
Concepts of Basement Construction Methods

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1.0 INTRODUCTION

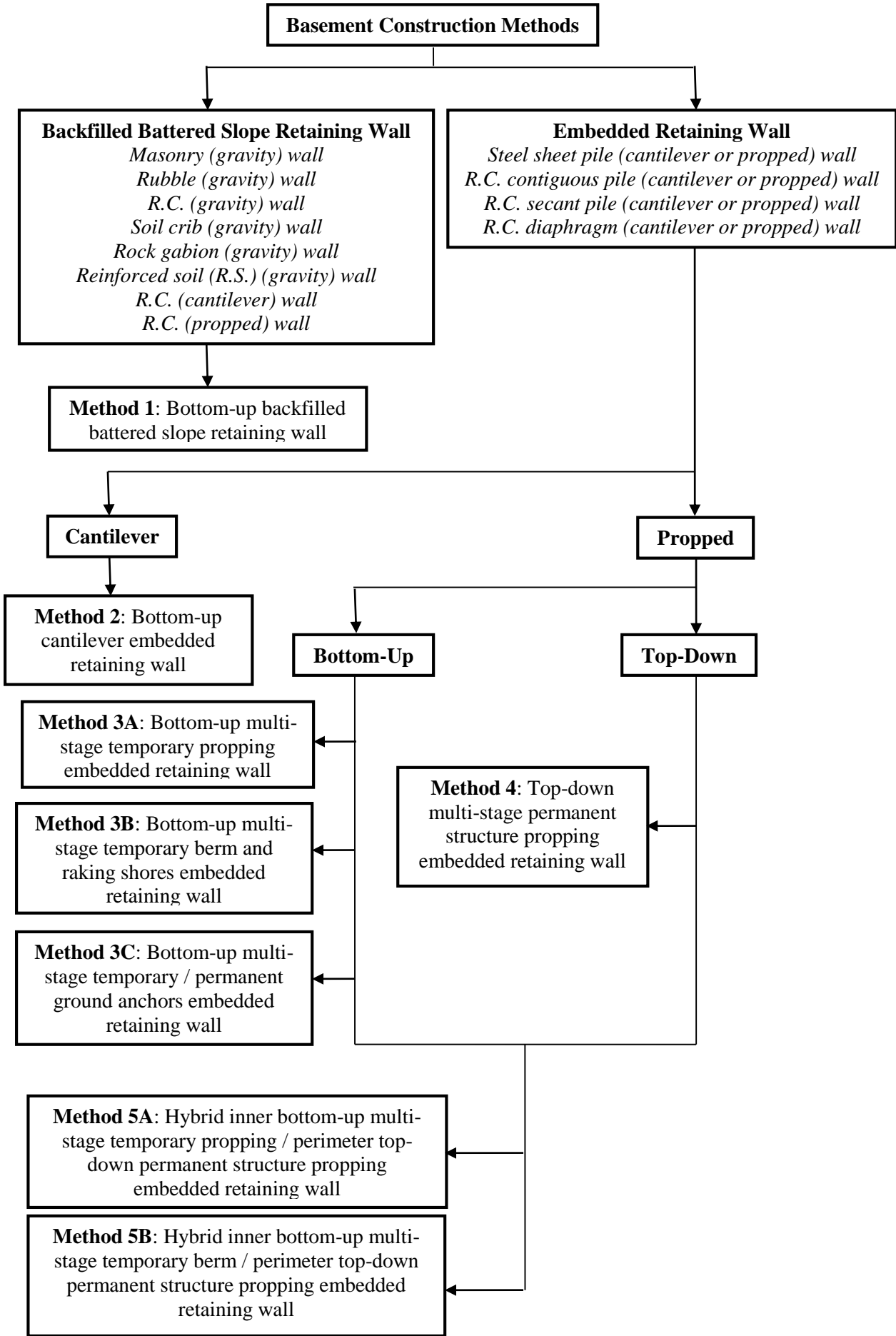
This document presents an overall encompassing conceptual summary of the commonly adopted basement construction methods. The objective of this paper is to lay out the available options to the structural engineer to facilitate the selection of the most suitable method of basement construction.

2.0 BASEMENT CONSTRUCTION METHODS SUMMARY

The following presents the types of retaining walls that are suitable for the different methods of basement construction. A flow-chart of the methods of basement construction is then presented.

1	Bottom-up backfilled battered slope retaining wall <i>Masonry (gravity) retaining wall</i> <i>Rubble (gravity) retaining wall</i> <i>R.C. (gravity) retaining wall</i> <i>Soil crib (gravity) retaining wall</i> <i>Rock gabion (gravity) retaining wall</i> <i>Reinforced soil (R.S.) (gravity) retaining wall</i> <i>R.C. (cantilever) retaining wall</i> <i>R.C. (propped) retaining wall</i>
2	Bottom-up cantilever embedded retaining wall <i>Steel sheet pile (cantilever) retaining wall</i> <i>R.C. contiguous pile (cantilever) retaining wall</i> <i>R.C. secant pile (cantilever) retaining wall</i> <i>R.C. diaphragm (cantilever) retaining wall</i>
3A 3B 3C	Bottom-up multi-stage temporary propping embedded retaining wall Bottom-up multi-stage temporary berm and raking shores embedded retaining wall Bottom-up multi-stage temporary / permanent ground anchors embedded retaining wall <i>Steel sheet pile (propped) retaining wall</i> <i>R.C. contiguous pile (propped) retaining wall</i> <i>R.C. secant pile (propped) retaining wall</i> <i>R.C. diaphragm (propped) retaining wall</i>
4	Top-down multi-stage permanent structure propping embedded retaining wall <i>Steel sheet pile (propped) retaining wall</i> <i>R.C. contiguous pile (propped) retaining wall</i> <i>R.C. secant pile (propped) retaining wall</i> <i>R.C. diaphragm (propped) retaining wall</i>
5A 5B	Hybrid inner bottom-up multi-stage temporary propping / perimeter top-down permanent structure propping embedded retaining wall Hybrid inner bottom-up multi-stage temporary berm / perimeter top-down permanent structure propping embedded retaining wall <i>Steel sheet pile (propped) retaining wall</i> <i>R.C. contiguous pile (propped) retaining wall</i> <i>R.C. secant pile (propped) retaining wall</i> <i>R.C. diaphragm (propped) retaining wall</i>

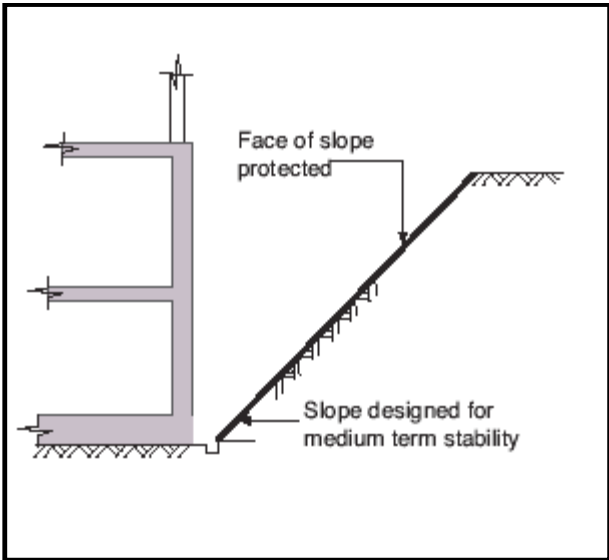
Note that method 5 is a combination of methods 3 and 4 and is used when the site is extensive such that the bottom-up techniques of method 3 is used in the middle of the site and the top-down technique of method 4 is used at the perimeter of the site. It is imperative to note that only single piles are possible at top-down locations, without future load path alterations. Top-down construction however minimizes the need for temporary props.



3.0 BASEMENT CONSTRUCTION METHODS DESCRIPTION

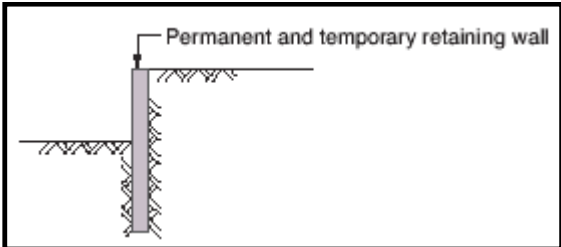
Method 1: Bottom-up backfilled battered slope retaining wall

Soil slopes battered with excavation. Construction follows bottom-up.



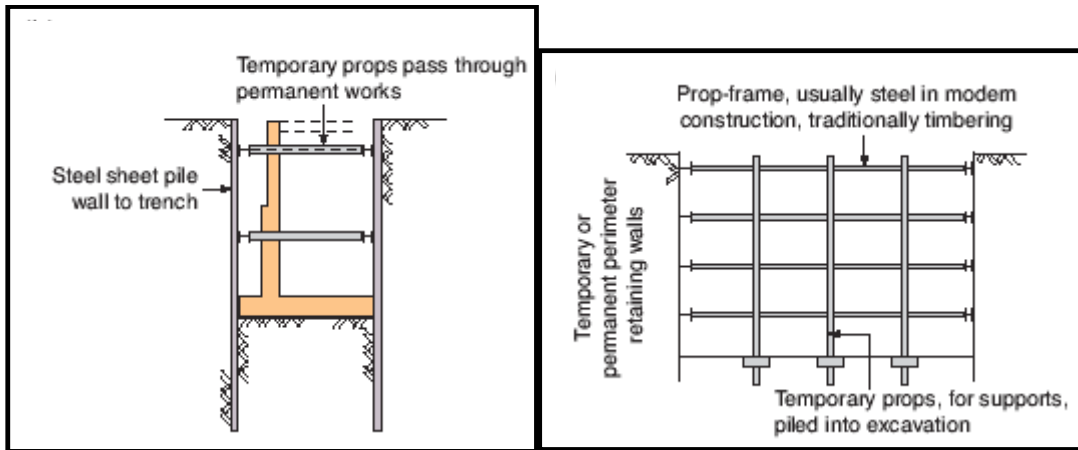
Method 2: Bottom-up cantilever embedded retaining wall

Cantilever retaining wall installed before excavation. Construction follows bottom-up.



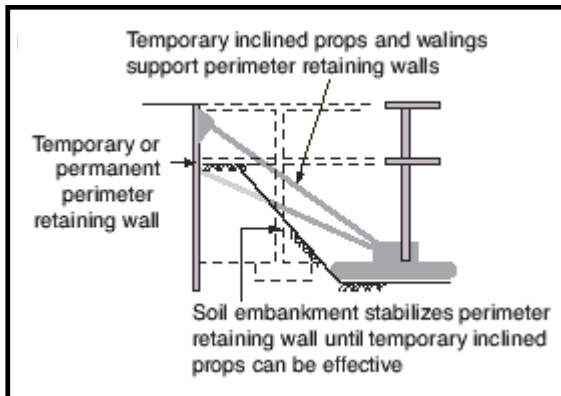
Method 3A: Bottom-up multi-stage temporary propping embedded retaining wall

Horizontal temporary propping between excavation walls at intermediate stages of excavation. Construction follows bottom-up and replaces props.



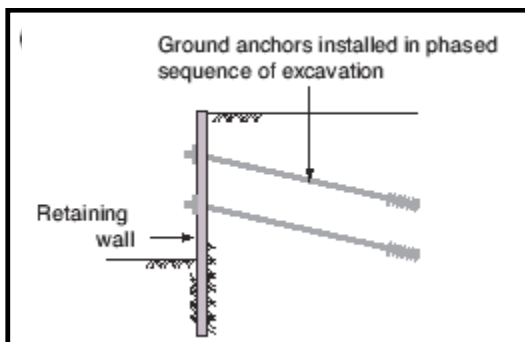
Method 3B: Bottom-up multi-stage temporary berm and raking shores embedded retaining wall

Inclined propping of excavation wall onto thrust blocks at the excavation depth within the excavation at intermediate stages of final phase of excavation. The initial phase contains berms to stabilise the sides of the excavation. In the final phase, intermediate berms are required at the intermediate stages prior to installation of the propping. Construction follows bottom-up and replaces props.



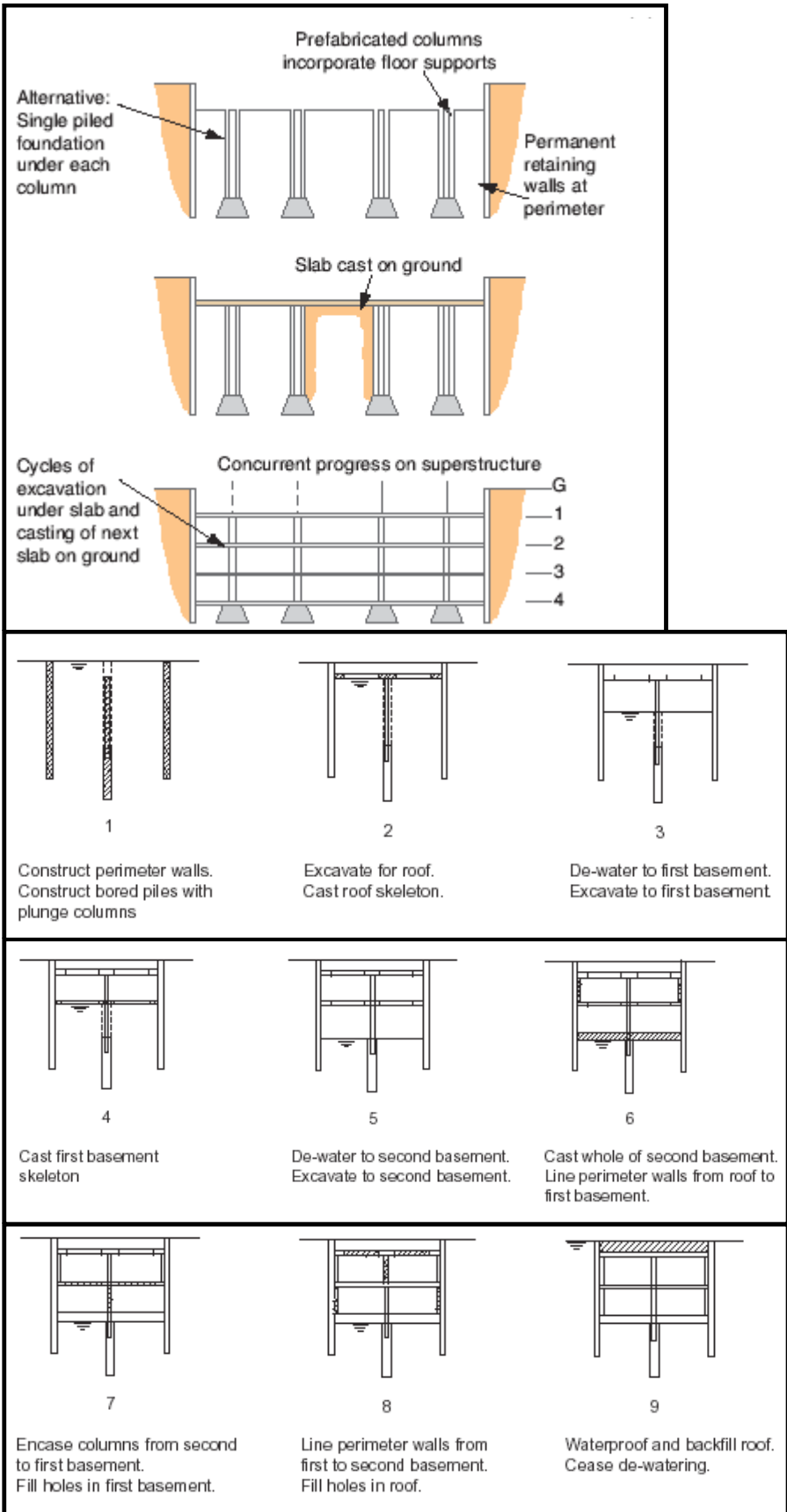
Method 3C: Bottom-up multi-stage temporary / permanent ground anchors embedded retaining wall

Inclined anchors back into soil behind excavation walls at intermediate stages of excavation. Construction follows bottom-up and potentially adds propping to anchors.



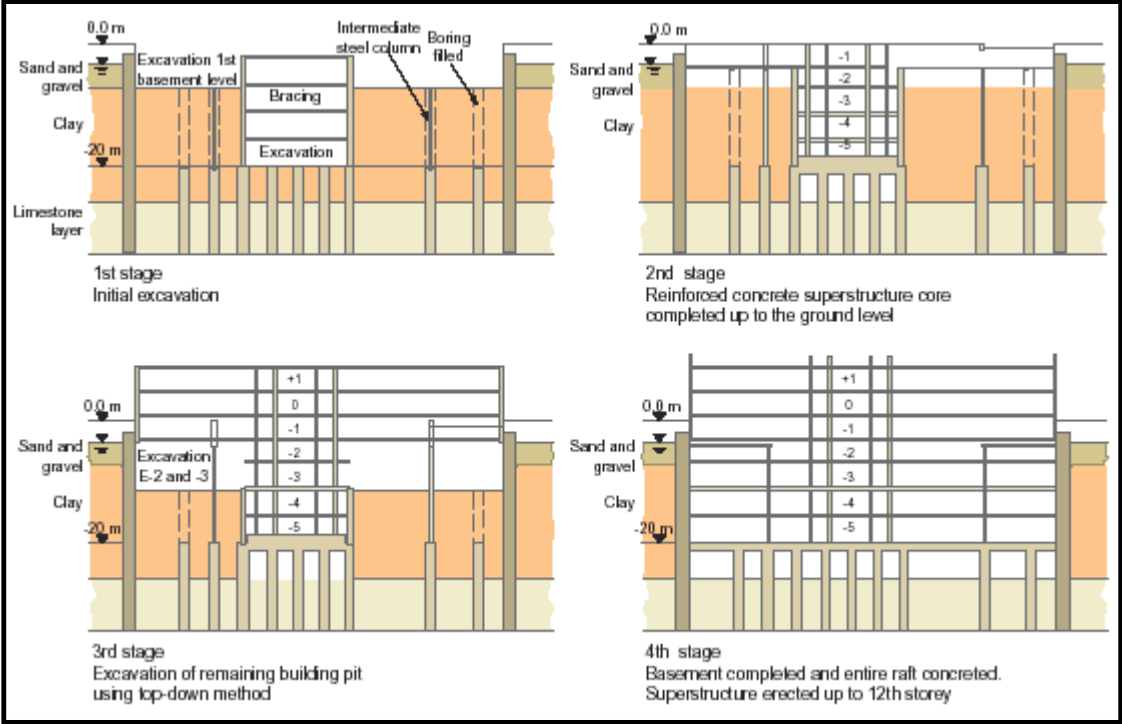
Method 4: Top-down multi-stage permanent structure propping embedded retaining wall

Horizontal propping between excavation walls employing the permanent structure at intermediate stages of excavation. Construction is top-down. Note only single piles possible with top-down construction.



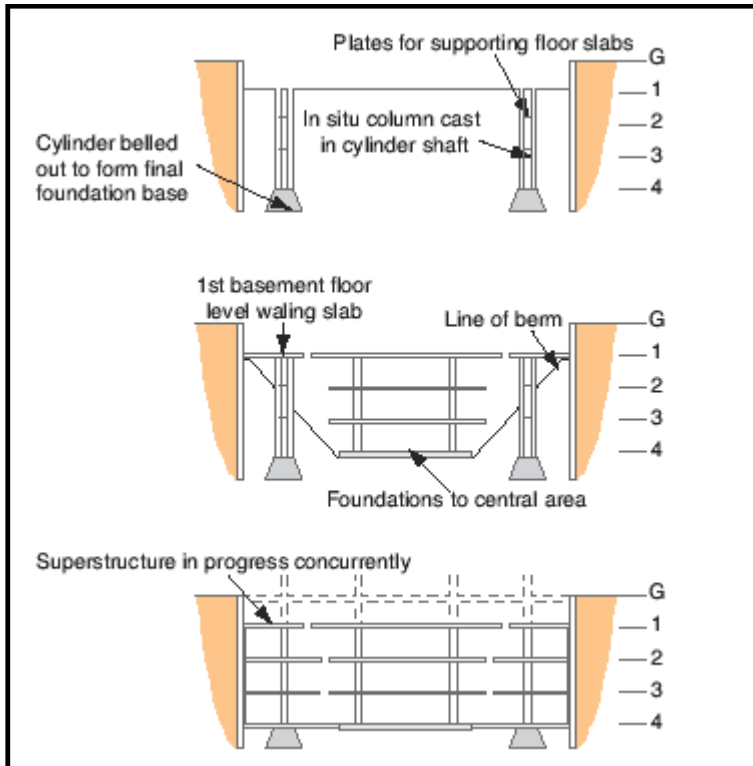
Method 5A: Hybrid inner bottom-up multi-stage temporary propping / perimeter top-down permanent structure propping embedded retaining wall

Horizontal propping between excavation walls employing the permanent structure at intermediate stages of final phase of excavation. The initial phase contains horizontal temporary propping between excavation walls of a smaller excavation within. Construction is bottom-up within the smaller excavation whilst construction is top-down elsewhere. Note only single piles possible at the locations with top-down construction.



Method 5B: Hybrid inner bottom-up multi-stage temporary berm / perimeter top-down permanent structure propping embedded retaining wall

Horizontal propping between excavation walls employing the permanent structure at intermediate stages of final phase of excavation. The initial phase contains berms to stabilise the sides of the excavation. In the final phase, intermediate berms are required at the intermediate stages prior to casting of the permanent structure. Construction is bottom-up except at the location of the berms where the gradual removal of berms requires a top-down construction. Note only single piles possible at the locations with top-down construction.



BIBLIOGRAPHY

1. BURLAND et al. *IStructE Design and Construction of Deep Basements Including Cut and Cover Structures*. Institution of Structural Engineers IStructE., United Kingdom, March 2004.