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Authorised and notified according to Article 10 of the Council Directive of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products (89/106/EEC)

Deutsches Institut für Bautechnik
DIBt

Mitglied der EOTA
Member of EOTA

European Technical Approval ETA-13/0400

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung *Trade name*	Lift Service Bochum Ankerschiene - LS *Lift Service Bochum Anchor Channel - LS*
Zulassungsinhaber *Holder of approval*	Lift Service Bochum GmbH Harpener Heide 14 44805 Bochum DEUTSCHLAND
Zulassungsgegenstand und Verwendungszweck *Generic type and use of construction product*	Ankerschienen *Anchor channels*
Geltungsdauer: *Validity:* vom *from*	20 June 2013
bis *to*	20 June 2018
Herstellwerk *Manufacturing plant*	LS Werk 1

Diese Zulassung umfasst *This Approval contains*	33 Seiten einschließlich 24 Anhänge *33 pages including 24 annexes*

I LEGAL BASES AND GENERAL CONDITIONS

1 This European technical approval is issued by Deutsches Institut für Bautechnik in accordance with:

- Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products[1], modified by Council Directive 93/68/EEC[2] and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council[3];
- *Gesetz über das In-Verkehr-Bringen von und den freien Warenverkehr mit Bauprodukten zur Umsetzung der Richtlinie 89/106/EWG des Rates vom 21. Dezember 1988 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedstaaten über Bauprodukte und anderer Rechtsakte der Europäischen Gemeinschaften (Bauproduktengesetz - BauPG) vom 28. April 1998[4], as amended by Article 2 of the law of 8 November 2011[5];*
- Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC[6].

2 Deutsches Institut für Bautechnik is authorized to check whether the provisions of this European technical approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European technical approval and for their fitness for the intended use remains with the holder of the European technical approval.

3 This European technical approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European technical approval.

4 This European technical approval may be withdrawn by Deutsches Institut für Bautechnik, in particular pursuant to information by the Commission according to Article 5(1) of Council Directive 89/106/EEC.

5 Reproduction of this European technical approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of Deutsches Institut für Bautechnik. In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European technical approval.

6 The European technical approval is issued by the approval body in its official language. This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

[1] Official Journal of the European Communities L 40, 11 February 1989, p. 12
[2] Official Journal of the European Communities L 220, 30 August 1993, p. 1
[3] Official Journal of the European Union L 284, 31 October 2003, p. 25
[4] *Bundesgesetzblatt Teil I 1998*, p. 812
[5] *Bundesgesetzblatt Teil I 2011*, p. 2178
[6] Official Journal of the European Communities L 17, 20 January 1994, p. 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

1.1 Definition of the construction product

The Lift Service Bochum Anchor Channel - LS is an anchor channel consisting of a C-shaped channel of cold-formed steel and at least two metal anchors non-detachably fixed on the profile back.

The anchor channel is imbedded surface-flush in the concrete. Lift Service Bochum special screws - LS (hooked) with appropriate hexagon nuts and washers will be fixed in the channel.

An illustration of the product and intended use is given in Annex 1.

1.2 Intended use

The anchor channel is intended to be used for anchorages for which requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 of Council Directive 89/106 EEC shall be fulfilled and failure of anchorages made with these products would cause risk to human life and/or lead to considerable economic consequences.

The anchor channel is to be used for anchorages subject to static or quasi-static loading in reinforced or unreinforced normal weight concrete of strength classes C12/15 at minimum to C90/105 at most according to EN 206-1:2000-12. The anchor channel may be anchored in cracked and non-cracked concrete.

The anchor channel may be used for transmission of tensile loads, shear loads or a combination of tensile and shear loads perpendicular to the longitudinal axis of the channel.

The anchor channels in combination with special screws - LS according to Annex 16, Table 17 may also be used under fatigue tension loads.

The intended use of the anchor channel (channel profile, anchor, special screw, washer and nut) concerning corrosion is given in Annex 3, Table 1 depending on the chosen material.

The provisions made in this European technical approval are based on an assumed working life of the anchor channel of 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

2 Characteristics of the product and methods of verification

2.1 Characteristics of the product

The anchor channel corresponds to the drawings and information given in Annex 2 to 7. The characteristic material values, dimensions and tolerances of the anchor channel not indicated in the Annexes shall correspond to respective values laid down in the technical documentation[7] of this European technical approval.

Regarding the requirements concerning safety in case of fire (ER 2) it is assumed that the anchor channel meets the requirements of class A1 in relation to reaction to fire in accordance with the stipulations of the Commission decision 96/603/EC, amended by 2000/605/EC.

The characteristic values for the design of the anchorages for static or quasi-static loads are given in Annexes 8 to 15. The design values for the design of the anchorages for fatigue loads are given in Annexes 16 to 22.

The anchor channel shall be marked with the identifying mark of the producer and the size, e.g. LS40/22 according to Annex 2. The position of the anchor is marked for anchor channels with weld-on anchors by nail holes in the channel profile.

Each special screw is marked with the identifying mark of the producer, the special screw type and the strength grade according to Annex 2.

2.2 Method of verification

2.2.1 General

The assessment of the fitness of the anchor channel for the intended use with regard to the requirements of mechanical resistance and stability as well as safety in use in the sense of the Essential Requirements 1 and 4 was performed based on the following verifications:

<u>Verifications for tension loads for</u>

1.	Distribution of acting tension loads	
2.	Steel failure - anchor	$N_{Rk,s,a}$
3.	Steel failure - special screw	$N_{Rk,s,s}$
4.	Steel failure - connection channel/ anchor	$N_{Rk,s,c}$
5.	Steel failure - local flexure of channel lips	$N_{Rk,s,l}$
6.	Steel failure - flexure resistance of channel	$M_{Rk,s,flex}$
7.	Steel failure - transfer of setting torque into prestressing force	T_{inst}
8.	Concrete failure - pullout	$N_{Rk,p}$
9.	Concrete failure - concrete cone	$N_{Rk,c}$
10.	Concrete failure - splitting due to installation	c_{min}, s_{min}, h_{min}
11.	Concrete failure - splitting due to loading	$N_{Rk,sp}$
12.	Concrete failure - blow-out	$N_{Rk,cb}$
13.	Reinforcement	$N_{Rk,re}$, $N_{Rd,a}$
14.	Displacement under tension loads	δ_N

7 The technical documentation of this European technical approval is deposited at Deutsches Institut für Bautechnik and, as far as it is relevant to the tasks of the approved body involved in the attestation of conformity procedure, is handed over to the approved bodies.

Verifications for shear loads for

1. Distribution of acting shear loads
2. Steel failure without lever arm - special screw $V_{Rk,s,s}$
3. Steel failure without lever arm - flexure channel lips $V_{Rk,sl}$
4. Steel failure with lever arm $M^0_{Rk,s}$
5. Concrete failure - pry-out $V_{Rk,cp}$
6. Concrete failure - concrete edge $V_{Rk,c}$
7. Reinforcement $V_{Rk,c,re}$
8. Displacement under shear loads δ_V

Verification for fatigue tension loads for

1. Distribution of acting fatigue tension loads
2. Steel failure $\Delta N_{Rd,s;0;n}$
3. Concrete failure - pullout $\Delta N_{Rd,p;0;n}$
4. Concrete failure - concrete cone $\Delta N_{Rd,c;0;n}$

In addition to the specific clauses relating to dangerous substances contained in this European Technical Approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

3 Evaluation and attestation of conformity and CE-marking

3.1 System of attestation of conformity

According to the Decision 2000/273/EC of the European Commission[8] system 2(i) (referred to as system 1) of the attestation of conformity applies.

This system of attestation of conformity is defined as follows:

System 1: Certification of the conformity of the product by an approved certification body on the basis of:

(a) Tasks for the manufacturer:
  (1) factory production control;
  (2) further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan;

(b) Tasks for the approved body:
  (3) initial type-testing of the product;
  (4) initial inspection of factory and of factory production control;
  (5) continuous surveillance, assessment and approval of factory production control.

Note: Approved bodies are also referred to as "notified bodies".

8 Official Journal of the European Communities L 86 of 07.04.2000

3.2 Responsibilities

3.2.1 Tasks of the manufacturer

3.2.1.1 Factory production control

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall insure that the product is in conformity with this European technical approval.

The manufacturer may only use initial/ raw/ constituent materials stated in the technical documentation of this European technical approval.

The factory production control shall be in accordance with the control plan which is part of the technical documentation of this European technical approval. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited with Deutsches Institut für Bautechnik.[9]

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

3.2.1.2 Other tasks for the manufacturer

The manufacturer shall, on the basis of a contract, involve a body which is approved for the tasks referred to in section 3.1 in the field of anchor channels in order to undertake the actions laid down in section 3.2.2. For this purpose, the control plan referred to in sections 3.2.1.1 and 3.2.2 shall be handed over by the manufacturer to the approved body involved.

The manufacturer shall make a declaration of conformity, stating that the construction product is in conformity with the provisions of this European technical approval.

3.2.2 Tasks of the approved bodies

The approved body shall perform the

- initial type-testing of the product,
- initial inspection of factory and of factory production control,
- continuous surveillance, assessment and approval of factory production control

in accordance with the provisions laid down in the control plan.

The approved body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

The approved certification body involved by the manufacturer shall issue an EC certificate of conformity of the product stating the conformity with the provisions of this European technical approval.

In cases where the provisions of the European technical approval and its control plan are no longer fulfilled the certification body shall withdraw the certificate of conformity and inform Deutsches Institut für Bautechnik without delay.

3.3 CE marking

The CE marking shall be affixed on each packaging of the anchor channel. The letters "CE" shall be followed by the identification number of the approved certification body, where relevant, and be accompanied by the following additional information:

- the name and address of the producer (legal entity responsible for the manufacture),
- the last two digits of the year in which the CE marking was affixed,

[9] The control plan is a confidential part of the European technical approval and only handed over to the approved body involved in the procedure of attestation of conformity. See section 3.2.2.

- the number of the EC certificate of conformity for the product,
- the number of the European technical approval,
- trade name of the anchor channels and special screws.

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

The European technical approval is issued for the product on the basis of agreed data and information, deposited with Deutsches Institut für Bautechnik, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data and information being incorrect, should be notified to Deutsches Institut für Bautechnik before the changes are introduced. Deutsches Institut für Bautechnik will decide whether or not such changes affect the approval and consequently the validity of the CE marking on the basis of the approval and if so whether further assessment or alterations to the approval shall be necessary.

4.2 Design of anchorages

4.2.1 Predominantly static load or quasi-static load

The fitness of the anchor channel for the intended use is given under the following condition:

The design of the anchorage is based on the CEN/TS 1992-4:2009 "Design of fastenings for use in concrete", part 1 and 3 under the responsibility of an engineer experienced in anchorages and concrete work.

The verification for shear load with supplementary reinforcement follows CEN/TS 1992-4-3:2009, section 6.3.6 and 6.3.7.

The reduction of the member cross section caused by the anchor channel is taken into account for the verification of the concrete member if necessary.

The member thickness is not less than h_{min} indicated in Annex 8, Table 7.

The edge distance of the anchors on the profile back of the channel is not less than c_{min} indicated in Annex 8, Table 7.

The spacing of the anchors is between s_{min} and s_{max} given in Annex 6, Table 4.

The spacing of the special screws is not less than $s_{min,s}$ given in Annex 9, Table 8.

The effective anchorage depth is not less than min h_{ef} according to Annex 8, Table 7.

The characteristic resistances are calculated with the minimum effective anchorage depth.

Taking into account the loads to be anchored verifiable calculation notes and drawings are generated.

The position, the size, the length of the anchor channel, if applicable the spacing of the anchors, and if applicable the position as well as the size of the special screws are indicated on the design drawings. The material of the anchor channel and the special screw is given additionally on the drawings.

4.2.2 Fatigue tension load

The design for fatigue tension loads may be calculated according section 4.2.2.1 for known cycles n and known fatigue load ΔN_{Ed}, for unknown cycles and known fatigue load and for known cycles and unknown fatigue load.

It may be calculated according section 4.2.2.2 for unknown cycles and unknown fatigue load.

The partial safety factor for fatigue loads shall be chosen to $\gamma_{F,fat}$ = 1.0, if there is a effective action collective with different level of actions and the anchor channel is verified with the maximum value of fatigue loads. It shall be chosen to $\gamma_{F,fat}$ = 1.2, if the effective action collective is actually a one level collective or converted to a collective of one level with an equivalent grade of damage.

4.2.2.1 Design method I for known fatigue load and/ or known load cycles

The verification may be done according Annex 19 if

(1) a definite allocation of all actions to a static or quasi-static part and a fatigue influenced part is possible and/or

(2) a upper limit of load cycles n during working life is known.

Three cases have to be divided:

Case 1: condition (1) and (2) is met,

Case 1.1: only condition (1) is met,

Case 1.2: only condition (2) is met.

The design fatigue resistances $\Delta N_{Rd;0;n}$ due to tension load without static pre-loading are given in Annex 16, 20 and 21 subject to the number of cycles.

For case 1 the verification may be done with the design fatigue resistances $\Delta N_{Rd;E;n}$ due to tension load with static pre-loading and n load cycles. The design fatigue resistances $\Delta N_{Rd;E;n}$ may be calculated according Annex 18 for steel, concrete cone and pull-out failure.

For case 1.1 the verification may be done with the design fatigue resistances $\Delta N_{Rd;E;\infty}$ due to tension load with static pre-loading and n ≥ 10^6 load cycles. The design fatigue resistances $\Delta N_{Rd;E;\infty}$ may be calculated according Annex 18 for steel, concrete cone and pull-out failure.

For case 1.2 the verification may be done with the total design action and the design fatigue resistances $\Delta N_{Rd;0;n}$ due to tension load without static pre-loading and n load cycles. The design fatigue resistances $\Delta N_{Rd;0;n}$ may be determined for steel, concrete cone and pull-out failure.

4.2.2.2 Design method II for unknown fatigue load and unknown load cycles

The verification may be done according Annex 22 if

(1) a definite allocation of all actions to a static or quasi-static part and a fatigue influenced part is not possible and

(2) a upper limit of load cycles n during working life is unknown.

All actions may be assumed to affect fatigue and load cycles n ≥ 10^7 may be chosen.

The design fatigue resistances $\Delta N_{Rd;0;\infty}$ due to tension load without static pre-loading are given in Annex 22 subject to the size of the anchor channel.

Since pull-out failure is not decisive the design fatigue resistances $\Delta N_{Rd;0;\infty}$ may be determined for steel and concrete cone failure only.

4.3 Installation of the anchor channel

The fitness for use of the anchor channel can only be assumed, if the following installation conditions are observed:

- Installation by appropriately qualified personnel and under the supervision of the person responsible for technical matters on site.
- Use of the anchor channel only as supplied by the manufacturer without exchanging the components.
- Installation in accordance with the manufacturer's specifications given in Annex 23 and 24 and the design drawings.
- The anchor channels are fixed on the formwork, reinforcement or auxiliary construction such that no movement of the channels will occur during the time of laying the reinforcement and of placing and compacting the concrete.
- The concrete under the head of the anchors are properly compacted. The channels are protected from penetration of concrete into the internal space of the channels.
- Size and spacing of special screws corresponding to the design drawings.
- Orientating the special screw (notch according Annex 7) rectangular to the channel axis.
- Observation of the prescribed values (e.g. T_{inst} according Annex 9) of installation.
- The setting torques given in Annex 9 must not be exceeded.

5 Responsibility of the manufacturer

It is in the responsibility of the manufacturer to ensure that the information on the specific conditions according to 1 and 2 including Annexes referred to and 4.2 and 4.3 is given to those who are concerned. This information may be made by reproduction of the respective parts of the European technical approval. In addition all installation data shall be shown clearly on the package and/or on an enclosed instruction sheet, preferably using illustration(s).

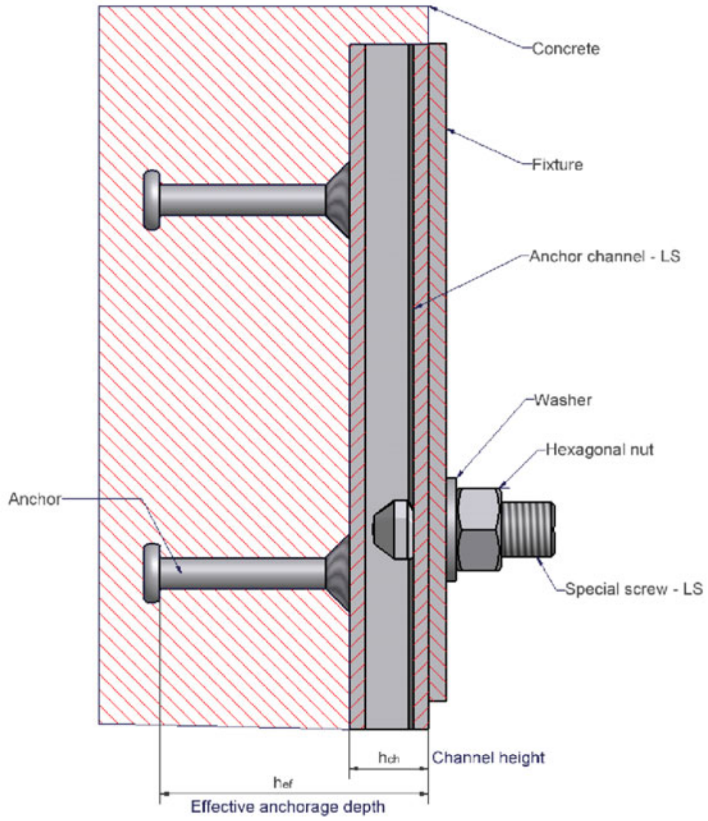
The minimum data required are:

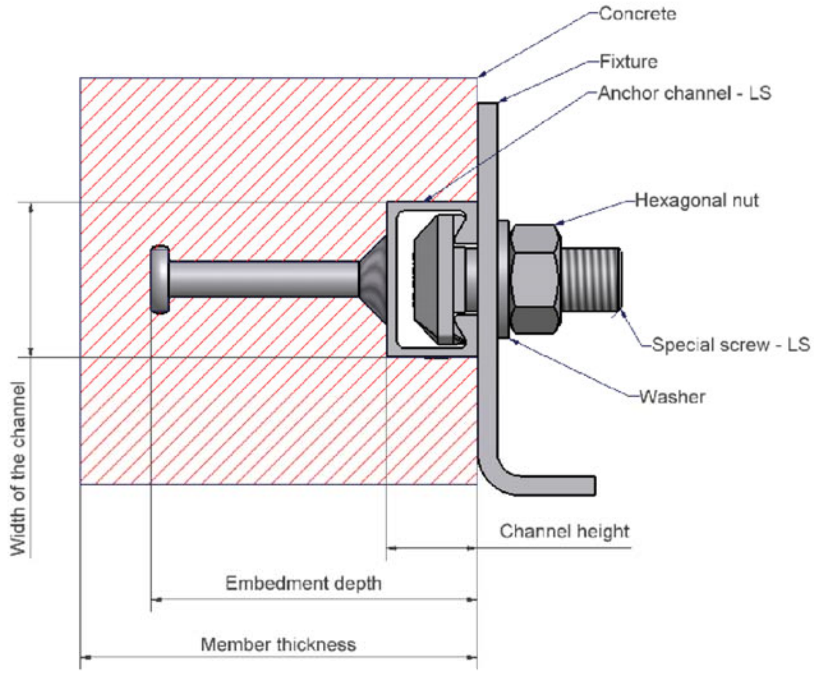
- dimensions of the anchor channel,
- mentioning of the matching screws,
- materials of the anchor channel (channel, anchor, screw , washer, nut)
- details on the installation procedure, preferably by using illustrations,
- maximum setting torque,
- identification of the manufacturing batch.

All data shall be presented in a clear and explicit form.

Andreas Kummerow
p. p. Head of Department

beglaubigt:
Müller



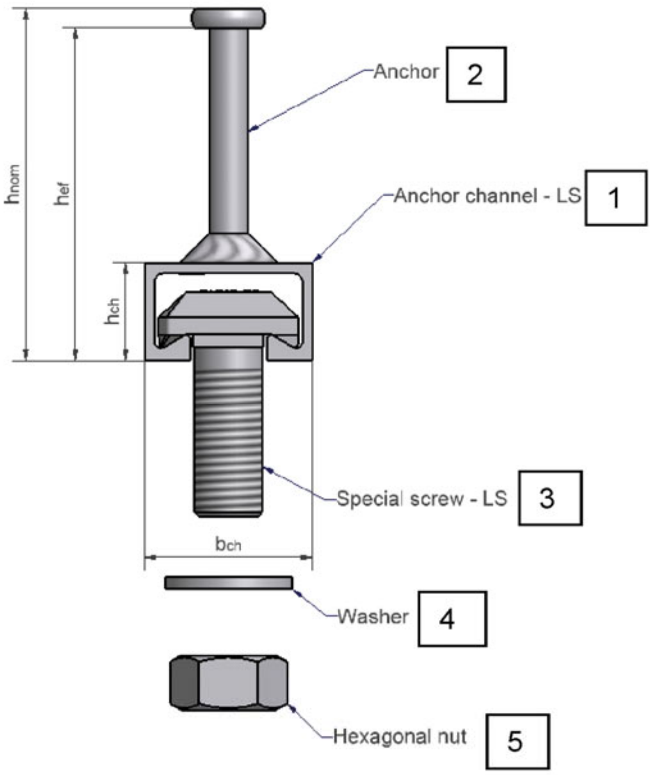


Lift Service Bochum Anchor Channel – LS	Annex 1
Product and intended use	

Anchor channel profile

Legend

h_{ch}	Channel height
b_{ch}	Width of the channel
h_{ef}	effective anchorage depth
h_{nom}	embedment depth



Marking of the Lift-Service Bochum anchor channel – e.g. LS40/22

LS = Identifying mark of the producer

Lift Service Bochum

40/22 = size

Close to the anchor a nail hole is positioned

Stumped on the inside the channel and on channel web

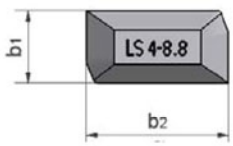
Marking of the Lift-Service Bochum special screw e.g. LS4-8.8

LS = Identifying mark of the producer

Lift Service Bochum

4 = screw type

8.8 = strength grade



Lift Service Bochum Anchor Channel – LS

Product and marking

Annex 2

Table 1: Materials and intended use

Item no.	Specification	Intended use 1 **Dry internal conditions** Anchor channels may only be used in structures subject to dry internal conditions (e.g. accommodations, bureaus, schools, hospitals, shops) **Materials**
1	Channel profile	Steel 1.0038 EN 10025 Hot-dip galv. [1] ≥ 50 µm
2	Anchor	Steel, Hot-dip galv. [1], ≥ 50 µm
3	Lift-Service Bochum Special screws shaft and thread according EN ISO 4018	Steel, strength grade 8.8 on the basis of EN ISO 898-1 Hot-dip galv. [2] ≥ 40 µm
4	Washer EN ISO 7089	Steel EN 10025 electroplated [3] ≥ 5 µm
5	Hexagonal nuts	Steel strength grade 8.8 electroplated [4] DIN 934 or EN 24032

[1] Hot-dip galv. on the basis of EN ISO 1461, but thickness ≥ 50µm
[2] Hot-dip galv. on the basis of EN ISO 10684
[3] Electroplated on the basis of EN ISO 4042
[4] Electroplated on the basis of EN ISO 4042

Fig. 1: Geometrical profile properties

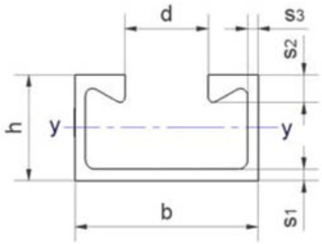


Table 2: Geometrical profile properties

Anchor channel	Figure	Dimensions						Materials	I_y
		b	h	S3	S1	d	S2		
		[mm]							[mm⁴]
LS40/22	**1**	40.0	22.0	2.5	2.5	18.0	6.0	Steel	17287

Fig. 2: Round anchors

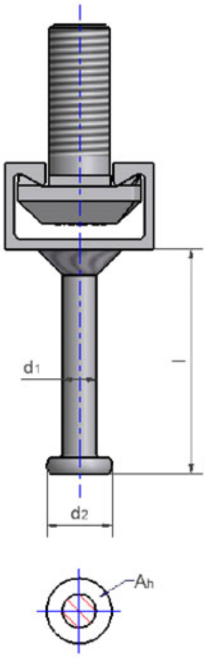


Table 3: welded round anchors

Anchor channel	Shaft Ø d_1	Head Ø d_2	Length min l
	[mm]		
LS40/22	9.0	16.0	60.0

Lift Service Bochum Anchor Channel – LS

Types of Anchors

Annex 5

Fig. 3

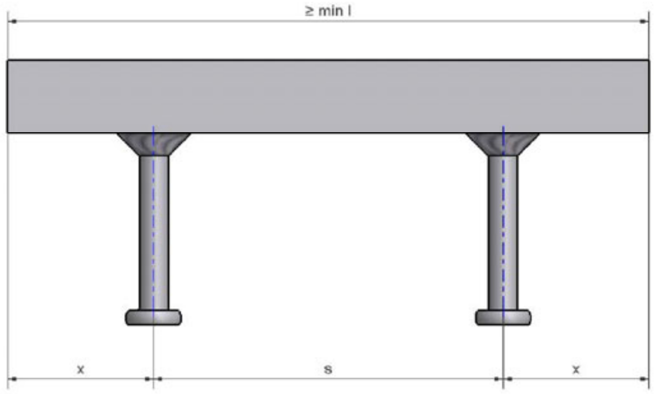


Table: 4 Anchor positioning

Anchor channel	Anchor spacing		End spacing x	min. Channel length min l
	s_{min}	s_{max}	Welded anchor Fig. 3	Welded anchor Fig. 3
	[mm]			
LS40/22	250	250	25	300

Lift Service Bochum Anchor Channel – LS	Annex 6
Anchor positioning and channel length	

Fig. 4: LS4

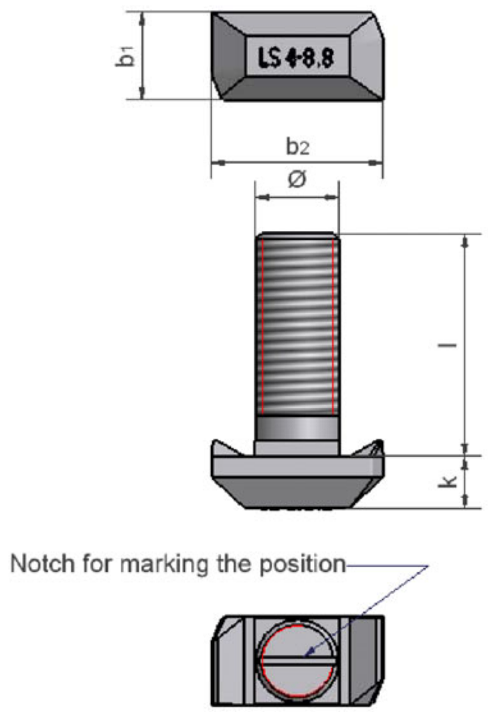


Table: 5 Dimensions, special screws

Anchor channel	Fig.	Screws dimensions				Length l
		b_1	b_2	k	Ø	
		[mm]				[mm]
LS40/22	4	17.0	32.5	13.0	16	40-200

Table: 6 Strength grade

Special screws	Steel
Strength grade	8.8
f_{uk} [N/mm²]	800
f_{yk} [N/mm²]	600
Finish	1)

1) Hot-dip galv.

Lift Service Bochum Anchor Channel – LS

LS-Special screws, dimensions and strength grade

Annex 7

Deutsches Institut für Bautechnik DIBt

Fig. 5:

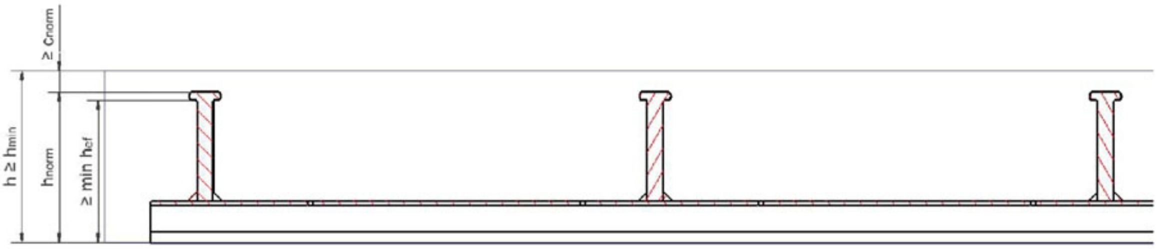


Fig.: 6

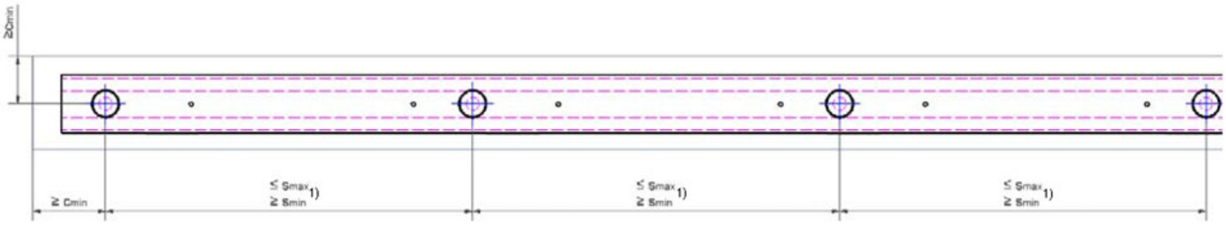


Table: 7 Minimum anchorage depth, edge distance and member thickness

Anchor channel			**LS40/22**
Min. anchorage depth	min h_{ef}	[mm]	78
Min. edge distance	c_{min}		82
Anchor head thickness	Δ_h		4
Min. member thickness	h_{min}		$h_{ef} + \Delta_h + c_{nom}$ 2)

1) s_{min} , s_{max} acc. Table 4
2) $c_{nom} \geq 40$ mm and acc. EN 1992-1-1

Lift Service Bochum Anchor Channel – LS	Annex 8
Installation parameters	

Deutsches Institut für Bautechnik DIBt

Table 8: Minimum spacing and setting torque of LS special screws

Anchor channel	Special-screw	Special-screw Ø	Min spacing $s_{min,s}$ [5] of the special screws	Setting torque T_{inst} [4] General[2]	Setting torque T_{inst} [4] Steel-Steel contact [3]
				8.8[1]	8.8[1]
		[mm]	[mm]	[Nm]	
LS40/22	LS4	16	80	25	180

[1] Materials according to Annex 3, Table 1
[2] According to Annex 10, Fig. 7
[3] According to Annex 10, Fig. 8
[4] T_{inst} must not be exceeded
[5] See Annex 11, Fig. 9

General:

The fixture is braced to concrete or to the anchor channel respectively braced to concrete and anchor channel.
The setting torques according to Annex 9, Table 8 shall be applied and must not be exceeded.

Steel – Steel contact:

The fixture is braced to the anchor channel by suitable washer. The setting torques according to Annex 9, Table 8 shall be applied and must not be exceeded.

Fig.: 7

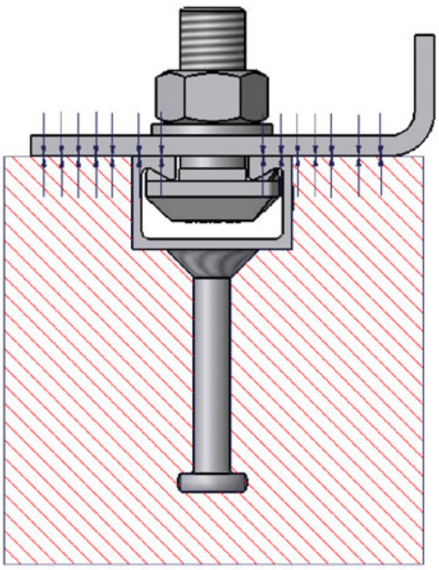
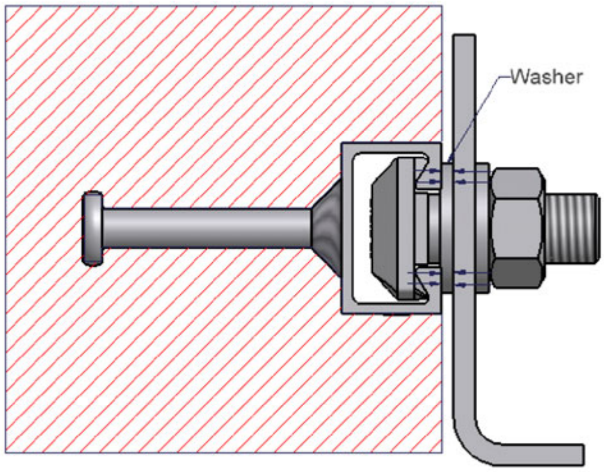


Fig.: 8



Lift Service Bochum Anchor Channel – LS	Annex 10
Position of the fixture	

Table 9: Characteristic values for tension loads – steel failure channel

Anchor channel			**LS40/22**
Steel failure, anchor			
Characteristic resistance	$N_{Rk,s}$	[kN]	36.8
Partial safety factor [1)]	γ_{Ms}		1.80
Steel failure, connection channel anchor			
Characteristic resistance	$N_{Rk,s,c}$	[kN]	15.4
Partial safety factor [1)]	$\gamma_{Ms,ca}$		1.80
Steel failure, local flexure of channel lips for $s_s \geq s_{slb}$			
Spacing of special Screws for $N_{Rk,sl}$	s_{slb}	[mm]	61
Characteristic resistance	$N_{Rk,sl}$	[kN]	15.4
Partial safety factor [1)]	$\gamma_{Ms,l}$		1.80
Steel failure, local flexure of channel lips for $s_{slb} \geq s_s \geq s_{min,s}$ [2)]			
Characteristic resistance	$N_{Rk,sl}$	[kN]	$0{,}5\ (1+s_s/s_{slb})$ $N_{Rk,s,l} \leq N_{Rk,s,c}$
Partial safety factor [1)]	γ_{Ms}		1.80

[1)] in absence of other national regulations
[2)] $s_{min,s}$ acc. to Annex 9, Table 8

Fig. 9: Distance between screws

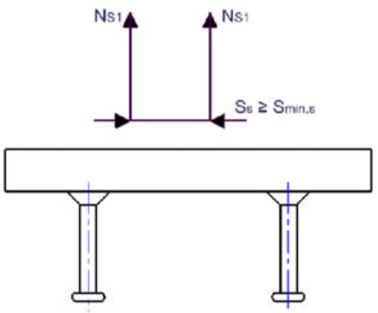


Fig. 10: Assumption of system

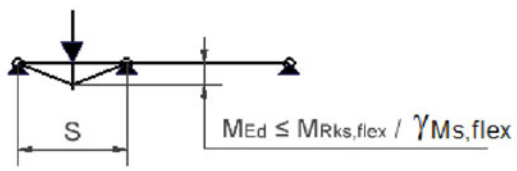


Table 10: Flexure resistance of channel

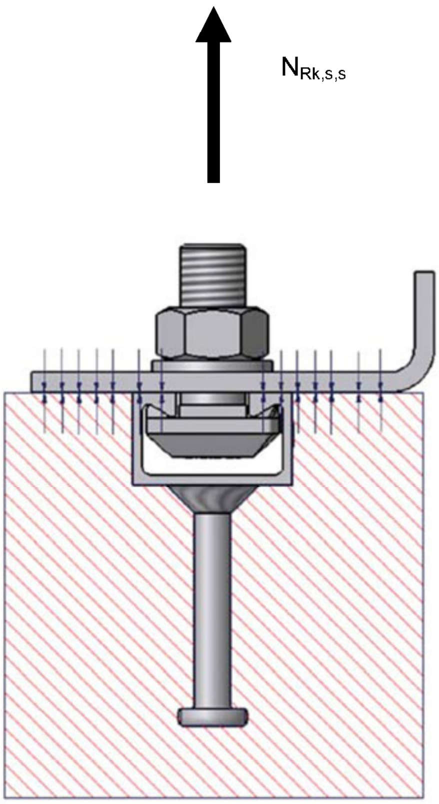
Anchor channel			**LS40/22**
Char. Flexure resistance of channel	$M_{Rk,s,flex}$	[Nm]	1276
Partial safety factor[1)]	$\gamma_{Ms,flex}$		1.15

[1)] in absence of other national regulations

Table 11: Characateristic values for tension load – steel failure of LS special screws

Special Screw Ø					**M16**
Steel failure					
Character resistance	$N_{Rk,s,s}$ 2)	[kN]	LS4-8.8	8.8 1)	125.6
Partial safety factor3)	γ_{Ms}				1.5

1) Materials according to Table 1, Annex 3
2) In conformity to EN ISO 898-1
3) in absence of other national regulations



Lift Service Bochum Anchor Channel – LS

Characteristic values for tension loads
Steel failure special screws

Annex 12

Table: 12 Characteristic values for tension loads – concrete failure

Anchor channel				**LS40/22**
Pullout failure				
Char. resistance in cracked concrete C12/15		$N_{Rk,p}$	[kN]	12.3
Increasing-factor for $N_{Rk,p}$	C16/20	ψ_c	[-]	1.33
	C20/25			1.67
	C25/30			2.00
	C30/37			2.47
	C35/45			3.00
	C40/50			3.33
	C45/55			3.67
	≥ C50/60			4.00
		$\psi_{ucr,N}$ [2]		1.4
Partial safety factor [1]		$\gamma_{Ms} = \gamma_{Mc}$		1.5
Concrete cone failure $N^0_{Rk,c}$ see CEN/TS 1992-4-3: 2009, section 6.2.5				
		α_{ch}		0.882
Effective anchorage depth		h_{ef}	[mm]	78
Characteristic edge distance		$c_{cr,N}$	[mm]	174
Chraracteristic spacing		$s_{cr,n}$	[mm]	348
		$\psi_{ucr,N}$ [2]		1.4
Partial safety factor [1]		γ_{Mc}		1.5
Splitting				
		Verification of splitting is not relevant		

[1] in absence of other national regulations
[2] Increasing factor for Non-cracked concrete

Table: 13 Displacements under tension loads

Anchor channel			**LS40/22**
Tension load	N_{Ek}	[kN]	9.7
Short time displacement	δ_{N0}	[mm]	1.0
Long time displacement	$\delta_{N\infty}$	[mm]	1.5

Lift Service Bochum Anchor Channel – LS

Characteristic values for tension loads - concrete failure and displacement

Annex 13

Table 14: Characteristic values for shear loads

Anchor channel			LS40/22
Steel failure, local flexure of channel lips			
Characteristic resistance		$V_{Rk,s,l}$ [kN]	15.4
Partial safety factor		$\gamma_{Ms,l}$ [1)]	1.8
Pry out failure			
Factor in equating (31) of CEN/TS 1992-4-3		k_5 [2)]	2
Partial safety factor [1)]		γ_{Mc}	1.5
Concrete edge failure			
Product of Factor α_p and $\psi_{re,V}$	Cracked concrete without edge reinforcement or stirrups	$\alpha_p \cdot \psi_{re,V}$	2.5
	Cracked concrete with straight edge reinforcement (≥ Ø 12 mm)	$\alpha_p \cdot \psi_{re,V}$	3.0
	Non-cracked concrete [2)] or cracked concrete with edge reinforcement and stirrups with a spacing a ≤ 100 mm und a ≤ c_1	$\alpha_p \cdot \psi_{re,V}$	3.5
Effect of the thickness of the structural component		$\alpha_{h,V}$	$(h/h_{cr,V})^{1/2}$
Characteristic height		$h_{cr,V}$	$2_{c1} + 2h_{ch}$
Characteristic distance		$c_{cr,V}$	$2c_1 + b_{ch}$
Characteristic spacing		$s_{cr,V}$	$4c_1 + 2b_{ch}$
Partial safety factor [1)]		γ_{Mc}	1.5

[1)] in absence of other national regulations

[2)] Proof acc. to CEN/TS 1992-4-3:2009

[3)] Without supplementary reinforcement. In case of supplementary reinforcement the factor k_5 should be multiplied with 0.75

Table 15: Characteristic values for shear load – steel failure of LS special screws

Special Screw - Ø					**LS4**
Steel failure					
Characteristic resistance	$V_{Rk,s}$ [2]	[kN]	LS4	8.8 [1]	62.8
Characteristic flexure resistance	$M^{0}_{Rk,s}$	[Nm]	LS4	8.8	266
Partial safety [3] factor	γ_{Ms}			8.8	1.25

[1] Materials according Annex 3, Table 1
[2] In conformity to EN ISO 898-1
[3] in absence of other national regulations

Table 16: Displacements under shear loads

Anchor channel			**LS40/22**
Shear load	V_{Ek}	[kN]	9.7
Short time displacement	δ_{V0}	[mm]	1.0
Long time displacement	$\delta_{V\infty}$	[mm]	1.5

Lift Service Bochum Anchor Channel – LS

**Characteristic values for shear loads
Steel failure of LS special screws and displacements**

Annex 15

Table 17: Possible Anchor channels / Special screws combination under fatigue tension loads

Anchor channel	Special screw-type	Ø	Strenght grade	corrosion-protection
LS40/22	LS4	M16	8.8	F [1)]

[1)] Hot-dip galv.

Table 18: Design fatigue resistance after n load cycles without static load (N_{Ed} = 0)

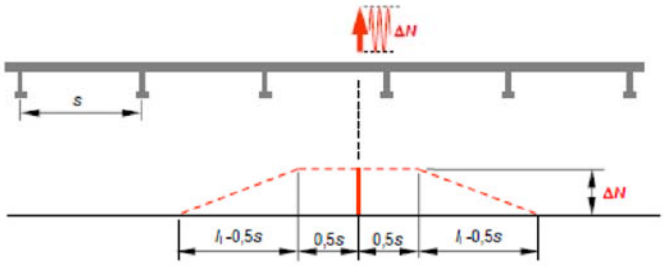
Anchor channel		**LS40/22**
Steel failure	n	$\Delta N_{Rd,s;0;n}$ [kN]
Design fatigue resistance without static load	$\leq 10^1$	6,61
	$\leq 10^2$	6,03
	$\leq 3 \cdot 10^2$	5,60
	$\leq 10^3$	5,04
	$\leq 3 \cdot 10^3$	4,47
	$\leq 10^4$	3,83
	$\leq 3 \cdot 10^4$	3,26
	$\leq 10^5$	2,69
	$\leq 3 \cdot 10^5$	2,25
	$\leq 10^6$	1,85
	$\leq 10^7$	1,36
	$> 10^7$	1,13

Fatigue design of anchor channels

Determination of the fatigue-relevant loadings

Existing static loads are taken into account according to the existing rules of CEN/TS 1992-4-3:2009.

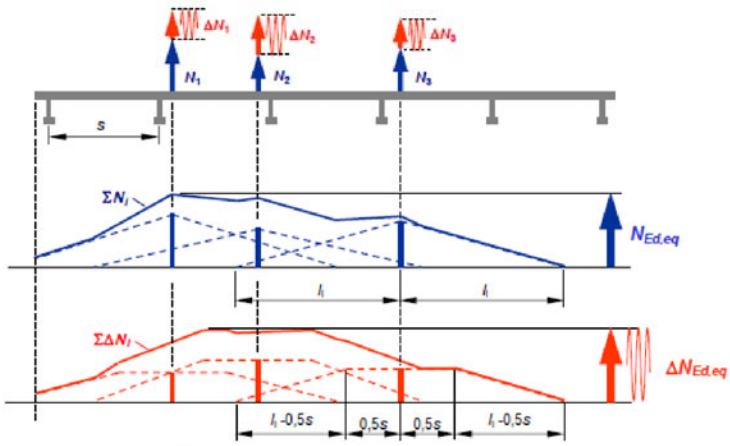
The dynamic loads are taken into account according to CEN/TS 1992-4-3:2009 as shown in Figure 12.



$l_i = 13 \cdot I_y^{0,05} \cdot s^{0,5} \geq s$ [mm]

Figure 12: Distribution of cyclic loads

Figure 13 shows an example of the loads to be taken into account from a combination of several cyclic and static loads. Simplifying, the max. equivalent static load $N_{Ed,eq}$ and max. equivalent cyclic load $\Delta N_{Ed,eq}$ can be applied at each point of the anchor channel within the circle of activity of the loads.



$l_i = 13 \cdot I_y^{0,05} \cdot s^{0,5} \geq s$ [mm]

Figure 13: Addition of the effect of several static and cyclic loads

The loads from several cyclic and static loads are superimposed as illustrated in Figure 13 and the aforementioned statements.

Lift Service Bochum Ankerschiene – LS	Annex 17
Design procedure for fatigue tension loads	

Design method I

General
Verification is done with this method if

(1) The total load can be divided into a mainly static load N_{Ed} and a fatigue load ΔN_{Ed} and (or)
(2) An upper limit of **n** load cycles during the service life is known.

Case 1 → Conditions (1) and (2) are fulfilled:

$\Delta N_{Rd;E;n}$ Design value of the fatigue resistance under cyclic loading with known static load portion N_{Ed} after n load cycles

Case 1.1 → Only condition (1) is fulfilled:

$\Delta N_{Rd;E;n} = \Delta N_{Rd;E;\infty}$ Characteristic value of fatigue resistance under continuous cyclic loading with known static load portion N_{Ed}

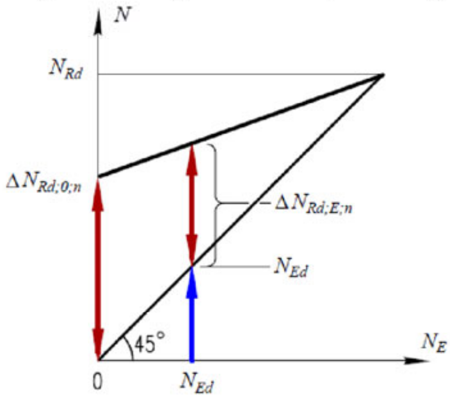
Case 1.2 → Only condition (2) is fulfilled:

$\Delta N_{Ed} = \Delta N_{Ed,tot}$ Design value of the total load

$\Delta N_{Rd;E;n} = \Delta N_{Rd;0;n}$ Design value of fatigue resistance without a static preload after n load cycles

Calculation of the fatigue resistance $\Delta N_{Rd;E;n}$

Fatigue loading with static preload ($N_{ED} \geq 0$)



$$\Delta N_{Rd;E;n} = \Delta N_{Rd;0;n} \cdot \left(1 - \frac{N_{Ed}}{N_{Rd}}\right)$$

and resp.

$$\Delta N_{Rd;E;\infty} = \Delta N_{Rd;0;\infty} \cdot \left(1 - \frac{N_{Ed}}{N_{Rd}}\right)$$

Figure 14: Goodman diagram

Lift Service Bochum Ankerschiene – LS	Annex 18
Design procedure for fatigue tension loads	

where:

N_{Ed}	Design value of the static load
N_{Rd}	Design value of the static resistance (Tab. 18, 19 and 20: values for $n \leq 10$)
$\Delta N_{Rd;0;n}$	Design value of the fatigue resistance without a static preload and n load cycles (Tab. 18, 19 and 20)
$\Delta N_{Rd;E;n}$	Design value of the fatigue resistance with combined effect of mainly static load N_{Ed} and fatigue relevant load ΔN_{Ed} and n load cycles
$\Delta N_{Rd;0;\infty}$	Design value of continuous fatigue resistance without a static load (Tab. 18, 19 and 20: values for $n > 10^7$ load cycles)
$\Delta N_{Rd;E;\infty}$	Design value of the fatigue resistance with combined effect of mainly static load N_{Ed} and fatigue relevant load ΔN_{Ed} and $n > 10^7$ load cycles

Design procedure I - required verification

	For case 1:	For case 1.1:	For case 1.2:
Steel failure:	$\Delta N_{Ed} / \Delta N_{Rd;s;E;n} \leq 1.0$	$\Delta N_{Rd;E;n} = \Delta N_{Rd;E;\infty}$	$\Delta N_{Rd;E;n} = \Delta N_{Rd;0;n}$
Pull-out:	$\Delta N_{Ed} / \Delta N_{Rd;p;E;n} \leq 1.0$		
Concrete pry-out:	$\Delta N_{Ed} / \Delta N_{Rd;c;E;n} \leq 1.0$		

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Table 19: Reduction factor $\eta_{c,fat}$ after n load cycles without static loads ($N_{Ed} = 0$)

Anchor channel		**LS40/22**
Concrete cone failure	n	$\eta_{c,fat}$ [-]
Design fatigue resistance without static load: $\Delta N_{Rd,c;0;n} = \eta_{c,fat} \cdot N_{Rd,c}$ [1)]	$\leq 10^1$	1,000
	$\leq 10^2$	0,923
	$\leq 3 \cdot 10^2$	0,888
	$\leq 10^3$	0,851
	$\leq 3 \cdot 10^3$	0,819
	$\leq 10^4$	0,785
	$\leq 3 \cdot 10^4$	0,755
	$\leq 10^5$	0,723
	$\leq 3 \cdot 10^5$	0,696
	$\leq 10^6$	0,667
	$\leq 10^7$	0,667
	$> 10^7$	0,667

[1)] $N_{Rd,c}$ concrete resistance with static load acc. Annex 13 and CEN TS 1992-4-3: 2009

Lift Service Bochum Ankerschiene – LS	Annex 20
Design fatigue resistance for tension loads – concrete cone failure	

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Table 20: Design fatigue resistance after n load cycles without static load (N_{Ed} = 0)

Anchor channel			**LS40/22**
Pullout failure		n	$\Delta N_{Rd,p,0;n}$ [kN]
Design fatigue resistance in cracked concrete C12/15 without static loads		$\leq 10^1$	8,2
		$\leq 10^2$	7,6
		$\leq 3 \cdot 10^2$	7,3
		$\leq 10^3$	7,0
		$\leq 3 \cdot 10^3$	6,7
		$\leq 10^4$	6,4
		$\leq 3 \cdot 10^4$	6,2
		$\leq 10^5$	5,9
		$\leq 3 \cdot 10^5$	5,7
		$\leq 10^6$	5,5
		$\leq 10^7$	5,5
		$> 10^7$	5,5
Increase factor at $\Delta N_{Rd,p,0;n}$	C16/20	ψ_c	1.33
	C20/25		1.67
	C25/30		2.00
	C30/37		2.47
	C35/45		3.00
	C40/50		3.33
	C45/55		3.67
	≥ C50/60		4.00
Increase factor by anchorage in not cracked concrete		$\psi_{ucr,N}$	1,4

Lift Service Bochum Ankerschiene – LS	Annex 21
Design fatigue resistance for tension loads – Pullout failure	

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Design method II

General

Verification is done with this method if

(1) A clear division of the total load into a mainly static load N_{Ed} and a fatigue load ΔN_{Ed} is **not** possible, and

(2) An upper limit of **n** load cycles during the service life does **not** exist or is **not** known

Case 2→ Conditions (1) and (2) are fulfilled:

$\Delta N_{Ed} = \Delta N_{Ed,tot}$ Design value of the total load

$\Delta N_{Rd} = \Delta N_{Rd,0,\infty}$ Characteristic value of continuous fatigue resistance without a static preload (Tab. 21)

Design procedure II - required verification

Steel failure: $\Delta N_{Ed,tot} / \Delta N_{Rd;s;0;\infty} \leq 1.0$

Pull-out: **Not required because not decisive**

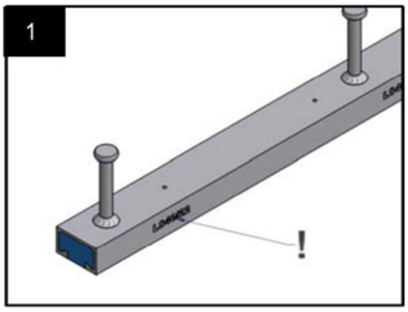
Concrete pry-out: $\Delta N_{Ed,tot} / \Delta N_{Rd;c;0;\infty} \leq 1.0$

Table 21: Design resistance after n → ∞ load cycles without static load (N_{Ed} = 0)

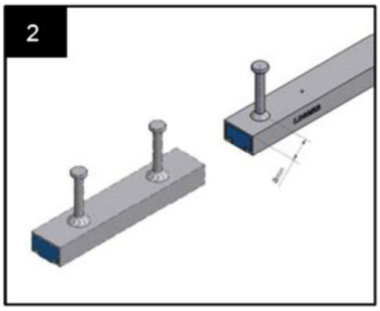
Anchor channels		**LS40/22**
Steel failure		
$\Delta N_{Rd;s;0;\infty}$	[kN]	1.13
Concrete pry-out		
$\Delta N_{Rd;c;0;\infty} = \eta_{c,fat} \cdot N_{Rd,c}$ [1)]	[-]	0.667

1) $N_{Rd,c}$ Concrete resistance under static load acc. Annex 13 and CEN/TS 1992-4-3:2009

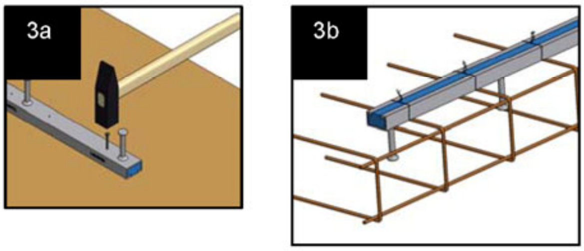
Lift Service Bochum Ankerschiene – LS	Annex 22
Design procedure II for fatigue tension loads	



Selection of anchor channel in accordance with the planning document.

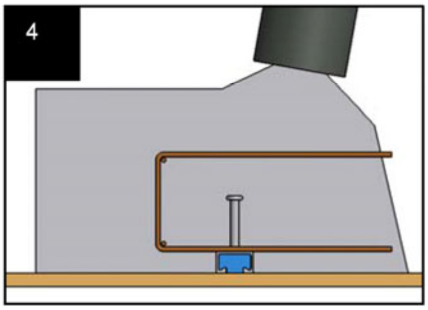


If cutting anchor channel follow min. end spacing x acc. Annex 6, Table 4.

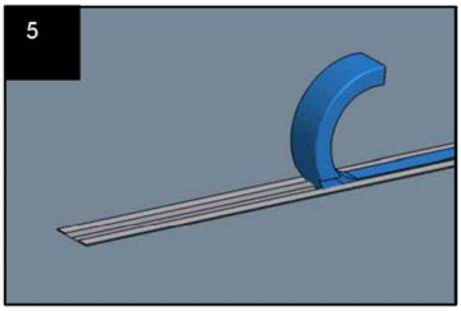


Placing channel into formwork as follows:

- Wood formwork: Fixing with nails (Fig. 3a)
- Fixing in the top surface of concrete: Fixing from above directly to the reinforcement (Fig. 3b)

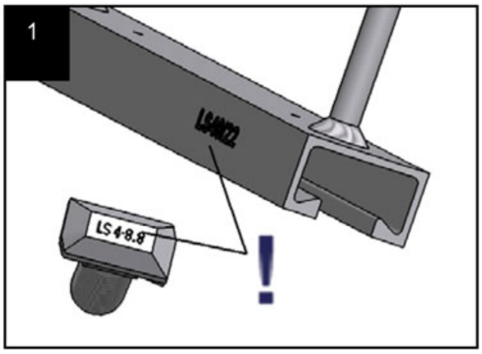


Cast in and compact the concrete.

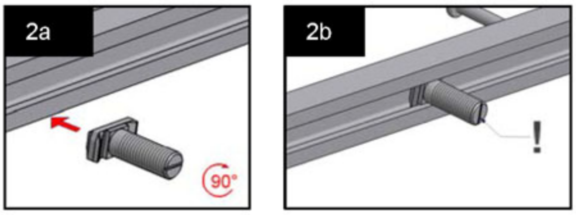


Removing the foam filler after hardening of the concrete and striking the formwork.

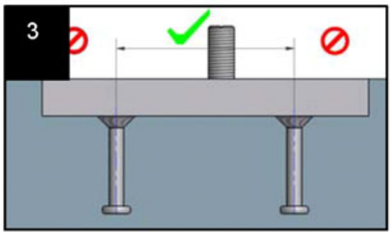
Lift Service Bochum Anchor Channel – LS	Annex 23
Manufacturerers' specification anchor channel	



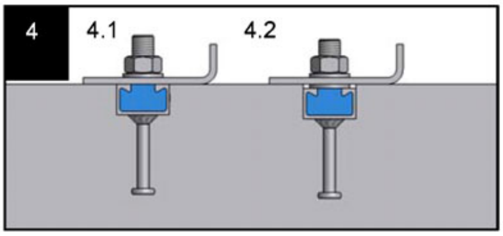
Selection of the LS special screws in accordance with the planning document.



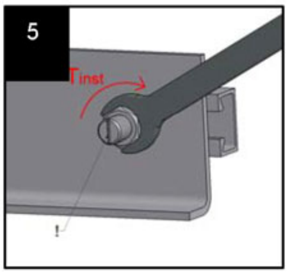
Insert the special screw into the channel. After a 90° turn clockwise, the special screw locks into the channel. Check of the position of the screw by notch.



Positioning of the special screw:
At the channel ends a minimum clearance must be maintained.



4.1: General Fixing
4.1: Fixing with steel to steel contact.



Tighten the hexagonal nut to the setting torque T_{inst} acc. Annex 9, Table 8. T_{inst} must not be exceeded. After fixing the nuts: check the correct position of the screw.

Lift Service Bochum Anchor Channel – LS	Annex 24
Manufacturer's specification LS special screw	