Building Control (Amendment) Act 2012 and Regulations 2012:
Geotechnical Building Works (GBW) – Submission Requirements

Building Engineering Group
Building and Construction Authority
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• **Geotechnical Aspects**
  - An analysis of the geological structure and earth materials of the site of the geotechnical building works and its influence on the geotechnical building works
  - An analysis of the ground-water regime and its influence on the wall stability and integrity of the geotechnical building works over time; and
  - Such other applications of earth sciences to and engineering aspects of the geotechnical building works as may be prescribed

• **Earth Retaining Structure**
  - Any structure, structural system or other means used to maintain the shape of excavation during construction, earth filling or cutting
General Definitions

• **Geotechnical Engineer, PE(Geo)**
  - A professional engineer who is registered under the Professional Engineers Act (Cap. 253) as a specialist professional engineer in the specialised branch of geotechnical engineering

**Specialist Accredited Checker, AC(Geo)**

- An accredited checker who is registered under section 16 to undertake the work of an accredited checker as regards the geotechnical aspects of any geotechnical building works
What is Geotechnical Building Works (GBW)?

- **Tunneling Works**
  - Any excavation or other building works to make a tunnel with a diameter, width or height or more than 2 m

- **Excavation Works and Earth Retaining Structures**
  - Any excavation, or other building works to make a caisson, cofferdam, trench, ditch, shaft, well with a depth of more than 6 m
  - Any building works for constructing, altering or repairing any earth retaining structures in or for a trench, ditch, shaft, well with a depth or height or more than 6 m
  - Any earthwork or other building works for constructing or stabilising a slope with a height of more than 6 m (measured as vertical distance between the highest level to the lowest level of the slope)

- **Foundation Works**
  - Foundation for buildings of 30 or more storeys
## Submission Requirement for ERSS

<table>
<thead>
<tr>
<th>All permanent or temporary building works that involve</th>
<th>Appointments Required</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Qualified Person (QP)</td>
</tr>
<tr>
<td>Excavation/ERSS ≤ 1.5 m** deep</td>
<td>Plan approval is not required</td>
</tr>
<tr>
<td>1.5 m** &lt; Excavation/ERSS ≤ 4 m deep</td>
<td>QP(ST)</td>
</tr>
<tr>
<td>4 m &lt; Excavation/ERSS ≤ 6 m deep</td>
<td>QP(ST)</td>
</tr>
<tr>
<td>Excavation/ERSS &gt; 6 m deep and not classified as GBW: e.g. excavation for sewer manhole associated with pipe diameter of 2 m or less</td>
<td>QP(ST)</td>
</tr>
<tr>
<td>Excavation/ERSS &gt; 6 m deep and classified as GBW. E.g. basement excavation.</td>
<td>QP(ST) QP(Geo)</td>
</tr>
</tbody>
</table>

Notes:
- Plan approval is not required for insignificant building works listed on First Schedule of Building Regulation 3A.
- ** If the structure that retains earth is not constructed of reinforced concrete or steel, then the applicable depth is 1 m instead of 1.5 m.
- Planning approval is no longer required for any retaining wall or earth-retaining structure for supporting the face of an excavation made for the purpose of constructing any pile cap, footing, sump, lift pit or trench, provided that the size of these structures does not exceed 10 square meters in area and 2 meters in depth.
GBW – Submission Requirements

• **Plans Submission**
  
  (a) Plans approval is required for GBW
  - To attach ERSS_GBW_Annex A
  - To include site investigation report with PE certification

  (b) Require Permit to commence work
  - to attach ERSS_GBW_Annex B
  - Commencement of work: to notify BCA

• **During Construction Stage**
  
  - To implement ERSS_GBW_Annex C at site
  - To submit ERSS_GBW_Annex E to BCA monthly
Advisory Note 1/09 on ERSS

Table 1: Allowable maximum ERSS wall deflection limits

<table>
<thead>
<tr>
<th>Wall deflection limits/Zones</th>
<th>Locations of buildings, structures and critical utilities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Zone 1 (x/H &lt; 1)</td>
</tr>
<tr>
<td>Allowable maximum ERSS wall deflection limits (δw/H)</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

Ground Type A refers to over-consolidated stiff clays and silts, residual soils, and medium to dense sands; and Ground Type B refers to soft clays, silts or organic soils extending to or below formation level (e.g. Kallang Formation) and loose fills.

10 In any case, the allowable wall deflection limits shall also be determined by the prevention of structural damage to neighbouring buildings or structures arising from ground deformations.

Table 2: Control strategies guides for ERSS.

<table>
<thead>
<tr>
<th>Zone 1</th>
<th>Allowable limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alert level</td>
<td>Work suspension level</td>
</tr>
<tr>
<td>70% WSL</td>
<td>Allowable wall deflection limit</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zones 2 and 3</th>
<th>Allowable limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check level</td>
<td>Alert level</td>
</tr>
<tr>
<td>50% WSL</td>
<td>70% WSL</td>
</tr>
</tbody>
</table>
Use of Ground improvement within retaining wall

• In view of uncertainty in using ground improvement, ground improvement shall be limited to soil improvement work only and shall NOT be used as part of retaining wall especially acting as cantilever retaining wall. This is in line with COI report and BCA’s Advisory Note 1/09.

• If grout mixed piles are present within the retaining wall, as a minimum the following conditions shall be met:
  a) all wall forces such as bending moments and shear forces shall be resisted by a separate structure system (such as soldier piles steel section inserted within the grout mixed pile, a separate analysis for obtaining wall forces shall be carried out with steel section only with grout mixed piles ignored in this analysis)
  b) separate structural laggings (concrete, timber, or steel) shall be provided between structural wall member.
Appointment of QPs and ACs

Supervision QP and his team shall not be a partner, an officer or an employee of the developer or builder

“Independence of QP is essential to avoid situations of conflict of interest”
COI Report 2005

*shall not have any financial or professional interest on the project
*shall be appointed by developer including for ERSS(GBW) submission

We shape a safe, high quality, sustainable and friendly built environment.
Examples of Geotechnical Building Works
(Excavation/earth retaining structures)
Basement Excavation Works: Open cut method

Single tier open cut slope

H > 6 m

GBW
Basement Excavation Works: Open cut method

Multi-tier open cut slope in stiff soils

\[ H = h_1 + h_2 \]

GBW
Excavation Works: Earth Retaining System

Note: Besides retaining wall and strutting supporting system, ground improvement layer is also need to be submitted as part of the GBW(ERSS) system.
Excavation Works in sloping ground

$H = h_1 + h_2$

Note: For computation of excavation depth of GBW, $H$ is computed from where the excavation started and to the final formation level

GBW = Earth retaining & support system, slope
Excavation Works in sloping/varying ground

GBW = Earth retaining & support system

Non-GBW

GBW
Excavation Works: Basement Construction

Excavation depth = H

H = h1

H > 6 m

GBW
Excavation Works: Basement Construction

Localise pits shall also be submitted as part of the main GBW plan.
Excavation Works: Construction of Basement structures

GBW = Temporary earth retaining & support system
Basement structures which is within the excavation support system, is not GBW
Excavation Works: Construction of Basement structure

Note:

a) The plan submission for the temporary retaining wall and permanent basement structure shall be submitted under the same ST and to be submitted as GBW (not submit as piling)

As temporary retaining wall also serves as permanent retaining system of basement structure, GBW = Temporary and permanent earth retaining & support system including basement slab
Excavation Works: Drainage Works

GBW = Temporary earth retaining & support system
Box culvert which is within the excavation support system, is not GBW
Plan submission is required for both temporary and permanent stages of ERSS(GBW).

For excavation involving hill slope (with reinforcing or strengthening works), QP and AC are required for plan submission if the affected slope height exceed 4 m. If the constructed or stabilised slope height exceed 6 m, QP(Geo) and AC(Geo) are also required for plan submission.
Independent retaining wall retaining on existing hill slope

Plan submission is required for both temporary and permanent stages

**GBW** = Slope or retaining wall with constructed retained height exceed 6 m
Earth Retaining Structures (retaining existing slopes/high ground)

$H > 6 \text{ m}$

GBW = Earth retaining wall
Earth Retaining Structure: Retaining wall

GBW = Earth retaining wall

H > 6 m
Earth Retaining Structure: Road Abutment

GBW = Road abutment

H > 6 m
Earth Filling Works: Embankment/Dam

GBW = Earth embankment/dam

H > 6
Earth Filing Works: Retaining Walls

GBW = Caisson

H > 6 m
Excavation Works: Utilities pipes (such as sewers, water and gas pipes) with diameter larger than 2 m and its associated shafts or manholes

GBW = Temporary earth retaining & support system
Utilities pipes or manholes which is within the excavation support system, is not GBW
Examples of Geotechnical Building Works (Tunneling Works)
Tunneling Works: Bored Tunnels/Jacked-in tunnel

GBW = Permanent (tunnel lining) and temporary tunnel support system
Tunneling Works: Cut-and-cover Tunnels

Cut-and-cover tunnels

H > 6 m

GBW = Temporary earth retaining and support system
Permanent tunnel structure exceeding 2 m in diameter, width or height is also GBW
**Tunneling Works: Mined Tunnel**

GBW = Temporary tunnel support system

Permanent tunnel structure exceeding 2 m in diameter, width or height is also GBW
Examples of Geotechnical Building Works
(Foundation Works)
Foundation of High-rise

GBW = Raft foundation

$H \geq 30$ storey

GBW = Caisson, barrette piled foundation or Piled raft foundation

$H \geq 30$ storey
Examples of Non Geotechnical Building Works
Building Works: Small area shaft and trenches

Any excavation for shaft and trenches with plan area of the excavation not exceeding 10 square metres (e.g. trench excavation for diaphragm wall, excavation for bored piles) is exempted from the requirements of geotechnical building works (GBW). For example, an excavation for a small shaft with plan area less than 10 sq m is exempted from the requirement of GBW but still subjected to ERSS submission requirements.
Insignificant Building Works: Utilities such as Sewers, water and gas pipes with diameter of 1m or less

Submission requirement for utilities within construction site together with other building works:

H ≤ 4 m – ERSS plan to be submitted by QP
H > 4 m – ERSS plan to be submitted by QP and AC
Utilities pipe – Plan to be submitted by QP

Any trench for the purpose of laying sewer/utility (including its associated shaft or manhole) not exceeding 1m in internal diameter in conjunction with the sewer/utility system is classified as insignificant building work which requires no plan submission. This exemption does not apply to cases where the trench for the purpose of laying sewer/utility (internal diameter less than 1m) are within a construction site with other building works where the size of trench exceeds 10 square metres or exceeds 2m in depth.
Excavation Works: Utility pipes (such as sewer, water and gas pipes) with diameter larger than 1 m and not greater than 2 m and its associated shaft or manhole

Submission requirement:

H ≤ 4 m – ERSS plan to be submitted by QP
H > 4 m – ERSS plan to be submitted by QP and AC
Utilities pipe – Plan to be submitted by QP and AC
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