

Quality Control and Supervision of Precast Concrete Construction

Introduction

In recent years, the use of precast concrete in private building developments in Hong Kong has increased. To ensure that the precast concrete elements are of good quality, proper supervision and adequate quality control are necessary during the production, erection and inspection processes of the concrete elements. This practice note sets out the requirements for the quality control and supervision of key precast concrete elements not fabricated on the building site. The requirements stipulated in this practice note do not apply to minor elements such as non-structural precast concrete block work, architectural features and planters.

Duties of the Authorized Person, Registered Structural Engineer and Registered Contractor

2. The Authorized Person (AP), Registered Structural Engineer (RSE) and Registered Contractor (RC) have the responsibilities under the Buildings Ordinance (BO) to ensure that the precast concrete works comply with the provisions and standards of the BO and the approved plans. In accordance with Section 4(3)(a) of the BO and Regulation 37 of the Building (Administration) Regulations (B(A)R), adequate supervision has to be provided by the AP and RSE for the carrying out of the precast concrete works, whereas the RC has to provide continuous supervision, as required under Section 9(5)(a) and 9(6)(a) of the BO and Regulation 41 of the B(A)R, for the carrying out of such works.

Quality Assurance

3. Under item 6 in Section 17(1) of the BO, a condition will be imposed, when giving approval of plans, that precast concrete elements should be manufactured by a factory with ISO 9000 quality assurance certification.

4. Under Regulation 10 of the B(A)R, a requirement will be imposed, when giving approval of plans, that a copy of the Quality Assurance Scheme of the manufacturer should be submitted prior to the application for consent to the commencement of the works. Such submission should be appended with a statement signed by the RSE to confirm that the scheme has adequate provisions in ensuring the quality of production complying with the provisions of the BO and the approved plans.

5. The Quality Assurance Scheme should cover the following items:

- (a) Quality control tests of materials;
- (b) Calibration of laboratory equipment for quality control tests;

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- (c) Efficiency and proper operation of equipment at the casting yard;
- (d) Production process;
- (e) Testing procedures and requirements;
- (f) Frequency and extent of inspection by in-house staff and independent parties; and
- (g) Frequency and extent of audit by in-house staff and independent parties.

Qualified Supervision

6. Under item 6 in Section 17(1) of the BO, a condition will be imposed, when giving approval of plans, that qualified supervision should be provided by the RSE and the RC for the fabrication, erection and examination of precast concrete elements.

7. The RSE should assign a structural quality control supervisor to supervise the precast concrete production works. The RSE should determine the necessary frequency of supervision, which should be no less than once a week. The minimum qualifications and experience of the quality control supervisor are to be the same as grade T3 technically competent person (TCP) under the RSE's stream, as stipulated in the Code of Practice for Site Supervision.

8. The RC should assign a quality control co-ordinator to provide continuous supervision of the precast concrete production works in the factory. The minimum qualifications and experience of the quality control co-ordinator are to be the same as grade T1 TCP under the RC's stream, as stipulated in the Code of Practice for Site Supervision.

9. The names and qualifications of the supervisory personnel assigned by the RSE and RC respectively should be recorded in an inspection log book. The details of precast concrete production, inspection, auditing and testing should be recorded in the log book by the supervisory personnel. The log book should be kept in the factory and a copy of it should be kept at the building site office and, when required, produced to officers of the Buildings Department for inspection.

10. In addition, the RSE and the Authorized Signatory (AS) of the RC should inspect and carry out audit checks to the precast concrete factory at least once every month. Under Regulation 10 of the B(A)R, a requirement will be imposed, when giving approval of plans, that a copy of the RSE's audit reports of the precast concrete factory and a copy of the AS's audit reports of the precast concrete factory duly endorsed by the RSE should be submitted to the Buildings Department for record purpose. The RSE and AS's audit reports should respectively also cover the qualified supervisions by the structural quality control supervisor of RSE's stream and the quality control co-ordinator of AS's stream. Minimum requirements of the audit checks are detailed in Appendix A.

11. As an alternative to the requirement for the RSE's qualified supervision at the precast concrete factory specified in paragraph 10 above, the RSE may consider carrying out on-site audit checks to the quality of the precast concrete elements delivered to the building site. In such situation, the RSE is required to notify the Building Authority in writing before commencement of works, and to submit a copy of on-site audit reports on the quality of the precast concrete elements delivered to the building site to the Buildings Department for record purpose, covering the qualified supervisions by the structural quality control supervisor. Minimum requirements of the on-site audit checks by the RSE are detailed in Appendix B.

12. For good practices in the design, construction and quality control of precast concrete works, reference should be made to the recommendations and guidelines given in the Code of Practice for Precast Concrete Construction issued by the Buildings Department.

Separate Registered Structural Engineer

13. For precast concrete elements not affecting the stability of the parent structure, such as the precast concrete façade or staircase, a separate RSE may be appointed to prepare the design and to supervise the production and erection of such precast concrete elements. In such situation, the specified Forms BA4 and BA5 notifying the appointment of a separate RSE and the scope of works for which he/she is responsible are required to be submitted together with the plans for approval. The project RSE shall also notify the Building Authority in writing that he/she is fully aware of the appointment of a separate RSE and the demarcation of responsibilities. Upon completion of the precast concrete construction works, the separate RSE so appointed is required to certify the satisfactory completion of the works in accordance with Regulation 25(3) of the B(A)R.

14. The separate RSE's submission should be accompanied by an assessment report prepared by him/her giving an account of the effect of the proposed precast concrete works on the parent structure. The assessment report shall be appended with a statement of the project RSE to confirm that he/she is fully aware of the connection details and their effects on the parent structure.

15. The separate RSE shall be responsible for the supervision of the production and erection of the precast concrete elements, including the connection between the precast concrete elements and the parent structure, i.e. ties, anchor plates, cast-in embeds etc., except in the event where such associated works have been installed in the parent structure prior to his/her appointment. For such cases, the structural details and layout of the pre-installed parts should be given in the superstructure plans submitted for approval by the project RSE who shall then be responsible for the supervision of the installation of such parts. The separate RSE should refer to the pre-installed connection details when designing the precast concrete elements and should co-ordinate with the project RSE for any necessary amendment if different connection details are to be used.

16. The separate RSE shall ensure that the conditions and requirements of the quality assurance and qualified supervision as stipulated in paragraphs 3 to 5 and 6 to 11 above respectively are complied with. He/she shall also be responsible for the submission of the documents required in paragraph 4 above.

17. A similar practice note has been issued to authorized persons, registered structural engineers and registered geotechnical engineers.

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**Minimum Requirements of the RSE and AS's Audit Check
at Precast Concrete Factory**

The audit checks carried out by the RSE and the AS at the precast concrete factory should include the following works items:.

Works Item		Scope
1	Formworks	<ul style="list-style-type: none"> ● Smoothness, cleanliness and dimensions of steel mould ● Application of mould releasing agents
2	Steel reinforcing bars	<ul style="list-style-type: none"> ● Size, pattern, fixing and layout of the steel reinforcing bars ● Spacers ● Concrete covers ● Material testing reports
3	Concrete	<ul style="list-style-type: none"> ● Placing and compaction ● Curing ● Material testing reports
4	Finished products	<ul style="list-style-type: none"> ● Concrete surface ● Sizes and dimensions ● Starter steel reinforcing bars
5	Inspection records	<ul style="list-style-type: none"> ● Log books of the structural quality control supervisor/quality control co-ordinator
6	Others	<ul style="list-style-type: none"> ● Any other items considered essential by the RSE/AS for the project.

**Minimum Requirements of the RSE's On-site Audit Check
on Precast Concrete Elements delivered to the Building Site**

The audit checks on the precast concrete elements delivered to the building site carried out by the RSE as an alternative to the audit check on precast concrete elements at the precast concrete factory as specified in Appendix A should comply with the requirements specified in paragraph 2 below.

2. The rate of sampling for the audit checks shall be at least 1% of the precast concrete elements with a minimum of one per every 20 batches of delivery to the building site. The audit check for each sample of the precast concrete element should include the following works items.

Works Item		Scope
1	Steel reinforcing bars	<ul style="list-style-type: none"> ● Opening-up of the concrete surface at 3 locations, each with an area of 100mm x 300mm, to check the size, pattern and layout of the steel reinforcing bars; and the concrete covers ● Measurement of the concrete cover to steel reinforcing bars by covermeter at 6 locations, each with 6 readings taken in an area of 450mm x 450mm ● Material testing reports
2	Concrete	<ul style="list-style-type: none"> ● Concrete coring at 3 locations tested for verification of concrete strength ● Material testing reports
3	Finished products	<ul style="list-style-type: none"> ● Concrete surface ● Sizes and dimensions ● Starter steel reinforcing bars
4	Inspection records	<ul style="list-style-type: none"> ● Log books of the structural quality control supervisor
5	Others	<ul style="list-style-type: none"> ● Any other items considered essential by the RSE for the project.

Remarks :

Tests for compressive strength of concrete cores should be carried out in accordance with the method specified in CS1:2010, by a laboratory accredited under HOKLAS for the particular test concerned. Test results should be reported on a HOKLAS Endorsed Certificate and submitted within 60 days of the delivery of the precast concrete elements to the building site.

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