Dear Sir / Madam

JOINT BCA / IES / ACES / GEOSS CIRCULAR 2019

GUIDELINES ON REUSE OF EXISTING PILES

In Singapore, old piles are frequently left in the ground after buildings have been demolished, to make way for en bloc redevelopment. It is often difficult, costly and even risky to remove the old piles. Over the years, BCA has received enquiries from the industry regarding the reuse of existing piles. It is essential that existing piles are reused safely to continue to sustain the loads of new buildings throughout their entire design life span.

2. Therefore, guidelines have been developed to ensure that existing piles will be reused safely. BCA has taken the initiative to form an industry working group comprising practitioners and members from Institution of Engineers Singapore (IES), Association of Consulting Engineers Singapore (ACES) and Geotechnical Society of Singapore (GeoSS), to jointly formulate the guidelines to meet the needs of the industry. The workgroup has also consulted major government agencies that have an interest in reusing the existing piles before finalising the guidelines as described in Annex A.

3. The guidelines specify conditions to be met for piles to be reused. Additionally, verification tests to determine the load carrying capacity and integrity of existing piles are proposed in the guidelines. These guidelines shall be complied with when making submissions of structural plans, that involve the reuse of existing cast-in-place bored piles for building foundations, to the Commissioner of Building Control for approval. Proposals that involve the reuse of other pile types shall be reviewed on a case-by-case basis.
4. **Notwithstanding the guidelines provided in this Circular, QPs proposing to reuse the existing piles must exercise their engineering judgement and evaluation with due diligence to ensure that their proposed foundation fulfils the objective and performance requirements as stipulated in the Fifth Schedule of the Building Control Regulations 2003.**

5. Pre-consultation with BCA by the developer and the appointed QP shall be conducted in advance for any redevelopment project involving the reuse of existing piles.

6. Please disseminate the contents of this circular to your members. If you need any clarification, please contact Er. Ben Tan Tuang Ho at tel. 1800 3425 222 or submit your enquiry through BCA’s Online Feedback Form at [https://www.bca.gov.sg/feedbackform/](https://www.bca.gov.sg/feedbackform/). Thank you.

Yours faithfully

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1. Objective

1.1 These guidelines are applicable for the reuse of cast-in-place bored piles to support the loads of new buildings in Singapore. They provide guidance to assist Qualified Persons (QPs), builders and developers in the design and construction of redevelopment projects involving the reuse of existing piles as building foundations, to fulfil the objectives and performance requirements stipulated in the Fifth Schedule of Building Control Regulations 2003.

1.2 The reuse of other pile types is not covered under these guidelines.

2. Recommended minimum conditions to be met for the reuse of existing piles

2.1 Developers of redevelopment project who intend to reuse the existing piles to support the new building shall appoint a QP to carry out a feasibility study and submit an assessment report to demonstrate the suitability of the reuse of existing piles.

2.2 Recommended minimum conditions that have to be met for existing piles to be reused are as follows:

(a) The availability of reliable as-built records of the existing piles, including as-built pile depth, pile cut-off-level, pile diameter, pile working load, records of pile reinforcement and concrete grade.

(b) Satisfactory performance of the existing piles, in terms of serviceability and durability, to support existing buildings. Hence, existing buildings should be surveyed to identify the presence of any problems pertaining to the existing foundations. It is worthwhile to interview clients and tenants to understand any potential problems with the existing foundation.

(c) Reasonable knowledge of the existing structural layout for the transfer of loads to the piles.

(d) Stakeholders’ agreement on the reuse of piles.

3. Verification tests to be conducted on reused piles

3.1 Stringent quality checks shall be conducted to confirm the load-carrying capacity, strength, durability and integrity of the existing piles that are intended to be reused. Table 1 shows the recommended minimum pile verification test schedule. QPs shall specify the Reused-Pile Test Plan on the piling plan to support their proposal to reuse the existing piles when submitting the structural plans to BCA for approval.
## Table 1: Pile Verification Test Schedule

<table>
<thead>
<tr>
<th>Type of Verification Tests</th>
<th>Recommended Pile Test Schedule</th>
</tr>
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<tbody>
<tr>
<td>(a) Working load test (to verify safe working load of pile)</td>
<td>2 numbers or 2% of reused piles, whichever is greater</td>
</tr>
<tr>
<td>(b) Full pile coring (to validate as-built pile depth)</td>
<td>2 numbers or 2% of reused piles, whichever is greater</td>
</tr>
<tr>
<td>(c) Compressive strength of concrete (to determine characteristic strength of concrete)</td>
<td>5 numbers or 10% of reused piles, whichever is greater</td>
</tr>
<tr>
<td>(d) Non-destructive integrity test - by high strain dynamic test (to assess pile integrity and verify pile depth)</td>
<td>25% of reused piles</td>
</tr>
</tbody>
</table>

**Note:** The test quantities in Table 1 are recommended as a minimum. QPs must assess all factors and propose an adequate number and appropriate types of verification tests to be conducted.

3.2 Full coring test on existing piles provides a direct verification of the as-built pile depth. In circumstances where full pile coring cannot be carried out, QPs can propose alternative methods of testing, such as geophysical survey techniques, to determine the as-built depth of existing piles. Under such circumstances, QPs will need to evaluate the accuracy and reliability of the adopted method and propose an adequate number of such verification tests to account for the lesser degree of certainty in test results.

3.3 Pile working load tests should be carried out by static maintained load test procedure. Rapid load tests can be adopted if its reliability has been established through calibration with a static maintained load test for the specific site, with due allowance for creep and loading rate effect.

4. **Other recommended verification tests on existing piles to be reused**

4.1 In addition to the verification tests shown in Table 1, QPs shall assess the need to carry out other tests to verify the durability, size of existing piles, and other essential pile information needed for design. This can include the following types of tests:

(a) Carbonation test on concrete – to assess risk of steel reinforcement corrosion  
(b) Petrographic test – to assess durability of concrete  
(c) Borehole sonar – to verify the as-built pile diameter and pile integrity

5. **What must be included in the QP’s assessment report?**

5.1 QPs shall carry out a detailed assessment of the existing piles they intend to reuse to support the new building. The report shall contain the following:
(a) Assessment and computation of the structural capacity of each pile to be reused, in full compliance to the present codes of practice, including the applicable Eurocode standards. The magnitude of the working load adopted shall not exceed the working load stated on the as-built drawings.

(b) Review of the records of the reused piles, such as records of pile design, pile installation, load test, as-built plans and existing conditions of the piles.

(c) Assessment of the durability of the existing piles to be able to endure the duration of the intended design life span of the piles.

(d) Assessment of the performance of the proposed foundation of the buildings supported by a mixture of new piles and existing piles, taking into consideration their relative stiffness and different pile types.

(e) Proposed types and number of verification tests to verify the as-built information of the existing piles, including depth, size, material strength, reinforcement size and reinforcement length.

(f) Precautionary measures implemented to ensure that piles are left intact and not affected by the demolition process. Demolition work has to be properly planned and supervised by competent personnel.

6. Review of the verification test results

6.1 QPs shall oversee the execution of the verification tests and carry out a review of the test results to ensure that the design intent is fulfilled. The review should be completed before the erection of any superstructure on top of the piles.

6.2 QPs shall also visually inspect all the reused piles when their pile heads are exposed to verify the size, and to assess the concrete and rebar conditions. The visual inspection of the pile heads of all reused piles shall be recorded.

6.3 QPs shall present the verification test results to BCA.

6.4 If the verification tests fail to verify the as-built pile information, or the piles to be reused are not able to achieve the design pile capacity, QPs shall submit rectification proposals to BCA as an amendment plan submission for approval.

7. References

(a) Code of Practice for Foundations (2017). By Hong Kong Buildings Department – Section 6.5

(b) Geo Publication No. 1/2006: Foundation Design and Construction. By Hong Kong Geotechnical Engineering Office – Section 5.3

(c) CIRIA Report C653 – Reuse of Foundations (2007)