Installation Manual
Maintenance Manual

for MAURER MODULAR BRIDGING SYSTEM
MMBS 1600 (width 1330, 1170, 1000)

Order No.: V 303 873 // P 104 676 001

Verification of Applicability in the Area of Federal Trunk Roads following TL/TP FÜ and ETAG 032

Document Issue Record				
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1 RANGE OF APPLICATION

The technical dossier covers operating conditions for all kinds of federal trunk roads with frequently recurring designs. The following restrictions to the range of application must be taken into account:

- Maximal speed limit **≤ 80 km/h**.
- The direction of structure movement correlates with the laying direction of the MMBS.
- The direction of traffic is determined in the approved design drawings and shall be respected.
- The transverse slope of the carriageway must **not exceed 5%** in the longitudinal and transversal directions
- The horizontal radius of the centre line of the carriageway **r > 1,500 m**.
- The maximum allowable movements of **± 130mm** according to chapter 4.1 shall not be exceeded.
- The maximum allowable structural gap according to chapter 4.2 shall not be exceeded.
- The maximum allowable periods of use according to chapter 4.3, chapter 4.6 and chapter 4.7 shall not be exceeded.
- The maximum allowable wind loads according to chapter 4.5 shall not be exceeded.

2 QUALITY ASSURANCE

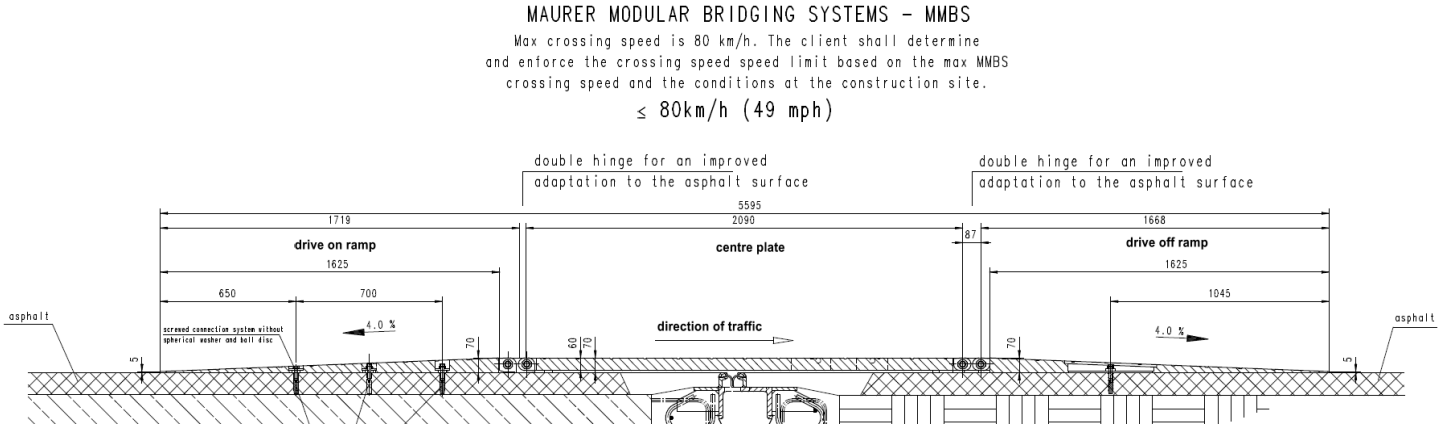
2.1 QA-System

The quality management system complies with the requirements of the standard DIN EN ISO 9001.

3 DESCRIPTION OF THE SYSTEM

3.1 General

The system is used to avoid closure of the entire carriageway during maintenance work on or the replacement of expansion joints. Without interrupting the traffic flow, the plates can be lifted up section by section to carry out the necessary installation work. This significantly reduces the impact on the traffic during rehabilitation or replacement of expansion joints.



The assessment of the system with regard to traffic was performed by the Engineering Company for Roads mbH Aachen [Ingenieursgesellschaft für Straßenwesen mbH Aachen (ISAC GmbH).
Speed limit ≤ 80 km/h, the client shall determine and enforce the crossing speed speed limit based on the max MMBS crossing speed and the conditions at the construction site.

3.2 System in closed position

Preparation of the system shortly before the opening to the traffic:

Figure 1: Illustration of MMBS System installation on construction site

3.3 System lifted up

Use of the system during replacement/repair work:

Figure 2: MMBS System lifted up

4 NOTES FOR USERS

4.1 Allowable movement

The MMBS-drive-off ramp is designed with a slotted hole of 300 mm. When installed in **middle position**, this allows for a **movement of ± 130 mm** in laying direction of the plates.

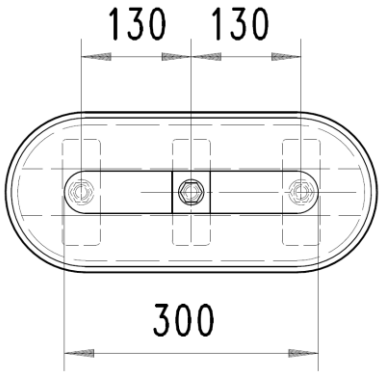


Figure 3: Movements that MMBS System can perform

The structure movements are to be checked for each individual project with regard to the design analysis of the ULS [Ultimate Limit State]. Taking into account an installation tolerance of 20 mm, installation in mid position allows for an admissible movement of ± 120 mm maximum.

4.2 Allowable bridging length

The maximum bridging length including all movements is 1.6 m. This results in a reserve strip of approx. 110 mm to the contact surface.

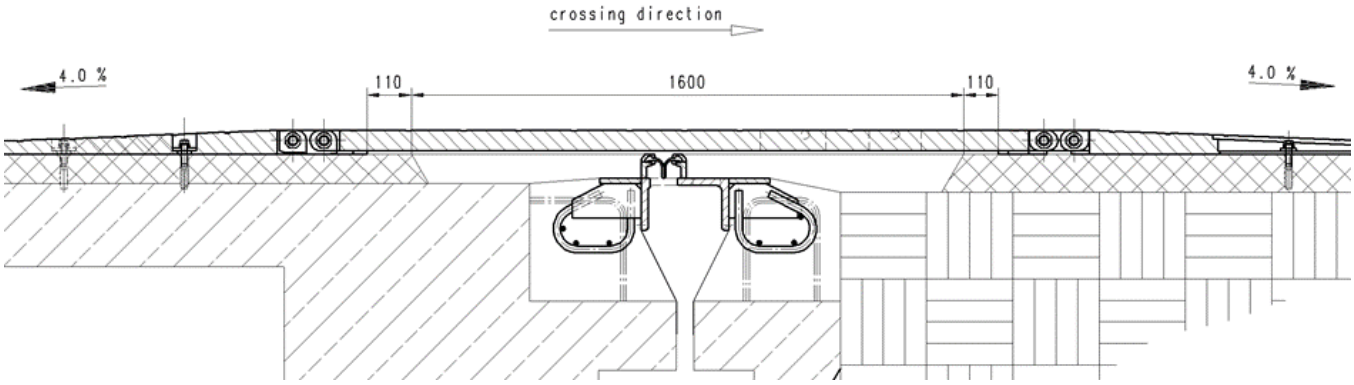


Figure 4: section center axis MMBS system and structure

Generally, the MMBS is to be installed in direction of movement at all times.

4.3 Period of use of the MMBS

If all maintenance intervals are respected, is the Maximum usage period is 6 months. This is valid for the parts delivered by MAURER. (Please see clause 6.4 in this document and AA 1.557 Maintenance Instructions.) For the anchorages, please use the manufacturers' advice. The recommended anchorages and their maintenance periods are given in the clauses 4.6 and 4.7 of this document.

4.4 Allowable axle loads

The design loads were based on axle loads as tandem system with a distance of 1,2m between axles according to ETAG 032. This requires the client's consent.

In the ultimate limit state, one wheel of a 30 tonnes tandem axle and one wheel of a 20 tonnes tandem axle each is taken into account per plate unit:

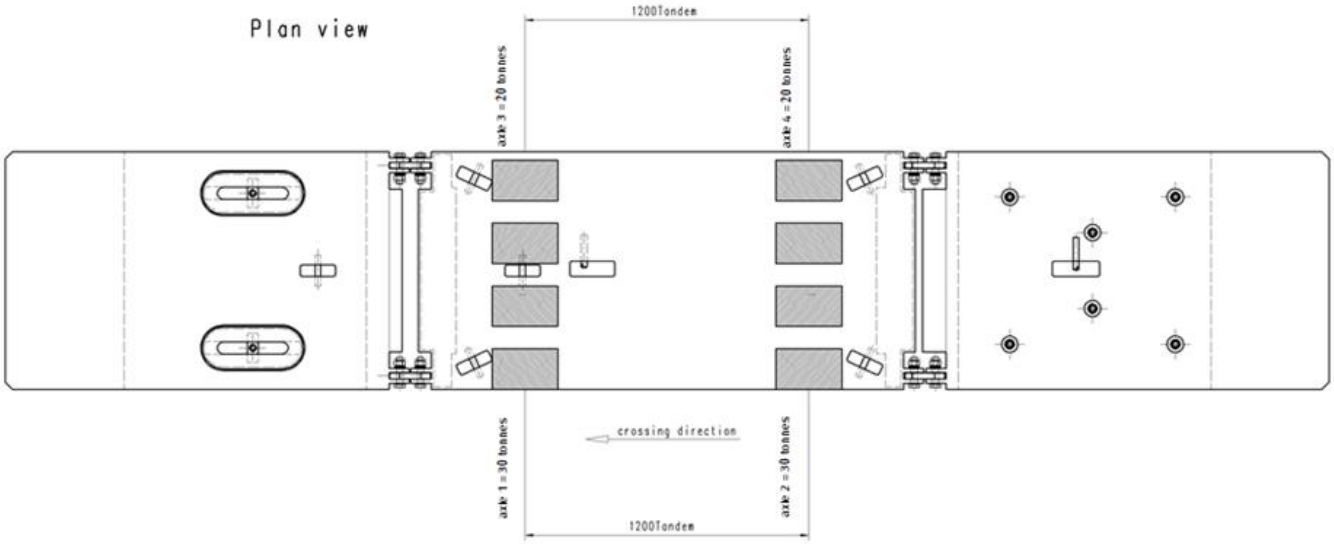


Figure 5: force distribution wheel axle

In the fatigue limit state, one wheel of a 21 tonnes tandem axle each is taken into account with a dynamic increase factor of 1.3:

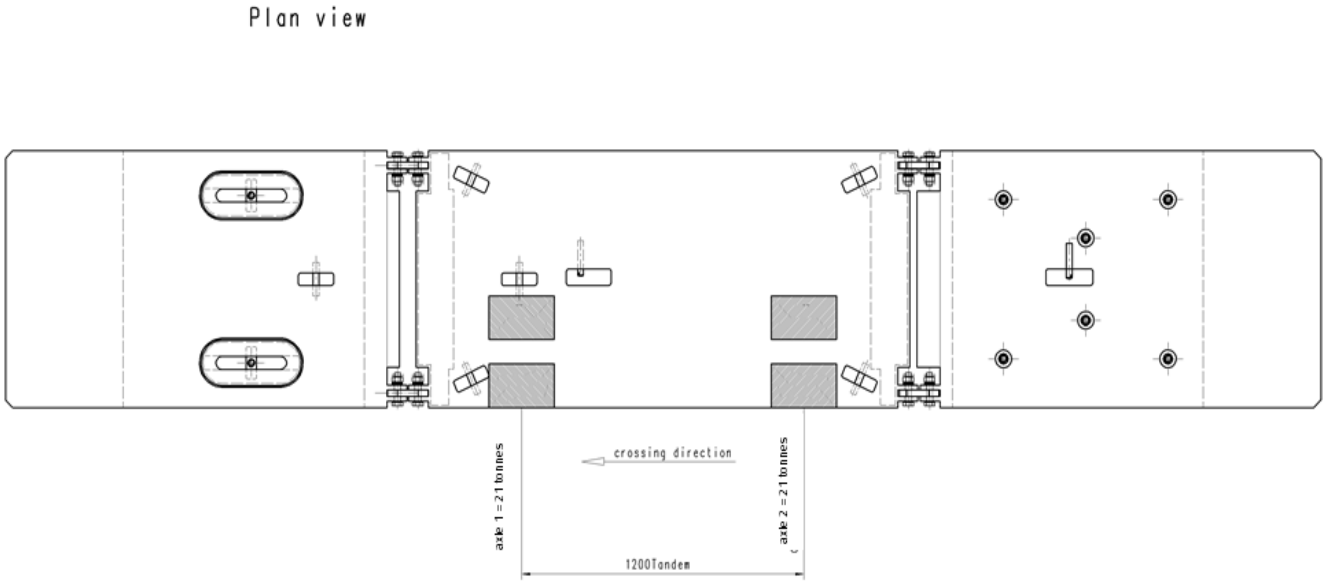


Figure 6: force distribution wheel axle - fatigue limit state

4.5 Allowable wind loads

The design analysis is based on the wind loads according to **DIN EN 1991-1-4 or DIN EN 1991-1-4/NA** for structure sites below a sea level of 800 m.

In the following tables, 3 structure heights (∑h = bridge height + MMBS height) are evaluated up to a design limit of 3.4 kN/m2 for a wind peak velocity pressure which is reduced to 24 months (area A = periphery) depending on the carriageway width l, the **wind zone [wz]** and the **terrain category [GK]**.
If the wind loads (assessment) are exceeded in lifted up MMBS systems, the anchorages must be checked.
If the wind loads (assessment) are exceeded, the MMBS system must no longer be lifted.

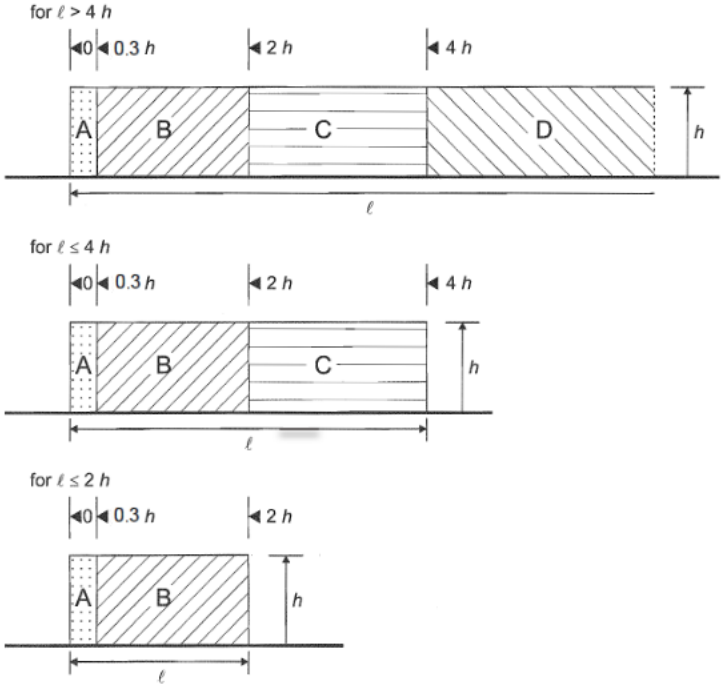


Figure 7: DIN EN 1991-1-4, illustration 7.19

Calculation of maximum w_d for area A [kN/m²] for MMBS with ∑h = 7.0 m									
l [m]	l/h [1]	Tab. 7.9 A	WZ1	WZ2		WZ3		WZ4	
			GK II/III	GK I/II	GK II/III	GK I/II	GK II/III	GK I/II	GK II/III
6.0	3.0	2.30	1.16	1.97	1.41	2.37	1.70	2.83	2.03
7.0	3.5	2.45	1.23	2.10	1.50	2.53	1.81	3.01	2.16
8.0	4.0	2.60	1.31	2.23	1.60	2.68	1.92	3.20	2.29
9.0	4.5	2.75	1.39	2.35	1.69	2.84	2.04	3.38	2.43
10.0	5.0	2.90	1.46	2.48	1.78	2.99	2.15	------	2.56
11.0	5.5	2.95	1.49	2.52	1.81	3.04	2.18	------	2.60
12.0	6.0	3.00	1.51	2.57	1.84	3.09	2.22	------	2.65
13.0	6.5	3.05	1.54	2.61	1.87	3.15	2.26	------	2.69
14.0	7.0	3.10	1.56	2.65	1.90	3.20	2.29	------	2.73
15.0	7.5	3.15	1.59	2.70	1.93	3.25	2.33	------	2.78
16.0	8.0	3.20	1.61	2.74	1.97	3.30	2.37	------	2.82
17.0	8.5	3.25	1.64	2.78	2.00	3.35	2.41	------	2.87
18.0	9.0	3.30	1.66	2.82	2.03	3.40	2.44	------	2.91
19.0	9.5	3.35	1.69	2.87	2.06	------	2.48	------	2.95
20.0	10.0	3.40	1.71	2.91	2.09	------	2.52	------	3.00

Calculation of maximum w_d for area A [kN/m²] for MMBS with ∑h = 16.0 m									
l [m]	l/h [1]	Tab. 7.9 A	WZ1	WZ2		WZ3		WZ4	
			GK II/III	GK I/II	GK II/III	GK I/II	GK II/III	GK I/II	GK II/III
6.0	3.0	2.30	1.56	2.46	1.90	2.96	2.29	------	2.73
7.0	3.5	2.45	1.66	2.62	2.03	3.16	2.44	------	2.91
8.0	4.0	2.60	1.76	2.78	2.15	3.35	2.59	------	3.09
9.0	4.5	2.75	1.87	2.94	2.27	------	2.74	------	3.27
10.0	5.0	2.90	1.97	3.10	2.40	------	2.89	------	------
11.0	5.5	2.95	2.00	3.15	2.44	------	2.94	------	------
12.0	6.0	3.00	2.04	3.21	2.48	------	2.99	------	------
13.0	6.5	3.05	2.07	3.26	2.52	------	3.04	------	------
14.0	7.0	3.10	2.10	3.31	2.56	------	3.09	------	------
15.0	7.5	3.15	2.14	3.37	2.61	------	3.14	------	------
16.0	8.0	3.20	2.17	------	2.65	------	3.19	------	------
17.0	8.5	3.25	2.21	------	2.69	------	3.24	------	------
18.0	9.0	3.30	2.24	------	2.73	------	3.29	------	------
19.0	9.5	3.35	2.27	------	2.77	------	3.34	------	------
20.0	10.0	3.40	2.31	------	2.81	------	3.39	------	------

Calculation of maximum w_d for area A [kN/m²] for MMBS with ∑h = 25.0 m									
l [m]	l/h [1]	Tab. 7.9 A	WZ1	WZ2		WZ3		WZ4	
			GK II/III	GK I/II	GK II/III	GK I/II	GK II/III	GK I/II	GK II/III
6.0	3.0	2.30	1.85	2.78	2.25	3.35	2.71	------	3.23
7.0	3.5	2.45	1.97	2.96	2.40	------	2.89	------	------
8.0	4.0	2.60	2.09	3.14	2.54	------	3.07	------	------
9.0	4.5	2.75	2.21	3.32	2.69	------	3.24	------	------
10.0	5.0	2.90	2.33	------	2.84	------	------	------	------
11.0	5.5	2.95	2.37	------	2.89	------	------	------	------
12.0	6.0	3.00	2.41	------	2.94	------	------	------	------
13.0	6.5	3.05	2.45	------	2.99	------	------	------	------
14.0	7.0	3.10	2.49	------	3.03	------	------	------	------
15.0	7.5	3.15	2.53	------	3.08	------	------	------	------
16.0	8.0	3.20	2.57	------	3.13	------	------	------	------
17.0	8.5	3.25	2.61	------	3.18	------	------	------	------
18.0	9.0	3.30	2.65	------	3.23	------	------	------	------
19.0	9.5	3.35	2.69	------	3.28	------	------	------	------
20.0	10.0	3.40	2.73	------	3.33	------	------	------	------

Note:
For GK I/II, the MMBS may be lifted up up to a structure height of ∑h = 25.0 m at all times as far as the fundamental value of the basic wind velocity vb,0 of 20.0 m/s for WZ2, 17.5 m/s for WZ3 and 15.0 m/s for WZ4 according to DIN EN 1991-1-4/NA.A is not exceeded.
For GK II/III, the MMBS may be lifted up up to a structure height of ∑h = 25.0 m at all times as far as the fundamental value of the basic wind velocity vb,0 of 22.5 m/s for WZ3 and 20.0 m/s for WZ4 according to DIN EN 1991-1-4/NA.A is not exceeded.
Weather forecasts and continuous measurement of wind velocities are required for this.

4.6 Anchoring in asphalt

For anchorage in the asphalt MAURER recommends, TOGE asphalt anchor bolts TSM A 22x155 (or equivalent):

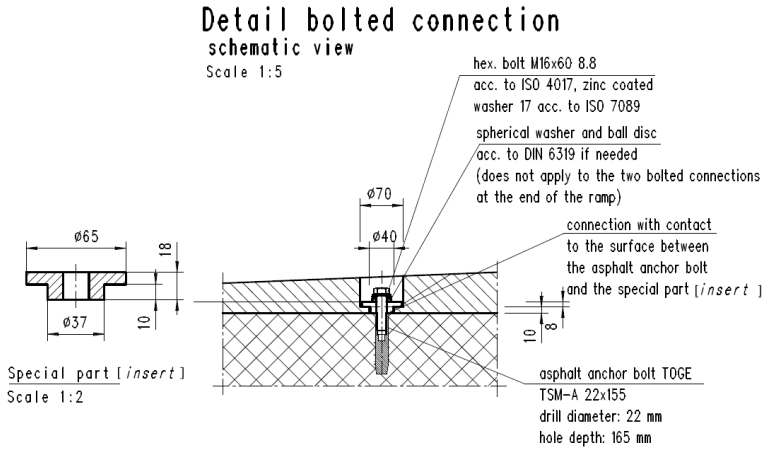


Figure 8: illustration of asphalt anchorage

The maximum period of use of the anchor bolts is limited to 4 weeks by static and dynamic proof. (For other brands, other periods of use possibly be evidenced). Afterwards, the bolted connection (TOGE asphalt bolt anchor and M16x50 hexagon bolt) is to be completely replaced . When lifting the ramps, the anchor bolts must be checked to maintain a tight connection.
With an operating period of max 4 weeks, it results in 530 000 (number of vehicle axles driven over) load cyles for anchor bolting.

4.7 Anchoring in concrete

For anchoring in concrete MAURER recommends to use HILTI concrete anchor bolt HDA-T M16x190/40 (or equivalent):

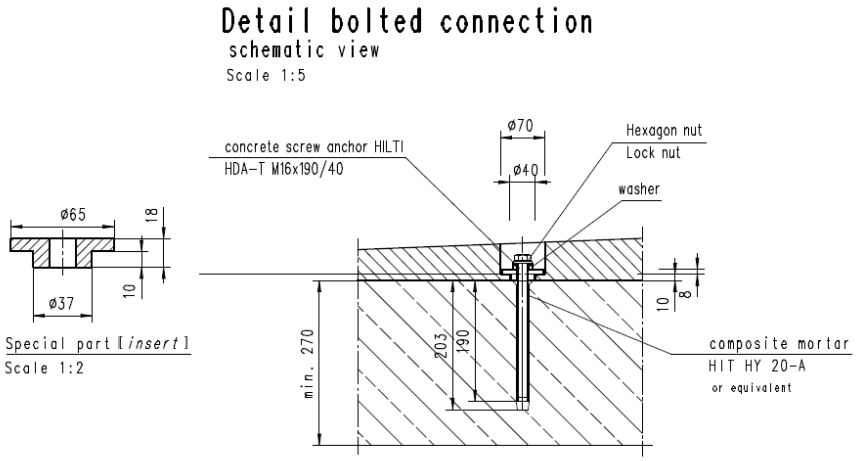


Figure 9: illustration of concrete anchorage

The MMBS anchorage (Hilti type for concrete connections) shall be visually inspected every 4 weeks. Any defect or loose anchorage, found after visual inspection, has to be replaced.
When lifting the ramps, the anchor bolts must be checked to maintain a tight connection.

The specified minimum anchoring depth shall be maintained! The concrete slab must be at least 270 mm thick!

5 CORROSION PROTECTION

5.1 Pretreatment

The MMBS system is hot-dip galvanized for better corrosion protection.

Preparation of surface:	abrasive blasting (surface preparation grade SA 2 1/2)
Primer layer:	80-100µm hot galvanized

5.2 Post-treatment

Preparation of surface:	Sweepen
Intermediate coat:	150 µm EP-based Micaceous iron ore CHING-EP-MIOX-TOP-COAT 695.12 (DB 704)
Intermediate coat:	apply steel mill slag (particle size range 1.5-3 mm)
Finishing coat:	80 µm PUR-based Micaceous iron ore CHING-PUR-MIOX-TOP-COAT 695.74 (DB 704)

The coating system is stated to fulfil the requirements of the DIN EN ISO 12944-6 with regard to the corrosivity categorie C5-M, durability high.
The zinc sprayed coating is applied directly after abrasive blasting, acc. to DIN EN ISO 2063.
Spraying material is zinc wire (diameter 2,5mm) acc. to DIN EN ISO 14919 with min. 99,995% zinc content acc. to DIN EN 1179.
Primer, intermediate and top coating will be applied each after the necessary drying time.

6 INSTALLATION INSTRUCTIONS

6.1 Overview MMBS

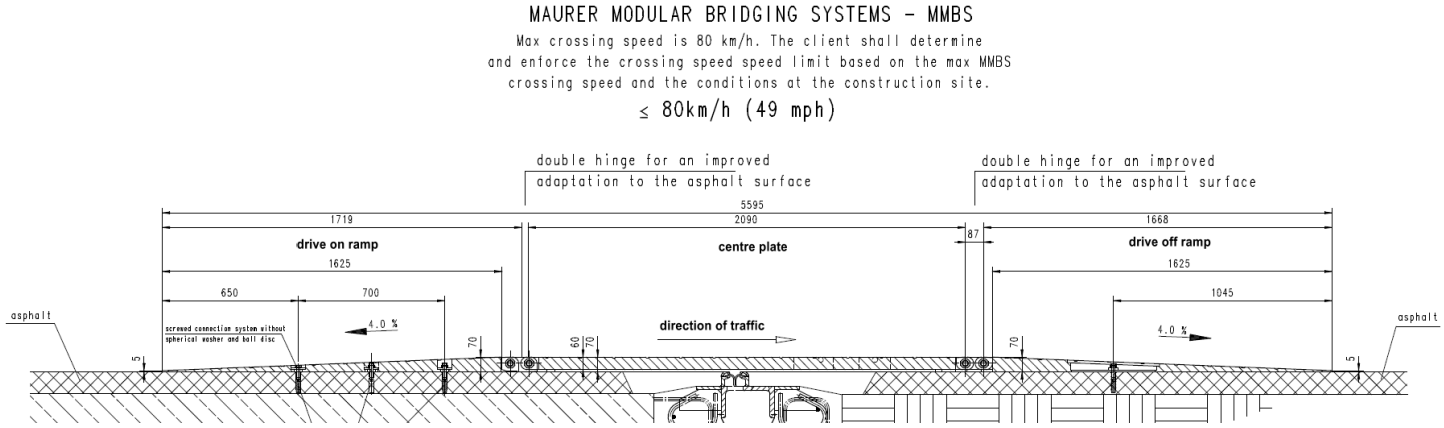


Figure 10: illustration of MMBS System

The MMBS-system consists of a drive-on ramp, which is positioned at the front of the system in the direction of traffic. It is fixed on the asphalt with TOGE-asphalt bolt anchors 22x155 mm **or equivalent**.
In case of concrete, it is fixed to the concrete with HILTI concrete anchors HDA-T M16x190/40mm **or equivalent**.
The centre plate (drive over plate) that bridges the actual work area, stands on 10 mm high supporting feet. For a calculative maximum load, they prevent the plate from contacting the expansion joint lying underneath as a result of deflection.
The drive-off ramp is positioned at the end of the system in the direction of traffic and is fixed with hold-down clamps. The hold-down clamps do not transfer loads.

6.2 Installation and disassembly instructions

6.2.1 Requirements for an asphalt surface

The evenness of the asphalt on the underside of the drive off ramp and the underside of the drive on ramp referring to a measuring section of 4 m must not exceed 5 mm in the transverse and longitudinal direction of the carriageway. Greater unevenness must be levelled (fine milling, refilling with an appropriate levelling compound such as Nadler [*German specialist supplier of road engineering*] liquid asphalt or equivalent).

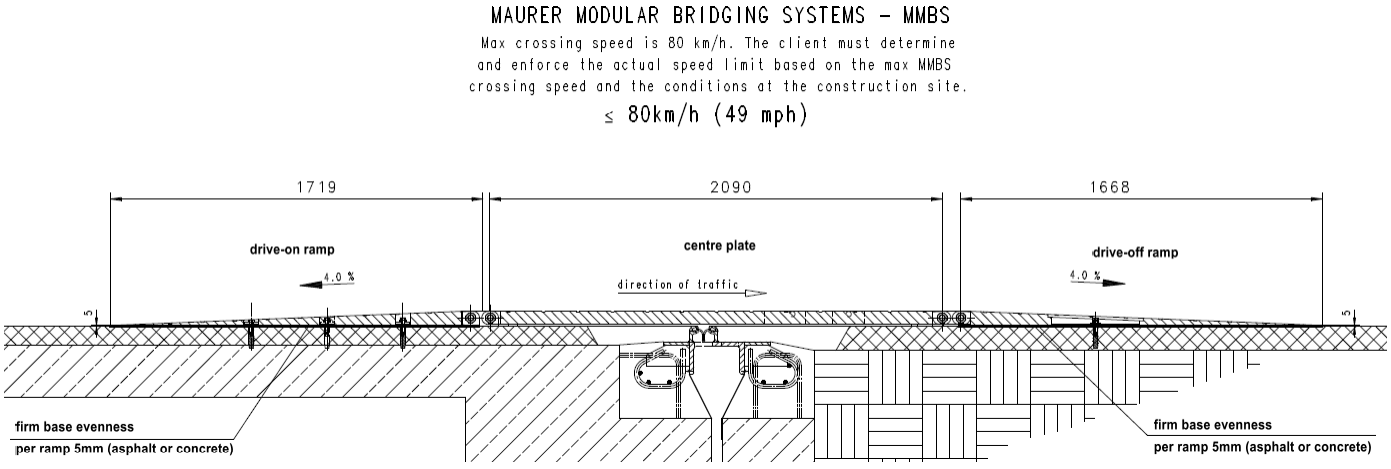


Figure 11: illustration of evenness underneath the ramp

6.2.2 Placement and alignment of the plates

It provides for through-hole installation so that the anchor bolts can be positioned after the plate has been set out. To ensure exact placement and alignment of the individual plates, long mandrels and crowbars have proven to be effective.
A suitable crane or telescopic handler with a sufficient radius and load capacity (at least 3 tonnes for the maximum radius) is provided as a lifting device. The MMBS-systems are fastened at the lifting lugs of the centre plate either by means of a small chain sling or with additional round slings; then they are lifted and placed. The panels are supplied with stabilisation crossbars (no lifting device), which must be moved from panel to panel before lifting.

<u>Attention:</u> Lifting from the stabilisation crossbars is strictly forbidden! The Stabilization cross bars are not lifting devices and are provided to stabilize the ramp plates during lifting.

Use the 4 LIFTING POINTS on the center plate. The stabilization crossbars must be installed when lifting so that the plates do not collapse.

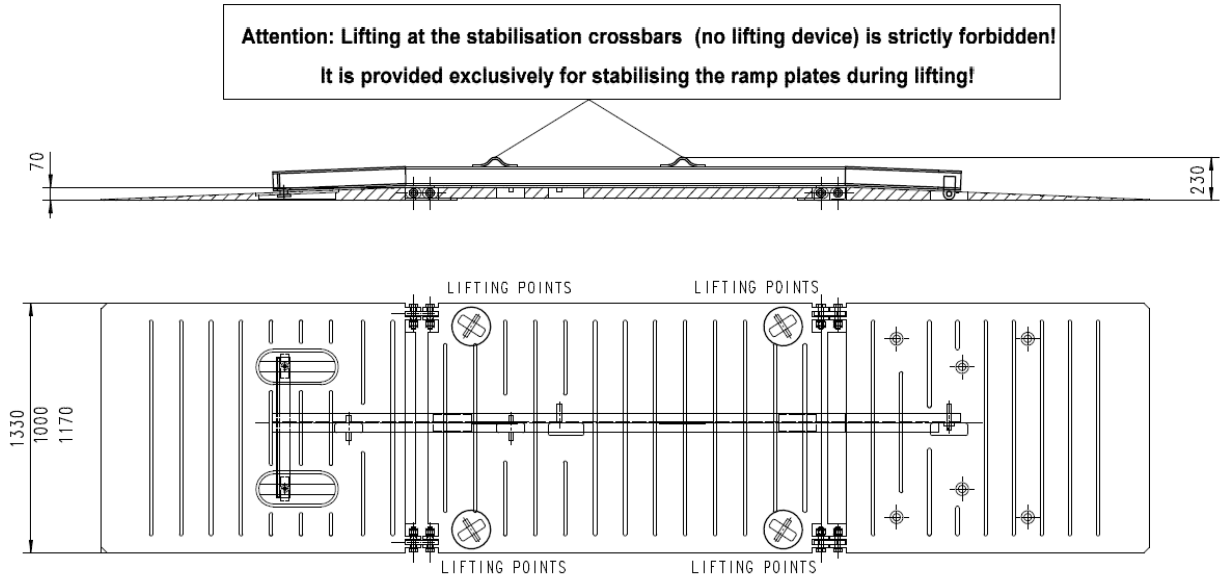


Figure 12: stabilisation crossbar

After all plates have been placed, the stabilisation crossbar is normally stored temporarily on site until the plates are removed.

6.2.3 Placement of anchor bolts at the drive on ramp

The anchor length must be adjusted to the asphalt thickness beforehand so that the water proofing system is not damaged.

After the plates have been placed, holes with a diameter of 22 mm are drilled through the plates according to the drawing using the insert as drilling template (internal diameter of 22.5 mm).
After finishing the drilling work, the template is removed/relocated and the holes are cleaned. Using a vacuum cleaner or compressed air is recommended. The specifications of the asphalt anchor bolt manufacturers must be observed when preparing the holes!
After the holes have been prepared, inject adhesive according to the manufacturer's data sheet and place the anchor bolts by using a setting tool (TOGE **or equivalent**). **It is necessary to observe and adhere to the cure time of the adhesive.**

6.2.4 Bolted connection and fixing at the drive on ramp

After setting the anchor bolts, the inserts are placed into the recesses of the MMBS and the bolt combinations (with washer or further bolting equipment) are bolted in according to the specifications of the drawing and tightened with a target torque of 50 Newton metres (tightening torque). This it is valid to the asphalt anchoring.

For the concrete anchorage use a target torque of 120 Newton metres (tightening torque).

Attention: Higher tightening torques can damage the bonding of the anchor bolt in the asphalt and should therefore be avoided!

6.2.5 Placement of ancher bolts at the drive-off ramp

The holes are generally placed centrally in the shifting devices. If it is necessary to pre-set the anchors bolts at the shifting device due to large movements of the structure, this is illustrated separately in the layout drawing. The anchor bolts are drilled without drilling template and positioned according to the manufacturer's specifications as described above.

6.2.6 Bolted connection and fixing of the drive-off ramp

The restraint plates in the shifting device are fixed with the bolts specified in the layout drawing and tightened hand-tight. Overstressing of the restraint plate leads to loosening of the anchor bolts.

6.2.7 Inspection prior to opening to the traffic

Prior to the opening to traffic, the proper fit of all bolted connections and fasteners is to be checked again. The MMBS plates must lie evenly on the asphalt. A non flat position of the plates on the asphalt will result in loose anchor bolts in the short term.

The anchor bolt connection must be checked daily for torque for the first week after placing the anchors on the drive-on ramp. If necessary, they must be retightened.

6.2.8 Disassembly of the MMBS

The MMBS is dismantled according to the following procedure.

- Loosen all elements of the bolted connections again and collect them afterwards. Prior to reuse, check them for completeness and intactness (not the bolts attached to the double hinge).
- Hang up the lifting beam in the first MMBS plate and secure it with cotter pin and bolts on both sides.
- Fasten the plate at the lifting lugs and load them.
- Dismantle the bolt anchors of the asphalt with a setting tool or other suitable small tools.
- Seal the holes with suitable material (such as Nadler Biophalt or equivalent). Any damage to the waterproofing of structures must be removed in consultation with the contractor and is not considered separately here due to the large number of waterproofing systems.

6.3 Opening and closing of the MMBS

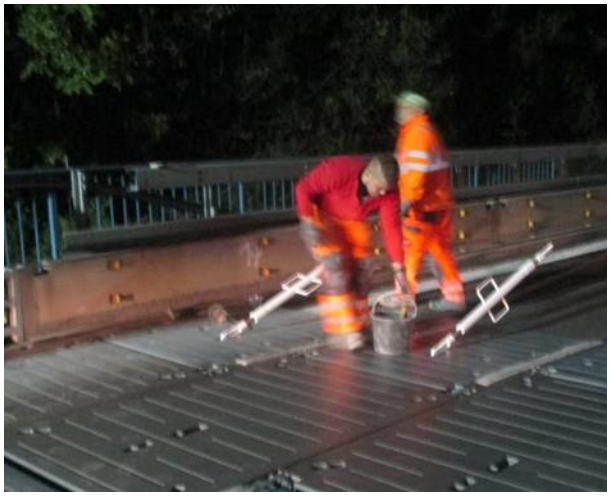
6.3.1 Preparation

A suitable piece of lifting equipment (minimum capacity of 3 tonnes for radius and hoisting height) must be provided.
Prior to the opening of the MMBS-systems, all bolted connections at the drive on ramp must be checked for proper fit and torque.

6.3.2 Opening and Closing of the MMBS

In order to open the MMBS-plates, it is necessary to observe the following procedure:

- Remove the hold-down clamps and bolts from on the drive-off ramp, and store them for reinstallation. If necessary, protect the threads of the embedded anchorage elements on the drive-off side with bolts or bolt sets.
- Insert the “inclined pillar” stay with inverse threads in the holder at the drive on ramp and secure it with a cotter pin.



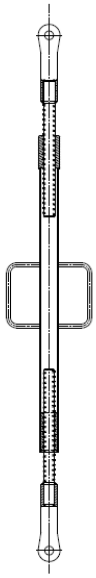


Figure 13: illustration and detail assembly part "inclined pillar"

Inclined pillar stays will be provided by MAURER.

- Hook in the steel rope and round slings at the lifting device and the main and drive-off plate using a deflection roll.

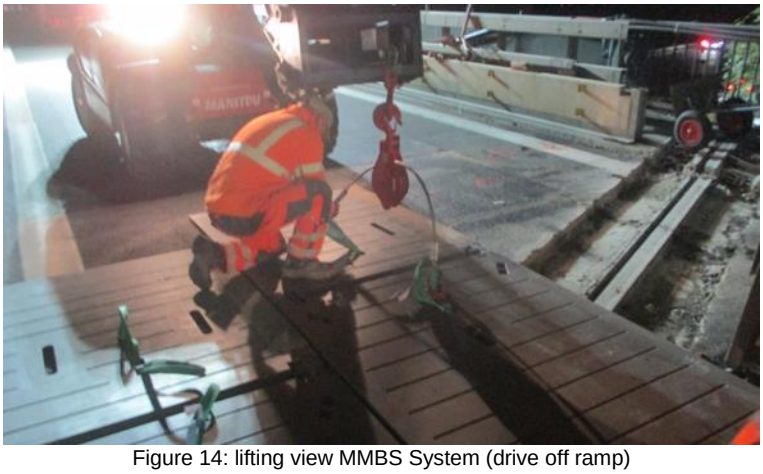


Figure 14: lifting view MMBS System (drive off ramp)

The drive on ramp stays fixed anchored in place!

- The MMBS can be lifted by moving the deflection roller back and forth.
- Swivel the centre plate open with a slight rotation in the double hinge, put the drive-off ramp against the centre plate and continue to hold the plates tightly at the rope.

movable element shown in its easy and quick opening- and closing process.

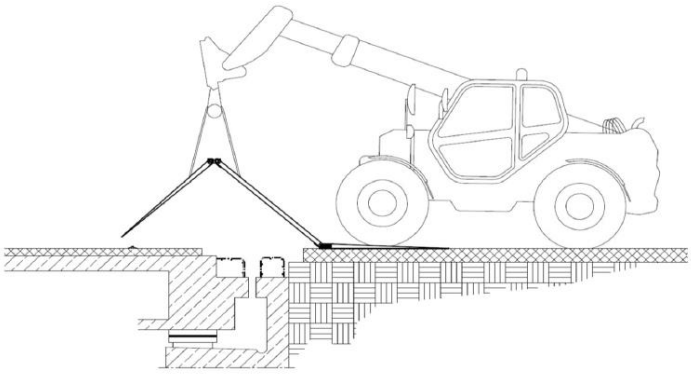


Figure 15: schematic figure opening and closing with steel rope and round slings

- Raise the “inclined pillar” stay, insert it into the centre plate and secure it at the centre plate (drive over ramp) with the cotter pin.
- The angle between the centre plate (drive over ramp) and the drive-on ramp must not exceed a maximum of 90°. An angle of approx. 80-89° should be the target. Cranking the centre plate (drive over ramp) with the “inclined pillar” stay in the direction of the bridging area such that 90° are exceeded should be avoided at all times. Should this still occur, the anchor bolts must be checked immediately for proper fit.

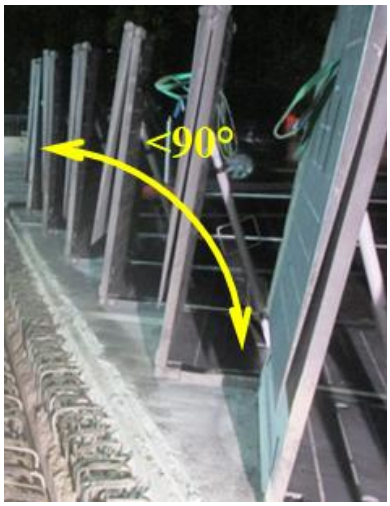
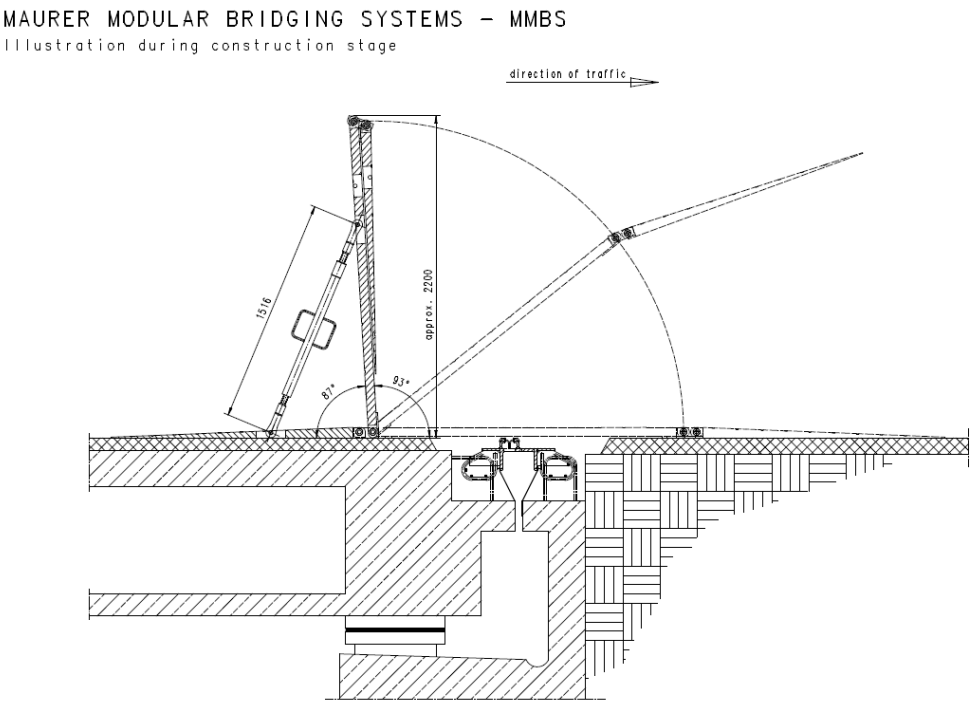


Figure 16: view opened state



- Unhook the rope at the centre plate (drive over ramp) and drive-off ramp.
- Secure the individual plates against each other with round slings/tension belts through the lifting holes.

Figure 17: view secured plates

Closing is proceeded in the reverse direction of opening.

6.4 Monitoring

The MMBS-system has to undergo regular inspections during use.

6.4.1 General

The following items act as a documentation aid and guideline for the on-site inspection of the MMBS. **The drive on ramp and the drive off ramp are to be checked and recorded on a daily basis for at least one week after installation, and then at least twice a week afterwards. For the double hinges, a visual inspection must be performed every 4 weeks.** In case of damage (e.g. collision of heavy transport, damage through snow plough or the like), an unscheduled inspection must be carried out. Non-destructive testing - penetrant testing and non-destructive testing - magnetic particle testing are recommended for this unscheduled inspection of double hinges.

6.4.2 Drive on Ramp

- The asphalt bolts are tightened with a target torque of 50 Nm (“tight”).
- The concrete bolts are tightened with a target torque of 120 Nm (“tight”).
- The plates lie properly on the surface, there are no unusual rattling noises.

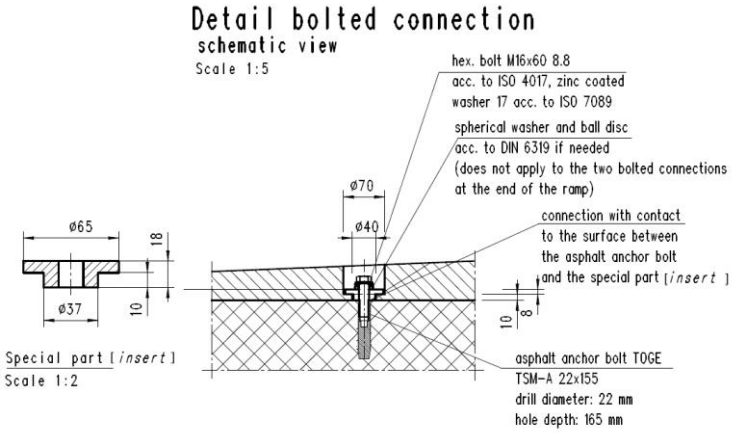


Figure 18: detail asphalt bolted connection

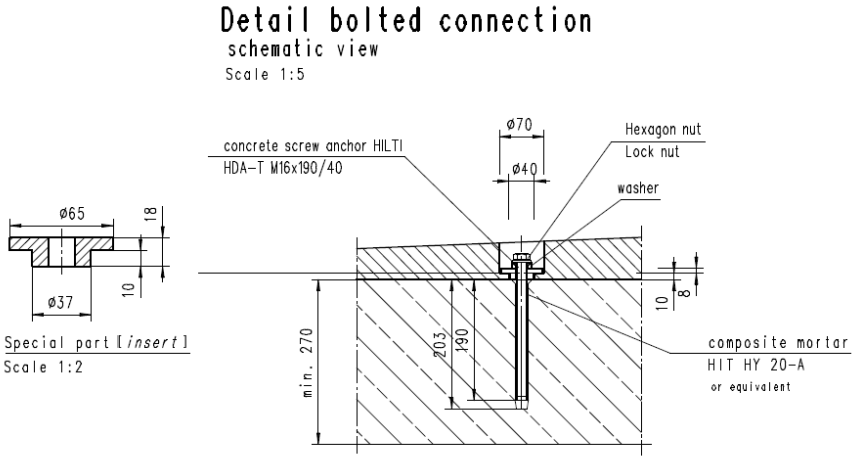


Figure 19: detail concrete bolted connection

6.4.3 Drive-Off Ramp

- The springs are intact/not broken.
- Alignment of the springs

Bolted connection is tightened with "half rotation", the springs are not squeezed or over overpressed.

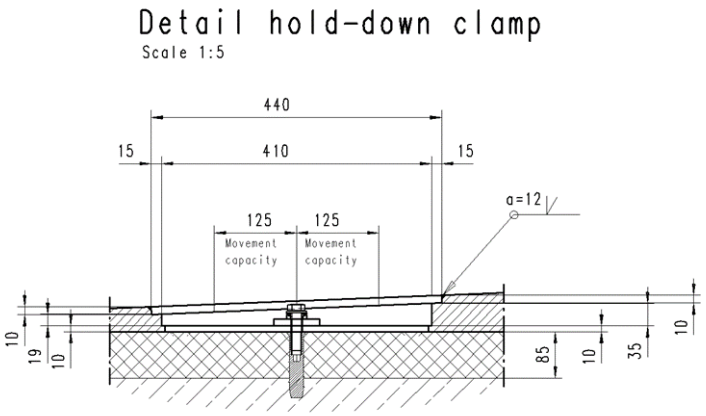


Figure 20: detail hold-down clamp

The maintenance intervals are specified in document *AA 1.557*.
Attention: Please observe the intervals and carry out the maintenance regularly and responsibly!

7 NOTES FOR THE MAINTENANCE OF THE MMBS

7.1 Purpose and scope of application

The maintenance of the MMBS is defined in document AA 1.557 [*maintenance instructions Report MAURER MMBS*]. The intervals are described in this document.
This document is used for following the proper maintenance guidelines for the MMBS panels and ensures that the maintenance intervals are observed.

7.2 Repairs

Repairs performed are to be recorded in the corresponding form FO 1.557 [*Inspection form / repair log*].

8 MMBS DRAWINGS

The execution plans contain the main features, dimensions and weights of the constructions. The following drawings are part of the request for approval and can be found in the annexe.

Sheet-No.	Description	Issue	Date
0001a	MAURER MODULAR BRIDGING SYSTEM – MMBS asphalt anchor		2021/01/20
0002a	MAURER MODULAR BRIDGING SYSTEM – MMBS concrete anchor		2021/01/20

9 LIST OF REFERENCED DOCUMENTS

Document	Description	Version.	Date
1	Maintenance instructions MAURER MMBS – AA 1.557	1	2021/01/20
2	Inspection form / repair log	1	2021/01/20

10 FIGURES INDEX