The BAUER Anchor
1958 was the “year of birth” for the grouted anchor. The company Bauer from Schrobenhausen developed it for the execution of a project by the Bayerischer Rundfunk (Bavarian broadcasting company) in Munich. For this project a deep excavation pit had to be provided without any hindering support elements. It was patented later on. The grouted anchor is used for tied-back pits, encompassments, slope secureings and support walls as well as uplift protection and stays. Grout and injection anchors can be executed as temporary or permanent measures. Depending on the base element we differentiate between single bar, multiple bar and stranded anchor.
More than 50 years of BAUER Anchor

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1958</td>
<td>Excavation pit for the television studio building of Bayerischer Rundfunk in Munich&lt;br&gt;The grouted anchor was invented</td>
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<td>1959</td>
<td>The first permanent anchor: Leitzach-Kraftwerk (power station) project</td>
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<td>1964</td>
<td>Bauer Patent “Method to install a tension anchor for tie-back of construction members in soil”</td>
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<td>1971</td>
<td>The “Olympia Anchor” is developed for the tie-back of the tent roof of the Olympia Stadium</td>
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<td>1973</td>
<td>Certificate of Conformity for permanent anchors</td>
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<tr>
<td>1992</td>
<td>Certificate of Conformity for strands</td>
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<tr>
<td>1997</td>
<td>Certificate for stranded anchors&lt;br&gt;Berlin “Lehrter Bahnhof”&lt;br&gt;First installation of anchors removable by blasting</td>
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<tr>
<td>2000</td>
<td>Campus Kronberg&lt;br&gt;First installation of staggered anchors</td>
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<tr>
<td>2007</td>
<td>Den Haag “Rijswijk”&lt;br&gt;First installation of partly removable wire strands with predetermined break point</td>
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<tr>
<td>2012</td>
<td>Certificate of Conformity for “anchor heads for grouted anchors with 2 to 12 strands” considering the “super strand” (0.62 inch)</td>
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</table>
Range of Application

Pile walls, sheet pile walls, Mixed-in-Place walls or diaphragm walls but also steep slopes, retaining walls and quay walls are secured with grouted anchors. Installing such anchors is a technically elegant, but also economic and particularly interesting solution for construction. No matter if it is temporary or permanent, rod or strand bundle, in dry soil or in ground water, the BAUER anchor can be deployed in almost all kinds of soil and in rock. Experienced and constantly trained personnel, high-capacity rigs and equipment and consistent quality control ensure a prompt and technically flawless installation.

Quality Assurance

By consistently documenting the installation process and the acceptance test according to DIN EN 1997-1 (EC7) for each anchor we prove a continuous quality assurance. Within Bauer documentation and quality assurance are drawn up in accordance with DIN EN ISO 9001. During the planning phase as well as while executing projects high standards are adhered to. The used construction methods and procedures are continuously improved. This and the skills of our trained staff ensure to meet the high requirements.
G routed anchors consist of the three main parts, steel tendon, anchor head and grout body. The steel tendon is flexible between the front edge of the grout body and the anchor head and is called free steel length. It acts like a spring with which the part to be tied is prestressed against the construction soil. The load is only transferred into the subsoil in the area of the grout body. For each anchor it has to be proofed that the design criteria is adhered to by executing an acceptance test according to DIN EN 1537 with DIN SPEC 18537 and DIN EN 1997-1:2009-09.

1. **Borehole is drilled**
   - using a drilling method relevant for the existing site conditions (subsoil, water, neighboring buildings).

2. **Drill rods are withdrawn**
   - after or during filling/grouting with cement mortar and installation of anchor tendon.

3. **Secondary grouting**
   - Cracking of the grout body and if necessary multiple post grouting.

4. **Acceptance test and securing the anchor**
   - to the calculated load $P_0$ after hardening of the grout body.

5. **Completed Anchor**
Types of Anchors

Temporary Anchors

Temporary anchors have a planned service life of up to two years. They can be installed as single rod, multiple rod or wire strands. If required they can be removed partly or completely. Each anchor has to undergo a local load test (acceptance test) to prove that they adhere with the design criteria.

Permanent Anchors

Permanent anchors are designed for a service life of more than two years. The main difference between the permanent anchor and the temporary one is the additional corrosion protection. Essential features are the following:

- The anchors have a complete and permanent corrosion protection.
- The anchors are fabricated ready to be installed.
- The installation and the qualifying test have to be controlled by test authorities (examination, surveillance and certification authority).
Within Bauer various drilling methods are available to install anchors. Depending on the essential side conditions such as existing soil, ground water and post treatment, a suitable method has to be identified. Especially in cohesive soil, the selection of the best method is decisive for gaining the necessary anchor bearing capacity. These are the most common methods: rotary drilling or rotary percussion with single rod, overburden drilling, double head drilling, auger drilling and driving.
Suitability and Acceptance Tests

Suitability test (DIN EN 1537 with DIN SPEC 18537 and DIN EN 1997-1:2009-09)

Load testing to confirm suitability of planned anchor installation for existing soil conditions. The suitability test is generally executed on anchors which are permanent part of the structure. A suitability test should be done for all the different soil and bearing conditions at at least three anchors to determine the characteristic pull out resistance.

If during a suitability test the criteria \( k_s = 2.0 \text{ mm} \) is exceeded already at a load level below proof level \( P_p \), the admissible anchor force has again to be determined for the anchors affected by this suitability test, based on the lowest test value. Otherwise, further suitability tests have to be executed (for example at anchors with changed installation methods).

If during a suitability test the anchor force is gradually increased until the maximum pull out resistance is reached, we talk about an exploration test.

Exploration tests for temporary and permanent anchors and suitability tests for permanent anchors can only be controlled and assessed by an authority presently approved for the surveillance of anchor installation (examination, surveillance and certification authority).

After test completion the anchor is specified with the determined load \( P_0 \).

Examination Test (DIN 1537 and DIN SPEC 18537)

Load test to identify the maximum pull out resistance of an anchor at the subsoil-grouting body-interface and the anchor characteristics at the working load level. The anchor is loaded to failure. This is defined by creep limit \( k_s = 2.0 \text{ mm} \). The examination test is an extended suitability test which is done in special cases if there is no experience available about bearing behavior of the anchors at similar soil conditions and the anchors are thus loaded until the maximum pull out resistance is reached (failure in soil).

Separate test anchors are necessary for this kind of test.

Acceptance Test (DIN EN 1537 with DIN SPEC 18537 and DIN EN 1997-1:2009-09)

Local load test at each anchor to check the adherence of the design criteria.

![Force displacement curve in exemplary suitability test of a permanent anchor in non-cohesive soil](image1)

![Force displacement curve in exemplary acceptance test of a permanent anchor in non-cohesive soil](image2)
BAUER Anchors on Site

Heart of Doha, Qatar - Wire Strands
On an area of approximately 350,000 m², Qatar executed the project “Heart of Doha”. By constructing theatres, various buildings, museums, hotels, a mosque and schools, a bridge is built between the past and the ultra-modern present. BAUER International Qatar LLC had to install pile walls, foundation piles, do soil excavation, a dewatering system and tie-back of excavation walls within a period from mid 2009 to mid 2011. A total of approximately 2,700 anchors were installed.

Historic Museum, Frankfurt - Staggered Anchors
We were awarded by the City of Frankfurt on the Main to do the excavation pit with a depth of 10 m right in the heart of the City for the new Historic Museum. We installed a secant bored pile wall with a pile diameter of 880 mm and a depth of 22 m. It was tied-back with 4,400 m staggered anchors with a length of up to 35 m.
Dettingen-Erms - Permanent Anchors
In the industrial area of Dettingen-Erms the company Elring Klinger builds a production facility on a slope. A contiguous CFA bored pile wall as well as more than 10,000 m permanent anchors in two layers with lengths between 17 and 20 m were installed.

Wusterwitz Lock - Permanent Anchors
The project in the western part of Brandenburg comprised the new construction of the lock and the extension of the offshore terminals. It belongs to Bauer Spezialtiefbau’s jobs to install the 15 m excavation pit, to execute the upper offshore terminal, the middle mole and the lower offshore terminal. For the tie-back 483 permanent anchors with a total length of 11,000 m were executed.