Raising the Bar for Better Bridges—Bar Reinforcement Support Standard for Reinforced Concrete

by Gregory Clauson, Concrete Reinforcing Steel Institute

In every concrete element, whether cast-in-place (CIP) or precast concrete, the reinforcement must be held at the correct elevation until the concrete is placed and hardened. Small devices—beam bolsters, high chairs, continuous chairs, slab bolsters, and other shapes—perform this duty. These devices are typically made from steel wire, plastic, or precast concrete, and they hold reinforcement in place during concrete placement and vibration. Reinforcing bars can sag or float when too few supports or weak supports are used, reducing concrete cover and thereby increasing the risk of corrosion or misalignment of the reinforcement. For many years, contractors relied on guidance about reinforcement supports from manuals, but there was no nationally recognized standard defining minimum performance requirements. Practices varied, and the quality of reinforcement support products and their installation—including load capacity, corrosion protection, and the ability to hold bars at the specified elevation to maintain concrete cover during placement and vibration—was inconsistent from project to project.

Developing a Consensus Standard

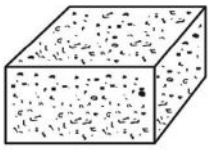
In 2013, the Concrete Reinforcing Steel Institute (CRSI) became an ANSI-accredited Standards Development Organization, which allowed CRSI to assemble balanced committees of designers, contractors, and manufacturers to develop consensus standards. Their first effort, *Supports for Reinforcement Used in Concrete* (ANSI/CRSI RB4.1),[1] was published in 2014. Unlike earlier guidance, the ANSI/CRSI RB4.1 standard uses mandatory language so that it can be cited in codes and project specifications.

After being adopted and incorporated in the American Concrete Institute's *Specifications for Structural Concrete* (ACI 301-16),[2] ANSI/CRSI RB4.1 became the national standard for bar support performance requirements. Work is now underway to have it referenced in the American Association of State Highway and Transportation Officials' *AASHTO LRFD Bridge Design Specifications* and *AASHTO Bridge Construction Specifications*. In April 2022, ANSI recorded final action on ANSI/CRSI RB4.1-2022,[3] a revision of the 2016 version of the standard, which reaffirmed the performance requirements and clarified phrasing.

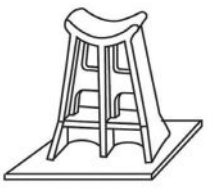
Performance Requirements and Testing

ANSI/CRSI RB4.1 considers bar supports to be engineered components rather than generic accessories. The 2016 edition introduced four key tests: a load test to measure how much weight a support can carry, an impact test to check resilience under accidental collisions, a water absorption test for plastic supports, and a concrete consolidation test to ensure that supports do not create voids or impede concrete flow. Bar support manufacturers must declare a load category—Non-Rated, 200 lb, 400 lb, 600 lb, or 800 lb—and report pass/fail results for impact, water absorption, and consolidation tests.

A variety of reinforcing bar supports of various materials and configurations can be used when placing reinforced concrete. *Supports for Reinforcement Used in Concrete* ANSI/CRSI RB4.1 provides objective criteria for selecting and approving reinforcement supports based on load category and corrosion protection class. All Photos and Figures: Concrete Reinforcing Steel Institute.

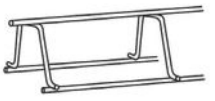


Plain Concrete Block

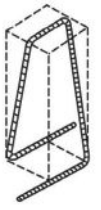


All-Composite Chair with Base Plate

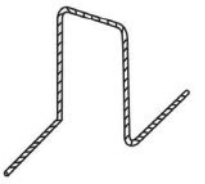
HCP



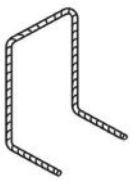
CHCU



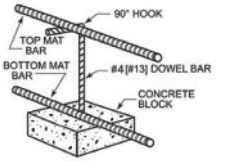
Standee (Shape 125)



Standee (Shape 126)



Standee (Shape 139)



Dowel Block

Workers place epoxy-coated reinforcing steel for a bridge deck, with bars supported at the specified elevation to maintain concrete cover during concrete placement.

While states vary in how they implement ANSI/CRSI RB4.1 testing requirements, the standard establishes the test methods and reporting requirements. The following is an example of the RB4.1 load test rather than a full-state-approval process.

In the load test, the support is loaded vertically through the reinforcement on a steel base plate until the rated load is reached and held for one minute, and then the specimen is evaluated based on deflection and damage. The load category is tied directly to the minimum test load in pounds, and the support must sustain that load without breaking or permanent deformation while limiting deflection to 0.25 in. Continuous supports are evaluated using multiple loading points to represent distributed loading. The impact, water absorption, and concrete consolidation tests are performed and reported independently as pass or fail.

Classes of Corrosion Protection

ANSI/CRSI RB4.1 categorizes supports by corrosion protection class rather than by material. Class 1 supports are intended for moderate to severe exposures; these types of supports are often plastic or protected by plastic. Class 1A supports include additional barrier systems compatible with epoxy-coated reinforcement. Class 2 supports provide enhanced metallic or nonmetallic protection for moderate environments. Class 3 supports have no special coating and are used only where blemishes are acceptable or the support is fully embedded. The standard does not dictate that supports in a particular class must be metal, plastic, or concrete; plastic supports can be designed and tested to qualify for any class, provided the specified performance and class requirements are met.

Adoption of ANSI/CRSI RB4.1 by Agencies and Codes

Major decision-makers have embraced ANSI/CRSI RB4.1. The U.S. Department of Defense's (DOD's) *Unified Facilities Guide Specification (UFGS) 03 30 00: Cast-in-Place Concrete,*[4] references ANSI/CRSI RB4.1 and requires compliant reinforcement supports on all DOD projects. UFGS 03 30 00 also calls for appropriate corrosion-resistant supports when corrosion-resistant reinforcement is used, prohibits using supports as runways for concrete conveying equipment, and requires supports for coated or galvanized bars to be coated at least 50 mm beyond the point of contact. State transportation agencies have adopted similar measures. For example, the Iowa Department of Transportation's Materials Instructional Memorandum 451.01[5] references ANSI/CRSI RB4.1 for approval of plastic bar supports.

ANSI/CRSI RB4.1 is also cited in municipal bid and construction specifications, including the City of Republic, Mo., the Town of Juno Beach, Fla., and the Borough of Rockaway, N.J., which specifies ANSI/CRSI RB4.1 Class 1A for epoxy-coated reinforcement. By using ANSI/CRSI RB4.1 with ACI 301, owners can enforce consistent requirements across projects.

What ANSI/CRSI RB4.1 Does Not Cover

ANSI/CRSI RB4.1 only addresses support performance and corrosion protection. It does not prescribe how many supports to use or where to place them. Those decisions are typically made by the contractor or producer based on constructability, reinforcement stability during placement, and the project's cover and tolerances, and are governed by the project documents. The standard also warns that supports should never be used to bear heavy equipment or serve as runways. Designers must therefore combine requirements from ANSI/CRSI RB4.1 with their own detailing standards and the requirements of ACI 301 and the *Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary (ACI 318R-19)*[6] to determine support layout and quantity.

Benefits for Contractors, Precast Concrete Manufacturers, and Transportation Agencies

Specifying ANSI/CRSI RB4.1-compliant supports reduces the risk of reinforcement displacement during concrete placement and vibration by requiring that supports meet defined load and impact performance. This helps maintain intended bar position and concrete cover and, in turn, reduces the likelihood of durability problems due to inadequate cover or corrosion.

Using the standard classification system also simplifies communication with contractors, designers, and inspectors because support selection can be verified against objective criteria rather than subjective product descriptions.

For public owners, referencing ANSI/CRSI RB4.1 ensures consistency and durability. Performance tests give confidence that supports will keep reinforcement in place and withstand incidental impacts. Following mandates to pair coated supports with epoxy-coated bars ensures that corrosion protection will be preserved. Uniform adoption of the standard across agencies reduces the likelihood of disputes over acceptable products and simplifies inspection and quality assurance.

Implementation Considerations

Specifiers should reference the latest version of ANSI/CRSI RB4.1 and specify the required class for each concrete element. Contractors should use certified products that meet the declared load category and pass the specified performance tests. Supports must not be overloaded or used to carry heavy equipment. Inspectors should verify compliance and proper coating where required.

Conclusion

ANSI/CRSI RB4.1 plays a crucial role in the quality and longevity of reinforced concrete. By defining load-tested performance requirements, corrosion-protection classes, and objective acceptance criteria, ANSI/CRSI RB4.1 gives engineers, manufacturers, and owners a common language and measurable expectations. The adoption of this standard in ACI 301, UFGS, and the requirements of several state transportation agencies demonstrates its relevance to both private and public projects. For precast concrete manufacturers, CIP contractors, and transportation agencies seeking to improve durability and reduce variability, referencing ANSI/CRSI RB4.1 is a practical step to ensure consistent reinforcement support performance and reliable reinforcement placement in both precast concrete elements and CIP bridge structures.

Continual efforts to monitor and update ANSI/CRSI RB4.1 will allow the industry to respond to new materials and methods. As new materials or conditions emerge, the standard will likely evolve to address them. Meanwhile, consistent adoption of ANSI/CRSI RB4.1 across projects fosters a culture of quality and reliability. By embracing ANSI/CRSI RB4.1, contractors, precast concrete manufacturers, and public owners can contribute to a more uniform, durable built environment.

ANSI/CRSI RB4.1, *Supports for Reinforcement Used in Concrete*, mandates that supports for epoxy-coated reinforcing bars must be nonconductive to avoid compromising the coating's corrosion protection.

References

1. Concrete Reinforcing Steel Institute (CRSI). 2014. *Supports for Reinforcement Used in Concrete*. ANSI/CRSI RB4.1-2014. Schaumburg, IL: CRSI.
2. American Concrete Institute (ACI). 2016. *Specifications for Structural Concrete*. ACI 301-16. Farmington Hills, MI: ACI.
3. CRSI. 2022. *Supports for Reinforcement Used in Concrete*. ANSI/CRSI RB4.1-2022. Schaumburg, IL: CRSI.
4. U.S. Department of Defense. 2025. *Unified Facilities Guide Specification (UFGS) 03 30 00: Cast-in-Place Concrete*. Washington, DC: U.S. Department of Defense. Available for download from Whole Building Design Guide: https://www.wbdg.org/dod/ufgs/ufgs-03-30-00.
5. Iowa Department of Transportation (IDOT). 2023. *Materials Structural Memorandum 451.01: Reinforcing Steel Supports*. Ames, Iowa: IDOT. https://ia.iowadot.gov/erl/current/im/content/451.01.htm.
6. ACI. 2019. *Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary (ACI 318R-19)*. Farmington Hills, MI: ACI.

Gregory Clauson is the Northeast Region manager and National Transportation manager for the Concrete Reinforcing Steel Institute (CRSI). He leads CRSI's Transportation Task Group efforts focused on integrating ANSI/CRSI RB4.1,* Supports for Reinforcement Used in Concrete*, into national bridge specifications, working closely with AASHTO, PCI, and allied industry committees to align fabrication and design practices with modern durability and constructability standards.