Headed bars – efficient technology for reinforcing and connecting concrete structures
Headed bars are an efficient technology to anchor forces into concrete. A significant amount of research about applications of headed bars in reinforced concrete joints has been performed over the past 15 years in Europe. The results of the research have been used for the development of innovative building products with superior added value. Examples of such developments will be presented here.
Jan Bujnak

*R&D Manager, Peikko Group, Finland*

Jan Bujnak is a Research and Development manager at Peikko Group, where he is responsible for the research and technical design of anchorage and reinforcement products. He obtained a PhD from Polytech Clermont-Ferrand (France) in 2007 and co-authored scientific publications dealing mainly with shear, punching shear and anchorage in reinforced concrete structures. Jan Bujnak is participating in development and testing of building products, European Technical Approvals and CE marking of building products as well in design tool development (software and technical manuals.)
Learning Objectives

1. Why anchorage matters?
2. How do headed bars work?
3. What are headed bars good for?
Anchorage in concrete construction
Combining steel and concrete

Where?
• Reinforced concrete
• Composite steel-concrete construction
• Steel construction

Why?
Structural interaction between steel and concrete, where steel typically:
• compensates the low tensile strength of concrete (bending, shear)
• transfers tensile forces in joints (column base)
• controls the cracking of concrete (shrinkage)
Anchorage in concrete construction
Combining steel and concrete

Where?
• Reinforced concrete
• Composite steel-concrete construction
• Steel construction

Why?
Structural interaction between steel and concrete, where steel typically:
• compensates the low tensile strength of concrete (bending, shear)
• transfers tensile forces in joints (column base)
• controls the cracking of concrete (shrinkage)
Anchorage in concrete construction
Anchorage by ribbed bars

- Mechanical interlock
- Friction
- Bond

\[ A_s f_y = f_{bd} l_{b,rqd} \pi \phi \]

- \( A_s \) = cross sectional area of steel
- \( f_y \) = yield strength of steel
- \( f_{bd} \) = design bond stress
- \( l_{b,rqd} \) = development length
- \( \phi \) = bar diameter
Anchorage in concrete construction

Short anchors

• Bent rebar
• Headed bar
Headed bars

Benefits

• Practical:
  – Small length
  – Less weight
  – Industrial production

• Structural
  – Resistance
  – Stiffness

Heeded bars
Application

• Practical:
  – Small length
  – Less weight
  – Industrial production

• Structural
  – Resistance
  – Stiffness

High performance joints
Compact concrete members
Simple detailing & installation
Standardized building products
Headed bars
Types

- **Base material**
  - S355 or similar (smooth bar)
  - B500B or similar (ribbed bar)
- **Manufacturing**
  - Forging by induction heating

Headed bars
Application

- Punching shear reinforcement
- Beam to column joints
- Anchor plates
- Bolted joints
Headed bars
Punching shear reinforcement

- Flat slabs supported on columns
- Fast and cost-efficient construction
- Slab-column connection governs the design
Headed bars
Punching shear reinforcement

- Flat slabs supported on columns
- Fast and cost-efficient construction
- Slab-column connection governs the design
Headed bars
Punching shear reinforcement

- Fast and simple installation of reinforcement in thin slabs
- Superior quality control
- Superior structural performance
Headed bars
Punching shear reinforcement

- Fast and simple installation of reinforcement in thin slabs
- Superior quality control
- Superior structural performance
- Reliable design
Headed bars
Punching shear reinforcement

- Research: Peikko Group & Prof. Muttoni/EPFL Lausanne (Switzerland)

Performance of Peikko PSB studs in floor slabs and foundation slabs. Detailed information available in:


Simões J. T., Bujnak J., Fernández Ruiz M., Muttoni A. Punching shear tests on compact footings with uniform soil pressure Structural Concrete, n° 4, Suisse, 2016, pp. 603-617

Reliable and cost efficient design of slab to column joints
Headed bars
Beam to column joints

• Transfer of the tensile force from beam to column (corbels or moment connections)

EN 1992-1-1
ACI 318-14

Tailor made bended rebar – conventional solution

ACI 318-14

Tailor made headed bar

Approval(s) by Peikko Group

Short headed bar – suitable solution for cost efficient industrial production
Headed bars
Beam to column joints

- Research: Peikko Group & Univ. Zilina (Slovakia)
Headed bars
Beam to column joints

- Research: Peikko Group & Univ. Zilina (Slovakia)

Bujnak, Farbak. Tests of short headed bars with anchor reinforcement used in beam to column joints. ACI Structural journal, V 115, N1, 2018

New opportunities for innovative beam to column solutions
Headed bars
Beam to column joints

- PCs corbel
- Standardised connection details to both
  - Concrete beam
  - Steel/Composite beams
Headed bars
Beam to column joints
Headed bars
Beam to column joints
Headed bars
Anchor plates

- WELDA® Anchor plate
- Steel to concrete assemblies
- Pre-designed standardized model → cost efficient solution
- Power plants
Headed bars
Anchor plates

- Power plants
Headed bars

Anchor plates

- Capacity limited by tensile strength of concrete (cone failure)
- Supplementary reinforcement
Headed bars
Anchor plates

- Research: Peikko Group & Prof. Eligehausen/Stuttgart (Germany)
- WELDA plates with supplementary reinforcement
Headed bars
Anchor plates

- Research: Peikko Group & Prof. Eligehausen/Stuttgart (Germany)
- 60 tests of plates performed
- New behavior patterns identified
- New design recommendations developed

New competitive edge for headed anchor technology


Summary

Headed bars

- Compact
- High performance
- Superior quality
- Easy installation on site
- Tested & approved innovative applications

Solutions with high added value for reliable and efficient designs and construction
Thank you for your attention

jan.bujnak@peikko.com