DYWIDAG Geotechnical Systems

GEWI® Piles

DYWIDAG GEWI® Piles (Micro-piles) with Load-Carrying Elements made of Reinforcing Bars with Thread Ribs B500B, Ø 20 mm, Ø 25 mm, Ø 28 mm, Ø 32 mm, Ø 40 mm and Ø 50 mm

Approval Number
Z-32.1-2

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Approval No.: Z-32.1-2
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Applicant:
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Subject of approval:
DYWIDAG GEWI Piles (Micropiles) with Load-Carrying Elements made of Reinforcing Bars with Thread Ribs B500B, Ø 20 mm, Ø 25 mm, Ø 28 mm, Ø 32 mm, Ø 40 mm and Ø 50 mm

The above-mentioned subject of the approval is hereby granted a general construction supervisory authority approval.
This approval certificate comprises twelve pages and eleven appended sheets.
The subject matter was granted a general construction supervisory authority approval on August 26, 1992 for the first time.

Important Notice
The approval in hand is the translation of a document originally prepared in the German language which has neither been verified nor officially authorized by the Deutsches Institut für Bautechnik ("DIBt", German Institute for Civil Engineering). In case of doubt in respect to wording and/or interpretation of this approval, the original German version of this document shall prevail exclusively. Therefore, no liability is assumed for translation errors or inaccuracies.
I  GENERAL PROVISIONS

1 This general construction supervisory authority approval verifies the suitability (fitness for the intended purpose) of the subject of the approval in keeping with the state construction ordinances.

2 If requirements for particular technical knowledge and experience of the persons entrusted with the manufacture of building products and building methods are imposed in accordance with state-specific regulations corresponding to Section 17 Sub-Section 5 of the Musterbauordnung (German Model Building Code), it must be observed that such technical knowledge and experience can also be proven by equal evidences of other member states of the European Union. Where required, this also applies for equal proofs submitted within the scope of the Agreement on the European Economic Area (EEA) or other bilateral agreements.

3 This general construction supervisory authority approval does not replace any permissions, agreements and certifications required by law for the construction projects to be carried out.

4 This general construction supervisory authority approval is granted without prejudice to the rights of third parties, especially private protection rights.

5 Notwithstanding any further regulations in the "Special Provisions" section, the manufacturer and distributor of the subject of approval shall provide the user with copies of the general construction supervisory authority approval; furthermore, they shall inform the user that the general construction supervisory authority approval must be available at the place of use. Copies of the general construction supervisory authority approval must be made available to involved authorities on request.

6 The general construction supervisory authority approval may only be copied completely. The publication of extracts is subject to approval by the DIBt. Texts and drawings of advertising material may not contradict the general construction supervisory authority approval. Translations of the general construction supervisory authority approval must contain the note "Translation of the German original which has not been verified by the DIBt".

7 The general construction supervisory authority approval is granted, but is revocable. The provisions in the general construction supervisory authority approval can be subsequently amended or changed, especially if the latest technical findings give reason for this.
II SPECIAL PROVISIONS

1 Subject of approval and applications

1.1 Subject of approval
Subject matter of this general construction supervisory authority approval are DYWIDAG GEWI piles with load-carrying elements made of reinforcing bars with thread ribs with nominal diameters of 20 mm, 25 mm, 28 mm, 32 mm, 40 mm and 50 mm. The piles in question are micropiles (composite piles) for which the stipulations of DIN EN 14199 in conjunction with DIN SPEC 135 39 shall be observed, unless stated otherwise below.

1.2 Applications
The piles may be used as tension or compression piles for permanent and temporary (≤ 2 years) application. The piles are designed for loading by axial loads only. A geotechnical expert must be consulted, if the soil contains elements which might weaken the corrosion protection of the cement grout, if they intrude into the grout body (e.g. organic material). The piles shall not be installed if the foundation soil contains ground water or seepage water from waste heaps and/or landfills presuming a high probability of steel corrosion in the form of cavities and holes in accordance with DIN 50929-3, Table 7, with W<sub>0</sub> < -8, unless the load-carrying steel element is protected by a corrugated plastic sheathing over its entire length.

2 Provisions covering the construction product

2.1 Properties and composition

2.1.1 General
In accordance with Appendices 1, 2 or 8, the piles shall be made from a continuous load-carrying steel element which may consist of 1 to 3 bars (see Section 2.1.2), and uniformly coated with cement grout over their entire length.

2.1.2 Load-carrying steel element

2.1.2.1 Steel grade and dimensions
Only generally approved reinforcing bars with thread ribs B500B, nominal diameters 20 mm, 25 mm, 28 mm, 32 mm, 40 mm and 50 mm, may be used.

2.1.2.2 Single-bar piles
The load-carrying steel element of single-bar piles consists of a reinforcing bar with thread ribs in diameters of 20 mm, 25 mm, 28 mm, 32 mm, 40 mm or 50 mm (see Appendices 1 or 2). The single-bar piles can be provided with a cement grouted corrugated plastic sheathing (see Section 2.1.3).

1 DIN EN 14199:2012-01 Execution of special geotechnical works - Micropiles; German version EN 14199:2005
2 DIN SPEC 18539:2012-02 Supplementary provisions to DIN EN 14199:2012-01, Execution of special geotechnical works - Micropiles
3 DIN 50929-3:1985-09 Corrosion of metals; probability of corrosion of metallic materials when subject to corrosion from the outside: buried and underwater pipelines
2.1.2.3 Multibar piles
The load-carrying element of the multibar piles (see Appendix 9) can be composed of the following combinations of reinforcing bars with thread ribs:
- 2 Ø 40 mm
- 2 Ø 50 mm
- 3 Ø 32 mm
- 3 Ø 40 mm
- 3 Ø 50 mm
- 1 Ø 40 mm, 1 Ø 50 mm
- 2 Ø 40 mm, 1 Ø 50 mm
- 1 Ø 40 mm, 2 Ø 50 mm

2.1.2.4 Coupler splices
In accordance with the general construction supervisory authority approvals for threaded splices, connections and anchorages for reinforcing bars with thread ribs B500B GEWI, No. Z-1.5-76 for diameters 20 mm to 32 mm and No. Z-1.5-149 for 40 mm and 50 mm, the reinforcing bars with thread ribs may be spliced with couplers (see Appendices 1 through 5). For tensile loads, the couplers shall be torqued with nuts.
If in the case of compressive piles the coupler is not secured with lock nuts, it shall either be glued to the load-carrying element or prevented from unscrewing by means of pins.
In the case of non-dynamic impacts, lock nuts can be neglected if a heat shrink sleeve is used for protection against corrosion in accordance with Appendices 3, 4 or 5. The material properties and the dimensions must correspond to the specifications deposited with the DIBt. In the case of load-carrying elements embedded in corrugated plastic sheathings (see Section 2.1.3), the couplers shall be protected with a heat shrink sleeve for protection against corrosion as shown in Appendices 3, 4 or 5. The hollow space between the grout and splice shall, pursuant to DIN 30672 \(^2\), be completely grouted with the plastic sealing tape "Densoplast Petrolatum" on both sides of the splice, before the heat-shrink sleeve is shrunk on. The petrolatum must be melted on through heating. The heat shrink sleeves must have a minimum wall thickness of 1.5 mm in the shrunk condition. The shrink sleeves are to be hot shrunk with hot air, infrared radiation or the low flame of a gas burner. The distance between the joints in the longitudinal direction of a reinforcing bar with thread ribs must be ≥ 1 m. The clear distance between the couplers in a multibar pile must be minimum 50 mm.
Irrespective of the above mentioned stipulations in this section, a fixing with lock nuts is always required in the case of alternating loads and dynamic impacts in accordance with DIN EN 1991-1-1\(^5\), Section 2.2 (see Appendix 3 or 5).

2.1.2.5 Pile connection in the foundation body
Load-carrying steel elements consisting of one reinforcing bar with thread ribs can be anchored either with GEWI anchorages pursuant to the general construction supervisory authority approval for splices, connections and anchorages of reinforced bars with thread ribs B500B GEWI (No. Z-1.5-76 or Z-1.5-149) and/or for diameters 32 mm to 50 mm through torqued plate anchorages as shown in Appendix 11 or through bonding as required by the relevant general construction supervisory authority approval for reinforced bars with thread ribs (see Section 2.1.2.1).

4 DIN 30672:2000-12
External organic coatings for the corrosion protection of buried and immersed pipelines for continuous operating temperatures up to 50°C- Tapes and shrinkable materials

5 DIN EN 1991-1-1:2010-12
If the load-carrying steel element consists of 2 or 3 reinforced bars with thread ribs, the load must be transferred from the load-carrying steel element into the foundation body via GEWI anchorages as required by general construction supervisory authority approval No. Z-1.5-76 or Z-1.5-149 (see Appendices 8 and 9).

The additional reinforcement in the pile head and the surface reinforcement, if any, shall be arranged in accordance with the related general construction supervisory authority approvals.

### 2.1.3 Corrugated plastic sheathing

The load-carrying element of single-bar piles can be embedded in a cement grouted corrugated plastic sheathing over its entire length, except for possible joints, as required by Section 2.1.2.2. (see Appendix 2). The load-carrying element shall be provided with a sheathing consisting either of PVC-U as specified in DIN EN ISO 1163-1\(^5\), of polyethylene with a molding compound as specified by DIN EN ISO 1872-1\(^7\) – PE, E, 45 – T022, or of polypropylene with a molding compound as specified by DIN EN ISO 1873-1\(^8\) – PP – B, EAGC, 10-16-003 or as specified by DIN EN ISO 1873-1\(^8\) – PP – H, E, 06-35-012/022. It is necessary to ensure that only straight tubes are used. The sheathing must have a uniform wall thickness of $\geq 1$ mm; only tubes may be used that do not show any trapped bubbles and that have a uniform pigmentation.

The possibly required individual segments of PVC-U sheathings shall be screwed together and carefully glued with specific PVC glue. Unspliced pipes are to be used as PE or PP sheathings.

A PE cap shall be connected to the corrugated sheathing using cams and glued on the earth-side end piece. The vent cap shall be glued to the corrugated sheathing on the air-side end piece of the corrugated sheathing.

### 2.2 Manufacture, transport, storage and marking

#### 2.2.1 Corrosion protection and manufacture of prefabricated piles for installation and grouting

The cement grout covering of the steel load-carrying element as required by Section 4.3.4 shall be ensured by the measures stipulated in said section.

In case the load-carrying steel element for single-bar piles is coated with a corrugated plastic sheathing in accordance with Section 2.1.3, the annulus between the load-carrying element and the corrugated sheathing shall be cement grouted from the bottom to the top as required by DIN EN 447\(^9\) with the load-carrying element inclined. In addition, DIN EN 445\(^10\) and DIN EN 446\(^11\) must be observed. To ensure complete grouting, the vent cap shall be connected to a 0.5 m long grout hose or to a grout cone. The load-carrying element shall be provided with plastic spacers every 1 m to maintain a distance of $\geq 5$ mm between the load-carrying element and the corrugated sheathing, or a 6 mm Ø PE helix with a pitch of 0.5 m shall be placed between them. The above work shall be carried out in a factory.

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**References:**


11. DIN EN 446:1996-07 Grout for prestressing tendons - Grouting procedures; German version EN 446:1996
2.2.2 Transport and storage
The effectiveness of corrosion protection depends on the integrity of the corrosion protection components. Therefore, special care must be taken during transport, storage and installation of the readily assembled piles that the corrosion protection components, in particular the corrugated plastic sheathing, are not damaged as a result of improper handling.
If in the case of a cased borehole the projecting end of the drill outfit has an edged internal thread or a sharp-edged pipe end, the load-carrying steel elements prepared in accordance with Section 2.2.1 may only be inserted into the borehole after an edge-free inserting trumpet or a pipe nipple that fully covers the internal thread of the casing has been placed onto the projecting end of the drill outfit. Care must be taken that the corrosion protection is not damaged when inserting the load-carrying element.

2.2.3 Marking
The delivery note for the prefabricated pile shall be marked with the conformity symbol by the manufacturer pursuant to the conformity symbol regulations issued by the German States. The marking may only be carried out if the requirements according to Section 2.3 have been met.
Among other things, the delivery note shall detail for which piles the prefabricated pile components are determined and in which factory they have been produced. Each delivery note may only specify the components for one type of micropile.

2.3 Evidence of conformity
2.3.1 General
Based on an in-house production inspection and regular external supervision including original inspection, every fabricating plant must observe the following provisions to confirm conformity of the pile components and the prefabricated piles for installation and grouting in accordance with the provisions of this general construction supervisory authority approval.
The manufacturer of the pile components and of the prefabricated piles shall commission a recognized certification institution to issue the certificate of conformity as well as a recognized inspection agency for external surveillance including product inspections.
The declaration that a certificate of conformity has been issued shall be made by the manufacturer by marking the building products with the mark of conformity, indicating the intended purpose.
The certification agency must send a copy of the issued certificate of conformity to the DIBt for information.
In addition, a copy of the original inspection report must be forwarded to the DIBt for information.

2.3.2 In-house manufacturing control
2.3.2.1 General
Each manufacturing plant must set up and also carry out its own quality control. In-house manufacturing control is understood to be the continual monitoring of production by the manufacturer who thus ensures that the construction products manufactured by him meet the requirements of this general construction supervisory authority approval.
The results of the internal quality control must be recorded and evaluated. The recordings must contain at least the following information:
- Description of the building product and/or of the basic material and of the components,
- type of control or inspection,
- date of manufacture and date of inspection of the building product and/or of the basic material or of the components,
- results of the controls and inspections and, if applicable, comparison with the requirements,
- a signature by the person responsible for in-house quality controls.

The records must be kept for at least five years and submitted to the external agency assigned with surveillance. On request, they must be submitted to the DIBt and the competent highest construction supervisory authority.

If the inspection results are unsatisfactory, the manufacturer must immediately take the action necessary for elimination of the problem. Construction products which do not meet requirements must be marked so that they cannot be mixed with conforming products. Once the problem has been eliminated, the original inspection must be repeated immediately, provided that this is technically feasible and also required, to verify elimination of the problem.

In-house quality control should at least include the following measures:

2.3.2.2 Reinforcing bars with thread ribs, anchoring components and parts for coupler splices
Only reinforcing bars with thread ribs, anchoring components and parts for coupler splices may be used in accordance with the statements made in Section 2.1.2 for which evidence of conformity has been conducted pursuant to the corresponding general construction supervisory authority approval.

The stipulations for the receiving inspection set therein must be observed.

2.3.2.3 Corrugated plastic sheathing
Composition of the molding compound is to be attested by a certificate of compliance "2.1" as per DIN EN 1020412. One corrugated plastic sheathing per batch (100 sheathings) shall be sampled to measure the wall thickness at one internal and one external corrugation and on the flank of the tubes as well as the diameter. The dimensions must correspond to the drawings deposited with the DIBt and the external surveillance agency. The decision whether a batch is accepted or rejected shall be made in accordance with Section 2.3.2.7.

2.3.2.4 Vent caps and grout caps
The material properties and dimensions must correspond to the specifications deposited with the DIBt and the external surveillance agency. The values shall be attested by a certificate of conformity "2.1" in accordance with DIN EN 1020412.

2.3.2.5 Shrink sleeves
The material characteristics of the shrink sleeves and of the bonding agent are to be attested by certificate of compliance "2.1" in accordance with DIN EN 1020412. The wall thickness shall be measured at 3 locations on the basic material and the adhesive application determined per batch (100 pieces). The decision whether the batch is accepted or rejected shall be made in accordance with Section 2.3.2.7.

12 DIN EN 10204:2005-01 Metallic products - Types of inspection documents; German version EN 10204:2004
2.3.2.6 Factory applied corrosion protection
The corrosion protection measures to be carried out in the factory pursuant to Section 2.2.1 shall be verified by visual inspection on each pile (statistical evaluation not necessary). Cement grout inspections shall be carried out pursuant to DIN EN 447. In addition, DIN EN 445 and DIN EN 446 must be observed.

2.3.2.7 Test plan
If each individually measured value equals or exceeds the minimum value stipulated, the batch is to be accepted. If not, further samples can be taken. The same measurements as those on the first sample must be carried out on such samples. The measuring results are to be summarized with the previous measurements. The mean average value $x$ and the standard deviation $s$ must be obtained from all values. If the resulting test value (numerical value) $z = x - 1.64 \times s$ equals or exceeds the minimum value stipulated, the batch is to be accepted, otherwise rejected.

2.3.3 External surveillance
The in-house quality control at each manufacturing plant is to be monitored by external surveillance on a regular basis, but at least twice a year. An original inspection is to be carried out as part of the external surveillance. Also samples for sampling tests are to be taken and testing tools inspected. Sampling and inspections are, in each case, the responsibility of the recognized surveillance authority. The results of certification and external surveillance must be kept for at least five years. On request, they must be presented to the DIBt and to the competent highest construction supervisory authority by the certification agency or the surveillance agency.

3 Provisions covering design and dimensions

3.1 General
Unless stated otherwise hereinafter, the technical construction standards, in particular DIN EN 1997-1, DIN EN 1997-1/NA, DIN 1054 and DIN 1054/A1, shall apply. In the case of dynamic impacts according to DIN EN 1991-1-1, Section 2.2, it must be demonstrated that the permissible fatigue stress range of the load-carrying steel element and/or of the coupler splices and the anchorages is not exceeded. The permissible fatigue stress range can be taken from the corresponding general construction supervisory authority approvals for reinforcing bars with thread ribs (see Section 2.1.2.1) and/or for the coupler connections and anchorages of reinforcing bars with thread ribs (No. Z-1.5-76, No. Z-1.5-149). As partial safety factor $\gamma_M$ for the material strength of the steel load-carrying element, $\gamma_M = 1.15$ shall be used in the design situations BS-P, BS-T and BS-A.

15 DIN 1054:2010 Subsoil - Verification of the safety of earthworks and foundations - Supplementary rules to DIN EN 1997-1
3.2 Tensile stressed piles with standard corrosion protection
Evidence shall be produced for piles provided with standard corrosion protection in accordance with Appendices 1 and 8 and which are intended for permanent installation (longer than 2 years) that the tensile stresses and/or marginal stresses do not exceed the value of 230 N/mm² when subjected to irregular bending stresses in steel based on the rated values of the impacts in the design situation BS-P.

3.3 Evidence of the transfer length (load transfer length) in the ground
It must be ensured that the load transfer length into the ground exceeds the required transfer length from the load-carrying steel element into the cement grout.
To demonstrate the transfer length, the rated value of the bond strength shall be determined in accordance with DIN EN 1992-1-1\textsuperscript{17}, Section 8.4.2, in conjunction with DIN EN 1992-1-1/NA\textsuperscript{18}. In the case of multibar piles, the reduction factor for determining the values \( f_{bd} \) is based on the largest bar in the load-carrying element. This applies similarly for the proof of anchorage through bonding.

3.4 Complete project
If required, the slip (see details in Appendix 3) occurring in tensile stressed coupler splices without the use of lock nuts shall be taken into account for the design of the complete project.

4 Provisions covering installation

4.1 General
DIN EN 14199\textsuperscript{1} in conjunction with DIN SPEC 185 39\textsuperscript{2} shall apply to the installation of micropiles, unless stated otherwise below.

4.2 Company carrying out the installation
The micropiles as described in this general construction supervisory authority approval may only be installed under the responsible technical supervision of DYWIDAG-Systems International GmbH.
The micropiles may also be manufactured by companies which can present a certificate by DYWIDAG-Systems International GmbH that they have been thoroughly trained in the manufacture of micropiles described in this general construction supervisory authority approval. The company executing the installation must declare that the micropiles produced by it comply with the provisions of this general construction supervisory authority approval.


4.3 Pile shaft

4.3.1 General

To prove the compressive strength of the grout body, two series of 3 samples every 7 work days shall be produced during which piles are concreted or per construction site respectively.

4.3.2 Cement grout

The basic materials for the cement grout are cements with particular properties in accordance with DIN 1164-10\textsuperscript{19} and cements in line with DIN EN 197-1\textsuperscript{20}, taking into consideration the present exposition class as defined by DIN EN 206-1\textsuperscript{21}/DIN 1045-2\textsuperscript{22} (Tables 1, F.3.1 and F.3.2), water as stipulated by DIN EN 1008\textsuperscript{23} and, where required, additives in accordance with DIN EN 934-2\textsuperscript{24} in conjunction with DIN EN 206-1\textsuperscript{25}/DIN 1045-2\textsuperscript{22} or a general construction supervisory authority approval, and natural aggregates for concrete in compliance with DIN EN 12620\textsuperscript{26} and the list of building regulations B Part 1, Annex 1/1.3, taking into account DIN EN 206-1\textsuperscript{21}/DIN 1045-2\textsuperscript{22}, Annex U.

4.3.3 Post-grouting

Piles subject to load shall not be post-grouted.

4.3.4 Centering and covering of the load-carrying steel element

The load-carrying steel element shall be centered within the borehole so that an adequate cement grout covering is provided at all positions and also above the couplers. DIN SPEC 185 39\textsuperscript{2}, A Annex C, shall apply to the minimum dimensions of the covering.

Piles with corrugated plastic sheathings as required by Appendix 2 must have a cement grout covering of at least 10 mm above the corrugated sheathings.

The cement grout coverings can be ensured with spring basket spacers (see Appendices 1, 2 or 10 "Spring Basket Spacer") or segment spacers (see Appendices 1, 2 or 10), also in combination with grout nozzles, or by the casing alone or in combination with the above spacers. The actions to be taken depend on the soil and the inclination of the piles (see also Table 1).

19 DIN 1164-10:2004-03 Special cement - Part 10: Composition, requirements and conformity evaluation for common cement with special characteristics

20 DIN 1164-10 Ber1:2005-01 Corrections to DIN 1164-10:2004-08


24 DIN EN 1008:2002-10 Mixing water for concrete - Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete; German version EN 1008:2002

25 DIN EN 934-2:2009-09 Admixtures for concrete, mortar and grout - Part 2: Concrete admixtures - Definitions, requirements, conformity, marking and labelling; German version EN 934-2:2009

Table 1: Inclination of the piles and distance between the spacers

<table>
<thead>
<tr>
<th>Spacer</th>
<th>Load-carrying steel element</th>
<th>Inclination of the Piles</th>
<th>Distance between spacers</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centering grout valve²</td>
<td>1 Ø 32 mm</td>
<td>0° (vertical)-15°</td>
<td>≤ 3.0 m</td>
<td>Swivel valves by 120°</td>
</tr>
<tr>
<td></td>
<td>1 Ø 40 mm</td>
<td>16°-80°</td>
<td>≤ 2.0 m</td>
<td>Valves on underside (control through marking on the air-side end piece of the load-carrying element)</td>
</tr>
<tr>
<td>Spring basket or segment spacer¹</td>
<td>1 Ø 20 mm</td>
<td>0° (vertical)-15°</td>
<td>≤ 3.0 m</td>
<td>Dimensions of the spacers, cf. Appendices 1 and/or 2</td>
</tr>
<tr>
<td></td>
<td>1 Ø 25 mm</td>
<td>16°-45°</td>
<td>≤ 2.6 m</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 Ø 28 mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 Ø 32 mm</td>
<td>46°-80°</td>
<td>≤ 2.2 m</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 Ø 40 mm</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>1 Ø 50 mm</td>
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<td></td>
</tr>
<tr>
<td>Multibar piles in accordance with Section 2.1.2.3</td>
<td>see Appendix 10</td>
<td></td>
<td></td>
<td>Dimensions of the spacers, cf. Appendix 10, segments with web height = required covering</td>
</tr>
</tbody>
</table>

¹ minimum of 3 spacers in each case
² for unspliced load-carrying elements only
³ If the wall thickness of the casing starter tube equals or exceeds the cement grout covering c, spacers can be neglected in non-cohesive soils pursuant to DIN 1054¹⁵.

4.3.5 Pile neck
4.3.5.1 Single-bar piles

A corrugated PE or PVC sheathing shall be provided as constructional protection of the pile neck in the transition region of the pile shaft to the foundation body (see Appendix 1). The minimum 1 mm thick corrugated sheathing shall have a distance of ≥ 5 mm from the load-carrying element and shall be encased with minimum 10 mm cement grout. The same holds for piles with corrugated plastic sheathing (see Section 2.1.3 and/or Appendix 2).

If the piles are used only temporarily (service life ≤ 2 years) to carry loads, the corrugated plastic sheathing can be neglected.

As an alternative to the corrugated sheathing, an additional reinforcement made of N 94 welded wire fabric (or a reinforcement cage of an equivalent cross-section and the same spacing between the wires) can be provided around the steel load-carrying element in the pile neck. The longitudinal wires must be on the outside; the overlap length in the direction of the bar circumference shall be ≥ 180°.

The additional reinforcement shall be located as far to the outside of the cross-section as possible; the longitudinal wires shall be covered with cement grout in accordance with DIN SPEC 18539⁶, A Annex C. The inner diameter of the longitudinal wires of the additional reinforcement must be ≥ (dₐ + 25 mm) of the steel load-carrying element. The welded wire fabric shall be positioned concentrically to the steel load-carrying element to meet the above conditions and centered in the borehole by suitable spacers.
4.3.5.2 Multibar piles

In the case of multibar piles, a helix shall be placed in the area of the pile neck and its ends welded (see Appendix 8). The dimensions of the helix can be taken from Appendix 9. The cement grout coverings of the helix must at least conform to the values of DIN SPEC 18539², A Annex C.

Anneliese Böttcher       Certified
Section Head
**DYWIDAG SYSTEMS International**

**GEWI-Pile Ø 20 - 50 mm**

**GEWI-Singlebar pile with Standard corrosion protection**

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**Spring basket spacer**

Concrete grade C20/25 or higher

<table>
<thead>
<tr>
<th>Bar Ø</th>
<th>dxs</th>
<th>L</th>
<th>min. D*</th>
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<tbody>
<tr>
<td>Ø 20</td>
<td>25x2</td>
<td>285</td>
<td>70</td>
</tr>
<tr>
<td>Ø 25</td>
<td>32x2</td>
<td>285</td>
<td>80</td>
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<tr>
<td>Ø 28</td>
<td>40x3</td>
<td>285</td>
<td>100</td>
</tr>
<tr>
<td>Ø 32</td>
<td>40x3</td>
<td>285</td>
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</tr>
<tr>
<td>Ø 40</td>
<td>48x3</td>
<td>285</td>
<td>100</td>
</tr>
<tr>
<td>Ø 50</td>
<td>63x3</td>
<td>285</td>
<td>110</td>
</tr>
</tbody>
</table>

Measurements in mm

*Min. D has to be increased by upsetting in dependence of the required covering

**Alternatively: Segment spacer**

Width = 30 mm

**Anchorage**

- Additional reinforcement, dimensions of the anchorage elements and torques in accordance with the relevant approval
  1. End anchorage acc. to approval certificates
  2. Plate anchorage (see Appendices 3-5)
  3. Bond anchorage acc. to approval for reinforcing steel with thread ribs (B500B)
- Reinforcement for securing bond and, if applicable, main reinforcement in accordance with the relevant approval certificate for GEWI bar (cf. Appendix 6/7)
- GEWI splice (cf. Appendices 3-5)
  Distance between the couplers > 1.0 m

**Pile neck:**

A. Corrugated sheathing
B. Helix
C. Reinforcement cage

In case of a service life of less than 2 years, the pile neck strengthening can be neglected

**Pile shaft:**

Arrangement of the GEWI post grouting system with grout valves and grout tubes for post grouting operations
Concrete grade C20/25 or higher

Spring basket spacer

<table>
<thead>
<tr>
<th>Bar Ø</th>
<th>dxs</th>
<th>L</th>
<th>min. D*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø 20</td>
<td>55x3</td>
<td>285</td>
<td>100</td>
</tr>
<tr>
<td>Ø 25</td>
<td>55x3</td>
<td>285</td>
<td>100</td>
</tr>
<tr>
<td>Ø 28</td>
<td>55x3</td>
<td>285</td>
<td>100</td>
</tr>
<tr>
<td>Ø 32</td>
<td>63x3</td>
<td>285</td>
<td>100</td>
</tr>
<tr>
<td>Ø 40</td>
<td>75x3.6</td>
<td>285</td>
<td>100</td>
</tr>
<tr>
<td>Ø 50</td>
<td>90x2.7</td>
<td>285</td>
<td>110</td>
</tr>
</tbody>
</table>

Measurements in mm

*Min. D has to be increased by upsetting in dependence of the required covering

Alternatively: Segmentspacer
width = 30mm

Anchorage
- Additional reinforcement, dimensions of the anchorage elements and torques in accordance with the relevant approval
  1. End anchorage acc. to approval certificates no Z-1.5-76 resp. Z-1.5-149 (see App. 3-5)
  2. Plate anchorage (see Appendices 3-5)
  3. Bond anchorage acc. to approval for reinforcing steel with thread ribs (B500B)
- Reinforcement for securing bond and, if applicable, main reinforcement in accordance with the relevant approval certificate for GEWI bar (cf. Appendix 6/7)
- GEWI splice (cf. Appendices 3-5)
  Distance between the couplers > 1.0 m

Pile shaft
Corrugated sheathing (Dimensions see Appendix 6/7)

Pile neck
Arrangement of the GEWI post grouting system with grout valves and grout tubes for post grouting operations

DYWIDAG SYSTEMS International

GEWI-Pile Ø 20 – 50 mm

GEWI-Singlebar pile with Double corrosion protection

Appendix 2
GEWI - Pile for tensile loads

End anchorage
(for Ø 20 - 50 mm)

Anchor piece
.. T 2073 G
Lock nut
.. T 2040

Plate anchorage
(for Ø 32 - 50 mm)

Anchor nut
.. T 2002
.. T 2163 G
Anchor plate
.. T 2139
-> App. 11
Lock nut
.. T 2040

Pile neck strengthening: see appendix 7

- For additional reinforcement and anchorage lengths:
  -- see approval Z-1.5-76 for Ø 32 mm
  -- see approval Z-1.5-149 for Ø 40 and 50 mm
- Pile neck strengthening: see appendix 6/7

Add. reinforcement for plate anchorage

<table>
<thead>
<tr>
<th>Ø32</th>
<th>Ø40</th>
<th>Ø50</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Ø</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>a</td>
<td>190</td>
<td>230</td>
</tr>
<tr>
<td>b</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>c</td>
<td>40</td>
<td>45</td>
</tr>
</tbody>
</table>

All measurements in mm

Coupler splice

For coupler splices, the following approvals apply:
- Z-1.5-76 (Ø 20-32 mm)
- Z-1.5-149 (Ø 40/50 mm)

Standard corrosion protection

Corr. sheathing

Double corrosion protection

for non-torqued tension splice

<table>
<thead>
<tr>
<th>Load (N&lt;sub&gt;e&lt;/sub&gt;)</th>
<th>Slip [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>230</td>
<td>2</td>
</tr>
<tr>
<td>435</td>
<td>3</td>
</tr>
</tbody>
</table>

DYWIDAG SYSTEMS International

GEWI–Pile Ø 20 - 50 mm
GEWI-Singlebar pile with anchorage and coupler splice for piles with tensile loads

Appendix 3
GEWI - Pile for compressive loads

End anchorage (for Ø 20 - 50 mm)

- Lock nut .. T 2040
- Anchor piece .. T 2073 G

Plate anchorage (for Ø 32 - 50 mm)

- Lock nut .. T 2040
- Anchor plate .. T 2139 → App. 11
- Anchor nut .. T 2002 .. T 2163 G

Pile neck strengthening: see appendix 7

<table>
<thead>
<tr>
<th>Add. reinforcement for plate anchorage</th>
<th>Ø32</th>
<th>Ø40</th>
<th>Ø50</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>3</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Ø</td>
<td>8</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>a</td>
<td>190</td>
<td>230</td>
<td>285</td>
</tr>
<tr>
<td>b</td>
<td>20</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>c</td>
<td>40</td>
<td>45</td>
<td>45</td>
</tr>
</tbody>
</table>

All measurements in mm

Coupler splice

- Standard corrosion protection
- Double corrosion protection

Coupler for Contact splice .. T 3106 G (.. T 3006)

Anti rotation:
- a. pins
- b. heat shrink sleeve
- c. adhesive

For coupler splices the following approval certificates shall be observed:
- approval Z-1.5-76 for Ø 20-32 mm
- approval Z-1.5-149 for Ø 40 and 50 mm

DYWIDAG SYSTEMS International

GEWI-Pile Ø 20 - 50 mm

GEWI-Singlebar pile with anchorage and coupler splice for piles with compressive loads

Appendix 4
GEWI - Pile for alternating loads

End anchorage (for Ø 20 - 50 mm)

- Anchor nut .. T 2002
- Anchor piece .. T 2073 G

Plate anchorage (for Ø 32 - 50 mm)

- Anchor nut .. T 2002
- Anchor plate .. T 2139
- Add. reinforcement for plate anchorage

- Standard corrosion protection
- Double corrosion protection

- For additional reinforcement and anchorage lengths:
  -- see approval Z-1.5-76 for Ø 20-32 mm
  -- see approval Z-1.5-149 for Ø 40 and 50 mm
- Pile neck strengthening: see appendix 6/7

Coupler splice

- For coupler splices the following approval certificates shall be observed:
  - approval Z-1.5-76 for Ø 20-32 mm
  - approval Z-1.5-149 for Ø 40 und 50 mm

<table>
<thead>
<tr>
<th>Ø32</th>
<th>Ø40</th>
<th>Ø50</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Ø</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>a</td>
<td>190</td>
<td>230</td>
</tr>
<tr>
<td>b</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>c</td>
<td>40</td>
<td>45</td>
</tr>
</tbody>
</table>

All measurements in mm

DYWIDAG SYSTEMS International

GEWI-Pile Ø 20 – 50 mm

GEWI-Singlebar pile with anchorage and coupler splice for piles with alternating loads

Appendix 5
GEWI-Singlebar pile B 500B  Ø 20; 25; 28 mm
Anchorage - Add. reinforcement - Pile neck strengthening

<table>
<thead>
<tr>
<th></th>
<th>GEWI-Pfähl with Standard-corrosion protection</th>
<th>GEWI-Pfähl with Double-corrosion-protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stab Ø</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td><strong>Anchorage</strong> *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bond anchorage</td>
<td>( l_0 )</td>
<td>in accordance with DIN 1045-1</td>
</tr>
<tr>
<td>End anchorage</td>
<td>( l_\alpha \times l_0 )</td>
<td>see approval certificates Z-1.5-76 resp. Z-1.5-149</td>
</tr>
<tr>
<td>Plate anchorage</td>
<td>no plate anchorage for piles Ø 20, 25 und 28 mm</td>
<td></td>
</tr>
<tr>
<td><strong>Additional reinforcement</strong> *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>for end anchorage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>for plate anchorage</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pile neck strengthening</strong> **</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrugated sheathing</td>
<td>( a_{RI} )</td>
<td>( \geq 35 )</td>
</tr>
<tr>
<td>Length in concrete</td>
<td>( t_{1R} )</td>
<td>150</td>
</tr>
<tr>
<td>Length of strengthening</td>
<td>( t_2 )</td>
<td>600</td>
</tr>
<tr>
<td>Helix</td>
<td>( \varnothing_W )</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>( a_{wL} )</td>
<td>( \geq 45 )</td>
</tr>
<tr>
<td></td>
<td>( c_W )</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>( n \times \varnothing )</td>
<td>4x Ø8</td>
</tr>
<tr>
<td>Longitudinal bars</td>
<td>( t_{1L} )</td>
<td>250</td>
</tr>
<tr>
<td>Length in concrete</td>
<td>( t_2 )</td>
<td>600</td>
</tr>
<tr>
<td>Length of strengthening</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reinforcement cage made of N94 welded wire fabric</td>
<td>( a_{Bi} )</td>
<td>( \geq 45 )</td>
</tr>
<tr>
<td>Length in concrete</td>
<td>( t_{1B} )</td>
<td>250</td>
</tr>
<tr>
<td>Length of strengthening</td>
<td>( t_2 )</td>
<td>600</td>
</tr>
</tbody>
</table>

All measurements in mm

*The related approvals for reinforcing steel with thread ribs (B500B) and approval Z-1.5-76 (GEWI anchorages Ø 20-28 mm) shall be observed.

**If the piles are only temporarily needed (service life < 2 years), the pile neck strengthening can be neglected.

Appendix 6

DYWIDAG SYSTEMS International

GEWI-Pile Ø 20 – 50 mm
GEWI-Singlebar pile BSt 500 S  Ø 32; 40; 50 mm
Anchorage - Add. reinforcement - Pile neck strengthening

<table>
<thead>
<tr>
<th>Anchorage *</th>
<th>GEWI-pile with Standard corrosion protection</th>
<th>GEWI-pile with Double corrosion protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bond anchorage</td>
<td>Bar Ø 32  40  50</td>
<td>Bar Ø 32  40  50</td>
</tr>
<tr>
<td></td>
<td>lo 1270  1760  2480</td>
<td>lo 1270  1760  2480</td>
</tr>
<tr>
<td>End anchorage</td>
<td>l₁=α₁x₁₀</td>
<td>see approval certificates Z-1.5-76 resp. Z-1.5-149</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional reinforcement *</th>
<th>for end anchorage B500 B</th>
<th>see approval certificates Z-1.5-76 resp. Z-1.5-149</th>
</tr>
</thead>
<tbody>
<tr>
<td>for plate anchorage B500 B</td>
<td>n 3 3 5</td>
<td>3 3 5</td>
</tr>
<tr>
<td></td>
<td>Ø 8 10 10</td>
<td>8 10 10</td>
</tr>
<tr>
<td></td>
<td>a 190 230 285</td>
<td>190 230 285</td>
</tr>
<tr>
<td></td>
<td>b 20 25 25</td>
<td>20 25 25</td>
</tr>
<tr>
<td></td>
<td>c 40 45 45</td>
<td>40 45 45</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pile neck strengthening**</th>
<th>Corrugated sheathing</th>
<th>Length in concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>a₁RI</td>
<td>≥46 55 66</td>
<td>≥46 55 66</td>
</tr>
<tr>
<td>t₁RI</td>
<td>150 200 200</td>
<td>150 200 200</td>
</tr>
<tr>
<td>t₂</td>
<td>600 600 600</td>
<td>600 600 600</td>
</tr>
</tbody>
</table>

| Helix | Øw 4 4 4 | 4 4 4 |
|-------| a₁w 4 4 4 | 4 4 4 |
| c₁w 75 75 75 | 75 75 75 |
| n x Ø 4x Ø8 4x Ø8 4x Ø8 | 4x Ø8 4x Ø8 4x Ø8 |
| t₁W | 250 300 300 | 250 300 300 |
| t₂ | 600 600 600 | 600 600 600 |

<table>
<thead>
<tr>
<th>Longitudinal bars</th>
<th>Length in concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>aBI</td>
<td>≥57 65 75</td>
</tr>
<tr>
<td>t₁B</td>
<td>250 300 300</td>
</tr>
<tr>
<td>t₂</td>
<td>600 600 600</td>
</tr>
</tbody>
</table>

All measurements in mm

*The related approvals for reinforcing steel with thread ribs (B500B) as well as approvals Z-1.5-76 (GEWI anchorages Ø 32 mm) and Z-1.5-149 (GEWI anchorages Ø 40 and 50 mm) shall be observed.

**If the piles are only temporarily needed (service life < 2 years), the pile neck strengthening can be neglected.
Anchorage
Type of anchorage is always an end anchorage equipped with an anchor piece (.. T 2073 G) and a lock nut (.. T 2040), or an anchor nut (.. T 2163 G or .. T 2202) respectively in accordance with appendices 3 to 5.

Add. reinforcement
The additional reinforcement of the GEWI multibar pile in the anchorage area depends on the use of the pile as a tensile pile or as a pile with compressive or alternating loads (see also Appendix 9)

Top view
Ø 80 mm (GEWI Ø32)
Ø 100 mm (GEWI Ø40)
Ø 125 mm (GEWI Ø50)

Section A-A
borehole
longit. bars
helix (Øw)
a_w (s. App. 9)

Lock nut .. T 2040
(not for contact splice)

Coupler .. T 3003
(for tension or compression) or
Contact coupler .. T 3106 G
resp. .. T 3006 (compression only)

Spring basket spacer or segment spacer

If necessary the DYWIDAG post grouting system can be mounted

DYWIDAG SYSTEMS International
GEWI-Pile Ø 20 – 50 mm
GEWI-Multibar pile with Standard corrosion protection

Appendix 8
# GEWI-Multibar pile B500 B  Ø 32; 40; 50 mm

## Anchorage - Add. reinforcement - Pile neck strengthening

<table>
<thead>
<tr>
<th></th>
<th>Bars n x Ø</th>
<th>3 x 32</th>
<th>3 x 40</th>
<th>3 x 50</th>
<th>2 x 40</th>
<th>2 x 50</th>
<th>1 x 40 1 x 50</th>
<th>2 x 40</th>
<th>1 x 40 2 x 50</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Torqued End anchorage</strong></td>
<td>acc. to Z-1.5-76</td>
<td>acc. to approval Z-1.5-149</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Additional reinforcement made of B500 B</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- only for tensile loads</td>
<td>n_{Z,A}</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>n_{Z,B}</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>9</td>
<td>11</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>n_{Z}</td>
<td>13</td>
<td>15</td>
<td>17</td>
<td>13</td>
<td>15</td>
<td>14</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Ø</td>
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<tr>
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<td>a</td>
<td>275</td>
<td>325</td>
<td>425</td>
<td>300</td>
<td>375</td>
<td>325</td>
<td>350</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>3 x c</td>
<td>135</td>
<td>135</td>
<td>160</td>
<td>135</td>
<td>160</td>
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<td>160</td>
<td>160</td>
</tr>
<tr>
<td>- for tensile and alternating loads</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>n_{D,A}</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>n_{D,B}</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>9</td>
<td>11</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>n_{D}</td>
<td>16</td>
<td>18</td>
<td>20</td>
<td>16</td>
<td>18</td>
<td>17</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Ø</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>10</td>
<td>12</td>
<td>12</td>
<td>14</td>
<td>14</td>
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<tr>
<td></td>
<td>a</td>
<td>275</td>
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<td>400</td>
</tr>
<tr>
<td></td>
<td>3 x c</td>
<td>135</td>
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<td>160</td>
<td>135</td>
<td>160</td>
<td>160</td>
<td>160</td>
<td>160</td>
</tr>
<tr>
<td><strong>Pile neck strengthening</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- total length</td>
<td>t</td>
<td>900</td>
<td>980</td>
<td>1160</td>
<td>900</td>
<td>1100</td>
<td>1100</td>
<td>1160</td>
<td>1160</td>
</tr>
<tr>
<td>- length in concrete</td>
<td>t_{1}</td>
<td>300</td>
<td>350</td>
<td>550</td>
<td>410</td>
<td>610</td>
<td>530</td>
<td>550</td>
<td>550</td>
</tr>
<tr>
<td>- length in pile neck</td>
<td>t_{2}</td>
<td>600</td>
<td>630</td>
<td>610</td>
<td>490</td>
<td>490</td>
<td>570</td>
<td>610</td>
<td>610</td>
</tr>
<tr>
<td>- min. bar bonding</td>
<td>t_{1+50}</td>
<td>350</td>
<td>400</td>
<td>600</td>
<td>460</td>
<td>660</td>
<td>580</td>
<td>600</td>
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<td><strong>Pile neck reinforcement</strong></td>
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<td></td>
<td></td>
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<tr>
<td>- length</td>
<td>t_{2}</td>
<td>600</td>
<td>630</td>
<td>610</td>
<td>490</td>
<td>490</td>
<td>570</td>
<td>610</td>
<td>610</td>
</tr>
<tr>
<td>- helix</td>
<td>Ø_{W}</td>
<td>6</td>
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<td>6</td>
<td>6</td>
<td>6</td>
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<td></td>
<td>a_{W}</td>
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<td>140</td>
</tr>
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<td></td>
<td>c_{W}</td>
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<td>60</td>
<td>45</td>
<td>80</td>
<td>65</td>
<td>80</td>
<td>55</td>
<td>50</td>
</tr>
<tr>
<td>- longitudinal bars</td>
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<td>3 Ø 10</td>
<td>3 Ø 12</td>
<td>4 Ø 8</td>
<td>4 Ø 8</td>
<td>4 Ø 8</td>
<td>3 Ø 10</td>
<td>3 Ø 12</td>
</tr>
</tbody>
</table>

---

**DYWIDAG SYSTEMS International**

GEWI—Pile Ø 20 — 50 mm

GEWI-Multibar pile with Standard corrosion protection

Appendix 9
Springbasket-Spacer

Distances between the Spring basket spacers at specified inclinations with regard to the vertical (see also Appendix 8)

<table>
<thead>
<tr>
<th>Bar Ø</th>
<th>3 x 32</th>
<th>3 x 40</th>
<th>3 x 50</th>
<th>2 x 40</th>
<th>2 x 50</th>
<th>1 x 40 1 x 50</th>
<th>2 x 40 1 x 50</th>
<th>1 x 40 2 x 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>α ≤ 80°</td>
<td>2.00 m</td>
<td>1.30 m</td>
<td>1.50 m</td>
<td>2.00 m</td>
<td>1.20 m</td>
<td>1.50 m</td>
<td>1.90 m</td>
<td>1.70 m</td>
</tr>
<tr>
<td>α ≤ 60°</td>
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<td>1.50 m</td>
<td>1.70 m</td>
<td>2.30 m</td>
<td>1.40 m</td>
<td>1.70 m</td>
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<td>1.90 m</td>
</tr>
<tr>
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<td>2.60 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
<td>2.50 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
</tr>
<tr>
<td>vertical</td>
<td>3.00 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
</tr>
</tbody>
</table>

Segment spacer

Geometry of the individual segments is the same as for the GEWI single bat piles (see Appendices 1 and 2). Alternatively: weld-on steel runners*. Distances subject to pile inclination with regard to the vertical according to the following table:

<table>
<thead>
<tr>
<th>Bar Ø</th>
<th>3 x 32</th>
<th>3 x 40</th>
<th>3 x 50</th>
<th>2 x 40</th>
<th>2 x 50</th>
<th>1 x 40 1 x 50</th>
<th>2 x 40 1 x 50</th>
<th>1 x 40 2 x 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>α ≤ 80°</td>
<td>2.20 m</td>
<td>2.20 m</td>
<td>2.20 m</td>
<td>2.20 m</td>
<td>2.20 m</td>
<td>2.20 m</td>
<td>2.20 m</td>
<td>2.20 m</td>
</tr>
<tr>
<td>α ≤ 45°</td>
<td>2.60 m</td>
<td>2.60 m</td>
<td>2.60 m</td>
<td>2.60 m</td>
<td>2.60 m</td>
<td>2.60 m</td>
<td>2.60 m</td>
<td>2.60 m</td>
</tr>
<tr>
<td>α ≤ 15°</td>
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<td>3.00 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
</tr>
<tr>
<td>vertical</td>
<td>3.00 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
<td>3.00 m</td>
</tr>
</tbody>
</table>

* DIN 4099 and the approvals for reinforced concrete with thread ribs (B500B) shall be observed for welding operations.
<table>
<thead>
<tr>
<th>Part no.</th>
<th>32 T 2139</th>
<th>40 T 2139</th>
<th>50 T 2139</th>
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<tbody>
<tr>
<td>Dimensions</td>
<td></td>
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<tr>
<td>a</td>
<td>120</td>
<td>150</td>
<td>190</td>
</tr>
<tr>
<td>t</td>
<td>30</td>
<td>40</td>
<td>45</td>
</tr>
<tr>
<td>d</td>
<td>37</td>
<td>45</td>
<td>58</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>3.14</td>
<td>6.56</td>
<td>11.82</td>
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<tr>
<td>Material</td>
<td>S235JR (St 37-2)</td>
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</tr>
</tbody>
</table>

DYWIDAG SYSTEMS International

GEWI—Pile ø 20 – 50 mm

Plate for Plate-Anchorages

Appendix 11