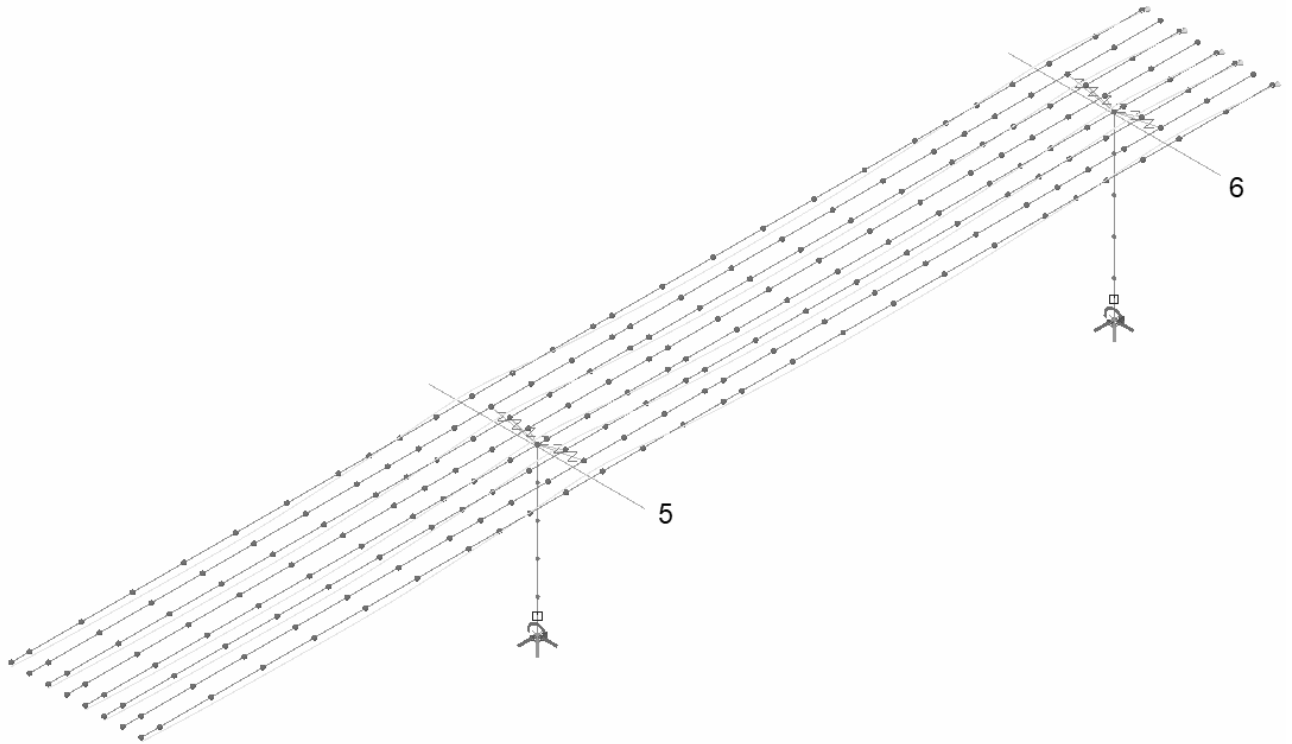
Offset distance from end 1 (start): 0 m

Jacking at end 1 (start): no
Jacking at end 2 (end): yes



Elevation

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:87
		Date :	Created :



3D-view

Disitribution of cables above.

Beams	Number of cables	Designation
LB 1	1	"Assignment 1"
LB 2	0	-
LB 3	1	"Assignment 2"
LB 4	0	-
LB 5	1	"Assignment 3"
LB 6	1	"Assignment 4"
LB 7	0	-
LB 8	1	"Assignment 5"
-	pcs	-

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:88
		Date :	Created :

Spread sheet input for KG 12:

x(+)	y(+)		z(+)	Remark
14,200	0,450		-0,050	Passive anchorage
15,400	0,665		0,165	-
18,300	0,805		0,305	Support4
22,175	0,440		-0,060	-
26,050	0,230	→	-0,270	-
29,925	0,130		-0,370	-
33,800	0,080		-0,420	-
37,675	0,090		-0,410	-
41,550	0,275		-0,225	-
45,425	0,540		0,040	-
49,300	0,795		0,295	Support5
53,175	0,470		-0,030	-
55,800	0,285		-0,215	Active anchorage
m	m		m	-

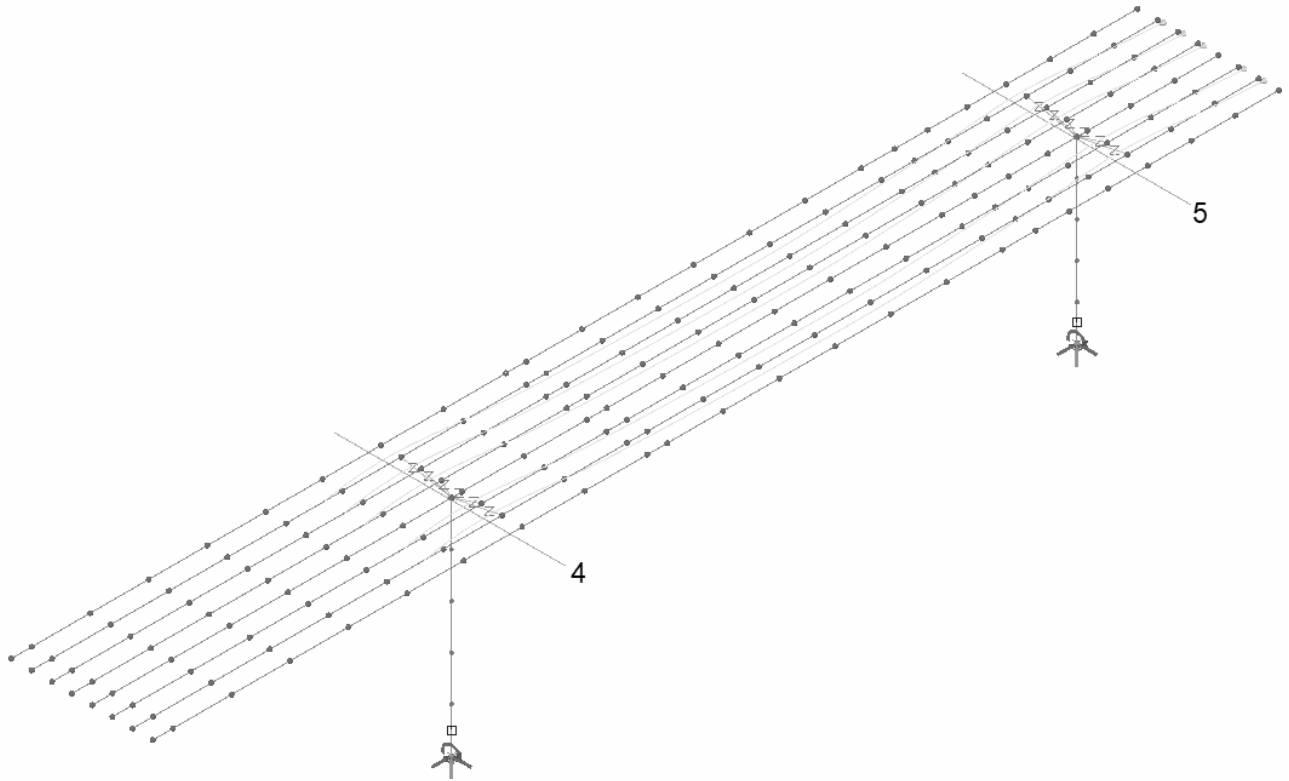
Offset distance from end 1 (start): 0 m

Jacking at end 1 (start): no
Jacking at end 2 (end): yes



Elevation

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:89
		Date :	Created :



3D-view

Disitribution of cables above.

Beams	Number of cables	Designation
LB 1	0	-
LB 2	1	"Assignment 1"
LB 3	1	"Assignment 2"
LB 4	1	"Assignment 3"
LB 5	0	-
LB 6	1	"Assignment 4"
LB 7	1	"Assignment 5"
LB 8	0	-
-	pcs	-

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:90
		Date :	Created :

Spread sheet input for KG 13:

x(+)	y(+)		z(+)	Remark
31,300	0,285		-0,215	Passive anchorage
32,550	0,215		-0,285	-
36,425	0,080	→	-0,420	-
40,300	0,080		-0,420	-
44,175	0,140		-0,360	-
48,050	0,320		-0,180	-
51,925	0,540		0,040	-
55,800	0,750		0,250	Support 6
58,925	0,555		0,055	-
60,800	0,410		-0,090	Active anchorage
m	m		m	-

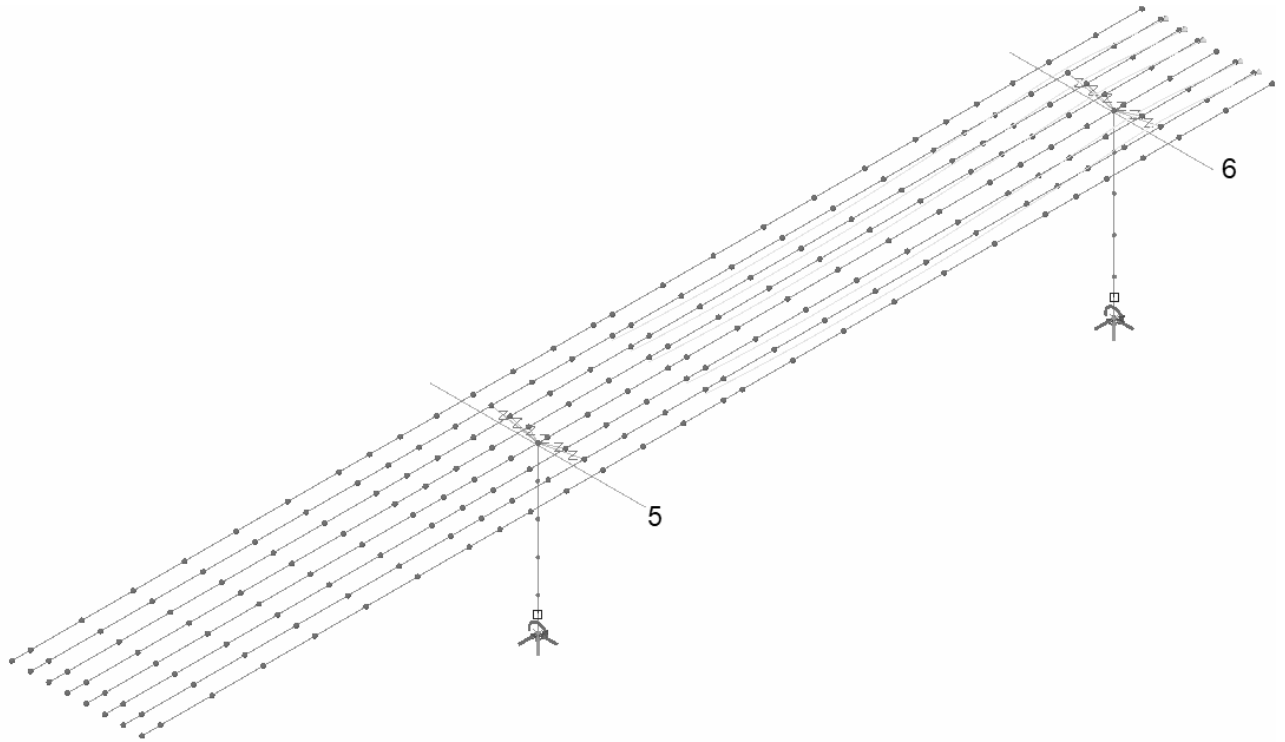
Offset distance from end 1 (start): 0 m

Jacking at end 1 (start): no
Jacking at end 2 (end): yes



Elevation

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:91
		Date :	Created :



3D-view

Disitribution of cables above.

Beams	Number of cables	Designation
LB 1	0	-
LB 2	1	"Assignment 1"
LB 3	1	"Assignment 2"
LB 4	1	"Assignment 3"
LB 5	0	-
LB 6	1	"Assignment 4"
LB 7	1	"Assignment 5"
LB 8	0	-
-	pcs	-

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:92
		Date :	Created :

Spread sheet input for KG 14:

x(+)	y(+)		z(+)	Remark
18,000	0,450		-0,050	Passive anchorage
20,000	0,200		-0,300	Support 3
21,450	0,210	→	-0,290	-
22,900	0,270		-0,230	-
24,900	0,455		-0,045	Active anchorage
m	m		m	-

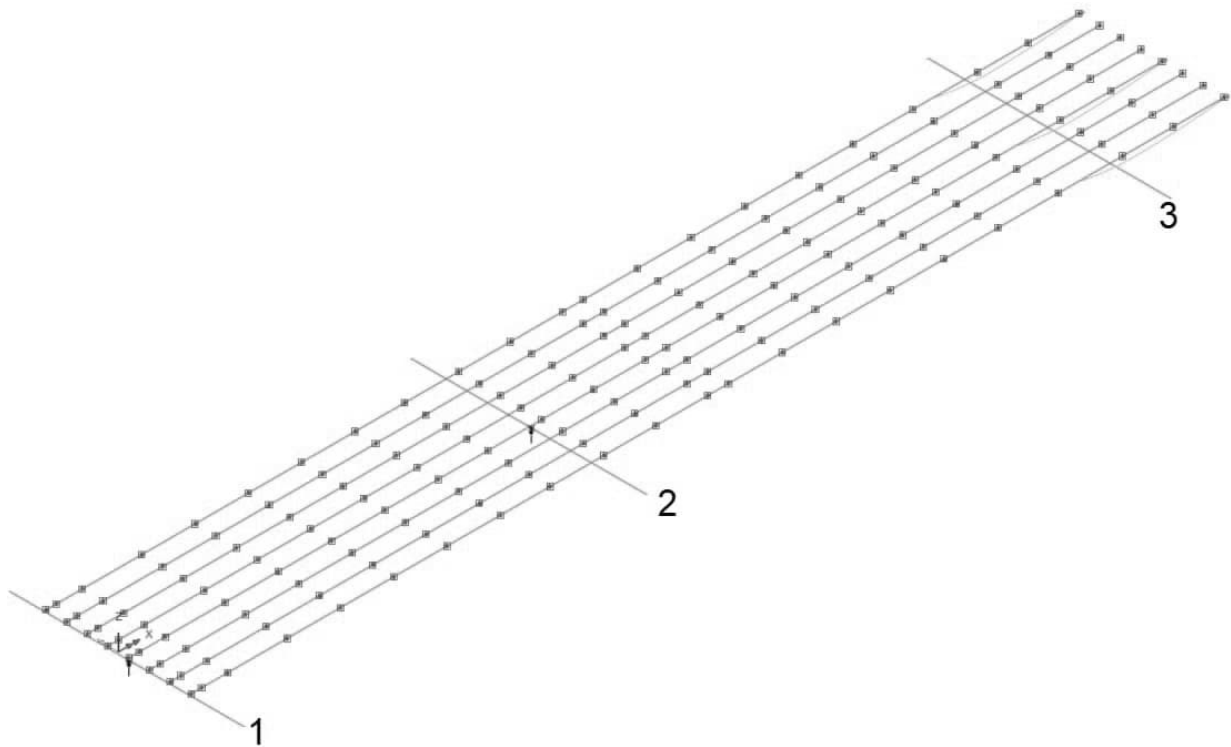
Offset distance from end 1 (start): 18.0 m

Jacking at end 1 (start): no
Jacking at end 2 (end): yes



Elevation

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:93
		Date :	Created :



3D-view

Disitribution of cables above.

Beams	Number of cables	Designation
LB 1	1	"Assignment 1"
LB 2	0	"Assignment 2"
LB 3	0	"Assignment 3"
LB 4	0	"Assignment 4"
LB 5	1	"Assignment 5"
LB 6	0	"Assignment 6"
LB 7	0	"Assignment 7"
LB 8	1	"Assignment 8"
-	pcs	-

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:94
		Date :	Created :

3.8.4.3 Tendon properties

Calculation of 'long term losses' is not done with LUSAS but separately. Hence 'Include: No' in the table below.

Tendon Properties ✕

Design: EN1992-1-1:2004 / 2014 Eurocode 2

Losses based on time inputs and calculated stresses
 Approximate losses, requiring input of estimated stresses

Elastic shortening

Based on design code Set losses...
 User-defined Set losses...
 Ignore effects

General		
Tendon area	1,11E3	mm ²
Modulus of elasticity for tendon	200,0E6	kN/m ²
Concrete stress at transfer	10,0E3	kN/m ²
Instantaneous losses		
Modulus of elasticity of concrete at transfer	32,0E6	kN/m ²
Unintentional angular displacement	3,0E-3	rad/m
Duct friction coefficient	0,25	
Long term losses		
Include	No	

Name: VSL 12-13 (1)

Friction coefficients during tensioning of cables:

$$P_{(x)} = P_o \cdot e^{-\mu(\alpha+k \cdot x)}$$

$$\mu = 0.25$$

$$k = 0.003 \frac{rad}{m}$$

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:95
		Date :	Created :

3.8.5 Load combination

Load combination basis PT-T0E:
(Static system "Analysis 1" → "Analysis 8")

Load case	Factor
KG 1-1	1.00
KG 2-3	1.00
KG 3-5	1.00
KG 4-7	1.00
KG 5-8	1.00
KG 6-2	1.00
KG 7-4	1.00
KG 8-6	1.00
KG 9-8	1.00
KG 10-3	1.00
KG 11-5	1.00
KG 12-4	1.00
KG 13-5	1.00
KG 14-2	1.00

Load combination basis PT-T0C:
(Static system "Analysis 9")

Load case	Factor
KG 1	1.00
KG 2	1.00
KG 3	1.00
KG 4	1.00
KG 5	1.00
KG 6	1.00
KG 7	1.00
KG 8	1.00
KG 9	1.00
KG 10	1.00
KG 11	1.00
KG 12	1.00
KG 13	1.00
KG 14	1.00

Basic load combination PT-T0:

Load case	Factor
PT-T0E	0.53
PT-T0C	0.47

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:96
		Date :	Created :

3.9 LOAD COMBINATIONS

Verification of load capacity shall be carried out for several limit states as detailed in this section.

Fatigue Limit State:

The risk of fatigue according to the partial factor method is checked using equation 6.69 provided in document SS-EN 1992-1-1.

Other Limit States:

For other limit states, section 6.4.3 of EN-1990 is applied.

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:97
	Pretensioned slab bridge: hollow deck	Date :	Created :

3.14.1 Ultimate Limit States (ULS)

When checking the ultimate limit state, the load factors vary depending on the type of failure as detailed below:

STR: Verification of structural bearing capacity

GEO: Verification of geotechnical bearing capacity

For checking the ultimate limit state, TRVNFRA-00227 section 7.1.6.3 specifies requirements for load combinations as follows.

Design Method D2 (Set B):

Design Method D2 (Set B) according to TSFS 2018:57 Table 4.4 shall be applied for the structural bearing capacity of the construction (STR; SK 3).

Design Method is defined according to EN-1990 equations 6.10a and 6.10b as detailed below.

$$E_{Sd}^{10a} = \sum_{j \geq 1} \gamma_{G,j} \cdot G_{k,j} + \gamma_{Q,1} \cdot \psi_{0,1} \cdot Q_{k,1} + \sum_{i > 1} \gamma_{Q,i} \cdot \psi_{0,i} \cdot Q_{k,i} = \psi \gamma_{ULS-A} \cdot \left(\sum_{j > 1} G_{k,j} + \sum_{i > 1} Q_{k,i} \right)$$

$$E_{Sd}^{10b} = \sum_{j \geq 1} \xi_j \cdot \gamma_{G,j} \cdot G_{k,j} + \gamma_{Q,1} \cdot Q_{k,1} + \sum_{i > 1} \gamma_{Q,i} \cdot \psi_{0,i} \cdot Q_{k,i} = \psi \gamma_{ULS-B} \cdot \left(\sum_{j > 1} G_{k,j} + \sum_{i > 1} Q_{k,i} \right)$$

Equation 6.10a refers to the (ULS-A) case where the permanent loads are dominant, usually during the construction phase.

Equation 6.10b refers to the (ULS-B) case where the variable loads are dominant.

Design method 2 (set B) according to TSFS 2018:57 table 4.4 shall be applied for the structural capacity (STR; SK3).

A1 (construction loads)

All load factors are greater than set C.

A2 (geotechnical loads)

- Load coefficient earth pressure:

$$\psi \gamma_{ULS-A} = \gamma_d \cdot 1.35 \cdot \eta_{sup,G} = 1.0 \cdot 0.89 \cdot 1.35 \cdot 1.1 = 1.49 \quad \leftarrow \text{dimensioning}$$

$$\psi \gamma_{ULS-B} = \gamma_d \cdot 0.89 \cdot 1.35 \cdot \eta_{sup,G} = 1.0 \cdot 0.89 \cdot 1.35 \cdot 1.1 = 1.33$$

- Load coefficient surcharge:

$$\psi \gamma_{ULS-A} = \gamma_d \cdot \psi_0 \cdot 1.50 = 1.0 \cdot 0.75 \cdot 1.50 = 1.13$$

$$\psi \gamma_{ULS-B} = \gamma_d \cdot 1.50 = 1.0 \cdot 1.50 = 1.50 \quad \leftarrow \text{dimensioning}$$

	Part A - CALCULATION ASSUMPTIONS	Status :	Page: A3:98
	Pretensioned slab bridge: hollow deck	Date :	Created :

3.14.1 Ultimate Limit States (ULS)

When checking the ultimate limit state, the load factors vary depending on the type of failure as detailed below:

STR: Verification of structural bearing capacity

GEO: Verification of geotechnical bearing capacity

For checking the ultimate limit state, TRVNFRA-00227 section 7.1.6.3 specifies requirements for load combinations as follows.

Design Method D2 (Set B):

Design Method D2 (Set B) according to TSFS 2018:57 Table 4.4 shall be applied for the structural bearing capacity of the construction (STR; SK 3).

Design Method is defined according to EN-1990 equations 6.10a and 6.10b as detailed below.

$$E_{Sd}^{10a} = \sum_{j \geq 1} \gamma_{G,j} \cdot G_{k,j} + \gamma_{Q,1} \cdot \psi_{0,1} \cdot Q_{k,1} + \sum_{i > 1} \gamma_{Q,i} \cdot \psi_{0,i} \cdot Q_{k,i} = \psi \gamma_{ULS-A} \cdot \left(\sum_{j > 1} G_{k,j} + \sum_{i > 1} Q_{k,i} \right)$$

$$E_{Sd}^{10b} = \sum_{j \geq 1} \xi_j \cdot \gamma_{G,j} \cdot G_{k,j} + \gamma_{Q,1} \cdot Q_{k,1} + \sum_{i > 1} \gamma_{Q,i} \cdot \psi_{0,i} \cdot Q_{k,i} = \psi \gamma_{ULS-B} \cdot \left(\sum_{j > 1} G_{k,j} + \sum_{i > 1} Q_{k,i} \right)$$

Equation 6.10a refers to the (ULS-A) case where the permanent loads are dominant, usually during the construction phase.

Equation 6.10b refers to the (ULS-B) case where the variable loads are dominant.

Design method 2 (set B) according to TSFS 2018:57 table 4.4 shall be applied for the structural capacity (STR; SK3).

A1 (construction loads)

All load factors are greater than set C.

A2 (geotechnical loads)

- Load coefficient earth pressure:

$$\psi \gamma_{ULS-A} = \gamma_d \cdot 1.35 \cdot \eta_{sup,G} = 1.0 \cdot 0.89 \cdot 1.35 \cdot 1.1 = 1.49 \quad \leftarrow \text{dimensioning}$$

$$\psi \gamma_{ULS-B} = \gamma_d \cdot 0.89 \cdot 1.35 \cdot \eta_{sup,G} = 1.0 \cdot 0.89 \cdot 1.35 \cdot 1.1 = 1.33$$

- Load coefficient surcharge:

$$\psi \gamma_{ULS-A} = \gamma_d \cdot \psi_0 \cdot 1.50 = 1.0 \cdot 0.75 \cdot 1.50 = 1.13$$

$$\psi \gamma_{ULS-B} = \gamma_d \cdot 1.50 = 1.0 \cdot 1.50 = 1.50 \quad \leftarrow \text{dimensioning}$$

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:99
		Date :	Created :

Design method D3 (set C):

Design method D3 (set C) according to TSFS 2018:57 table 4.5 shall be applied for determining geotechnical bearing capacity (GEO; SK 2).

The design method is defined according to EN-1990 equation 6.10a and 6.10b as presented below.

$$E_{Sd}^{10a} = \sum_{j \geq 1} \gamma_{G,j} \cdot G_{k,j} + \gamma_{Q,1} \cdot \psi_{0,1} \cdot Q_{k,1} + \sum_{i > 1} \gamma_{Q,i} \cdot \psi_{0,i} \cdot Q_{k,i} = \psi \gamma_{ULS-GA} \cdot \left(\sum_{j > 1} G_{k,j} + \sum_{i > 1} Q_{k,i} \right)$$

$$E_{Sd}^{10b} = \sum_{j \geq 1} \xi_j \cdot \gamma_{G,j} \cdot G_{k,j} + \gamma_{Q,1} \cdot Q_{k,1} + \sum_{i > 1} \gamma_{Q,i} \cdot \psi_{0,i} \cdot Q_{k,i} = \psi \gamma_{ULS-GB} \cdot \left(\sum_{j > 1} G_{k,j} + \sum_{i > 1} Q_{k,i} \right)$$

Equation 6.10a refers to the (ULS-A) case where the permanent loads are dominant, usually during the construction phase.

Equation 6.10b (ULS-B) refers to the case where the variable loads are dominant.

Design method 3 (set C) according to TSFS 2018:57 table 4.5 shall be applied for determining geotechnical bearing capacity (GEO).

A1 (construction loads)

All load factors are less than set B.

A2 (geotechnical loads)

• Load coefficient earth pressure: $\psi \gamma_{jord} = \gamma_d \cdot 1.1 \cdot \eta_{sup.G} = 0.91 \cdot 1.1 \cdot 1.1 = 1.10$

• Load coefficient surcharge: $\psi \gamma_{over} = \gamma_d \cdot 1.40 = 0.91 \cdot 1.40 = 1.27$

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:100
		Date :	Created :

Load combination smart ULS-PERM:

Load case	Permanent factor	Variable factor
EGEN	1.00	1.20
BELÄGG	1.00	1.20
JORD	1.00	1.20
STOD	0	$1.2 \cdot f_{STOD} = 0.40$
KRYMP	0	$1.2 \cdot s_{KRYMP} = 0.40$

Load combination smart ULS-VAR:

(Load cases to consider : 5 / Variable loadcases : 1)

Load case	Permanent factor	Variable factor
TRAFIK	1.13	1.50
BROMS	1.13	1.50
SIDO	1.13	1.50
TEMP	$0.90 f_{TEMP} = 0.70$	$1.5 \cdot f_{TEMP} = 1.2$
VIND	0.45	1.50

For STR load case TEMP may be neglected, see SS-EN 1992-1-1 section 2.3.1.2(2).

Load combination smart ULS-0:

Load case	Permanent factor	Variable factor
ULS-PERM	1.00	1.00
ULS-VAR	0	1.00

Load combination smart ULS:

Load case	Permanent factor	Variable factor
ULS-PERM	1	0
PT	1	1.35
ULS-VAR	0	1

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:101
		Date :	Created :

3.14.2 Service state (SLS)

The serviceability limit state is divided into 3 load combinations depending on their duration. The load combinations are presented below.

Load combination	Duration
SLS:K	Characteristic
SLS:F	Frequent
SLS:Q	Quasi-permanent

Load combination SLS:K according to EN 1990 eq. 6.14b is presented below.

$$E_{sd} = \sum_{j \geq 1} G_{k,j} + Q_{k,1} + \sum_{i > 1} \psi_{0,i} \cdot Q_{k,i} = \psi \gamma_{SLS,K} \cdot \left(\sum_{j > 1} G_{k,j} + \sum_{i > 1} Q_{k,i} \right)$$

The truck combination SLS:F according to EN 1990 eq. 6.15b is presented below.

$$E_{sd} = \sum_{j \geq 1} G_{k,j} + \psi_1 \cdot Q_{k,1} + \sum_{i > 1} \psi_{2,i} \cdot Q_{k,i} = \psi \gamma_{SLS,2} \cdot \left(\sum_{j > 1} G_{k,j} + \sum_{i > 1} Q_{k,i} \right)$$

Load combination SLS:Q according to EN 1990 eq. 6.16b is presented below.

$$E_{sd} = \sum_{j \geq 1} G_{k,j} + \sum_{i > 0} \psi_{2,i} \cdot Q_{k,i} = \psi \gamma_{SLS,Q} \cdot \left(\sum_{j > 1} G_{k,j} + \sum_{i > 1} Q_{k,i} \right)$$

In design, load factors belonging to equations 6.14a, 6.15b, and 6.16b are applied; for derivation, see page A3:137.

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:102
		Date :	Created :

Nr	Load		$\Psi\gamma_{SLS-K}$	$\Psi\gamma_{SLS-F}$	$\Psi\gamma_{SLS-Q}$
	<u>Permanent loads</u>				
1	Egentyngd	max	1,00	1,00	1,00
		min	1,00	1,00	1,00
2	Beläggning	max	1,10	1,10	1,10
		min	0,90	0,90	0,90
3	Överfyllnad	max	1,10	1,10	1,10
		min	0,90	0,90	0,90
4	Jordtryck	max	1,10	1,10	1,10
		min	0,90	0,90	0,90
5	Vattentryck	max	1,00	1,00	1,00
		min	1,00	1,00	1,00
6	Stödförskjutning	max	1,00	1,00	1,00
		min	1,00	1,00	1,00
7	Krympning	max	1,00	1,00	1,00
		min	1,00	1,00	1,00
8	Spännkraft	max	1,00	1,00	1,00
		min	1,00	1,00	1,00
	<u>Variable loads</u>				
	Lastmodell LM 1 :				
9	Boggiesystem		0.75/1.00	0/0.75	0
10	Utbredd last		0.40/1.00	0/0.40	0
11	Bromskraft		0.56/0.75	0/0.56	0
12	Sidokraft		0.56/0.75	0/0.56	0
13	Centrifugalkraft		0.56/0.75	0/0.56	0
	Lastmodell LM 2 :				
14	Enstaka axellast		0.75/1.00	0/0.75	0
	Typfordon EG A/B :				
15	Typfordon EG A/B		0.75/1.00	0/0.75	0
20	Bromskraft		0.56/0.75	0/0.56	0
22	Sidokraft		0.56/0.75	0/0.56	0
22	Centrifugalkraft		0.56/0.75	0/0.56	0
16	Temperatur		0.60/1.00	0.50/0.60	0.50
	Vindlaster:				
17	Vindlast mot bro		0.30/1.00	0/0.30	0
18	Vindlast mot trafik		0.30/1.00	0/0.30	0
19	Överlast		0.75/1.00	0/0.75	0

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:103
		Date :	Created :

Load combination smart SLS-PERM.:

Loadcase	Permanent factor	Variable factor
EGEN	1.00	1.00
BELÄGG	0.90	1.20
JORD	0.90	1.20
STOD	0	$1.0 \cdot f_{STOD} = 0.33$
KRYMP	0	$1.0 \cdot f_{KRYMP} = 0.33$

Load combination smart SLS-K-VAR.:

(Load cases to consider : 5 / Variable loadcases : 1)

Loadcase	Permanent factor	Variable factor
TRAFIK	0.75	1.00
BROMS	0.56	0.75
SIDO	0.56	0.75
TEMP	$0.60 f_{TEMP} = 0.50$	$1.0 \cdot f_{TEMP} = 0.80$
VIND	0.60	1.00

Load combination smart SLS-F-VAR.:

Load case	Permanent factor	Variable factor
TRAFIK	0	0.75
BROMS	0	0.56
SIDO	0	0.56
TEMP	0	$0.60 f_{TEMP} = 0.50$
VIND	0	0.30

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:104
		Date :	Created :

Load combination smart SLS-K0:

Load case	Permanent factor	Variable factor
SLS-PERM	1	1
SLS-K-VAR	0	1

Load combination smart SLS-K:

Load case	Permanent factor	Variable factor
SLS-PERM	1	1
PT	1	1
SLS-K-VAR	0	1

Load combination smart SLS-F0:

Load case	Permanent factor	Variable factor
SLS-PERM	1	1
SLS-F-VAR	0	1

Load combination smart SLS-F:

Load case	Permanent factor	Variable factor
SLS-PERM	1	1
PT	1	1
SLS-F-VAR	0	1

Load combination smart SLS-Q0:

Load case	Permanent factor	Variable factor
SLS-PERM	1	1
TEMP	0	$0.50f_{TEMP} = 0.40$

Load combination smart SLS-Q:

Load case	Permanent factor	Variable factor
SLS-PERM	1	1
PT	1	1
TEMP	0	$0.50f_{TEMP} = 0.40$

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:105
		Date :	Created :

3.14.3 Fatigue load combination

Fatigue is considered according to SS EN 1992-1-1, 6.8.4 and 6.8.6, and SS EN 1992-2, 6.8 and Appendix NN.

The risk of fatigue is checked using a simplified method, denoted as the λ -method.
Load combination according to equation SS-EN 1992-1-1 section 6.8.3 equation 6.69.

In this load combination, the traffic load is considered to consist of UTM, whereby other traffic loads are excluded.

$$E_{Sd} = \sum_{j \geq 1} G_{k,j} + P + \psi_{1,1} \cdot Q_{k,1} + \sum_{i > 1} \psi_{2,i} \cdot Q_{k,i} + Q_{fat} = \psi \gamma_{UTM} \cdot \left(\sum_{j \geq 1} G_{k,j} + P + \sum_{i \geq 1} Q_{k,i} + Q_{fat} \right)$$

Fatigue is considered according to SS EN 1992-1-1, 6.8.4 and 6.8.6, and SS EN 1992-2, 6.8 and Appendix NN.

The risk of fatigue is checked using a simplified method, denoted as the λ -method.
Load combination according to equation SS-EN 1992-1-1 section 6.8.3 equation 6.69.

In this load combination, the traffic load is considered to consist of UTM, whereby other traffic loads are excluded.

Permanent loads:

Nr	Load		$\psi \gamma_{UTM}$
1	Egentyngd	max	1.00
		min	1.00
2	Beläggnig	max	1.10
		min	0.90
3	Överfyllnad	max	1.10
		min	0.90
4	Jordtryck	max	1.48
		min	0.90
5	Vattentryck	max	1.00
		min	1.00
6	Stödförskjutning	max	1.00
		min	1.00
7	Krympning	max	1.00
		min	1.00
8	Spännkraft	max	1.00
		min	1.00

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:106
		Date :	Created :

Variable loads:

Nr	Load	$\Psi\gamma_{UTM}$
	Lastmodell LM 1 :	
9	Boggiesystem	-
10	Utbredd last	-
11	Bromskraft	-
12	Sidokraft	-
13	Centrifugalkraft	-
	Lastmodell LM 2 :	
14	Enstaka axellast	-
	Typfordon EG A/B :	
15	Typfordon EG A/B	-
16	Bromskraft	-
17	Sidokraft	-
18	Centrifugalkraft	-
19	Temperatur	0.60
	Vindlaster:	
20	Vindlast mot bro	0.30
21	Vindlast mot trafik	0.30
22	Överlast	1.01
23	UTM3	1.00

	Part A - CALCULATION ASSUMPTIONS Pretensioned slab bridge: hollow deck	Status :	Page: A3:107
		Date :	Created :

Load combination smart FAT :

(FAT-0 is identical but does not contain load case PT-t0)

Load case	Permanent factor	Variable factor
EGEN	1.00	0
BELÄGG	1.00	0
JORD	-	-
STOD	-	-
KRYMP	-	-
PT-t0	0.84	-
VIND	-	-
UTM	-	1.00
OVER	-	-
TEMP	-	-

Load cases BELÄGG, STOD and KRYMP are not fatigue loads, thus load coefficient 1.0 is applied.

Load cases pretension is not a fatigue loads, thus load coefficient lowest load value of value is assumed PT-t2 (= 0.84·PT-t0) is applied.

Load case JORD is not a fatigue load, thus load coefficient highest load coefficient is applied.

Load cases TEMP, VIND and OVER are not fatigue loads, thus load is not considered.

During verification STR, the load case TEMP can be neglected according to SS-EN 1992-1-1 section 2.3.1.2(2).