

Headed Bars – Past, Present & Future

By Lou Colarusso

For many years, the traditional method for terminating reinforcing steel has been hooked rebar anchorages. Recent code changes have significantly increased the amount of rebar required while, at the same time, designers are striving for more compact structural elements. This results in rebar congestion and placement problems. Headed bar terminators answer these challenges by eliminating the majority of rebar embedment lengths required, while reducing job-site related man-hours.

Many structural engineers, architects, and specifiers have discovered the advantages of using headed bar anchors to terminate reinforcing bars and to provide mechanical anchorage in concrete construction as a viable option to hooked bars. Headed bars can be used: to replace hooked reinforcing bar as mechanical anchors, as shear reinforcement, as transverse reinforcement, for connecting roof-columns, and in beam-column connections. Headed bars have been used in a variety of applications, and their beginning's go back to nuclear construction in the US in the 1960s and 70s. They were also evaluated and used by Departments of Transportation in the 1970s for anchoring large bars. Today their use is expanding rapidly, as their benefits become known and their usage is becoming more common.

What is a Headed Bar?

A headed bar is an oversized coupler, plate or 'head' that is attached to one or both ends of a piece of reinforcing steel. Headed bars are used to terminate reinforcing bars and provide mechanical anchorage. These end anchorages are the heads. Headed bars utilize the Shear Cone Theory, where a shear cone is developed off the bearing face of the headed bar projecting out as a cone to the concrete surface. The capacity of a headed bar can be achieved by a



Headed bar applications.

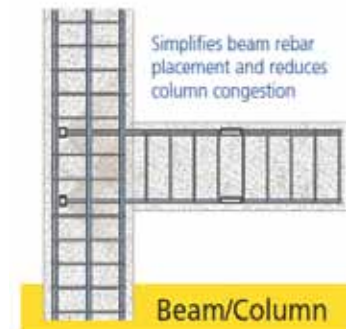
combination of bearing on the concrete and bond development length in front of the head, or simply by bearing alone. Though they can be used for confinement applications, the most common application for headed bars are as an anchor or 90- and 180-degree hooked bar anchorage replacements. The heads are very effective in anchoring the bar.

Within industry, the terms 'headed bar', 'headed bar anchor', 'terminator' and sometimes simply 'anchor' are commonly used interchangeably.

Advantages of Headed Bars

- Reduces Congestion – Standard hooked rebar usage can result in steel congestion. The use of headed bars reduces the length of reinforcing bar required and allows for quicker installations. Headed bars offer less congestion and make possible the use of fewer, larger reinforcing bars. This allows for better concrete consolidation and quality of concreting.
- Reduces placing costs – provides for faster installation of reinforcement.
- Headed bars allow for the use of larger bar diameters in situations where the minimum required hook bar bend radius and bar length would otherwise be geometrically impossible to place.
- The strength of embedded hook bars can be compromised by any loss of bond caused along its length. Headed bars rely primarily upon the shear strength of the concrete and bearing strengths that are less affected by loss of bond strength.
- Tensile loads applied are more evenly applied to headed bars, whereas hooked bars will tend to crush the concrete under the radius of the hooked bar.
- Can be used effectively with high strength reinforcement and high strength concrete, where hooks may be prohibitive.
- Increased shear capacity and overall ductility of the connection detail.

Many worldwide codes and design guides allow for the use of headed bars, including ACI 318-08. ACI 318-08 does require the net head bearing area to be not less than 4 times the area of the reinforcing bar. Headed



Simplifies beam rebar placement.

bars can be used with virtually any size, type or grade of reinforcement including ASTM A615, A706 or A955 and other worldwide rebar specifications. They are available for use with epoxy coated, galvanized, and stainless steel reinforcement.

As reinforcement technologies continue to evolve, with greater usage of higher strength reinforcement and higher strength concrete, the benefits of headed bars will be vital to the success of these materials. Along the development length of the reinforcing bar, the force that can be achieved gradually increases to reach the full yield force in the bar. This development length can become lengthy, particularly if the amount of confining steel is low. Thus, there has always been a desire and a need to find methods to minimize the development length and therefore reduce the amount of steel, associative costs and eliminate detailing issues. Headed bars help to achieve this ideal, as conventional hooked bars are limited or unfeasible in these applications.

Headed bars come in a variety of attachment methods, the most common being threaded, forged and welded. There are many sources available to provide the design professional and user guidance on the use of headed bars, including CRSI, ACI, ASTM, various industry groups, and mechanical coupler manufacturers' literature and websites.

Headed bars are one of the key rebar developments in the last 20 years, and will play an important part in the evolution of reinforced concrete design and constructability over the next 20 years.■

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