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Analysis of Common Problems and Preventive Measures for Quality Acceptance in Reinforcement Engineering

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Abstract

During the acceptance process of steel engineering, various quality defects often arise, including steel material damage, disorderly stacking, improper processing, incorrect connections, inadequate anchorage length, non-standard installation, insufficient bar quantity, and bar leakage. This paper analyzes the forms and causes of these common quality faults, combining the current construction acceptance code, standard guidelines, and civil construction experience. It proposes prevention and control measures that can serve as a valuable reference for improving the installation quality of reinforcement engineering, ensuring structural safety, and eliminating hidden quality issues.

Keywords

Reinforcement engineering, Common quality problems, Prevention and control measures, Anchorage length.

1. INTRODUCTION

Reinforcement engineering is a crucial aspect of civil engineering, primarily responsible for bearing tensile, shear, and compressive loads, thus significantly impacting the structural safety. Therefore, it is vital to ensure the quality and installation of reinforcement materials before concrete pouring. Detecting any issues after pouring becomes challenging and may lead to hidden quality and safety hazards. Strict control measures must be implemented to ensure the quality of steel, enhance on-site installation of steel bars, prevent common defects, and adhere to the standards specified in specifications, drawings, and atlases.

2. REINFORCEMENT APPROACH ACCEPTANCE MANAGEMENT

2.1. Key Points of Quality Acceptance

2.1.1 Data Check

(1) File Check: Verify the qualification certificate or quality certificate of steel products, factory inspection report, and steel labels. Each bundle or plate should have two nameplates containing essential information such as the factory name, production date, brand number, steel number, batch number, model, specification, and weight.

(2) Check the Content:

Regular steel bars should have a fixed steel nail for attaching the nameplate, while irregular steel bars (from small workshop foundries) commonly use wire to tie the nameplate. Check for any indications of OEM production on the back of the nameplate, as the production from the original factory is more reliable than that of small factories.

Compare the data on the quality certificate (manufacturer, grade, specification, and bundle quantity) with the nameplate and surface marks of the steel bars on-site. Additionally, check if the manufacturer's original seal is present on the quality certificate.

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Verify if the strong bend ratio, over bend ratio, and maximum elongation on the test report meet the standard requirements.

2.1.2 Technical Check

(1) Appearance Inspection: Hot rolled steel bars should be straight without any damage, oil, sheet rust, cracks, scars, or other surface defects. They should also meet the specified size requirements. Cold rolled steel bars should have a smooth surface without cracks, folded interlayers, or pits.

(2) Diameter and Weighing Check: Note that the nominal diameter does not refer to the inside or outside diameter or their average value. Careful attention should be paid during acceptance. For example, a ribbed steel bar with a nominal diameter of 12mm may have an optical inner diameter less than 12mm, so the specification to be checked is 11.5mm, allowing for a deviation of 0.4mm. Therefore, steel bars with diameters measuring 11.1-11.9mm are considered qualified when using vernier calipers. The length of steel bars used for weight deviation detection should be at least 500mm. The allowable weight deviation range for secondary steel bars with diameters from 6mm to 12mm is $\geqslant$-8%, while steel bars with diameters greater than 12mm should have an allowable weight deviation range of $\geqslant$-6%.

2.2. Management Points

(1) The construction unit must establish a steel bar inspection ledger, documenting the steel bar specifications, models, grades, batch numbers, lot numbers, usage positions, approach and inspection time, inspection results, etc. This ledger should be submitted to the engineering department of Party A for review and recording after each acceptance.

(2) Upon arrival at the site, steel bars must undergo inspection application, witness sampling, and witness submission within 24 hours. They should not be used before the inspection results are obtained, and the raw materials must be stored on-site.

(3) Unqualified steel materials submitted for inspection should have video records and written data documenting the exit processing.

(4) All reinforcement used in the main structure should be processed on-site, and off-site processing is not permitted.

2.3. Steel Bar Storage and Stacking

(1) Classification of Reinforcement: The classification of reinforcement should be based on the level, variety, diameter, manufacturer's stack, and identification cards. The identification cards should indicate the origin, specifications, varieties, quantity, and quality inspection status (to be inspected, qualified, unqualified).

(2) Reinforcement Stacking: The storage site should undergo hardened treatment and have proper drainage measures. Reinforcement should not be stacked directly on soil or water; instead, it should be placed 10-20cm above the hardened ground (using wooden pads or concrete). The stacked reinforcement should be covered with colored cloth to protect it from sun and rain. Unused steel bars that are stored for long periods should be kept indoors to prevent corrosion.

3. COMMON DEFECTS AND PREVENTION MEASURES FOR REINFORCEMENT CONSTRUCTION QUALITY

3.1. Improper Processing of Steel Bars

3.1.1 Improper Angle of Bar Bending Hook

Common Issue: Insufficient curved hook or inadequate bending length.

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Prevention and Control: The length of the inner arc and straight section of the steel bar should meet the requirements of national standard specifications, such as the "Code for Acceptance of Concrete Structure Engineering Construction" and "16G101 Atlas." For first-grade longitudinal reinforcement, the end should have a 180° bent hook. For three-stage longitudinal bars, the end should have a 90° bending hook, with a flatness length of 12d or 15d. When the end bend hook is 135°, the flatness length should be 5d. The seismic closed stirrup (including spiral stirrup) or the length of the straight stretch should be between 10d and 75mm. The length of shear wall reinforcement (135° at both ends or 135° at one end and 90° at the other end) should be 5d.

3.1.2 Straight Thread Buckle End Face is Not Straight

Common Issue: The end is oblique, horseshoe-shaped, or flat-headed.

Prevention and Control: Non-serrated cutting should be employed to ensure there are no burrs. The length of the buckle should be 1/2 of the sleeve length ±1mm.

3.2. Contamination of Steel Reinforcement

Prevention and Control: Vertical reinforcement of walls and columns should be protected by plastic pipes before pouring concrete to prevent contamination. Steel bars should be wiped with steel wire or wet cloth to remove any contaminants before concrete placement.

3.2.1 Uncleared Sundries

Prevention and Control: Before pouring concrete on the floor and after binding the reinforcement of the beam, use a vacuum cleaner to clean up garbage, oil stains, wood chips, and other debris on the template. Clean pollutants on the bottom of the beam mold before embedding the beam. After cleaning the concrete block residue or any remaining steel pipes at the wall and column root, ensure timely cleaning and application of interface agent.

3.2.2 Corrosion of Steel Bars

Prevention and Control: Anti-rust measures should be taken for steel bars at construction joints and post-pouring belts. Exposed steel bars should be brushed with anti-rust paint after being set aside.

3.2.3 Non-Straight End of Straight Thread Steel Bar

Prevention and Control: Ensure that the end of the steel bar is straight by cutting off cracks or grooves and using plastic protective caps.

3.3. Improper Steel Bar Installation

3.3.1 Misalignment of Steel Bar Position

Prevention and Control: Before pouring concrete in wall columns, take positioning measures for the steel skeleton, such as setting positioning hoops at the bottom of column reinforcement, transverse ladder reinforcement, double F clamp, or internal bracing at the bottom of shear walls. If the reinforcement is misaligned, correct it using the following methods.

3.3.2 Insufficient Anchorage Length

Prevention and Control: Ensure the correct understanding of La, Lab, LaE, and LabE. The length of steel bars should be appropriate. LaE is used for seismic components, while La is used for non-seismic components such as beams, columns, walls, plates, secondary beams, and windows. The bottom tendons of plates should generally extend the lintel cross-section by at least half and not less than 5d.

3.3.3 Non-Standard Joint Position and Percentage

Prevention and Control: The percentage of steel cross-section connection joints for beam plate wall members should not exceed 25%, with a maximum of 50% for beam members. The

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joint percentage for column members should not exceed 50%. For welded or mechanically connected shear walls, the joints should be staggered with a spacing between 500mm and 35d. Stagger the position of lap joints of horizontal distribution bars by 500mm. The lapping joints of the first and second seismic strengthening parts should adhere to the above standards. The connection position of reinforcement in the beam plate is the area with minimal force, referring to the standard drawing set. Rebar joints should not be installed in post-pouring belts.

3.3.4 Improper Reinforcement at the Entrance

Prevention and Control: When the hole on the plate is ⩽300mm, the steel bar should bypass the hole edge. If the hole is >300mm, stiffeners should be set according to the requirements of the atlas or design.

3.3.5 Improper Installation Position in Space

Prevention and Control: Use elastic positioning, implement proper binding measures, control the thickness of the protective layer, and follow the drawing specifications. For the floor, the short-span bar should be positioned below, and the long-span bar above. The opposite arrangement applies to the top bar. For foundation floors, the upper and lower positions of the steel bar are opposite to those of the floor. At the intersection of plates, secondary beams, and main beams, the plate's steel bar should be on top, the secondary beam's steel bar in the center, and the main beam's steel bar at the bottom. The vertical longitudinal bars of underground shear walls bear lateral soil pressure, with the vertical bar on the outside and the horizontal bar on the inside. The horizontal reinforcement of the shear wall of the main structure should be on the outside, while the vertical longitudinal reinforcement should be on the inside. The outermost vertical steel at the end of the shear wall should be placed in the horizontal bar, and the outermost vertical steel of the dark column should be outside the horizontal bar.

3.3.6 Missing or Insufficient Loading of Additional Reinforcement

Prevention and Control: Strengthen the management and inspection of additional reinforcement for the basement roof, core area, beam-column junctions, primary and secondary beam connections, and other areas specified in the drawings.

3.3.7 Core Area of Beam-Column or Beam Memory Hole

Prevention and Control: Control the spacing of steel bars, especially in beam and column joints and beam gluten. The clear distance between upper longitudinal bars of the beam should be ≥30mm and ≥1.5d, while the net distance between longitudinal bars at the lower part of the beam should be ≥25mm and ≥1.0d. Multiple rows of steel bars can be isolated by using short steel bar heads.

3.3.8 Insufficient Number of Stirrups in Beam-Column Joint Area

Prevention and Control: First, tie the internal stirrup of the column according to the drawing, and then install the longitudinal reinforcement of the beam.

3.3.9 Inadequate Anchoring Length of Variable Section Components

Prevention and Control: The anchoring length of variable section members is generally 1.2LaE.

3.3.10 Excessive Starting Distance of Reinforcement

Prevention and Control: Except for the starting distance between the stirrup and the dark column floor surface, which should be 30mm, the starting distance between other stirrups, horizontal distribution reinforcement, and plate reinforcement should be 50mm.

3.3.11 Missing or Insufficient Reinforcement

Prevention and Control: According to the drawing requirements, set up reserved holes, wall pipe fittings, embedded wire boxes, etc. The positive angle of the plate should increase the diameter of the radial steel bar with the plate gluten. Reinforcing bars should be added around

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embedded pipelines as specified in the drawings. Three reinforcing bars should not be omitted in folding plates. Construct the stirrup in the encryption area and the reinforcement on the top panel of the basement according to the drawing.

3.3.12 End Cracks in Overhanging Plates

Prevention and Control: During the construction of floor reinforcement, set up bridle tracks and strictly control trampling on negative reinforcement to prevent damage to overhanging plate gluten.

3.3.13 Incorrect Position of Auxiliary Member

Prevention and Control: Correctly understand the drawings and distinguish between vertical and horizontal haunches. Use Yc1 x c2 for vertical haunches and PYc1 transverse haunch x c2.

3.4. Non-Standard Safety Construction

Common Issue: Steel lifting drop.

Prevention and Control: When hoisting steel bars, avoid using the tower crane to lift long steel bars to prevent deformation. Single-strand wire rope lifting is strictly prohibited when using the tower crane for direct lifting. When lifting stirrups with a hopper, loading should not exceed the top of the material.

4. CONCLUSION

(1) Acceptance should be conducted from various aspects, including data and report analysis, visual inspection, sampling, sampling inspection, and management system evaluation.

(2) The processing, connection, binding, installation, and lifting processes of reinforcement should be strictly controlled in accordance with national standards, specifications, atlases, design drawings, and other relevant guidelines. Refer to the prevention and control measures in the article for detailed information.

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