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BLOG

THE SECRETS OF NO-FINES CONCRETE (NFC) ON SEGMENTAL RETAINING WALLS (SWR's)

In recent years there has been an increasing demand for Allan Block® and Rocklok® retaining walls designed and built using No-fines Concrete (NFC). Sometimes called pervious concrete or porous concrete, NFC is essentially a special type of concrete containing little or no fine aggregate, such as sand.

As explained on the previous technical blog, the maximum wall height that can be constructed using the Allan Block® or Rocklok® retaining wall systems is directly proportional to their weight, width, inter unit shear strength, and vertical batter of construction for any given soil and site geometry conditions. NFC can be used to create a deeper and heavier concrete mass, augmenting the retaining wall resistance against external stability forces such as sliding and overturning. This will allow the maximum wall height of a simple gravity wall to be exceeded, facilitating taller and safer retaining walls with minimum excavation, faster construction, and lower labour costs.

NO-FINES CONCRETE PROPERTIES

NFC is a combination of coarse aggregate, cement, and water, obtained by omitting fine aggregate from conventional concrete. The NFC has properties such as zero-slump, and it will exert similar pressures on the Allan Block® and Rocklok® blocks as loosely placed aggregate until cured.

The NFC should be made from carefully controlled amounts of water and cement with a ratio between 0.45 to 0.55, being the typical amount of cement 210 kg/m^3. Using an average single-sized coarse aggregate of 20mm, surrounded and held together by the cement paste, creates a substantial 20% to 30% void ratio, making the mixture free draining.

A 6:1 gravel to cement ratio should provide a compressive strength exceeding 10MPa, which would be used for design purposes. Depending on the density of the coarse aggregate used, the NFC density should fall between 1,600 kg/m^3 to 2,160 kg/m^3.

Testing conducted on samples of NFC by Allan Block Corporation determined an average internal friction angle of 77.2°.

ADVANTAGES OF NO-FINES CONCRETE

Possibly the main advantage of using NFC is that it allows for taller gravity walls with less excavation and space maximisation. A common NFC depth is 40% to 50% of total wall height, while a geogrid reinforced retaining wall of the same height would require the geogrid length to be around 60% to 70% of total wall height. Occasionally a NFC base width greater than 50% may be required when the retaining wall is supporting high loads, steep backslopes are present, and for poor soil conditions.

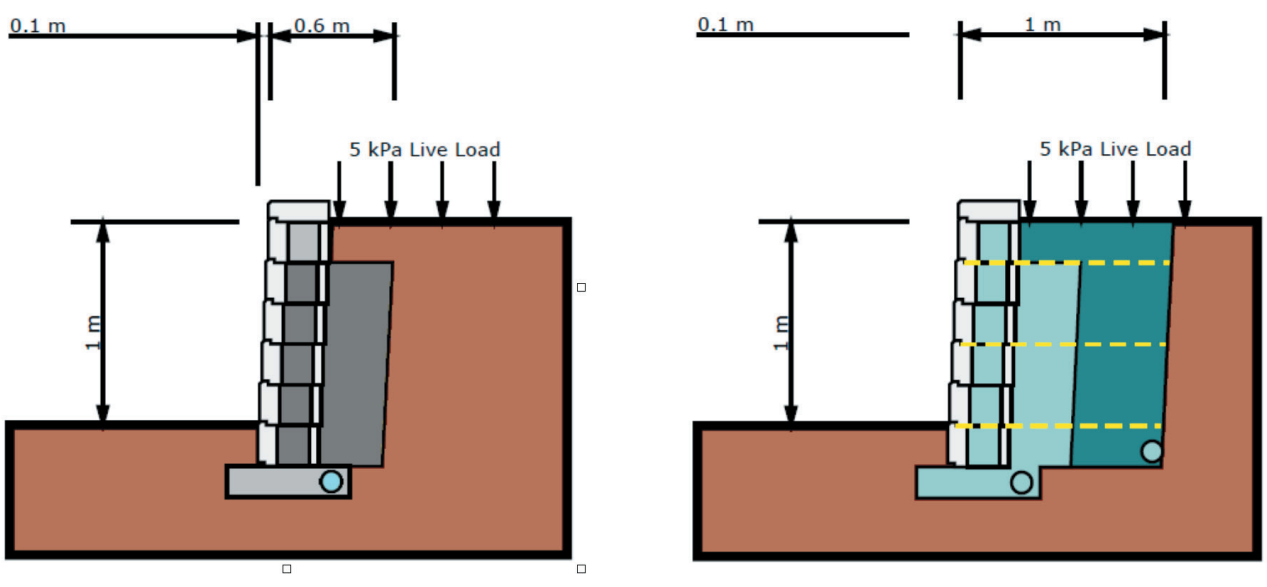

Figure 1: No-fines Concrete vs Geogrid reinforcement

From an operational point of view, the use of NFC simplifies the construction process and removes the necessity for compaction, compaction testing and heavy equipment on-site. NFC eliminates the need of having to import a well-graded backfill material and geogrid rolls, but it also removes the need of drainage metal within the Allan Block® or Rocklok® cores and behind the wall facing. The NFC is already highly permeable, providing a much higher drainage capacity as the entire mass if porous, dissipating hydrostatic pressure behind the wall.

In addition, NFC provides design flexibility when there are various site obstacles and constrains such as, property boundaries, tight corners or areas, manholes, and so on.

Figure 2: On-site obstacles

CONSTRUCTION TIPS WHEN USING NFC

NFC must be used to fill both all the open core/cavities and spaces between Allan Block® or Rocklok® units and behind the blocks as backfill to the specified depth. However, the absolute minimum NFC depth should be not less than 600mm (including the SRW units' width).

The recommended vertical lift of a pour should not exceed 600mm or three courses of blocks, although we suggest a vertical lift of 400mm as it will allow the contractor to comfortably rod the NFC into the cores of the lower courses making sure the cavities are full. Although the concrete pour will start to cure right after being placed, allowing for 2 to 3 hours between pours will help get higher aggregate stability, especially when building retaining walls over 1.2 metres in height. It is extremely important to brush off any material excess or concrete on top of the Allan Block® or Rocklok® units before it dries as it can affect the next course installation and the wall vertical and horizontal alignment.

To improve the anchorage of the Allan Block® or Rocklok® units to the NFC mass, it is suggested for straight wall sections that we remove one back wing per block as this will allow the NFC pour to flow into the spaces between units and lock the other wing securing the block wall facing.

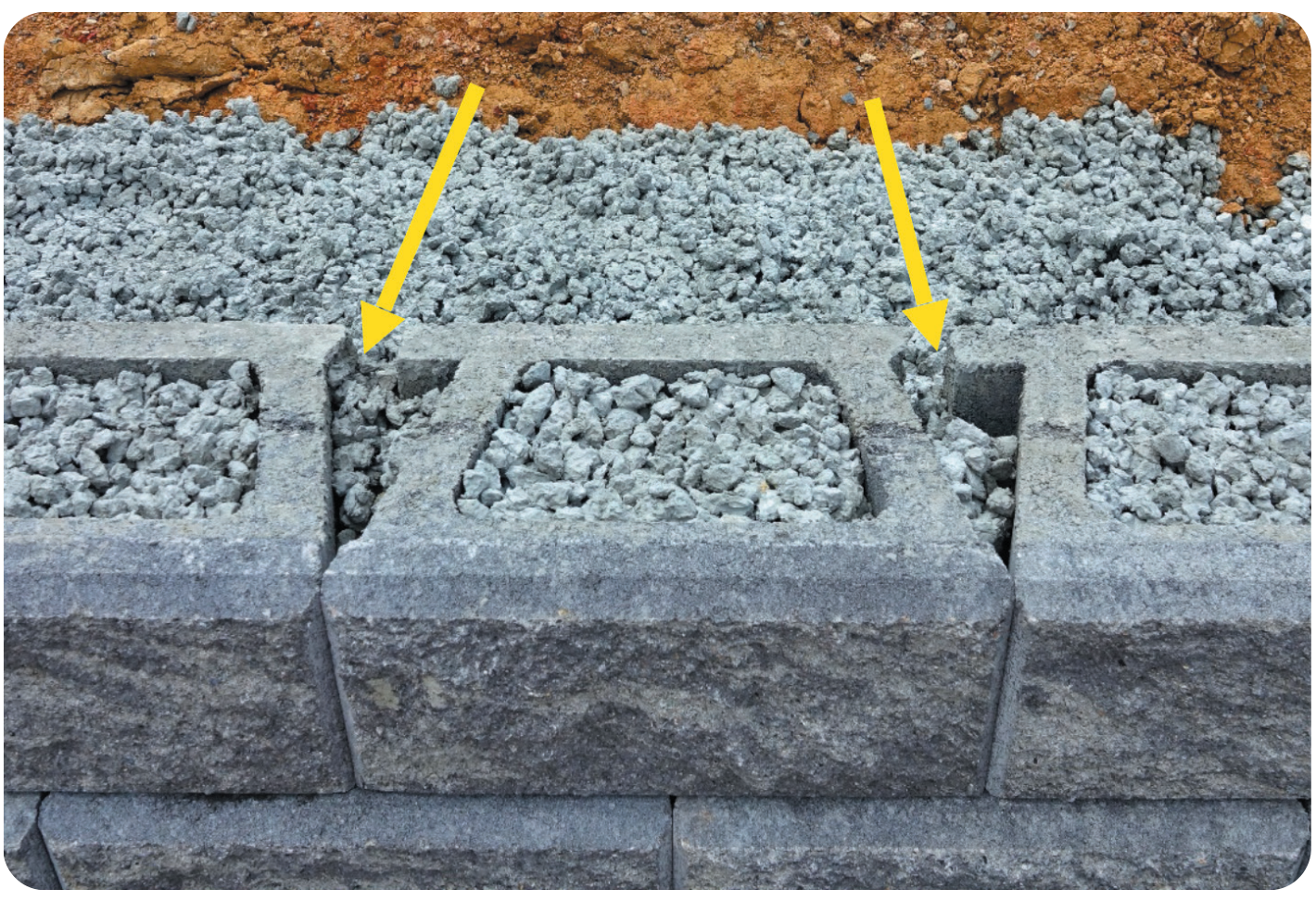

Figure 3: Remove one wing per unit

When finishing the retaining wall and before placing the 200mm of low permeable soil on top of the NFC structure, a layer of geotextile/filter fabric needs to be horizontally placed on top of the NFC mass to prevent the settlement and migration of fines particles and to avert the NFC from clogging up.

REFERENCES

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