Deutsches Institut für Bautechnik

Zulassungsstelle für Bauprodukte und Bauarten

Bautechnisches Prüfamt

Eine vom Bund und den Ländern gemeinsam getragene Anstalt des öffentlichen Rechts

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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-09/0338

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung *Trade name*	Jordahl-Ankerschiene JTA *Jordahl-anchor channel JTA*
Zulassungsinhaber *Holder of approval*	JORDAHL GmbH Nobelstraße 51 12057 Berlin DEUTSCHLAND
Zulassungsgegenstand und Verwendungszweck *Generic type and use* *of construction product*	Ankerschienen *Anchor channels*
Geltungsdauer: vom *Validity:* *from* bis *to*	17 June 2013 17 June 2018
Herstellwerk *Manufacturing plant*	14959 Trebbin, Industriestr. 5

Diese Zulassung umfasst *This Approval contains*	37 Seiten einschließlich 27 Anhänge *37 pages including 27 annexes*
Diese Zulassung ersetzt *This Approval replaces*	ETA-09/0338 mit Geltungsdauer vom 28.02.2012 bis 15.02.2015 *ETA-09/0338 with validity from 28.02.2012 to 15.02.2015*

EOTA

E u r o p ä i s c h e   O r g a n i s a t i o n   f ü r   T e c h n i s c h e   Z u l a s s u n g e n
E u r o p e a n   O r g a n i s a t i o n   f o r   T e c h n i c a l   A p p r o v a l s

Z36142.13

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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.

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[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

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II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

1.1 Definition of the construction product

The Jordahl-anchor channel JTA is an anchor channel consisting of a C-shaped channel of hot-rolled or 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. Jordahl-special screws (hammerhead or 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 may be used for anchorages with requirements related to resistance to fire.

The anchor channel is to be used only 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 W 40/22, W 50/30 and W 53/34 in combination with special screws JC and JB according to Annex 21, Table 22 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.

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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 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 17. The characteristic values for the design of the anchorages regarding resistance to fire are given in Annex 18 and 19. They are valid for use in a system that is required to provide a specific fire resistance class. The design values for the design of the anchorages for fatigue loads are given in Annexes 20 to 25.

The anchor channel shall be marked with the identifying mark of the producer, the manufacturing method, the size and if applicable additionally with the type of stainless steel, e.g. Jordahl W 53/34-A4 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 bolt type and if applicable with the strength grade and if applicable with the type of stainless steel 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:

Verifications for tension loads for

1. Distribution of acting tension loads
2. Steel failure - anchor $\qquad$ $N_{Rk,s,a}$
3. Steel failure - special screw $\qquad$ $N_{Rk,s,s}$
4. Steel failure - connection channel/ anchor $\qquad$ $N_{Rk,s,c}$
5. Steel failure - local flexure of channel lips $\qquad$ $N_{Rk,s,l}$
6. Steel failure - flexure resistance of channel $\qquad$ $M_{Rk,s,flex}$
7. Steel failure - transfer of setting torque into prestressing force $\qquad$ T_{inst}
8. Concrete failure - pullout $\qquad$ $N_{Rk,p}$
9. Concrete failure - concrete cone $\qquad$ $N_{Rk,c}$
10. Concrete failure - splitting due to installation $\qquad$ c_{min}, s_{min}, h_{min}

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[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.

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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

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 $\Delta N_{Rd,c;0;n}$

The assessment of the anchor channel for the intended use in relation to the requirements for resistance to fire has been made in accordance with the Technical Report TR 020 "Evaluation of anchorages in concrete concerning resistance to fire".

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;

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[8]   Official Journal of the European Communities L 86 of 07.04.2000

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(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".

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.

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[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.

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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,
- 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/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/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 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 or alternatively Annexes 16 and 17.

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 8 and 9.

The edge distance of the anchors on the profile back of the channel is not less than c_{min} indicated in Annex 8, Table 8 and 9.

The spacing of the anchors is between the s_{min} and s_{max} given in Annex 6, Table 5.

The spacing of the special screws is not less than $s_{min,s}$ given in Annex 9, Table 10.

The effective anchorage depth is not less than min h_{ef} according to Annex 8, Table 8 and 9.

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

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

The position, the manufacturing method, 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 the 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 21 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 23 and Annex 24 subject to the size of the anchor channel and 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 22 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 $n \geq 10^7$ load cycles. The design fatigue resistances $\Delta N_{Rd;E;\infty}$ may be calculated according Annex 22 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.

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

The verification may be done according Annex 25 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 $n \geq 10^7$ may be chosen.

The design fatigue resistances $\Delta N_{Rd;0;\infty}$ due to tension load without static pre-loading are given in Annex 25 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.

4.2.3 Fire exposure

The design of anchorages under fire exposure has to consider the conditions given in the Technical Report TR 020 "Evaluation of anchorages in concrete concerning resistance to fire". The relevant characteristic values are given in Annex 18 and 19. The design method covers anchors with a fire attack from one side only. If the fire attack is from more than one side, the design method may be taken only, if the edge distance of the anchor is $c \geq 300$ mm.

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 Annexes 26 and 27 and the design drawings.
-   The anchor channels are fixed on the formwork 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.

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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).
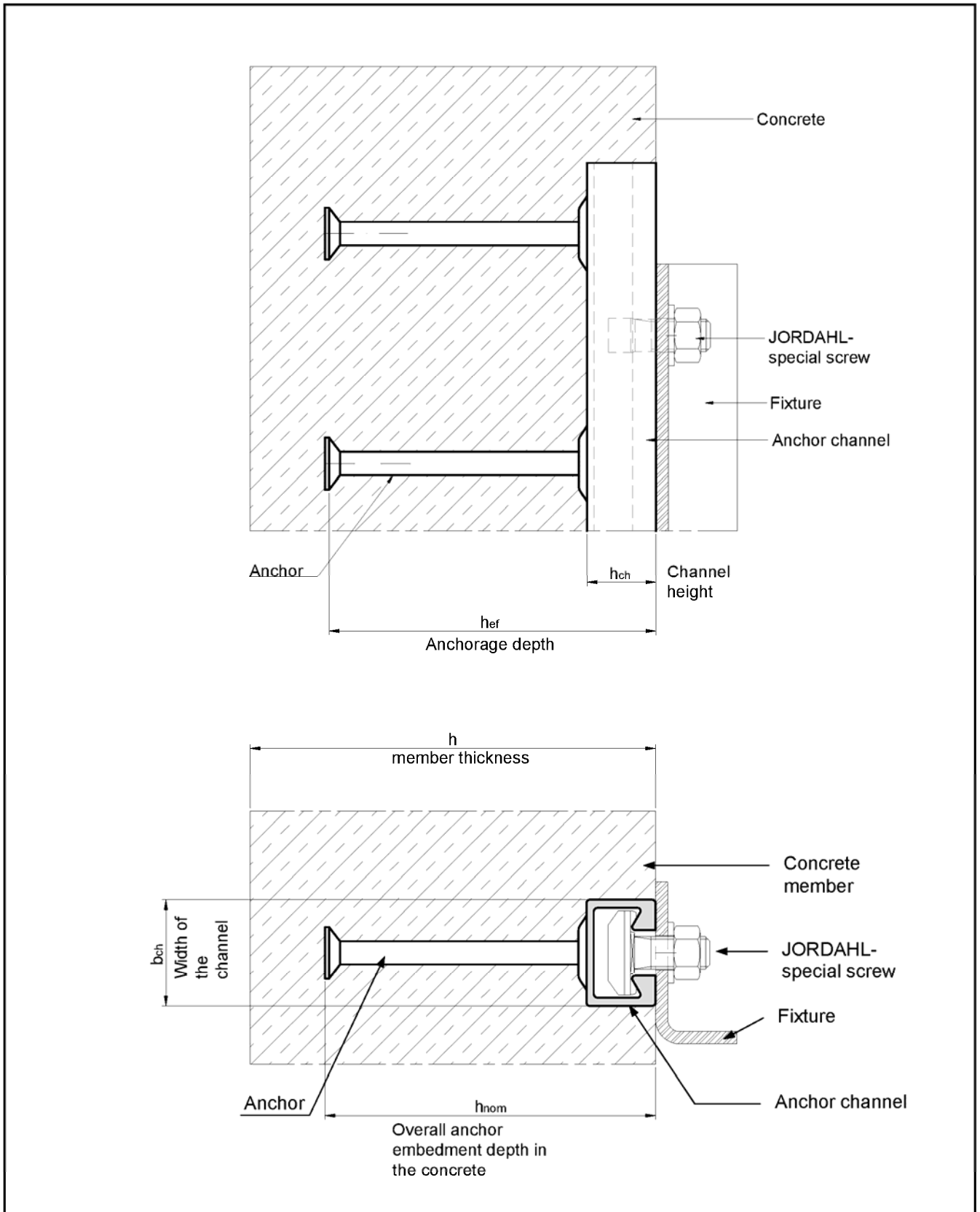
The minimum data required are:

- 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   *beglaubigt:*
p. p. Head of Department   Müller

Deutsches
Institut
für
Bautechnik

DIBt

Concrete

JORDAHL-
special screw

Fixture

Anchor channel

Anchor

h_{ch}

Channel
height

h_{ef}
Anchorage depth

h
member thickness

b_{ch} Width of the channel

Concrete
member

JORDAHL-
special screw

Fixture

Anchor channel

Anchor

h_{nom}

Overall anchor
embedment depth in
the concrete

JORDAHL - Anchor Channel JTA	**Annex 1**
Product and intended use	

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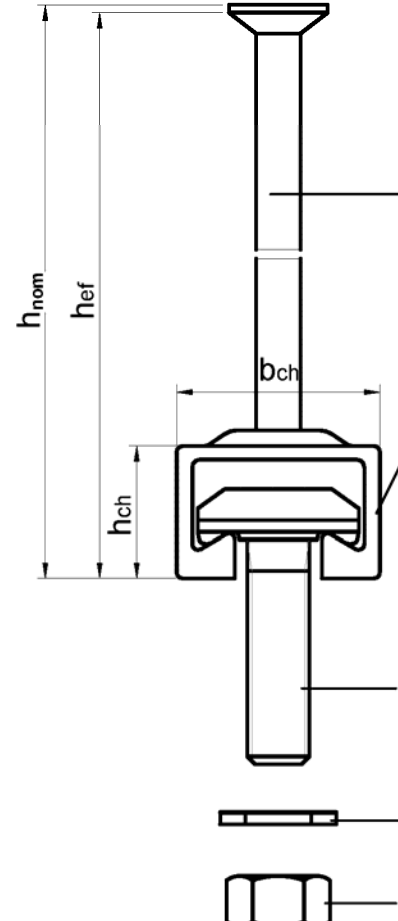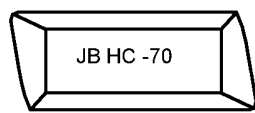
Anchor channel
hot rolled profile

Anchor channel
cold rolled profile

Cold rolled profile
C-shape

h_{nom}

h_{ef}

b_{ch}

b_{ch}

Anchor
(also
possible
as weld-on
anchor, as
I-profile or
as round
anchor

h_{ch}

Channel e.g.
JTA-W 53/34

h_{ch}

Channel
special
screw e.g.
JB M16x60

Channel e.g.
JTA-K 53/34

— **Washer**

Legend
h_{ch} Channel height
b_{ch} Width of the channel
h_{ef} Anchorage depth
h_{nom} Embedment depth

— **Hexagon nut**

Marking of the JORDAHL - Anchor Channel:
e.g.   JORDAHL W 53/34-A4

JORDAHL or J = Identifying mark of the manufacturer
W   = Manufacturing method
53/34   = Size
A4   = Material
Close to the anchors a nail hole is positioned

Material channels:
No marking for 1.0038/1.0044
A4   = 1.4401/1.4404/1.4571
F4   = 1.4462
HC or HCR   = 1.4529/1.4547
L4   = 1.4362 (Lean Duplex)

e.g. JORDAHL W 53/34 – A4

Manufacturing method:
W = hot rolled
K = cold rolled

Marking of the JORDAHL – special screw:
e.g.   JB HC – 70

J   = Identifying mark of the manufacturer
B   = Special screw type
HC-70 = Material/Strength grade

JB HC -70

Material/Strength grade special screws:
4.6   = Strength grade 4.6
8.8   = Strength grade 8.8
A4   = Stainless steel (1.4401/1.4404/1.4571)
            Strength grade -50
A4-70   = Stainless steel (1.4401/1.4404/1.4571)
            Strength grade -70
F4-70   = Stainless steel (1.4462), Strength grade -70
L4-70   = Stainless steel (1.4362), Strength grade -70
HC-50   = Stainless steel (1.4529/1.4547), Strength grade -50
HC-70   = Stainless steel (1.4529/1.4547), Strength grade -70

JORDAHL - Anchor Channel JTA

Product and marking

Annex 2

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Table 1: Materials and intended use

Item no. (1)	Specification (2)	Intended use			
		Dry internal conditions (3)	Internal conditions with usual humidity (4)	Medium corrosion exposure (5)	High corrosion exposure (6)
	Anchor channels may only be used in structures subject to dry internal conditions (e.g. accommodations, bureaus, schools, hospitals, shops, exceptional internal conditions with usual humidity acc. column 4)		Anchor channels may also be used in structures subject to internal conditions with usual humidity (e.g. kitchen, bath- and laundry in residential buildings, exceptional permanently damp conditions and application under water)	Anchor channels may also be used in structures subject to external atmospheric exposure (including industrial and marine environment) or exposure in permanently damp internal conditions, if no particular agressive conditions (e.g. permanent, alternating immersion in seawater etc. acc column 6) exist.	Anchor channels may also be used in structures subject to exposure in particular agressive conditions (e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with chemical pollution e.g. in desulphurization plants or road tunnels where deicing materials are used)
				Materials	
1	Channel profile	Steel 1.0038; 1.0044 EN 10025 hot-dip galv. $\geq 50\ \mu m$ [5]	Steel 1.0038; 1.0044 EN 10025 hot-dip galv. $\geq 50\ \mu m$ [5]	Stainless steel 1.4401/ 1.4404/ 1.4571; 1.4362, EN 10088	Stainless steel 1.4462 [1] 1.4529/ 1.4547 EN 10088
2	Anchor	Steel 1.0038; 1.0214, 1.0401, 1.1132, 1.5525 EN 10263 hot-dip galv. $\geq 50\ \mu m$ [5]	Steel 1.0038; 1.0214, 1.0401, 1.1132, 1.5525 EN 10263 hot-dip galv. $\geq 50\ \mu m$ [5]	Stainless steel 1.4401/ 1.4404/ 1.4571/ 1.4578; 1.4362; 1.0038 [2] EN 10088	Stainless steel 1.4462 [1], 1.4529/ 1.4547 EN ISO 3506-1
3	JORDAHL-special screw with shaft and thread according to EN ISO 4018	Steel, strength grade 4.6/8.8 in dependance on EN ISO 898-1 electroplated $\geq 5\ \mu m$ [3][6]	Steel, strength grade 4.6/8.8 in dependance on EN ISO 898-1 hot-dip galv. $\geq 40\ \mu m$ [4][6]	Stainless steel 1.4401/ 1.4404/ 1.4571; 1.4362, EN ISO 3506-1	Stainless steel 1.4462 [1], 1.4529/ 1.4547 EN ISO 3506-1
4	Washer, EN ISO 7089 and EN ISO 7093-1 production class A, 200HV	Steel EN 10025 electroplated $\geq 5\ \mu m$ [3]	Steel EN 10025 hot-dip galv. $\geq 40\ \mu m$ [4]	Stainless steel 1.4401/ 1.4404/ 1.4571, EN 10088	Stainless steel 1.4462 [1], 1.4529/ 1.4547 EN 10088
5	Hexagonal nuts EN ISO 4032	Steel strength grade 5/8 EN 20898-2 electroplated $\geq 5\ \mu m$ [3]	Steel strength grade 5/8 EN 20898-2 hot-dip galv. $\geq 40\ \mu m$ [4]	Stainless steel 1.4401/1.4404/ 1.4571 EN ISO 3506-2	Stainless steel 1.4462 [1], 1.4529/ 1.4547 EN ISO 3506-2

[1] 1.4462 not applicable for indoor swimming-pools
[2] Steel acc. to EN 10025, 1.0038 not for anchor channels K28/15 and K38/17
[3] Electroplated acc. to EN ISO 4042
[4] Hot-dip galvanized acc. to EN ISO 10684
[5] Hot-dip galvanized on the basis of EN ISO 1461, but coating thickness $\geq 50\ \mu m$
[6] Properties according to EN ISO 898-1 only in threaded part of the screw

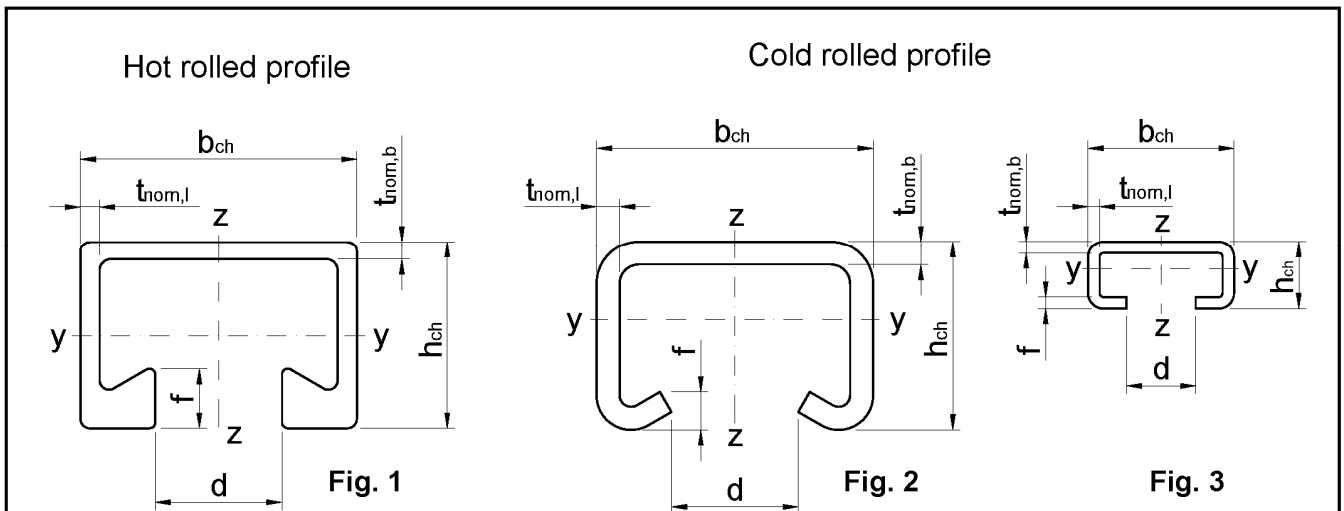JORDAHL - Anchor Channel JTA

Materials and intended use

Annex 3

Hot rolled profile   Cold rolled profile

Fig. 1   **Fig. 2**   **Fig. 3**

Table 2: Geometrical profile properties

Anchor channel	Figure	Dimensions						Material	I_y
		b_{ch}	h_{ch}	$t_{nom,b}$	$t_{nom,l}$	d	f		
		[mm]							[mm⁴]
K 28/15	3	28.00	15.25	2.25	2.25	12.00	2.25	Steel	4060
K 38/17	3	38.00	17.50	3.00	3.00	18.00	3.00		8547
K 40/25	2	40.00	25.00	2.75	2.75	18.00	5.60		20570
K 50/30	2	50.00	30.00	3.00	3.00	22.00	7.39		41827
K 53/34	2	53.50	33.00	4.50	4.50	22.00	7.90		72079
K 72/48	2	72.00	49.00	6.00	6.00	33.00	9.90		293579
W 40/22	1	39.50	23.00	2.40	2.40	18.00	6.00		19703
W 40+	1	39.50	23.00	2.40	2.40	18.00	6.00		19703
W 50/30	1	49.00	30.00	3.00	2.75	22.50	7.85		51904
W 50+	1	49.00	30.00	3.00	2.75	22.50	7.85		51904
W 53/34	1	52.50	33.50	4.10	4.00	22.50	10.50		93262
W 55/42	1	54.50	42.00	5.00	5.00	26.00	12.90		187464
W 72/48	1	72.00	48.50	4.50	5.00	33.00	15.50		349721
K 28/15	3	28.00	15.25	2.25	2.25	12.00	2.25	Stainless steel	4060
K 38/17	3	38.00	17.50	3.00	3.00	18.00	3.00		8547
K 40/25	2	39.50	25.00	2.50	2.50	18.00	5.40		19097
K 50/30	2	50.00	30.00	3.00	3.00	22.00	7.39		41827
K 53/34	2	53.50	33.00	4.50	4.50	22.00	7.90		72079
K 72/48	2	72.00	49.00	6.00	6.00	33.00	9.90		293579
W 40/22	1	39.50	23.00	2.40	2.40	18.00	6.00		19759
W 50/30	1	49.00	30.00	3.00	2.75	22.50	7.85		51904
W 53/34	1	52.50	33.50	4.10	4.00	22.50	10.50		93262
W 72/48	1	72.00	48.50	4.50	5.00	33.00	15.50		349721

JORDAHL - Anchor Channel JTA	**Annex 4**
Geometrical profile properties	

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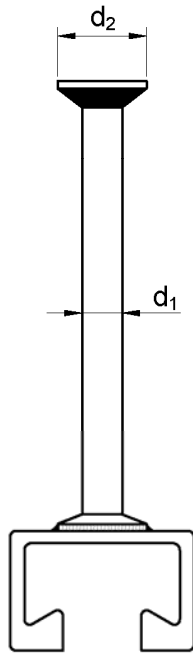
Table 3: Types of round anchors

Type	Shaft Ø d_1	Head Ø d_2
	[mm]	
R	7.0	12.0
	8.5	15.0
	9.0	17.0
	9.0	17.5
	10.0	19.0
	10.8	19.0
	11.5	23.5
	15.5	28.0
	15.5	31.0
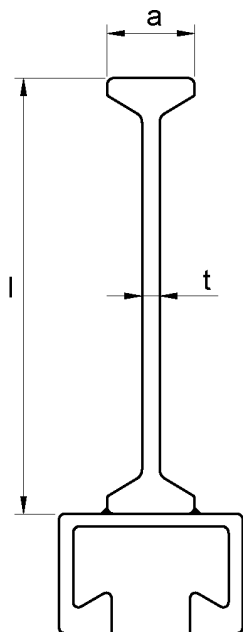
Table 4: Types of I-anchors

Type	Length l	Head width a	Web thickness t
		[mm]	
I 60	62	18	5
I 69	69	18	5
I 128	128	17	6
I 140	140	20	7.1

JORDAHL - Anchor Channel JTA

Types of anchors

Annex 5

| Fig. 1 | Fig. 2 | Fig. 3 |
| Round anchor | Welded anchor (I-anchor) | Round welded anchor |
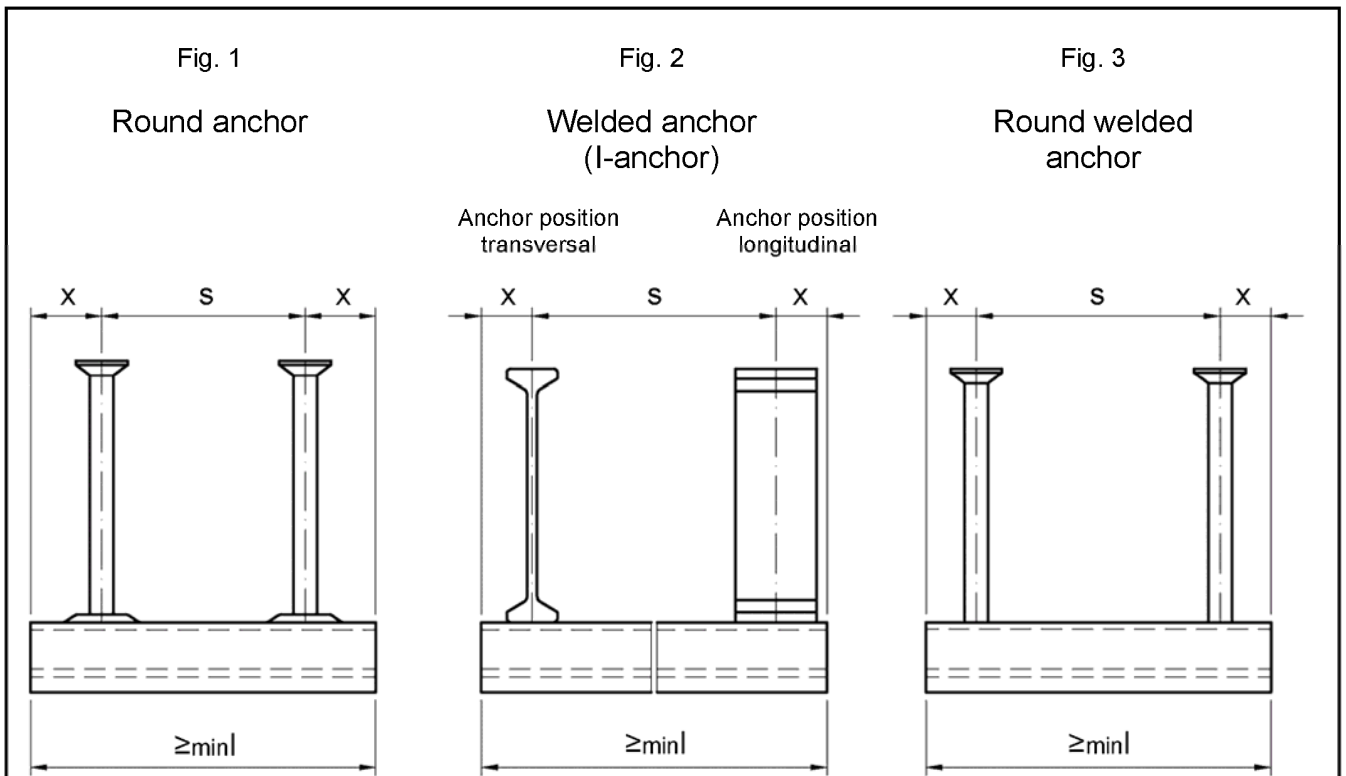
Table 5: Anchor positioning

Anchor channel	Anchor spacing		End spacing x		Min. channel length (min l)	
	s_{min}	s_{max}	Round anchor Fig. 1	Welded anchor Fig. 2 and Fig. 3	Round anchor Fig. 1	Welded anchor Fig. 2 and Fig. 3
	[mm]		[mm]		[mm]	
K 28/15 K 38/17	50	200	25 [1]	25	100	
K 40/25 W 40/22 W 40+ K 50/30 W 50/30 W 50+	50	250	25 [1]	25	100	
K 53/34 W 53/34	100 (80)	250	35	25 (35)	150	
W 55/42	100 (80)	300	35	25 (35)	150	
K 72/48 W 72/48	100 (80)	400	35	25 (35)	150	

( ) Values for round anchors acc. to Fig. 1 and welded anchors with 35 mm end spacing

[1] The end spacing of round anchors for channel lengths ≥150 mm may be increased from 25 mm to 35 mm
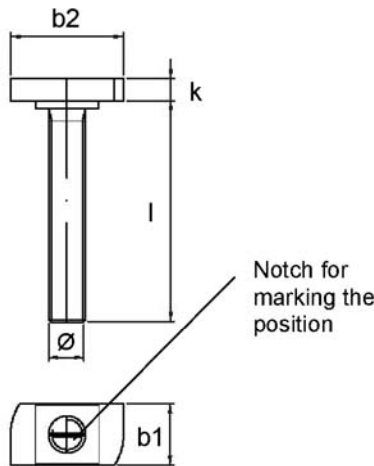
| JORDAHL - Anchor Channel JTA | **Annex 6** |
| Anchor positioning | |

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Hammer-head special screw
Fig.1

Notch for marking the position

Hook-head special screw
Fig.2

Notch for marking the position

alternative head shape
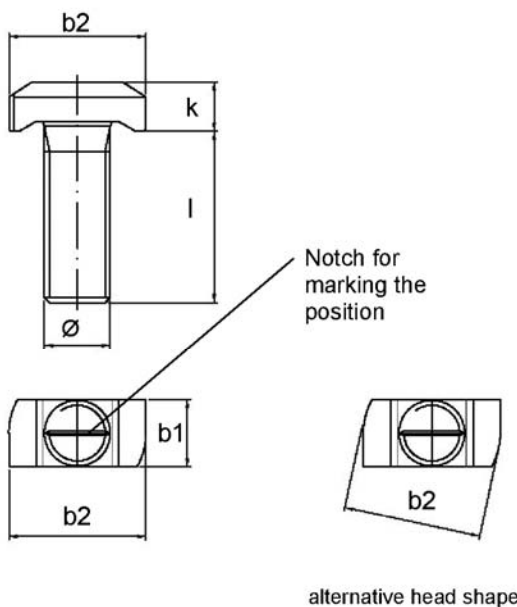
Table 6: Dimensions of the JORDAHL special screw

Anchor channel	Fig.	Special screw type	Special screw dimensions				Length l
			b_1	b_2	k	Ø	
			[mm]				[mm]
K 28/15	1	JD	11.2	22.4	4.5	6	15-60
					4.5	8	15-150
					5.0	10	15-200
		JD/JUD	11.2	22.4	6.5	12	20-200
K 38/17	1	JH	16.5	30.5	6.0	10	20-175
					7.0	12	20-300
		JH/JUH	16.5	30.5	8.0	16	20-300
K 40/25 W 40/22 W 40+	2	JC	14.0	32.5	8.0	10	20-150
					8.0	12	20-250
			17.0	32.5	8.0	16	30-300
K 50/30 W 50/30 W 50+ K 53/34 W 53/34	2	JB	17.0	41.6	9.0	10	25-100
					10.0	12	30-300
					11.0	16	30-300
			20.5	41.6	12.0	20	30-300
W 55/42	2	JB	17.0	41.6	9.0	10	25-100
					10.0	12	30-300
					11.0	16	30-300
			20.5	41.6	12.0	20	30-300
		JE	24.5	41.5	16.0	24	40-300
K 72/48 W 72/48	2	JA	25.0	58.0	14.0	20	50-200
			25.0		20.0	24	50-250
			28.0		20.0	27	50-250
			31.0		20.0	30	50-300

Table 7: Strength grade

Special screws		Steel [1]		Stainless steel [1]	
Strength grade		4.6	8.8	A4-50 HC-50	A4-70 HC-70 F4-70 L4-70
f_{uk}	[N/mm]	400	800	500	700
f_{yk}		240	640	210	450
Finish		z.p., h.d.g.			

[1] Materials according to Annex 3, Table 1

Marking of the special screw head acc. to Annex 2

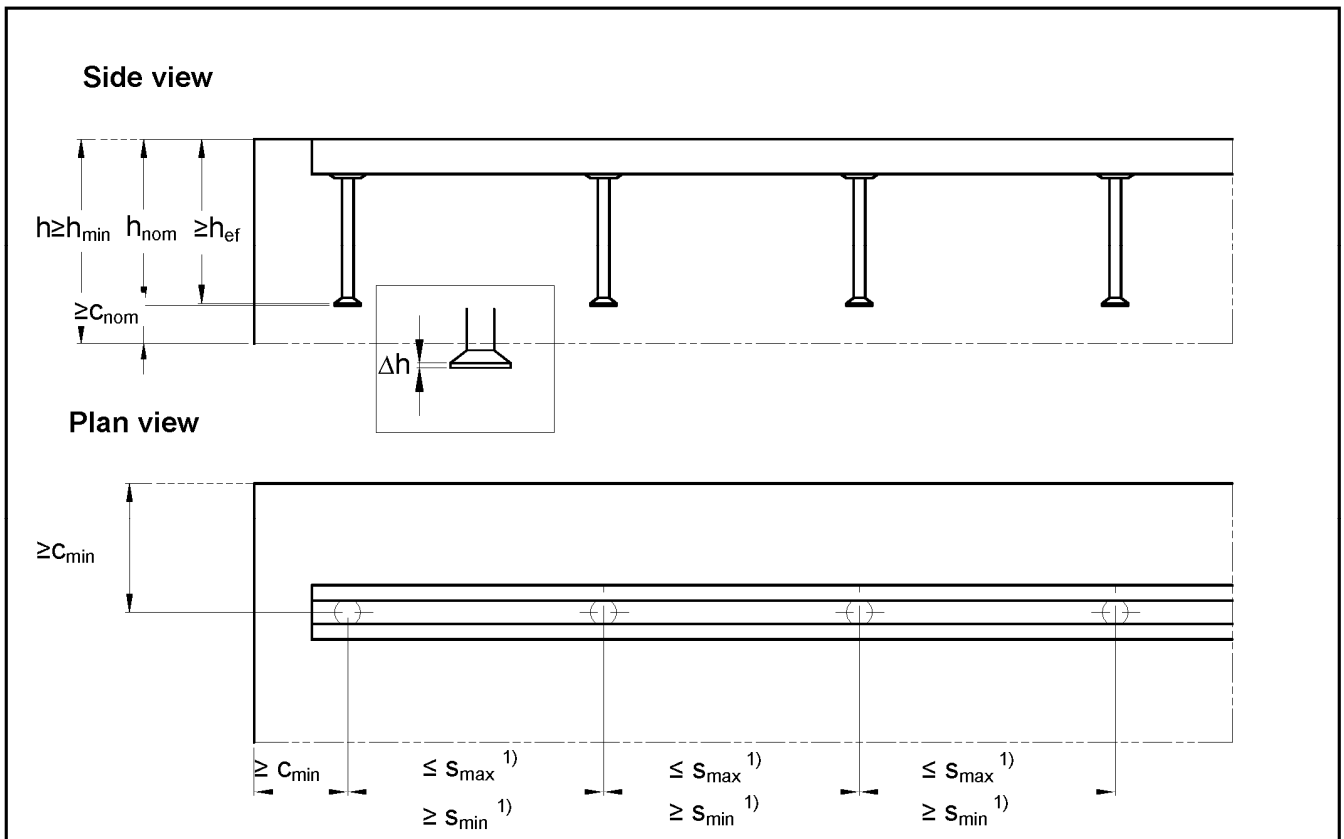| JORDAHL - Anchor Channel JTA	**Annex 7**
JORDAHL - special screw – Dimensions and strength grade	

Side view

Plan view

Table 8: Minimum anchorage depth, edge distance and member thickness for cold rolled profiles

Anchor channel			K 28/15	K 38/17	K 40/25	K 50/30	K 53/34	K 72/48
Min. anchorage depth	min h_{ef}	[mm]	45	76	79	94	155	179
Min. edge distance	c_{min}		40	50	50	75	100	150
Min. member thickness	h_{min}		$h_{ef} + \Delta_h$ [2] + c_{nom} [3]					

Table 9: Minimum anchorage depth, edge distance and member thickness for hot rolled profiles

Anchor channel			W 40/22	W 40+	W 50/30	W 50+	W 53/34	W 55/42	W 72/48
Min. anchorage depth	min h_{ef}	[mm]	79	91	94	106	155	175	179
Min. edge distance	c_{min}		50	50	75	75	100	100	150
Min. member thickness	h_{min}		$h_{ef} + \Delta_h$ [2] + c_{nom} [3]						

[1] s_{min}, s_{max} acc. to Annex 6, Table 5

[2] Δ_h = anchor head thickness

[3] c_{nom} acc. EN 1992-1-1 and $c_{nom} \geq 15$ mm

JORDAHL - Anchor Channel JTA

Annex 8

Installation parameters for cold - and hot rolled anchor channels

Table 10: Minimum spacing and setting torque of JORDAHL – special screws

Anchor channel	Special screw Ø	Min. spacing $s_{min,s}$ [4] of the special screw	Setting Torque T_{inst} [5]		
			General [2]	Steel-Steel contact [3]	
			4.6; 8.8; A4-50; HC-50; A4-70; HC-70; F4-70; L4-70 [1]	4.6; A4-50; HC-50 [1]	8.8; A4-70; HC-70; F4-70 L4-70 [1]
	[mm]	[mm]	[Nm]		
K 28/15	6	30	-	3	-
	8	40	8	8	20
	10	50	13	15	40
	12	60	15	25	70
K 38/17	10	50	15	15	40
	12	60	25	25	70
	16	80	40	65	180
K 40/25 W 40/22 W 40+	10	50	15	15	40
	12	60	25	25	70
	16	80	45	65	180
K 50/30 W 50/30 W 50+	10	50	15	15	40
	12	60	25	25	70
	16	80	60	65	180
	20	100	75	130	360
K 53/34 W 53/34	10	50	15	15	40
	12	60	25	25	70
	16	80	60	65	180
	20	100	120	130	360
W 55/42	10	50	15	15	40
	12	60	25	25	70
	16	80	60	65	180
	20	100	120	130	360
	24	120	200	230	620
K 72/48 W 72/48	20	100	120	130	360
	24	120	200	230	620
	27	135	300	340	900
	30	150	380	460	1200

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

JORDAHL - Anchor Channel JTA

Installation parameters of JORDAHL-special screws

Annex 9
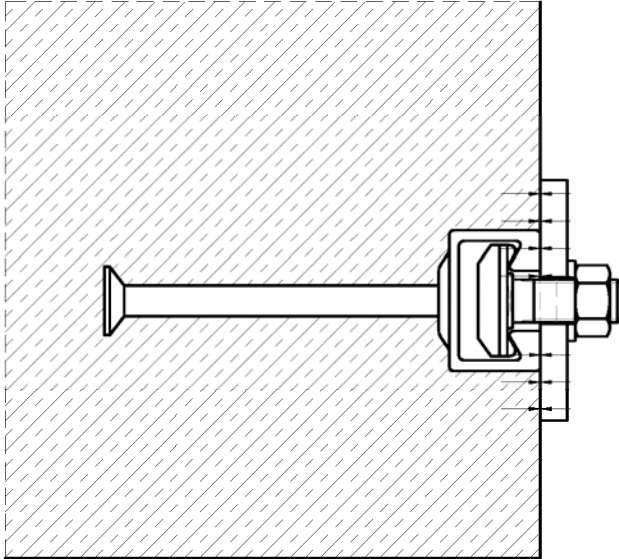
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General:

The fixture is braced to the concrete <u>or</u> to the anchor channel respectively braced to concrete <u>and</u> anchor channel.
The setting torques acc. to Annex 9, Table 10 shall be applied and must not be exceeded.
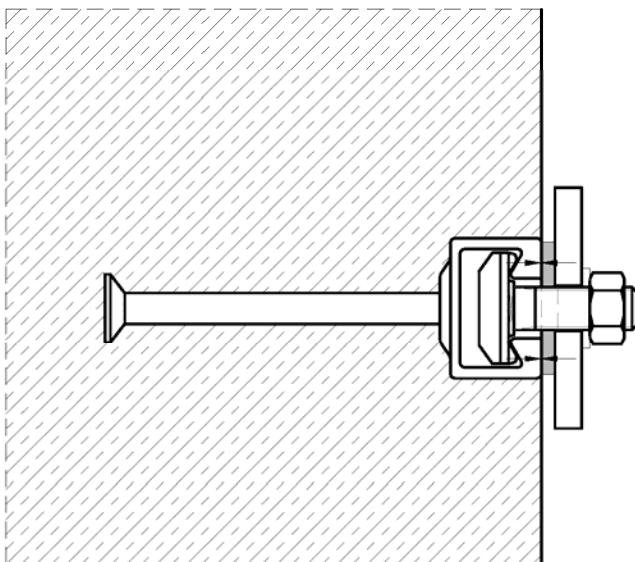
Fig. 1

Steel-steel contact:

The fixture is braced to the anchor channel by suitable washer.
The setting torques acc. to Annex 9, Table 10 shall be applied and must not be exceeded.

Fig. 2

JORDAHL - Anchor Channel JTA

Positions of the fixture

Annex 10

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Table 11: Characteristic values for tension loads – Steel failure channel

Anchor channel			K 28/15	K 38/17	K 40/25 W 40/22	W 40+	K 50/30 W 50/30	W 50+	K 53/34 W 53/34	W 55/42	K 72/48 W 72/48
Steel failure, Anchor											
Characteristic resistance	$N_{Rk,s,a}$	[kN]	nicht relevant								
Partial safety factor	γ_{Ms}[1]					1.8					
Steel failure, Connection channel / anchor											
Characteristic resistance	$N_{Rk,s,c}$	[kN]	9	18	20	26	31	36	55	80	100
Partial safety factor	$\gamma_{Ms,ca}$[1]					1.8					
Steel failure, Local flexure of channel lips for $s_s \geq s_{slb}$											
Spacing of special screws for $N_{Rk,s,l}$	s_{slb}	[mm]	42	52	65	65	81	81	88	109	129
Characteristic resistance	$N_{Rk,s,l}$	[kN]	9	18	20 / 35	35	31 / 36	36	55 / 65	80	100
Partial safety factor	$\gamma_{Ms,l}$[1]					1.8					
Steel failure, Local flexure of channel lips for $s_{slb} \geq s_s \geq s_{min,s}$ [2]											
Characteristic resistance	$N_{Rk,s,l}$	[kN]	$0.5 \, (1+s_s/s_{slb}) \, N_{Rk,s,l} \leq N_{Rk,s,c}$								
Partial safety factor	$\gamma_{Ms,l}$[1]					1.8					

[1] In absence of order national regulations

[2] $s_{min,s}$ acc. to Annex 9, Table 10

Fig. 1 $N_{Rk,s,l}$ $\geq$ $N_{Rk,s,l}$, s_s, $s_{min,s}$
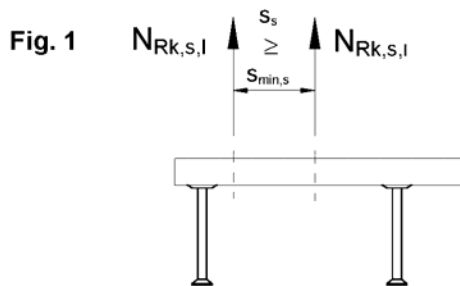
Fig. 2 Assumption of system

M_{Ed}, S

$M_{Ed} \leq M_{Rk,s,flex}/\gamma_{Ms,flex}$
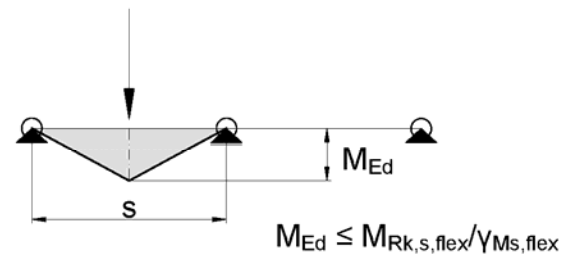
Table 12: Flexure resistance of channel

Anchor channel			K 28/15	K 38/17	K 40/25	K 50/30	K 53/34	K 72/48	W 40/22	W 40+	W 50/30	W 50+	W 53/34	W 55/42	W 72/48
Steel failure, Anchor															
Characteristic flexure resistance of channel $M_{Rk,s,flex}$ [Nm]	Steel		317	580	1099	1673	2984	8617	1076	1076	2038	2038	3373	6447	8593
	Stainless steel		324	593	1071	1708	2984	8617	1080	1080	2081	2081	3445	-	8775
Partial safety factor	$\gamma_{Ms,flex}$[1]		1.15												

[1] In absence of other national regulations

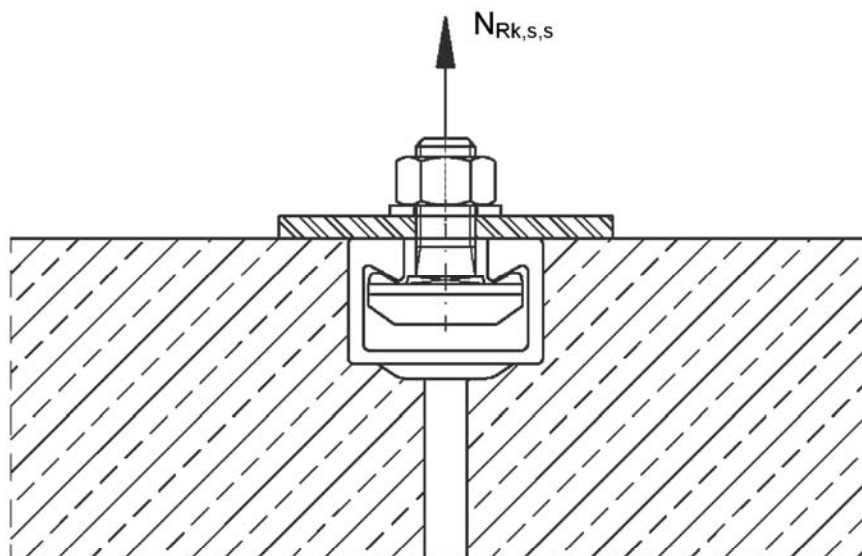| JORDAHL - Anchor Channel JTA	**Annex 11**
Characteristic values for tension loads – Steel failure channel	

Table 13: Characteristic values for tension loads – Steel failure JORDAHL-special screws

Special screw Ø				M 6	M 8	M 10	M 12	M 16	M 20	M 24	M 27	M 30
				Steel failure								
Characteristic resistance	$N_{Rk,s,s}$ [2)]	[kN]	4.6	8.0	14.6	23.2	33.7	62.8	98.0	141.2	183.6	224.4
			8.8	16.1	29.3	46.4	67.4	125.6	196.0	282.4	367.2	448.8
			A4-50 HC-50 [1)]	10.1	18.3	29.0	42.2	78.5	122.5	176.5	229.5	280.5
			A4-70 F4-70 L4-70 HC-70 [1)]	14.1	25.6	40.6	59.0	109.9	171.5	247.1	321.3	392.7
Partial safety factor	$\gamma_{Ms,s}$ [3)]		4.6	2.00								
			8.8	1.50								
			A4-50 HC-50 [1)]	2.86								
			A4-70 F4-70 L4-70 HC-70 [1)]	1.87								

[1)] Materials according to Annex 2 and Annex 3, Table 1

[2)] In conformity to EN ISO 898-1:1999

[3)] In absence of other national regulations

JORDAHL - Anchor Channel JTA

Characteristic values for tension loads
Steel failure JORDAHL-special screws

Annex 12

Table 14: Characteristic values for tension loads – Concrete failure

Anchor channel			K 28/15	K 38/17	K 40/25 W 40/22	W 40+	K 50/30 W 50/30	W 50+	K 53/34 W 53/34	W 55/42	K 72/48 W 72/48
Pullout failure											
Characteristic resistance in cracked concrete C12/15	Round anchors	$N_{Rk,p}$ [kN]	6.7	14.7	10.8	17.3	15.9	17.3	29.7	38.4	50.9
	Welded anchors		11.7	11.7	14.0	15.8	21.1	21.8	25.7	37.2	46.4
Increasing factor of $N_{Rk,p}$	C20/25	ψ_c [-]	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								
	$\psi_{ucr,N}$		1.4								
Partial safety factor	$\gamma_{Mp} = \gamma_{Mc}$ [1]		1.5								
Concrete cone failure $N^0_{Rk,c}$ see CEN/TS 1992-4-3:2009, chap. 6.2.5											
	α_{ch}		0.81	0.88	0.88	0.90	0.91	0.92	0.98	1.00	1.00
Effective anchorage depth	h_{ef}	[mm]	45	76	79	91	94	106	155	175	179
Characteristic edge distance	$c_{cr,N}$	[mm]	111	171	176	195	199	216	260	269	270
Characteristic spacing	$s_{cr,N}$		223	342	352	390	399	431	521	538	540
	$\psi_{ucr,N}$		1.4								
Partial safety factor	γ_{Mc} [1]		1.5								
Splitting											
			Verification of splitting is not relevant								

[1] In absence of other national regulations

Table 15: Displacements under tension loads

Anchor channel			K 28/15	K 38/17	K 40/25 W 40/22	W 40+	K 50/30 W 50/30	W 50+	K 53/34 W 53/34	W 55/42	K 72/48 W 72/48
Tension load	N_{Ek}	[kN]	3.6	7.1	8.3	10.3	12.3	14.3	21.8	31.7	39.7
Short time displacement	δ_{N0}	[mm]	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5	0.5
Long time displacement	$\delta_{N\infty}$	[mm]	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2

JORDAHL - Anchor Channel JTA	**Annex 13**
Characteristic values for tension loads Concrete failure and displacements	

Table 16: Characteristic values for shear loads

Anchor channel			K 28/15	K 38/17	K 40/25 W 40/22	W 40+	K 50/30 W 50/30	W 50+	K 53/34 W 53/34	W 55/42	K 72/48 W 72/48
Steel failure, Local flexure of channel lip											
Characteristic resistance	$V_{Rk,s,l}$	[kN]	9	18	20	35	31	36	55	104	100
					26		40.3		71.5		130
Partial safety factor	$\gamma_{Ms,l}$ [1]					1.8					
Pry out failure											
Factor k in equation (31) of CEN/TS 1992-4-3	k_5 [2]					2.0					
Partial safety factor	γ_{Mc} [1]					1.5					
Concrete edge failure											
Product of factor α_p and factor $\psi_{re,v}$	Cracked concrete without edge reinforcement or stirrups	$\alpha_p \, \psi_{re,V}$	2.5	3.5	4.0	4.0	4.0	4.0	4.0	4.0	4.0
	Cracked concrete with straight edge reinforcement (≥Ø 12mm)	$\alpha_p \, \psi_{re,V}$	3.0	4.1	4.7	4.7	4.7	4.7	4.7	4.7	4.7
	Non-cracked concrete [2] or cracked concrete with edge reinforcement and stirrups with a spacing a ≤ 100mm and a ≤ 2c₁	$\alpha_p \, \psi_{re,V}$	3.5	4.7	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Effect of the thickness of the structural component	$\alpha_{h,V}$					$(h/h_{cr,V})^{0.5}$					
Characteristic height	$h_{cr,V}$					$2c_1 + 2h_{ch}$					
Characteristic edge distance	$c_{cr,V}$					$2c_1 + b_{ch}$					
Characteristic spacing	$s_{cr,V}$					$4c_1 + 2b_{ch}$					
Partial safety factor	γ_{Mc} [1]					1.5					

[1] In absence of other national regulations

[2] Proof acc. to CEN/TS 1992-4-1:2009, section 5

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

JORDAHL - Anchor Channel JTA

Characteristic values for shear loads

Annex 14

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Table 17: Characteristic values for shear loads – Steel failure JORDAHL-special screw

Special screw Ø			M 6	M 8	M 10	M 12	M 16	M 20	M 24	M 27	M 30
			Steel failure								
Characteristic resistance	$V_{Rk,s,s}$ [2]	[kN]	4.6	4.8	8.8	13.9	20.2	37.7	58.8	84.7	110.2	134.6
			8.8	8.0	14.6	23.2	33.7	62.8	98.0	141.2	183.6	224.4
			A4-50 HC-50 [1]	6.0	11.0	17.4	25.3	47.1	73.5	105.9	137.7	168.3
			A4-70 F4-70 L4-70 HC-70 [1]	8.4	15.4	24.4	35.4	65.9	102.9	148.3	192.8	235.6
Characteristic flexure resistance	$M°_{Rk,s}$	[Nm]	4.6	6.3	15.0	29.9	52.4	133.2	259.6	449.0	665.8	899.6
			8.8	12.2	30.0	59.8	104.8	266.4	519.3	898.0	1331.5	1799.2
			A4-50 HC-50 [1]	7.6	18.7	37.4	65.5	166.5	324.5	561.3	832.2	1124.5
			A4-70 F4-70 L4-70 HC-70 [1]	10.7	26.2	52.3	91.7	233.1	454.4	785.8	1165.1	1574.3
Partial safety factor	$\gamma_{Ms,s}$ [3]		4.6	1.67								
			8.8	1.25								
			A4-50 HC-50 [1]	2.38								
			A4-70 F4-70 L4-70 HC-70 [1]	1.56								

[1] Materials according to Annex 2 and Annex 3, Table 1

[2] In conformity to EN ISO 898-1:1999

[3] In absence of other national regulations

Table 18: Displacements under shear loads

Anchor channel			K 28/15	K 38/17	K 40/25 W 40/22	W 40+	K 50/30 W 50/30	W 50+	K 53/34 W 53/34	W 55/42	K 72/48 W 72/48
Shear load	V_{Ek}	[kN]	3.6	7.1	8.3	13.9	12.3	14.3	21.8	31.7	39.7
Short time displacement	δ_{V0}	[mm]	0.6	0.6	0.6	0.6	0.6	0.6	1.2	1.2	1.2
Long time displacement	$\delta_{V\infty}$	[mm]	0.9	0.9	0.9	0.9	0.9	0.9	1.8	1.8	1.8

JORDAHL - Anchor Channel JTA	**Annex 15**
Characteristic values for shear loads Steel failure JORDAHL-special screw and displacements	

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Verification for anchor channels for shear loads with reinforcement (only for loading perpendicular to the edge)
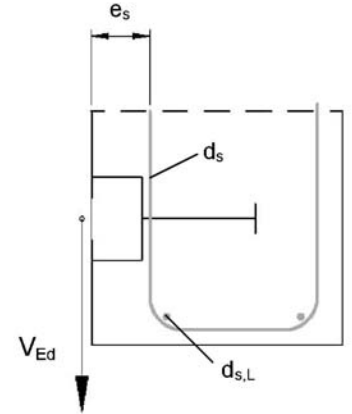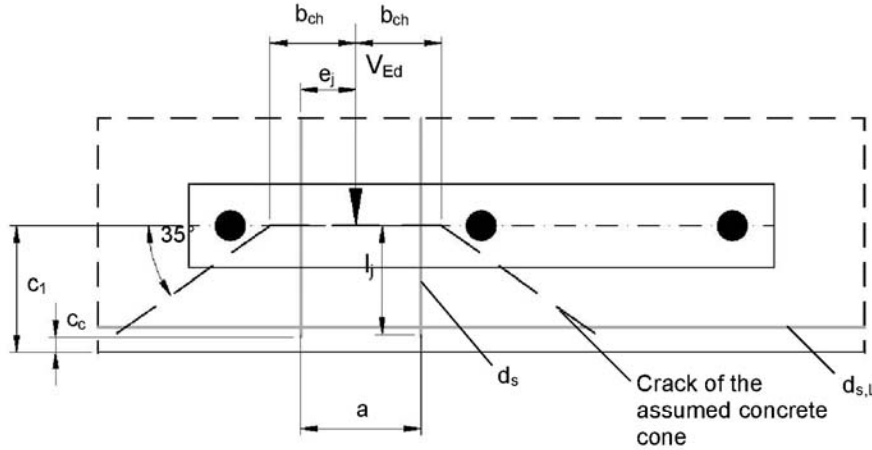
$$V_{Ed} \le V_{Rd,re} = V_{Rk,re}/\gamma_{Mc} \qquad V_{Ed} = \max(V_{Ed}; V_{Ed}^a) \tag{1}$$

$$V_{Rk,re} = V_{Rk,c,re}/x \tag{2}$$

$$V_{Rk,c,re} = V_{Rk,c,hook} + V_{Rk,c,bond} \le V_{Rk,c,re,max} \tag{3}$$

$$\le \sum_{m+n} A_s \cdot f_{y,k}$$

$$V_{Rk,c,hook} = \sum_{j=1}^{m}\left(\psi_1 \cdot \psi_3 \cdot \psi_4 \cdot A_s \cdot f_{y,k} \cdot \left(\frac{f_{ck}}{30}\right)^{0,1}\right) + \tag{4}$$

$$\sum_{j=1}^{n}\left(\psi_2 \cdot \psi_3 \cdot \psi_4 \cdot A_s \cdot f_{y,k} \cdot \left(\frac{f_{ck}}{30}\right)^{0,1}\right)$$

$$V_{Rk,c,bond} = \sum_{j=1}^{m+n}\left(\pi \cdot d_s \cdot l_j \cdot f_{bk}\right) \tag{5}$$

$$V_{Rk,c,re,max} = 4.2 \cdot c_1^{-0,12} \cdot V_{Rk,c} \tag{6}$$

$$V_{Rk,c} = V_{Rk,c}^0 \cdot \alpha_{s,V} \cdot \alpha_{c,V} \cdot \alpha_{h,V} \tag{7}$$

Reinforcement requirements

$$50 \text{ mm} \le a \le \begin{cases} s \\ 150\text{mm} \\ (c_1 - c_c + 0,7b_{ch} - 4d_s)/0.35 \\ c_1 - c_c \end{cases} \tag{8}$$

$$6\text{mm} \le d_s \le 20\text{mm} \tag{9}$$

JORDAHL - Anchor Channel JTA	**Annex 16**
Verification for shear loads with reinforcement	

ψ_1 = effectiveness factor

= 0.67 for stirrups directly besides a shear load

    • for a stirrup at the location of a shear load

    • for stirrups between 2 shear loads acting on an anchor channel
(distance between the loads $p \leq s_{cr,v}$ acc. to Table 16)

ψ_2 = effectiveness factor

= 0.11 for other stirrups in the concrete cone

ψ_3 = $(d_{s,L}/d_s)^{2/3}$

d_s = diameter of stirrup [mm]

$d_{s,L}$ = diameter of edge bars [mm]

ψ_4 = $\left(\dfrac{l_j}{c_1}\right)^{0,4} \cdot \left(\dfrac{10}{d_s}\right)^{0,25}$

l_j = anchorage length of a stirrup leg in the concrete cone [mm]

= $c_1 - c_c - 0,7 \cdot (e_j - b_{ch})$ [mm] for stirrups crossed diagonally by the assumed crack

= $c_1 - c_c$ [mm] for stirrups directly under the load or for stirrups crossed orthogonally by the assumed crack

$\geq$ $4 \cdot d_s$

c_1 = edge distance [mm]

c_c = concrete cover [mm]

e_j = distance of the stirrup leg to the point of load action [mm]

b_{ch} = width of the anchor channel [mm] (according to Table 2)

A_s = cross section of one leg of the stirrup [mm²]

f_{yk} = characteristic yield strength of the reinforcement [N/mm²]

f_{ck} = characteristic concrete strength measured on cubes with a side length of 150 mm [N/mm²]

f_{bk} = characteristic bond strength [N/mm²]

m = number of stirrups in the assumed concrete cone with ψ_1

n = number of stirrups in the assumed concrete cone with ψ_2

a = spacing of stirrups

x = factor taking into account eccentricity between reinforcement force and load

= $e_s/z + 1$ [-]

e_s = distance between reinforcement and shear force acting on the anchor channel

z = internal lever arm of the concrete member

$\approx$ $0,85d$ [mm]

d = $\min(2h_{ef}, 2c_1)$

$V_{Rk,c}^0$ = according to CEN/TS 1992-4-3:2009, section 6.3.5.3

V_{Ed}^a = according to CEN/TS 1992-4-1:2009, section 3.2.2
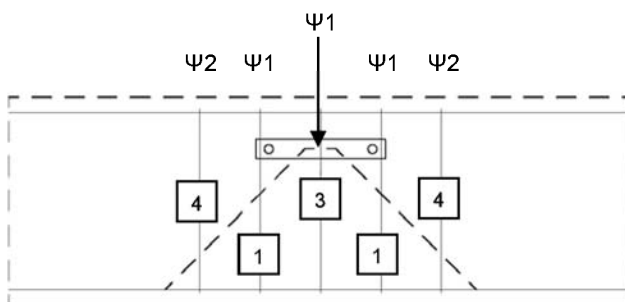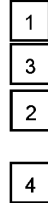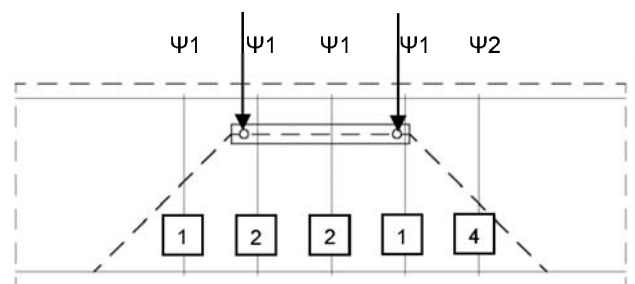

Fig 1: effectiveness factor for one load   Fig 2: effectiveness factor for two loads

JORDAHL - Anchor Channel JTA	
Verification for shear loads with reinforcement	**Annex 17**

Table 19: Characteristic values for tension load under fire exposure

Anchor channels				K 28/15	K 38/17	K 40/25 W 40/22 W 40+	K 50/30 W 50/30 W 50+	K 53/34 W 53/34	W 55/42	K 72/48 W 72/48
Special screw ≥			[mm]	M12	M16	M16	M16	M16	M24	M24
Steel failure: Anchor, Connection channel/anchor, Local flexure of channel lip										
Char. Resistance	R90	$N_{Rk,s,fi}$	[kN]	0.7	1.4	2.0	2.5	2.5	7.3	7.3
	R120			0.5	1.0	1.2	2.1	2.1	5.4	5.4
Partial safety factor [3]		$\gamma_{Ms,fi}$		1.0						
Pull-Out										
The characteristic resistance $N_{Rk,p,fi}$ under fire exposure for concrete C20/25 may be determined by: $$N_{Rk,p,fi(90)} = 0.25 \cdot N_{Rk,p} \qquad (\leq R90)$$ $$N_{Rk,p,fi(120)} = 0.20 \cdot N_{Rk,p} \qquad (\leq R120)$$ With $N_{Rk,p}$ as characteristic resistance for pull-out failure in cracked concrete C20/25 under normal temperature										
Partial safety factor [3]		$\gamma_{Mc,fi}$		1.0						
Concrete cone failure										
The characteristic resistance $N^0_{Rk,c,fi}$ under fire exposure for concrete C20/25 may be determined by: $$N^0_{Rk,c,fi(90)} = h_{ef}/200 \cdot N^0_{Rk,c} \leq N^0_{Rk,c} \qquad (\leq R90)$$ $$N^0_{Rk,c,fi(120)} = 0.8 \cdot h_{ef}/200 \cdot N^0_{Rk,c} \leq N^0_{Rk,c} \qquad (\leq R120)$$ With $N^0_{Rk,c}$ as characteristic resistance of an single anchor for concrete cone in cracked concrete C20/25 failure under normal temperature										
Partial safety factor [3]		$\gamma_{Mc,fi}$		1.0						
Edge distance	$c_{cr,N,fi}$	[mm]		$2\,h_{ef}$ [1]						
	$c_{min,fi}$			2 hef [1], max (2 hef, 300 mm) [2]						
Spacing	$s_{cr,N,fi}$	[mm]		$4\,h_{ef}$						
	$s_{min,fi}$			acc. to Annex 6, Table 5						

[1] Fire exposure from one side only   **1)**

[2] Fire exposure from more than one side

[3] In absence of other national regulations

Table 20: Concrete cover [4]

Concrete cover (axis distance)	R90	a	[mm]	45	45	45	45	50	50	50
	R120			60	60	60	60	65	70	70

[4] The reinforced concrete has to be build acc. to EN 1992. The fire resistance class of the reinforced concrete is not part of this evaluation
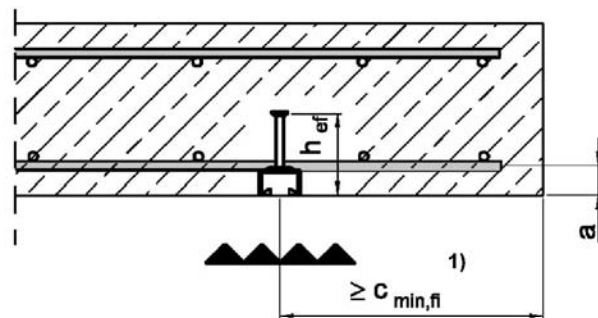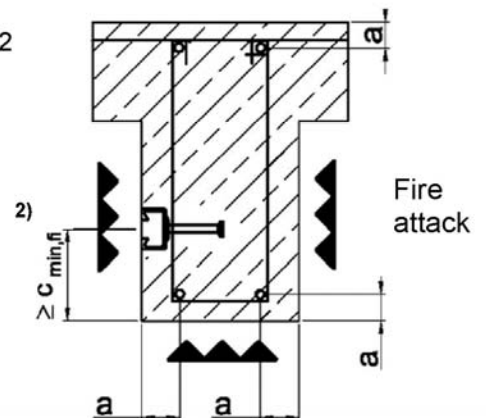

Fig. 1

Fig. 2

Fire attack

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Characteristic values for tension load under fire exposure, Concrete cover

Annex 18

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Table 21: Characteristic values for shear load under fire exposure

Anchor channels			K28/15	K38/17	K 40/25 W 40/22 W 40+	K 50/30 W 50/30 W 50+	K 53/34 W 53/34	W 55/42	K 72/48 W 72/48
Special screw ≥		[mm]	M12	M16	M16	M16	M16	M24	M24
Steel failure: Anchor, Connection channel/anchor, Local flexure of channel lip									
Char. Resistance	R90	$V_{Rk,s,fi}$ [kN]	0.7	1.4	2.0	2.5	2.5	7.3	7.3
	R120		0.5	1.0	1.2	2.1	2.1	5.4	5.4
Partial safety factor [1]		$\gamma_{Ms,fi}$	1.0						
Pry Out									
The characteristic resistance $V_{Rk,cp,fi}$ under fire exposure for concrete C20/25 may be determined by:									
			$V_{Rk,cp,fi} = k_5 \cdot N_{Rk,c,fi}$						
Faktor k in equation (31) of CEN/TS 1992-4-1		k_5	2.0						
Partial safety factor [1]		$\gamma_{Mc,fi}$	1.0						
Concrete edge failure									
The characteristic resistance $V^0_{Rk,c,fi}$ under fire exposure for concrete C20/25 may be determined by:									
			$V^0_{Rk,c,fi(90)} = 0.25 \cdot V^0_{Rk,c}$ (≤ R90)						
			$V^0_{Rk,c,fi(120)} = 0.20 \cdot V^0_{Rk,c}$ (≤ R120)						
With $V^0_{Rk,c}$ as characteristic resistance of a single anchor in cracked concrete C20/25 under normal temperature									
Partial safety factor [1]		$\gamma_{Mc,fi}$	1.0						

[1] In absence of other national regulations

JORDAHL - Anchor Channel JTA	**Annex 19**
Characteristic values shear load under fire exposure	

Fatigue design

Fatigue-inducing actions

The distribution of static actions on the anchors is in accordance with CEN/TS 1992-4-3:2009. The fatigue-inducing actions are distributed on the anchors according to Fig. 1. For the local load application, the complete load range ΔN has to be considered.
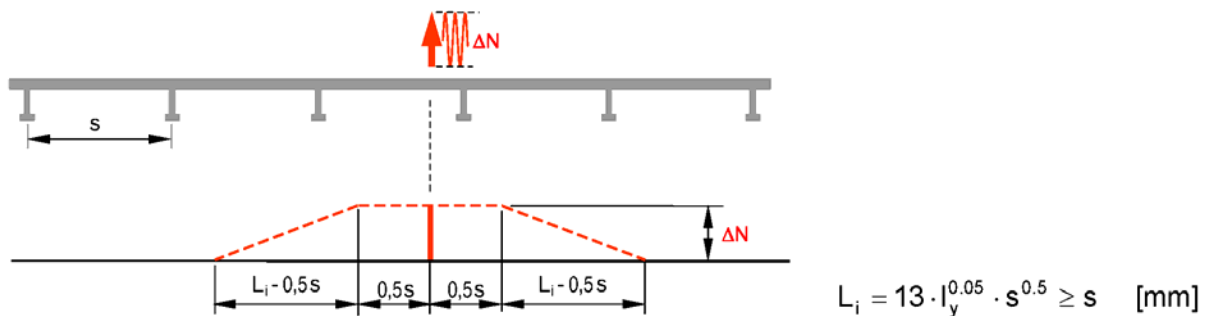

$$L_i = 13 \cdot l_y^{0.05} \cdot s^{0.5} \geq s \quad \text{[mm]}$$

Fig. 1: Distribution of fatigue-inducing actions on the anchors

Figure 2 shows an example of a combination of static and fatigue-inducing actions. Simplifying, it can be assumed that the max. equivalent static load $N_{Ed,eq}$ and the max. equivalent fatigue load $\Delta N_{Ed,eq}$ are applied at the same position along the anchor channel.
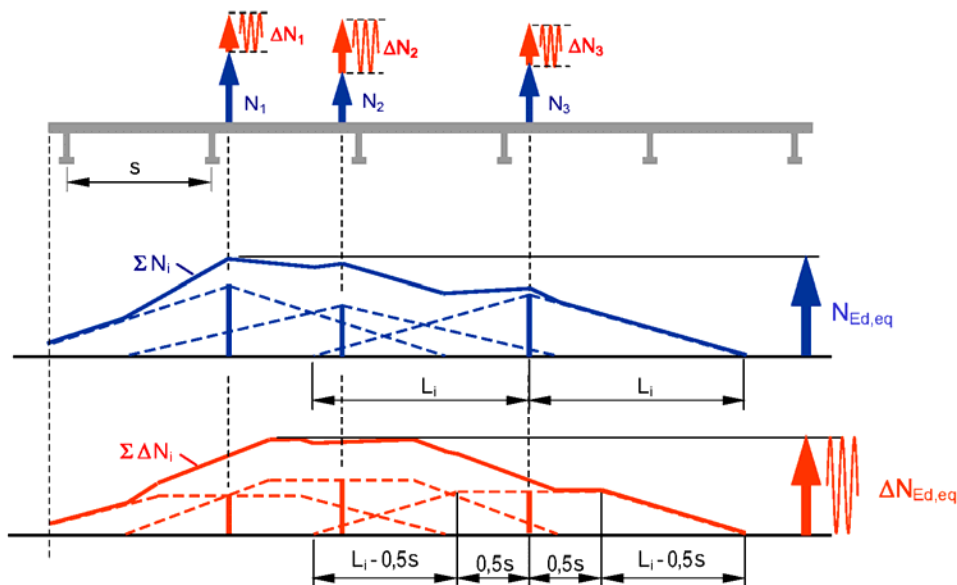
Fig. 2: Superposition of static and fatigue-inducing actions

The loads due to static and fatigue-inducing actions are superimposed according to Fig. 2.

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Fatigue design – Fatigue-inducing actions	**Annex 20**

Table 22: Combinations for anchor channels and special screws for fatigue-inducing repeated tensile loading

Anchor channel	Anchor		Special screw			
	Type	d_1 [mm]	Type	d	Strength	Finish
W 40/22	R	9.0	JC	M12	8.8	z.p. h.d.g.
				M16	4.6 8.8	
W 50/30		9.0	JB	M16 M20	4.6 8.8	
W 53/34		11.5	JB	M16 M20	8.8	

Design method I – Verification procedure of fatigue limit state

The fatigue verification under repeated tensile loading may be assumed, if the following conditions are satisfied.

Table 23: Relevant design verifications

Failure mode	Case 1 ΔN_{Ed} known n known	Case 1.1 ΔN_{Ed} known n unknown	Case 1.2 ΔN_{Ed} unknown n known
Steel failure	$\Delta N_{Ed} \leq \Delta N_{Rd,s,E,n}$	$\Delta N_{Ed} \leq \Delta N_{Rd,s,E,\infty}$	$N_{Ed,max} \leq \Delta N_{Rd,s,0,n}$
Concrete cone failure	$\Delta N_{Ed} \leq \Delta N_{Rd,c,E,n}$	$\Delta N_{Ed} \leq \Delta N_{Rd,c,E,\infty}$	$N_{Ed,max} \leq \Delta N_{Rd,c,0,n}$
Pullout failure	$\Delta N_{Ed} \leq \Delta N_{Rd,p,E,n}$	$\Delta N_{Ed} \leq \Delta N_{Rd,p,E,\infty}$	$N_{Ed,max} \leq \Delta N_{Rd,p,0,n}$

where

ΔN_{Ed} = Design value of the acting fatigue load range under the relevant load combination

$N_{Ed,max}$ = Design value of the acting maximum load under the relevant load combination

= $N_{Ed} + \Delta N_{Ed}$

$\Delta N_{Rd,E,n}$ = Design fatigue resistance of a failure mode

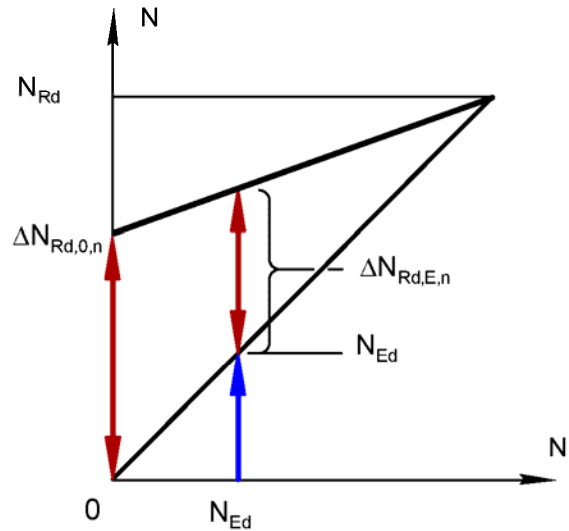| JORDAHL - Anchor Channel JTA	**Annex 21**
Fatigue design – Combinations and design method I	

Determining the characteristic fatigue resistance of a failure mode with static preload ($N_{Ed} > 0$):

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

or

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

where

ΔN_{Ed} = Design value of the acting fatigue load range under the relevant load combination

N_{Ed} = Design value of the acting static load under the relevant load combination
= $N_{Ed,max} - \Delta N_{Ed}$

$N_{Ed,max}$ = Design value of the acting maximum load under the relevant load combination

N_{Rd} = Design value of the static resistance of a failure mode according to Annex 11 to 13 and if applicable CEN/TS 1992-4

$\Delta N_{Rd,E,n}$ = Design fatigue resistance of a failure mode

$\Delta N_{Rd,0,n}$ = Design fatigue resistance of a failure mode without static preload ($N_{Ed} = 0$) according to Table 23 and if applicable CEN/TS 1992-4

$\Delta N_{Rd,E,\infty}$ = Design fatigue resistance for $n \rightarrow \infty$ of a failure mode

$\Delta N_{Rd,0,\infty}$ = Design fatigue resistance for $n \rightarrow \infty$ of a failure mode without static preload ($N_{Ed} = 0$) according to Table 24 and if applicable CEN/TS 1992-4

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Fatigue design – Design method I

Annex 22

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Table 24: Design fatigue resistance after n load cycles without static preload ($N_{Ed} = 0$)

Anchor channel				W 40/22	W 50/30	W 53/34
Steel failure						
Design fatigue resistance for n load cycles	$\leq 2 \cdot 10^3$	$\Delta N_{Rd,s,0,n}$	[kN]	9.7	16.5	23.3
	$\leq 5 \cdot 10^3$			8.8	14.8	20.1
	$\leq 10^4$			7.9	13.3	17.6
	$\leq 2 \cdot 10^4$			6.9	11.7	14.9
	$\leq 5 \cdot 10^4$			5.5	9.5	11.8
	$\leq 10^5$			4.5	7.9	9.8
	$\leq 2 \cdot 10^5$			3.7	6.5	8.3
	$\leq 5 \cdot 10^5$			3.1	5.1	7.0
	$\leq 10^6$			2.8	4.3	6.4
	$\leq 2 \cdot 10^6$			2.7	3.7	6.1
	$\leq 5 \cdot 10^6$			2.7	3.3	6.0
	$\leq 10^7$			2.7	3.2	5.9
	$> 10^7$			2.7	3.0	5.9
Concrete cone failure						
Design fatigue resistance				$\Delta N_{Rd,c,0,n} = \eta_{c,fat,n} \cdot N_{Rd,c}$ [1]		
Reduction factor for n load cycles	$\leq 2 \cdot 10^3$	$\eta_{c,fat,n}$		0.830		
	$\leq 5 \cdot 10^3$			0.804		
	$\leq 10^4$			0.785		
	$\leq 2 \cdot 10^4$			0.766		
	$\leq 5 \cdot 10^4$			0.741		
	$\leq 10^5$			0.723		
	$\leq 2 \cdot 10^5$			0.706		
	$\leq 5 \cdot 10^5$			0.684		
	$\leq 10^6$			0.667		
	$> 10^6$			0.667		

[1] $N_{Rd,c}$ according to Annex 13, Table 14 and CEN/TS 1992-4

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Fatigue design – Design fatigue resistance for steel failure and concrete cone failure

Annex 23

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Table 24: Design fatigue resistance after n load cycles without static preload ($N_{Ed} = 0$)
          continued

Anchor channel				W 40/22	W 50/30	W 53/34
Pullout failure						
Design fatigue resistance in cracked concrete C12/15 for n load cycles	$\leq 2 \cdot 10^3$	$\Delta N_{Rd,p,0,n}$	[kN]	6.0	8.8	16.4
	$\leq 5 \cdot 10^3$			5.8	8.5	15.9
	$\leq 10^4$			5.6	8.3	15.5
	$\leq 2 \cdot 10^4$			5.5	8.1	15.2
	$\leq 5 \cdot 10^4$			5.3	7.9	14.7
	$\leq 10^5$			5.2	7.7	14.3
	$\leq 2 \cdot 10^5$			5.1	7.5	14.0
	$\leq 5 \cdot 10^5$			4.9	7.2	13.5
	$\leq 10^6$			4.8	7.1	13.2
	$> 10^6$			4.8	7.1	13.2
Increasing factor for concrete > C12/15	C20/25	ψ_c		1.67		
	C25/30			2.00		
	C30/37			2.47		
	C35/45			3.00		
	C40/50			3.33		
	C45/55			3.67		
	$\geq$ C50/60			4.00		
Factor for un-cracked concrete		$\psi_{ucr,N}$		1.4		

JORDAHL - Anchor Channel JTA

Annex 24

Fatigue design – Design fatigue resistance for pullout failure

Design method II – Simplified verification of fatigue limit state

The simplified fatigue verification under repeated tensile loading may be assumed, if the following conditions are satisfied.

<u>Steel failure verification:</u>

$$N_{Ed,max} \leq \Delta N_{Rd,s,0,\infty}$$

<u>Concrete cone failure verification:</u>

$$N_{Ed,max} \leq \Delta N_{Rd,c,0,\infty}$$

where

$N_{Ed,max}$ = Design value of the acting maximum load under the relevant load combination

       = $N_{Ed} + \Delta N_{Ed}$

$N_{Rd,s,0,\infty}$ = Design fatigue resistance for n → ∞ against steel failure without static preload (N_{Ed} = 0) according to Table 25

$N_{Rd,c,0,\infty}$ = Design fatigue resistance for n → ∞ against concrete cone failure without static preload (N_{Ed} = 0)

       = $\eta_{c,fat,\infty} \cdot N_{Rd,c}$, where $\eta_{c,fat,\infty}$ according to Table 25

$N_{Rd,c}$ = Design resistance against concrete cone failure according to Annex 13, Table 14 and CEN/TS 1992-4

Pullout verifications are not required.

Table 25: Design fatigue resistance for n → ∞ without static preload (N_{Ed} = 0)

Anchor channel			W 40/22	W 50/30	W 53/34
Steel failure					
Design fatigue resistance	$N_{Rd,s,0,\infty}$	[kN]	2.7	3.0	5.9
Concrete cone failure					
Reduction factor	$\eta_{c,fat,\infty}$		0.667		
Pullout failure					
			not required		

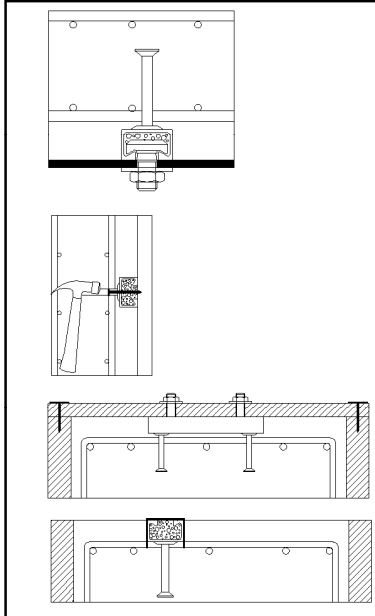|	
JORDAHL - Anchor Channel JTA	**Annex 25**
Fatigue design – Design method II	

1. Fixing anchor channel
Install the channel surface flush and fix the channel undisplaceable to the formwork or to the reinforcement.

b) **Fixing to steel formwork**
With JORDAHL-special screws and nuts, with rivets, cramps or with magneting fixings.

or

a) **Fixing to timber formwork**
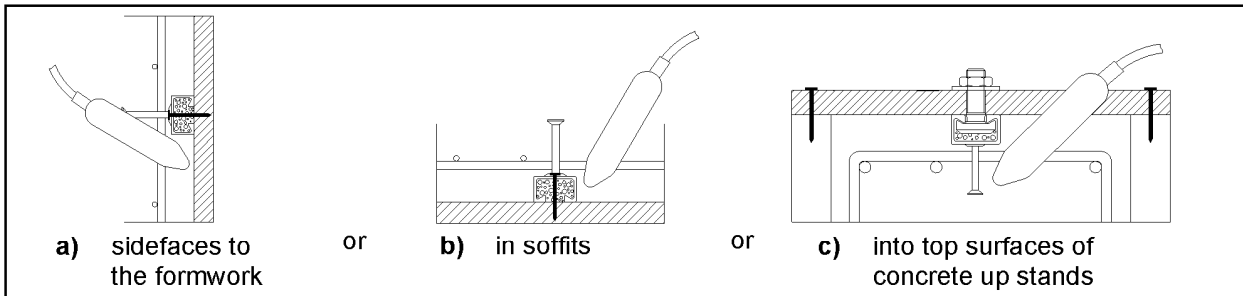With nails through the pre punched holes in the back of the channels and with staples.

or

c) **Fixing to anchor channels at the top**
- To timber batten on the side formwork (e.g. with JORDAHL-special screws).
- Fixing from above directly to the reinforcement or to a mounting rebar, attach the channel by wire binding.

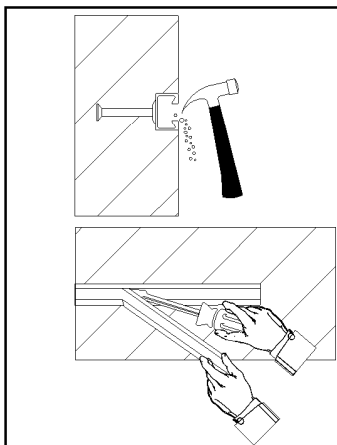## 2. Pouring concrete and regular compacting of concrete
Compact the concrete properly around the channel and the anchors.

a) sidefaces to the formwork   or   b) in soffits   or   c) into top surfaces of concrete up stands

3. Removing of the channel infill
Clean the channel on the outside after removing the formwork.

a) **Foam infill**
With a hammer or a hook.

or

b) **PE - foam infill**
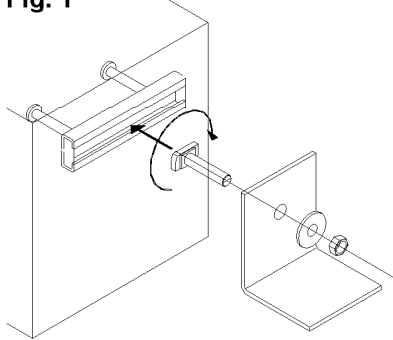By hand or with help of a screw driver in one piece.

JORDAHL - Anchor Channel JTA

Manufacturer's Specification – Anchor Channel

Annex 26

4. Fastening the JORDAHL-special screw to the anchor channel

Fig. 1

a) Setting torques (General)

1. Insert the JORDAHL-special screw into the channel slot at any point along the channel length (Fig. 1).
2. Turn the special screw 90° clockwise and the head of the screw locks into position (Fig. 1).
3. Do not mount the special screw at the end of the channel within the end spacing x acc. to Annex 6.
4. Use the washer under the nut (Fig. 1).
5. Check the correct fit of the JORDAHL-special screw. The groove on the shank end of the special screw must be perpendicular to the channel longitudinal axis.
6. Tighten the nuts to the setting torque according to Table 26 (Fig. 2). The setting torque must not be exceeded.
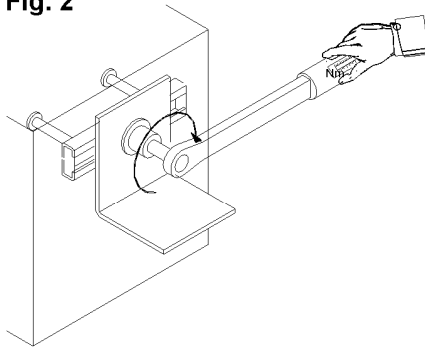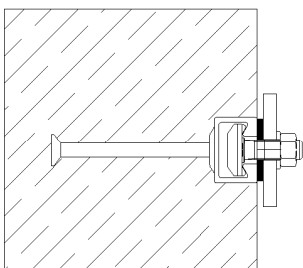
Fig. 2

Table 26	Anchor channel	T_{inst} [Nm]								
		M6	M8	M10	M12	M16	M20	M24	M27	M30
Strength Grade	K 28/15	-	8	13	15	-	-	-	-	-
	K 38/17	-	-	15	25	40	-	-	-	-
4.6 8.8 A4-50 HC-50 A4-70 HC-70 F4-70 L4-70	K 40/25 W 40/22 W 40+	-	-	15	25	45	-	-	-	-
	K 50/30 W 50/30 W 50+	-	-	15	25	60	75	-	-	-
	K 53/34 W 53/34	-	-	15	25	60	120	-	-	-
	W 55/42	-	-	15	25	60	120	200	-	-
	K 72/48 W 72/48	-	-	-	-		120	200	300	380

or

Fig. 3

b) Setting torques (Steel-to-steel contact)

1. Use washers between the channel and the fixture to create a defined contact.
2. Tighten the nuts to the setting torque according to Table 27. The setting torque must not be exceeded.

Table 27	Strength/ Material grade	T_{inst} [Nm]								
		M6	M8	M10	M12	M16	M20	M24	M27	M30
JA, JB JC, JE JD/JUD JH/JUH	4.6 A4-50, HC-50	3	8	15	25	65	130	230	340	460
	8.8 A4-70, HC-70 F4-70, L4-70	--	20	40	70	180	360	620	900	1200

JORDAHL - Anchor Channel JTA

Manufacturer's Specification – Special Screw

Annex 27