Building and Construction Authority

An MND Statutory Board

In Collaboration With

ASSOCIATION OF CONSULTING ENGINEERS SINGAPORE

THE INSTITUTION OF ENGINEERS SINGAPORE

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https://www.bca.gov.sg/feedbackform/

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2 September 2024

See **Distribution List**

Dear Sir/Madam

JOINT BCA / ACES / IES CIRCULAR 2024

GUIDELINES FOR CUTTER HEAD INTERVENTION

Objective

This guideline for Cutterhead Intervention (CHI) aims to enhance safety in our bored tunnelling building work and is to be read in conjunction with our Circular dated 15 Sep 2017 and 1 Sep 2020.

Background

2 In Singapore, bored tunnelling work is complex work that requires proper implementation of various mitigation measures to avoid damage to buildings and to safeguard public safety. BCA has previously issued circulars which have laid out comprehensive guidelines for implementation by project parties to minimize the risk of damage to buildings and risk of tunnel incidents. The recent bored tunnelling incidents were related to activities of entry into the excavation chamber while the Tunnel Boring Machine (TBM) is stationary. This process is also known as cutterhead intervention (CHI) in the tunnelling industry. This guideline provides a summary of requirements incorporating lessons learnt from recent incidents for CHI in bored tunnelling works.

3 This guideline, which has incorporated inputs from the professional institutions, is for compliance by Site Supervisors, Builders, Qualified Persons (“QPs”), Accredited Checkers (“ACs”) and developers that are involved in bored tunnelling work.

Requirements for Cutterhead Intervention

4 Design QP shall identify adequate planned CHI locations, assess, and specify necessary measures in the approved plan for safe execution of the CHI. Where possible, unplanned CHIs should be avoided. Ground treatment should be provided at high-risk CHI locations.

5 Design QP shall specify necessary instruments including rod extensometer (RX) and/or deep settlement markers (DSM), face support pressure during CHI, pressure step-down procedure, allowable stand-up time, for each CHI planned and unplanned CHI, in the approved plan. For cases where the RX or DSMs are not feasible to be installed, the Builder and QP shall propose alternative means to monitor the sub-surface movements, such as appropriate geophysical survey.

6 The Supervising QP(Geo) and/or RE(Tunnel), and Builder shall continuously monitor and review the key tunnelling operational parameters including face pressure, face pressure step down procedures and excavation/material removal volume during CHI to ensure the tunnel face remains stable. Supervising QP(Geo) and/or RE(Tunnel) shall perform and review the face inspection results at least once every 6 hours during the entire period of CHI to determine the overall stability of the tunnel face before allowing the CHI to continue. Each review session shall include interpretation of instrumentation readings on ground response, face inspection with measurement of strength (e.g., use of pocket penetrometer in OA or grout block) of the exposed tunnel face, water ingress observations, and looking out for any sign of face instability, to determine the overall stability of the tunnel face before allowing the CHI to continue. The inspection form shall only to be signed off if the tunnel face is stable.

For all CHIs when the tunnelling works encounter difficulties or unforeseen or unexpected problems, for example, when any sign of instability at the tunnel face is observed leading to unsuccessful or abandoned CHI, or when unauthorized flushing is conducted, the Builder is to carry out probing and grouting from ground surface and the Supervising QP and Builder shall immediately report the occurrence of said difficulties to CBC.

7 The Supervising QP(Geo) shall review/assess daily the instrumentation results and ensure continuous monitoring of the geotechnical aspects of tunnelling works (e.g. ground movement, change in water pressure), ground condition at the tunnel face and CHI records to determine whether the tunnel face is stable, and CHI is carried out in accordance with design and approved plan during the entire duration of CHI. The Supervising QP(Structural) shall monitor and assess daily the structural (and non-geotechnical) aspects of the tunnelling works (e.g. instruments for monitoring of structures, impact assessment to adjacent structures). If there are any deviations detected during construction, the supervising QP(structural) and/or QP(Geo) shall report the deviations to the design QP(structural) and QP(Geo) immediately.

8 Design QP(Geo) shall assess daily the inspection records submitted by supervising QP(Geo), for the Design QP (Geo) to verify that the ground condition at the tunnel face is in accordance to his/her design, and assess monitoring results and site conditions to ensure that the geotechnical aspects during construction are within design assumptions and parameters at every critical stage of construction, and review or modify the design so as to ensure its adequacy as appropriate.

9 The Builder is to carry out CHI before entering the Control Zone to ensure that cutter tools and TBM are in good conditions.

Updated Specific Conditions of Permit for Bored Tunnelling Works

10 Specific Conditions of Permit for bored tunnelling works are updated to incorporate lessons learnt from tunnel incidents to minimise tunnelling risks. The updated Specific Conditions of Permit for bored tunnelling works are available on BCA's website under Guidelines/Circulars/Advisory to Prepare for Plans and Permit Applications | Building and Construction Authority (BCA). The term 'Supervising QP' refers to Supervising QP for structural work for non-GBW as well as to both Supervising QP for structural work and Supervising QP(Geotechnical) for geotechnical aspects of GBW for GBW. Both the Builder and Supervising QP are reminded to monitor and review excavation or material removal volume continuously during tunnelling and CHI to ensure that the tunnelling is safe and stable. For slurry TBM,

builders are to install real-time density meter and slurry level sensors at the slurry tanks to better estimate the excavation or material removal volume.

11 Key changes include:

a) Adoption of an appropriate geophysical survey by project parties for early detection of any potential void during tunnelling so that grouting work can be implemented in a timely manner so as to avoid a potential sink hole incident for tunnelling under high to very high-risk categories.
b) Simplification of definitions relating to over-excavation control measures so as to align with the same practice of Annex 4 of the 2017 Circular.
c) Redefining what flushing of TBM entails so as to provide better clarity for the industry and expected actions required of the Builder when unauthorised flushing is detected.
d) Amending requirements for Cutterhead Intervention:
    i. QP to specify allowable stand-up time to ensure stability of tunnel face during CHI
    ii. Specify minimum face pressure to ensure tunnel face stability to minimise risk during CHI
    iii. Include conditions for CHI in weak rock (cemented hard Old Alluvium) to allow face pressure to be stepped down gradually.

12 <u>Nothing contained in this circular is meant to replace or negate the need to comply with the provisions of the Building Control Act 1989 and the subsidiary building regulations in all aspects. QPs are to note that they have duties under the Building Control Act, amongst others, to take all reasonable steps and exercise due diligence to ensure that building works are designed in accordance with the provisions of the Building Control Act and the subsidiary building regulations.</u>

13 We would appreciate if you could disseminate the contents of this circular to your members. Please contact us at Tel 1800-3425222 or through the online feedback form (https://www.bca.gov.sg/feedbackform/) should you need any clarification. Thank you.

Yours faithfully

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