

Safety Barriers for Bridges

Installation and Maintenance Manual

Documentation for License Partners

General	2
Planning	3
Installation process DB 80AS-R and DB 100AS-R	5
Installation process DB 80AS-A	7
Terminal and transition elements	9
Placement of bridge expansion joints	10
Assembly process 8cm expansion (AS-R)	11
Assembly process 25cm or 40cm expansion (AS-R)	13
Assembly process 90cm expansion (AS-R)	14
Assembly process 40cm expansion (AS-A)	17
Maintenance and inspection	18
Procedure after an impact	19
Operational safety	20
Tools and equipment	21
Additional information	22

General

The DELTABLOC® system is selected according to the requirement profile defined by the contractor which corresponds to EN 1317-1 and -2 in light of local conditions. Available are the following DELTABLOC® systems: DB 80AS-R, DB 80AS-R Step, DB 80AS-A and DB 100AS-R.

All systems make use of the New Jersey profile and externally only differ in the dimensions of height and length. The DB 80AS-A is additionally fixed to the ground.

The terms of the relevant guidelines as well as the technical delivery and contract conditions must be followed.

Maintenance terminology

Definition of **maintenance**:

Source: extract from DIN 31051:2003-06

"A combination of all technical and administrative measures as well as management methods during the lifecycle of an observation unit to maintain its fully functional state or to return it to such a state, thus making it possible to fulfil the required function."

"Maintenance can [...] be divided into the basic steps of maintenance, inspection and repair work [...]."

- ▶ **Maintenance:** Maintenance is a periodically recurring measure used to maintain the target state.
- ▶ **Inspection:** Inspection is a measure used to determine the current state. It generally refers to an inspection in the sense of a check carried out by an inspector or supervisor. The aim is to determine that an object is in due order. Where necessary, repair measures must be initiated.
- ▶ **Repair work:** Measures to restore the target state of an object, with the restoration or replacement of parts on the basis of inspection results.

Planning

General

To achieve the effectiveness according to EN 1317-1 and -2, a minimum length is required to install the system:

- ▶ DB 80AS-R: 78m
- ▶ DB 80AS-R Step: 86m
- ▶ DB 80AS-A: 48m
- ▶ DB 100AS-R: 90m

The appropriate terminal elements with anchoring into the subsoil (foundation and/or abutment) are to be applied at the beginning and the end of the DELTABLOC® chain; otherwise force-fit transitions to other restraint systems have to be installed.

The contractor must timely communicate the exact location prior to the time the installation begins and must continuously mark the concrete barrier's position.

Contact area

The contact area is usually a bridge cap and an end trestle adjacent to the bridge bearing structure or an equally adjacent foundation strip. It is also possible to use supporting walls and other civil engineering structures. Before taking the final decision for the foundation please contact your DELTA BLOC contact person.

± 1cm on a length of 6m is recommended as the maximum tolerance for the exactness of the surface's execution.

Bridge elements are installed on the bridge cap with a distance of up to 50cm to the road-side edge of the bridge cap (depending on national requirements).

Curvature of the longitudinal axis

If the longitudinal axis of an element chain becomes curved, the following minimum radii must be applied for bends, crests and sags.

The minimum radii result from the use of the standard elements with a length of 6m.

Curve radii

The following minimum radii are required for curves:

System families	Element length	Outside radius (m)
DB 80AS-R	3m	60*
	6m	120*
	6m	350 [#]
DB 80AS-R Step	3m	50*
	6m	100*
	6m	350 [#]
DB 80AS-A	6m	120
DB 100AS-R	3m	60*
	6m	120*
	6m	350 [#]

*with use of bent stiffening plates

[#]with use of straight stiffening plates

Crests and sags

The following minimum radii are required for crests and sags:

System families	Element length	Sag radius	Crest radius
DB 80AS-R	3m	36m	132m
	6m	72m	261m
DB 80AS-R Step	3m	36m	132m
	6m	72m	261m
DB 80AS-A	6m	72m	261m
DB 100AS-R	3m	62m	168m
	6m	122m	336m

Minimum installation length

The tested minimum installation lengths for DELTABLOC® safety barriers can be found in the relevant test report. Shorter installation lengths are non-critical for force-fit connections to other systems.

Installation position

The elements are installed perpendicularly to the subsoil and at the height of the upper edge of the road surface. Bridge elements are installed on the bridge cap with a distance of up to 50cm to the road-side edge of the bridge cap (depending on national requirements). Deviations from this installation position are possible within a limited range. Thus, for example, the elements can also be placed on kerbstones with a height of up to 7.5cm.

When deviating from the installation position, care must be taken that the height and angle of the elements in relation to the installation surface are still guaranteed. In this way, DELTABLOC® elements can also be used on lower-lying verges and on roads with a tonnage profile or a horizontal incline.

Strong horizontal inclines or alternating inclines of the installation surface may be compensated by using horizontal-incline compensation sets.

Drainage

DELTABLOC® restraint systems are equipped and tested with water drainage openings.

Planning for drain shafts

Where possible, planning should be such that drain shafts are bypassed. For this purpose short elements with a length of two or four metres may be used to construct small bends.

Where this is not possible, a 90cm expansion element may be used, which has a gap up to 90cm wide under a cover and the hydraulic tension and shock buffer.

Where necessary, shafts can also be covered with DELTABLOC® standard elements, which subsequently have to be removed with suitable lifting tool to open the shaft.

Climbing aids

Climbing aids can be easily realised for all DELTABLOC® systems.



Climbing aid on the lane side



Climbing aid at the back side

Installation process DB 80AS-R and DB 100AS-R

Elements are moved with suitable lifting device (e.g. concrete safety barrier grab).



Direct grabbing of the elements from the properly-placed transport vehicle

The elements should be exactly along the markings placed by the customer.



Alignment of the elements at the established line-up edge

The elements are connected to each other at the element butt using a stiffening plate in the elements' base area and a coupling.

After setting down, the element is lifted at the element butt joint in order to insert the stiffening plate under the element.



Lifting an element to slide the stiffening plate under it

Attention must be paid to ensure that the assembly hole that secures the position is located on the side away from traffic.



Aligning and pushing the stiffening plate under. Arrow: assembly hole to secure the position

Attention must be paid that the coupling is introduced completely. Possibly existing concrete residue in the coupling's Y profile ought to be removed prior to application.



Correctly applied coupling

The elements are to be fixed in their position after the entire element chain is aligned. Drilling is carried out with a spacer in order to ensure a drilling depth of max. 13cm.



Ø18mm drilling with spacer

After drilling, the bore is cleaned with compressed air. The manufacturer's instructions (temperature, holding time, torque etc.) are to be exactly followed when applying the glue and assembling the composite anchor.



Applying the epoxy-resin adhesive



Inserting the M16 composite anchor (here: asphalt screw)



Finished M16 composite anchor

After installation of the whole element chain, scheduled gaps occur which are being filled with separately manufactured fitting elements. For the temporary securing of those installation gaps, special metal hoods have to be used and fixed on the element prior to the metal hood.



Temporary metal hood for closing the assembly gap

Note:

 When creating the bore, care must be taken not to damage the permeable layer located under the bridge cap (planned examination of the bridge structure is recommended, max. bore depth: 13cm).

Installation process DB 80AS-A

Marking

The respective site management must clearly mark the exact start and end points at the edge of the carriage way before installation begins.

The drillings needed for bolting need to be positioned and marked by means of a steel calibre. If needed, the hole positions may be marked by first installing the concrete element.



Steel calibre for marking of drill hole positions

Drilling

The required $\varnothing 22\text{mm}$ borings must preferably be created by the use of a core drill.

Caution: Precisely positioned borings are precondition for smooth mounting of the elements. In case of imprecise borings, the adhesive anchors cannot be mounted correctly.

One must pay special attention to the cleaning of boreholes. The surface of the boring must be completely cleaned from borehole cuttings by repeatedly brushing it with a wire round brush (on a battery operated drill) and alternately air-cleaning it with compressed air.



Precise drilling with a core drill

Moving

The elements must only be moved by means of a suitable lifting device (e. g. a concrete safety barrier gripper).

The element that is to be relocated is lifted above the intended end position and then slowly lowered. During lowering, the coupling is inserted into the metal claws located on the face side of the element. Immediately above the contact area, the element is pushed away by the element that is already standing and placed into the end position (without end clearance of the coupling). Here, the bore holes must be positioned in center position under the anchoring sleeves.



Correct position of the bore holes under the anchoring sleeves of the DB 80AS-A element

Conglutination

In order to ensure the operation of the anchoring system and thus for the entire restraint system, it is of utmost importance to ensure a clean and professional conglutination of the anchoring posts M20x285 8.8 FVZ.

The installation instructions for the cartridge adhesive *HILTI HIT RE500* must be observed, especially in regard to temperature and waiting time.

Fixing

The anchoring must be screwed on by means of a torque spanner and the fastening torque should be 50Nm.

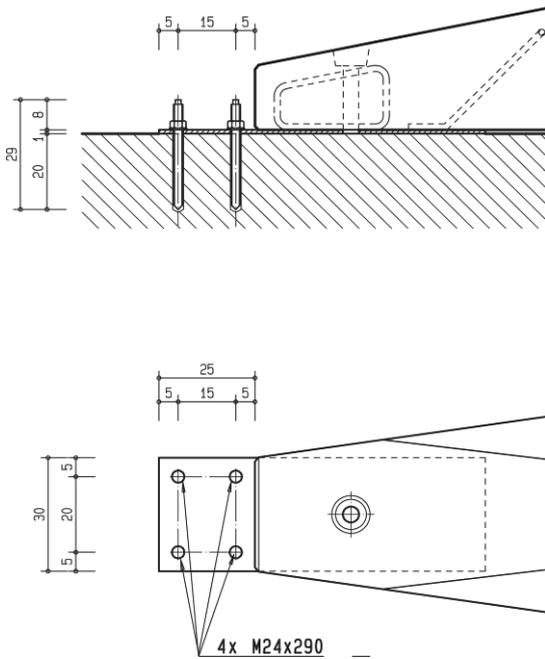


Correctly installed anchoring point with anchoring post M20

Terminal and transition elements

Terminals

The terminal element is to be securely anchored in the ground.



System sketch for anchoring terminal elements

The assembly instructions of the anchor manufacturer should also be observed. Special attention is to be paid to temperature, holding time and torque.



End anchoring of the safety barrier

Transition to EDSP/DDSP

The transition for EDSP and DDSP steel safety barrier systems is made using special transition elements.



Transition to EDSP

Transition to in-situ concrete barrier

The transition to in-situ concrete barriers is carried out by simply hooking a combination of a coupling and tension bar to the last element. The actual connection is created by casting concrete with a slipform paver over the tension bar.



Hooked-in coupling/tension bar element

Placement of bridge expansion joints

Placement of bridge expansion joints is required for the placement of restraint systems on bridges in the area of the joint between the bridge section and the mainland section of roads.

A set of bridge expansion joints consists of 2 elements, one of which is placed *in front* of the dilatation joint in the direction of travel, the other of which is placed *behind* the dilatation joint in the direction of travel.

Correct placement of the elements is to be observed as

The elements are asymmetrical

The cover on the first element must be attached in the direction of travel.

Elements and alignment positions

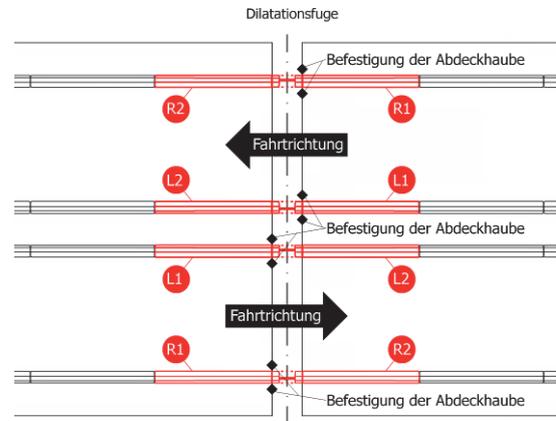
Naming of elements is as a result of the alignment position dependent on the side of the road and the sequence of the positioning.

Side of road:

- ▶ R = Direction of travel right
- ▶ L = Direction of travel left

Sequence:

- ▶ 1 = First element in direction of travel
- ▶ 2 = Second element in direction of travel



Picture 1: Placement of bridge expansion joints

Information

The cover is always to be attached to the first element in the direction of travel with 8 screws.

Which expansion joint elements are available can be found in the current *call-of-sheet*.

Assembly process 8cm expansion (AS-R)

Structural movements up to $\pm 4\text{cm}$

Given changes in bridge length influenced by temperature, it becomes necessary to compensate these movements at at least one point on the bridge.



Carriageway transition construction (slight structural movement)

DELTABLOC[®] expansion elements have been developed for this purpose. They can absorb changes in the bridge's length and at the same time guarantee that the element connections are force-closed.

For each road deck transition, there are two DELTABLOC[®] expansion elements that belong together.

Mounting the expansion elements

After establishing the size of the joints for the assembly (dependent on the structural temperature; information to be found in project planning), the initial position of both elements is marked.



Marking the initial position of the elements

Afterwards, the first element with the lagging shroud is aligned to the marking.



Element with lagging shroud: alignment to the marking

The second element is then placed at a greater distance and the lagging shroud is assembled.



Aligning the counter element and assembling the lagging shroud

After the expansion element is finally positioned along the marking, the coupling can be applied.



Inserted coupling

Mounting the covering hood

To protect the expansion, a special covering hood is finally screwed on the concrete element on the side of the incoming traffic.



Applied expansion covering hood

Note:

 During installation, care must be taken that the elements do not stand on the bridge's transition structure.



The elements may not stand on the bridge's transition structure!

Assembly process 25cm or 40cm expansion (AS-R)

Structural movements up to $\pm 12.5\text{cm}$ or $\pm 20\text{cm}$

Given changes in bridge length influenced by temperature, it becomes necessary to compensate these movements at at least one point on the bridge.



Carriageway transition structure under moderate structural movement conditions

DELTABLOC[®] expansion elements have been developed for this purpose. They can absorb changes in the bridge's length and at the same time guarantee that the element connections are force-fit.

For each road deck transition, there are two DELTABLOC[®] expansion elements that belong together.

Mounting the expansion elements

After establishing the size of the joints for the assembly (dependent on the structural temperature; information to be found in project planning), the initial position of both elements is marked.



Marking the position of the elements

Afterwards, the first element with the lagging shroud is aligned to the marking.



Element with lagging shroud: alignment to the marking

The second element is then placed at a greater distance and the lagging shroud is assembled. The coupling can be hooked in after the element is finally positioned.

Assembling the covering hood

A covering hood is assembled to protect the expansion. The screwing is made on the incoming traffic side.



Final screwing of the covering hood

Note:

 During installation, care must be taken that the elements do not stand on the bridge's transition structure.

Assembly process 90cm expansion (AS-R)

Given changes in bridge length influenced by temperature, it becomes necessary to compensate these movements at at least one point on the bridge.



Carriageway transition construction prior to renewing the bridge cap

DELTABLOC® expansion elements have been developed for this purpose. They can absorb changes in the bridge's length and at the same time guarantee that the element connections are force-fit.

For each road deck transition, there are two DELTABLOC® expansion elements that belong together.

Mounting the Teflon shell bearing

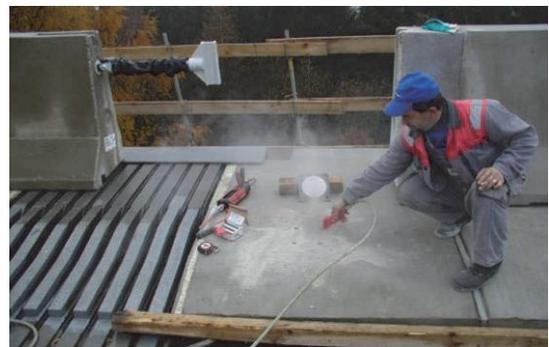
As the first step, the Teflon shell bearings are mounting. They are anchored by means of internally threaded cartridges (HIS-N M12 x 125, galvanised) and fixed with countersunk head screws.

Procedure:

- ▶ mark the position
- ▶ set the bore
- ▶ blow out the bore
- ▶ apply the adhesive
- ▶ set the adhesive anchor
- ▶ fasten the Teflon shell bearing after the adhesive has hardened (the instructions of the adhesive manufacturer must be followed)



Mounting the shell bearing: bore



Blowing out the bore



Applying the adhesive, inserting the threaded cartridge



Mounting the Teflon shell bearing

The Teflon shell bearing serves to compensate the lateral displacement during the expansion process.

Mounting the expansion stiffening plate

The galvanised stiffening plate is now brought into position between the two Teflon shell bearings.



Positioning of the stiffening plate



Positioning over the stiffening plate



Lowering the fixed expansion element into the expansion stiffening plate

Mounting the expansion elements



View from below: shell bearing counter punch

Under the expansion elements there are stainless steel plates which serve as sliding surface for the Teflon disks.

First, the fixed expansion element is placed onto the expansion stiffening plate.

Applying the expansion tension damper

The expansion damper is installed into the movable expansion element. For this purpose, the expansion damper is installed in the expansion element's cladding tube. The anchoring bore must align with the recesses in the expansion element. Now, the anchoring bolt can be applied, the disk can be fit on and the nut can be screwed on.



Inserting the expansion tension damper into the coupling of the fixed expansion element

The movable expansion element is then inserted into the stiffening plate. Here care must be taken to simultaneously couple the expansion damper into the fixed expansion element.

The adjustment of the distance is carried out through a lateral tug with the crane until the gap is reached which matches the temperature diagram that is to be provided by the bridge building company.



Installed expansion without covering hood



Installed expansion with covering hood

Note:

 During installation, care must be taken that the elements do not stand on the bridge's transition structure.

Mounting the steel covering hood

The steel covering hood is attached to the expansion element situated on the side of the incoming traffic. The sliding movement takes place on the other expansion element.

The steel covering hood is set on the expansion from above by means of a lifting loop and is to be anchored on the side of the incoming traffic with a metal dowel (M12) and countersunk head screws (M12 x 30). The bores (60mm depth) are set \varnothing 15mm by means of a rock drill and are then cleaned. At this time, the metal dowels are to be inserted up to the fixed stop and expanded by means of a caging tool (steel stud). Finally, the countersunk head screws (M12 x 30) are screwed in and tightened (M12 countersunk head screw with internal hexagon; 8 mm hex key).

Assembly process 40cm expansion (AS-A)

Structural movement of $\pm 20\text{cm}$

Given changes in bridge length influenced by temperature, it becomes necessary to compensate these movements at at least one point on the bridge.

For this purpose the DELTABLOC® expansion elements have been developed. These can compensate any length expansion in the bridge structure and also ensure a force-fitting connection between the elements.

For each carriageway transition, there are two DELTABLOC® expansion elements that belong together.



Expansion joint with DB 80AS-A expansion elements

Mounting the expansion elements

First of all, the correct position of the two expansion elements is marked.



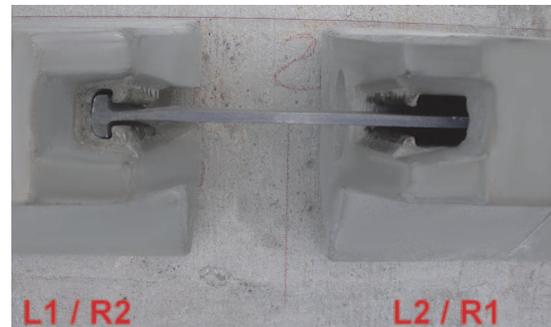
For the correct arrangement of expansion elements check the chapter on *Placement of bridge expansion joints*.

Ensure that the elements do not stand on the bridge's transition structure.

Using the bore-hole template, mark the bore holes and drill the holes, as described in the chapter *Installation process DB 80AS-A*.

After that, the expansion element with the closed coupling seat (L1 / R2) is mounted, also according to the chapter *Installation process DB 80AS-A*.

Before the expansion element with the extended coupling seat (L2 / R1) is installed, first the coupling must be inserted into the extended coupling seat. Then the element including the coupling is mounted; while it is lowered, the other end of the coupling is threaded into the coupling seat of the expansion element with the closed coupling seat (L1 / R2).



Expansion elements L1 / R2 with closed coupling seat and L2 / R1 with extended coupling seat

After positioning both expansion elements the two are fastened to the underground by means of two adhesive anchors, as described in chapter *Installation process DB 80AS-A*.

Mounting the cover

To protect the expansion, a covering hood is mounted. This is screwed onto the element on the side of the incoming traffic.



Final fixing of the cover

Maintenance and inspection

General

According to the requirements stipulated in EN 1317 the DELTA BLOC® restraint system is maintenance-free with regard to its function.

Drainage outlets

To guarantee unhindered drainage of water (rain water or melt water), the drainage channels must be inspected once a year and if necessary cleaned using high-pressure cleaning equipment.

Reflectors

To ensure proper functioning, the fitted reflectors have to be regularly cleaned, depending on the environmental conditions at the site. This can also be done with the aid of high-pressure cleaning equipment.

Inspection

An inspection of the entire system will be required in the event of an impact (accident). Depending on the intensity of the collision, repair measures may have to be initiated (see chap. Procedure after an impact).

Inspection activities

The inspection of DELTABLOC® restraint systems has to take place in two steps:

1. Inspection of total system: *see table 1*
2. Inspection of individual components: *see Table 2*

Completeness of the restraint system

When inspecting the DELTABLOC® restraint system for completeness, the presence of the following individual components must be checked:

- ▶ coupling between consecutive elements
- ▶ elastomer inserts on both sides in the butt joint between elements
- ▶ elastomer ring for fixing the elastomer inserts
- ▶ bolted connections of anchors for terminal elements

Table 1: Inspection activities for the entire system

Component	Inspection activity	Measure
entire system	<ul style="list-style-type: none"> ▶ inspection of couplings for evident damage ▶ check for any displacement of elements following each collision within the range 50m before and after the point of impact 	where necessary, initiate repair measures

Table 2: Inspection activities for individual components

Component	Inspection activity	Measure
restraint element	<ul style="list-style-type: none"> ▶ visual inspection for cracks or spalling ▶ check for correct positioning of elements 	where necessary, initiate repair measures
coupling element	check for completeness and damage	where necessary, replace elements
butt joint inserts	check for completeness and damage	where necessary, replace elements
elastomer ring	check for completeness and functionality	where necessary, replace elements

Procedure after an impact

The effectiveness of the DELTABLOC® bridge system is also permanently ensured after impacts if the following recommendations are followed. In case of doubts, the system supplier should be consulted for an expert assessment!

The condition of the safety barrier elements after an impact is as follows:

No displacement of the safety barrier

Damage pattern: No visible cracks or spalling in the concrete elements, no deformation of the stiffening plates, the ground anchorings or the coupling elements. Tyre marks, scratch and paint traces are the only indications of vehicle contact.

Measure: No kind of action to be taken.

Slight displacement of the safety barrier

Displacement < 6cm

Damage pattern: Slightly visible damage to the concrete elements, such as cracks, concrete breakings etc. Clear traces of contact exist. No deformations can be seen in the ground anchorings, the tension plates and the coupling elements.

Measure: Minor damage to the concrete elements can be repaired on site with repair mortar. When returning the elements, the position stabilisation must first be loosened and then the displaced DELTABLOC® elements are to be aligned again with appropriate hoisting devices.

In case of cracks in the area of the ground anchorings, stiffening plates or coupling elements, the affected parts are to be replaced. The mounting of new elements must be carried out as in the initial installation.

Considerable displacement of the safety barrier

Displacement ≥ 6cm

Damage pattern: Clearly visible damage to the elements, such as cracks, concrete breakings etc. The ground anchorings, stiffening plates and/or coupling elements are clearly and visibly deformed.

Measure: If the damages to the concrete elements are slight, they can be repaired at the location with repair mortar; otherwise the damaged DELTABLOC® elements ought to be exchanged.

The position anchor of the stiffening plate (M16 adhesive anchor) is to be newly anchored if the displacement is greater than 6cm (Ø 20mm coring). If the deformation or cracks are significant, the stiffening plate or coupling will have to be exchanged. The mounting of new elements must be carried out as in the initial installation.

Remark on the repair mortar to be used

Commercial repair mortar is to be used to repair minor damage. The type of mortar to be used is hydraulic-setting, plasticised dry mortar. Preparation of the surface and processing of the mortar must be done in accordance with the processing instructions of the mortar manufacturer.

Operational safety

General

Please refer to all the relevant national regulations regarding occupational safety. The information below should be regarded as an addition to these national regulations.

Material, tools and equipment

Care must be taken that all materials, tools and equipment correspond to the safety regulations and are suitable for the purpose they are used for.

Securing the construction site

Safe access to the construction site must be guaranteed.

The construction site must be secured against unauthorised access by third parties by putting up the corresponding signs and barriers. Care must be taken that the general traffic can safely pass the construction site. Sources of danger should be identified while setting up the construction site, with suitable measures being taken.

A suitable traffic control plan is to be developed in good time and implemented at the site. All site employees should be constantly aware of the risks posed by the traffic flow and must wear high-visibility vests.

Loading and unloading

The driver is responsible for securing the load! Before loosening the straps that are securing the load, it must be ensured that the load is still stable.

Lifting equipment such as cranes, concrete barrier grabs, straps, ropes, chains etc. must be maintained in a good condition. It must be ensured that all lifting equipment has been tested and certified.

There may be no people in the danger zone of the hoisting equipment.

It must be ensured that all employees are wearing suitable work clothing, including their personal protective equipment (safety shoes, helmet, high-visibility jackets, gloves).

Crane

Cranes may only be operated by suitably trained staff.

The crane must be set up in accordance with the requirements. Special care must be taken that there are no power cables within the operating range of the crane. All overhead cables should be regarded as high-voltage cables and both the crane and the load should be kept at a safe distance. In the event of problems with overhead cables, work must be discontinued and the responsible authorities are to be contacted.

Cleaning

Protective goggles and a dust mask is to be worn when cleaning DELTA BLOC® elements, thus avoiding injuries caused by small airborne particles.

Clearing the construction site

High-visibility vests must also be worn when leaving or clearing the construction site. When removing traffic lights and signs, corresponding precautionary measures must be taken in order to avoid accidents with passing traffic. Any waste and dirt on the construction site must be removed.

Tools and equipment

Equipment required

1. Lorry with loading crane or mobile crane, excavator or fork lift
2. Concrete barrier grab
3. Crowbars and lifting rods
4. Spanner for M16 screws
5. Drill (with drill head)
6. Electricity supply
7. Tape measure or distance meter

Material

1. Elements, terminals, transitions
2. Expansions
3. Lagging shrouds, expansion damper
4. Shell bearings, stiffening plates
5. Nuts and bolts M16
6. Couplings
7. Expansion couplings
8. Covering hoods
9. Reflectors (if required)
10. Anchors for terminals

Transport

1. Suitable lorries
2. Load-securing straps
3. Safety boots
4. Delivery note

Additional information

Other relevant documents

- ▶ Product information DB 80AS-R
- ▶ Product information DB 80AS-R Step
- ▶ Product information DB 100AS-R
- ▶ Installation instruction steel covering hood

Internet

- ▶ For further information, photos as well as videos of crash tests please visit www.deltabloc.com



DELTA BLOC International GmbH
Industriestrasse 28
2601 Sollenau
Austria
Tel: +43 57715 / 470 473
Fax: +43 57715 / 470 474
office@deltabloc.com
www.deltabloc.com

DELTABLOC® and CITYBLOC® are registered trademarks of DELTA BLOC International GmbH | © 2010 DELTA BLOC International GmbH