Building and Construction Authority

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In Collaboration With

THE INSTITUTION OF ENGINEERS - SINGAPORE -

ASSOCIATION OF CONSULTING ENGINEERS SINGAPORE

GeoSS

Our Ref : APPBCA-2019-11

02 September 2019

For enquiries, please contact:
Building Engineering Group (#12-01)
Tel : 1800 3425 222 (1800-DIAL-BCA)
or use our Online Feedback Form at:
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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*.**

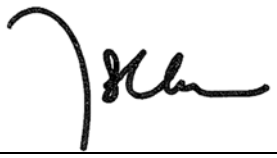
5. Pre-consultation with BCA by the developer and the appointed QP shall be conducted in advance for any redevelopment project involving the reuse of existing piles.

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/. Thank you.

Yours faithfully

ER. DR. YET NAI SONG
DIRECTOR
BUILDING ENGINEERING GROUP
for COMMISSIONER OF BUILDING CONTROL

ER. CHAN EWE JIN
CHAIRMAN, INFRASTRUCTURE CLUSTER
INSTITUTION OF ENGINEERS SINGAPORE (IES)



ER. CHUA TONG SENG
PRESIDENT
ASSOCIATION OF CONSULTING ENGINEERS SINGAPORE (ACES)

ER. CHANDRASEGARAN SUNDARARAJU
PRESIDENT
GEOTECHNICAL SOCIETY OF SINGAPORE (GEOSS)

DISTRIBUTION LIST

ASSOCIATIONS / SOCIETIES

PRESIDENT
INSTITUTION OF ENGINEERS, SINGAPORE (IES)
70, BUKIT TINGGI ROAD
SINGAPORE 289758
ies@iesnet.org.sg

PRESIDENT
ASSOCIATION OF CONSULTING ENGINEERS, SINGAPORE (ACES)
18 SIN MING LANE
#06-01 MIDVIEW CITY
SINGAPORE 573960
secretariat@aces.org.sg

PRESIDENT
SINGAPORE CONTRACTORS ASSOCIATION LIMITED (SCAL)
CONSTRUCTION HOUSE
1 BUKIT MERAH LANE 2
SINGAPORE 159760
enquiry@scal.com.sg

PRESIDENT
SINGAPORE INSTITUTE OF ARCHITECTS (SIA)
79 NEIL ROAD
SINGAPORE 088904
info@sia.org.sg

PRESIDENT
SOCIETY OF PROJECT MANAGERS (SPM)
MACPHERSON ROAD P.O.BOX 1083
SINGAPORE 913412
sprojm@yahoo.com

PRESIDENT
SINGAPORE INSTITUTE OF BUILDING LIMITED (SIBL)
70 PALMER ROAD,
#03-09C PALMER HOUSE
SINGAPORE 079427
josephine@sibl.com.sg

PRESIDENT
REAL ESTATE DEVELOPERS' ASSOCIATION OF SINGAPORE (REDAS)
190 CLEMENCEAU AVENUE
#07-01 SINGAPORE SHOPPING CENTRE
SINGAPORE 239924
enquiry@redas.com

PRESIDENT
SINGAPORE INSTITUTE OF SURVEYORS & VALUERS (SISV)
110 MIDDLE ROAD #09-00
CHIAT HONG BUILDING
SINGAPORE 188968
sisv.info@sisv.org.sg

PRESIDENT
SINGAPORE STRUCTURAL STEEL SOCIETY (SSSS)
1 LIANG SEAH STREET
#02-11/12 LIANG SEAH PLACE
SINGAPORE 189022
secretariat@ssss.org.sg

PRESIDENT
GEOTECHNICAL SOCIETY OF SINGAPORE (GEOSS)
C/O GLOBEWERKS INTERNATIONAL PTE LTD
22 SIN MING LANE
#03-85 MIDVIEW CITY
SINGAPORE 573969
secretariat@geoss.sg

PRESIDENT
PROFESSIONAL ENGINEERS BOARD, SINGAPORE (PEB)
52 JURONG GATEWAY ROAD, #07-03
SINGAPORE 608550
registrar@peb.gov.sg

PRESIDENT
BOARD OF ARCHITECTS (BOA)
5 MAXWELL ROAD
1ST STOREY TOWER BLOCK
MND COMPLEX
SINGAPORE 069110
boarch@singnet.com.sg

DIRECTOR OF INFRASTRUCTURE
SCHOOL CAMPUS DEPARTMENT
MINISTRY OF EDUCATION
1 NORTH BUONA VISTA DRIVE
SINGAPORE 138675
choo_boon_chiao@moe.gov.sg

DIRECTOR
BEST SOURCING DEPARTMENT
PUBLIC UTILITIES BOARD
40 SCOTTS ROAD #18-01
ENVIRONMENT BUILDING
SINGAPORE 228231
herman_ching@pub.gov.sg
lim_kim_tee@pub.gov.sg

DEPUTY CHIEF EXECUTIVE
INFRASTRUCTURE & DEVELOPMENT
LAND TRANSPORT AUTHORITY
1 HAMPSHIRE ROAD
BLOCK 8 LEVEL 1
SINGAPORE 219428
chong_kheng_chua@lta.gov.sg

DEPUTY DIRECTOR
PROJECT DEVT & MGT SECT 1 (C&S)
BUILDING QUALITY GROUP
HOUSING & DEVELOPMENT BOARD
HDB HUB
480 LORONG 6 TOA PAYOH
SINGAPORE 310480
low_kiang_heng@hdb.gov.sg

AG DIRECTOR
TECHNICAL SERVICES DIVISION
JTC CORPORATION
THE JTC SUMMIT
8 JURONG TOWN HALL ROAD
SINGAPORE 609434
tan_su_chern@jtc.gov.sg

DIRECTOR
BUILDING
PEOPLE'S ASSOCIATION
9 STADIUM LINK
SINGAPORE 397750
foo_soon_leng@pa.gov.sg

PRESIDENT
THE TUNNELLING AND UNDERGROUND
CONSTRUCTION SOCIETY SINGAPORE (TUCSS)
C/O CMA INTERNATIONAL CONSULTANTS PTE LTD
1 LIANG SEAH STREET
#02-12 LIANG SEAH PLACE
SINGAPORE 189022
info@tucss.org.sg

PRESIDENT
SOCIETY OF ROCK MECHANICS AND ENGINEERING GEOLOGY
1 LIANG SEAH STREET
#02-12 LIANG SEAH PLACE
SINGAPORE 189022
srmeg@cma.sg

DEPUTY CHIEF EXECUTIVE OFFICER
SENTOSA DEVELOPMENT CORPORATION
33 ALLANBROOKE ROAD, SENTOSA
SINGAPORE 099981
agencies_circulars@sentosa.com.sg

HEAD (FIRE SAFETY AND BUILDING CONTROL)
BUILDING AND INFRASTRUCTURE
DEFENCE SCIENCE & TECHNOLOGY AGENCY
1 DEPOT ROAD
DEFENCE TECHNOLOGY TOWER A
SINGAPORE 109679
hahmeng@dsta.gov.sg

DIRECTOR
BUILDING AND INFRASTRUCTURE
DEFENCE SCIENCE & TECHNOLOGY AGENCY
1 DEPOT ROAD
DEFENCE TECHNOLOGY TOWER A
SINGAPORE 109679
lee_eng_hua@dsta.gov.sg

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ANNEX A

JOINT BCA / IES / ACES / GEOSS CIRCULAR GUIDELINES ON REUSE OF EXISTING PILES

DATE OF ISSUANCE: 2 SEPTEMBER 2019

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

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

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)

(d) Guide to Using Existing Piles – for Current and Future Use (2018). By General Association of Japan Construction Industry Association, Ground Foundation Special Subcommittee, Promotion of Reuse of Piles WG (in Japanese only).