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21 POST INSTALLED ANCHORS AND REINFORCEMENT BARS

21.1 GENERAL

21.1.1 Scope

- 1 This part provides guidance on specifications and design for Post Installed Anchors/ Reinforcement Bars in concrete.
- 2 Related Sections and Parts are as follows:

Section 04 / Part 05 ----- Fundamentals of retaining structures

Section 05 / Part 16 ----- Miscellaneous

Section 05 / Part 17 ----- Structural Precast Concrete

Section 16 / Part 06 ----- Bolting

21.1.2 Adapted References

ACI 318Building code requirements for structural concrete.

ISO 898Mechanical Properties of Fasteners Made of Carbon Steel and Alloy Steel

BS 8539Code of Practice for the selection and installation of post installed anchors in concrete and masonry

EN 1992-1-1.....Eurocode 2: Design of concrete structures -Part 1-1: General rules and rules for buildings

EN 1992-4.....Eurocode 2: Design of concrete structures - Part 4: Design of fastenings for use in concrete

Related ACI codes and ASTM standards

CFA Guidance Note.... Procedure for site testing construction fixings

21.1.3 Definitions

- 1 Post Installed anchors: used to attach objects or structures to a concrete element. There are two types of Post Installed anchors, the first type is the Mechanical anchors (such as expansion bolt, screw bolts, drop in anchors, etc.) and the second type is the Chemical anchors which consists of adhesive and inserts.
- 2 Post Installed reinforcing bars: used to attach new concrete elements to existing concrete structure. Any reinforcement anchorages or splices that are fixed into already cured concrete by injecting adhesive in drilled holes are called "Post installed rebar connections" as opposed to normal, so called "cast-in", reinforcement. Post installed rebar connections are used in a wide range of applications, which vary from new construction projects, to structure upgrades and infrastructure requalification such as vertical & horizontal connections, slab connections, cantilevers, balconies, structural upgrade, wall and slab strengthening.

21.1.4 Submittals

- 1 Product specifications with design values for the Post Installed Anchors/ Reinforcement Bars systems.
- 2 Samples: Contractor shall submit sample of each type of Post Installed Anchors / Adhesives for Post Installed Reinforcement Bars, shown on the drawings.
- 3 Approvals and Guidelines Submissions
 - (a) Product qualification documents (Post Installed Anchors)

- (i) ICC ESR (ICC- Evaluation Service Report) / for ACI 318 based design projects
 - (ii) ETA (European Technical Assessment) of EOTA (European organization for Technical Assessment) .
 - (b) Product qualification documents (Post Installed Reinforcement Bars)
 - (i) ICC ESR (ICC- Evaluation Service Report) / for ACI 318 based design projects (report should clearly be referring to Post Installed Rebar application)
 - (ii) ETA (European Technical Assessment) of EOTA (European organization for Technical Assessment)
 - (c) Manufacturer's installation instructions.
 - (d) Material safety data sheet for chemical component
 - (e) Declaration of performance from supplier for post installed rebar connections (DOP)
- 4 Installer Qualifications
- (a) Submit installer qualifications as stated in Section 21.4.2 Submit a letter stating manufacturer training date and a list of the personnel trained on Post Installed Anchors/ Reinforcement Bars installation.

21.2 MATERIALS

21.2.1 Post Installed Anchors

- 1 Post installed anchors (Mechanical / Chemical) for concrete connections shall have a valid ETA (European Technical Assessment) or a valid ICC-ESR (ICC- evaluation service report).
- 2 Store anchors in accordance with manufacturer's recommendations.

21.2.2 Post Installed Reinforcement Bars

- 1 The adhesive system for Post Installed Reinforcement Bars shall have a valid ICC-ESR (Evaluation service report) or a valid ETA (European Technical Assessment) for post installed rebar connections & the design information of EU Metric Post Installed Reinforcement Bars shall be published in the report.
- 2 If the seismic conditions need to be considered, then only ICC-ESR (Evaluation service report) or ETA (European Technical Assessment) covering this condition shall be used.
- 3 Store Adhesive materials in accordance with manufacturer's recommendations.

21.3 DESIGN

21.3.1 Post Installed Anchors

- 1 The design of Post Installed Anchors shall be carried out in accordance with one of the following requirements:
 - (a) EN 1992-4 (Eurocode 2: Design of concrete structures - Part 4: Design of fastenings for use in concrete)
 - (b) ACI318 (Building code requirements for structural concrete).

21.3.2 Post Installed Reinforcement Bars

- 1 The design of post installed reinforcing bars shall be carried out in accordance with one of the following requirements:
 - (a) The development and splice requirements of the ACI318 (Building code requirements for structural concrete).

- (b) EN 1992-1-1..... Eurocode 2: Design of concrete structures -Part 1-1: General rules and rules for buildings

21.4 Quality assurance

- 1 Installer Qualification: Installation of Post Installed Anchors/ Post installed Reinforcement Bars shall be undertaken only by qualified/trained installers.
- 2 Installer Training: Conduct a training by the manufacturer or by authorised local distributor for the contractor/ installer on the project. The installer shall be trained on the specific manufacturer systems that he is willing to use including the training on anchor / rebar positioning, drilling tools and other important instructions required by the system manufacturer. The training certificate will be only valid for this specific post installed anchor / post installed reinforcing bars system. If the installer is going to use another system he shall attend another training by the relevant manufacturer.
- 3 Manufacturer training authority letter for the local distributor need to be submitted to the site management prior to the training.
- 4 The installer shall comply in all respects with the manufacturer's installation instructions and material safety data sheets and to use only the tools described there.
- 5 In case of any conflict with the Manufacturer installation instructions or the design specifications the installer should refer to the specifier and, if necessary, the manufacturer, so that a solution can be provided and an alternative method can be specified.

21.5 INSPECTION AND TESTING

21.5.1 Inspection

- 1 Close supervision of the installation of Post Installed Anchors/ Reinforcement Bars shall be undertaken by a special inspector agency or supervisor who is a competent member of the site management team. The inspector appointed to undertake this role shall be trained in the installation of Post Installed Anchors/ Reinforcement Bars and be competent to undertake this role.
- 2 Visual inspection of Post Installed Anchors/ Reinforcement Bars shall be conducted at the time of installation and subsequent to Post Installed Anchors/ Reinforcement Bars installation.
- 3 The inspector must verify that the installation is in accordance with the requirements of the design specification and the manufacturer installation instructions, including verification of the location of the Post Installed Anchors/ Reinforcement Bars, edge distance and spacing requirements. Pre-installation inspection of Post Installed Anchors/ Reinforcement Bars usually consists of verification of Post Installed Anchors/ Reinforcement Bars, material, size and length, drilling method, drill bit type and size, hole cleaning procedures, and anchor installation and setting procedures.
- 4 If at any stage, the supervisor has any concerns regarding the installation of the Post Installed Anchors/ Reinforcement Bars, he needs to address it to the specifier or the manufacturer representative for clarifications and advice.

21.5.2 On-site testing

- 1 Non-destructive testing to evaluate Post Installed Anchors/ Reinforcement Bars setting quality.
- 2 On-site testing may not be required if ETA or ICC-ESR qualified Post Installed Anchors/ Reinforcement Bars intended to be used by manufacturer trained installer and under the supervision of inspector personnel.

- 3 If Engineer has any doubt on Post Installed Anchors/ Reinforcement Bars installation or setting procedures or for a purpose of increasing the safety aspects in the project, On-site testing can be conducted.
- 4 On-site testing shall be carried out on installed Post- Installed Anchors/ Reinforcement Bars to ensure that they have been installed correctly and they can perform as specified. This test is not intended to determine the allowable resistance of the Post Installed Anchors/ Reinforcement Bars or the performance & suitability of the particular base material where the Anchors/ Reinforcement Bars is installed.
- 5 On-site testing shall be carried out in accordance with BS 8539 (Code of Practice for the selection and installation of post-installed anchors in concrete and masonry) and the test procedures shall be in accordance with CFA (Guidance note Procedure for Site Testing Construction Fixings).
 - (a) Torque shall be applied with a calibrated torque wrench (if required).
 - (b) Proof loads shall be applied with a calibrated testing tool.
 - (c) Pull-out Test as per ISO 898-1 (if required).
 - (d) Hardness Test as per ISO 898-1 (if required).
 - (e) Shear Test as per ISO 898-1 (if required).
- 6 The minimum number of fixings to be proof tested should always be at least 2.5% and at least 3 of the total number of post-installed anchors / reinforcing bars installed on a job. The minimum of 3 applies in any discrete area where different anchors may have been used, the base material is different, the condition of the base material has been affected by weather conditions e.g. on a different elevation or where anchors have been installed by different installation teams.
- 7 Acceptance criteria: anchors can be said to have satisfied a proof test if the required load is held without movement or any damage or deformation occurring to either the fixing or the base material.
- 8 Failures during Proof Testing: if the correct selection and installation procedures have been carried out as recommended by respectively BS 8539 and the manufacturer then no failures should be encountered. Failures indicate that one or other of these processes may not have been carried out correctly and further measures must be taken as follows. If in any discrete area, 1 failure is encountered then the reason for failure should be investigated. The number of anchors tested in that area should be doubled to 5% and at least 6. If more than one fails then 100% of the anchors should be tested, the reasons for failure determined and the specification reconsidered. Reasons for failure should be communicated to the specifier and installer to prompt either the improvement of the installation method or a revised fixing specification.
- 9 All the tests shall be carried out as per the procedure described above and the results shall be recorded in the test report.

END OF PART