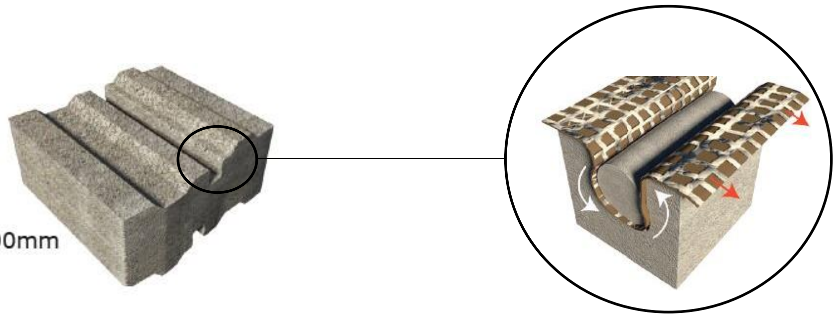
BOSUN VFC CONCRETE BLOCK IN COMBINATION WITH KAYTECH XGRIDS D6638 TEST RESULTS

1. Bosun concrete VFC facing units

Bosun concrete VFC blocks are dry-cast concrete manufactured products. The VFC system is a 90-degree vertical retaining system. There is a positive mechanical interlock connection between the geogrid and the block, through an oval shaped interlocking pin.

VFC block
Dimensions 300 x 300mm
Height 140mm
Mass per Block ±26kg



- Interchangeable face
- Positive mechanical connector (locking mechanism)

VFC base block
Dimensions 300 x 250mm
Height 80mm
Mass per Block ±13kg

- Concave and Convex curves
- No concrete infill or cutting of blocks on curves
- 2m radius on curves

The blocks are manufactured in accordance with SANS 508:2012 and have the characteristics shown in the following table:

Characteristic	Manufacturers performance value
Dimensional Tolerance (mm)	±3
Weight of VFC block (kg)	±26
Gross dry Density ($kg.m^{-3}$)	2150-2250
Compressive strength (MPa)	26
Nib Shear Strength mean (kN/m)	224.80
Nib Shear Strength statistical inferior value (kN/m)	196.10

*Higher compressive strength concrete blocks can be manufactured on request

2. ASTM D6638

Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks)

Key factors assessed:

Mechanical Properties – the method of fixed and friction connection between the geogrids and Bosun VFC concrete block has been assessed, and the short-term & long-term connection strength values have been determined for various wall heights and geogrid/concrete block combinations.

2.1 Kaytech XGrid

Two different grades of XGrid were tested in the test, with the following T_{char} (short-term strength):

XGrid	T_{char} (kN/m)
XG 40-20	40
XG 60-20	60

* Tema technologies and Materials, 2014, XGrid PET-PVC-0 40/20, Rev 3

2.2. Design strength reduction factors:

RF_{ID} (damage) = 1.1-1.15 (sand gravel, coarse gravel, coarse sand)

RF_{CR} (creep) = 1.43 (120 yrs, 20°C)

RF_{CH} (environment) = 1.15 (pH 5-8)

RF_{W} (weathering) = 1.0 (not exposed to sunlight)

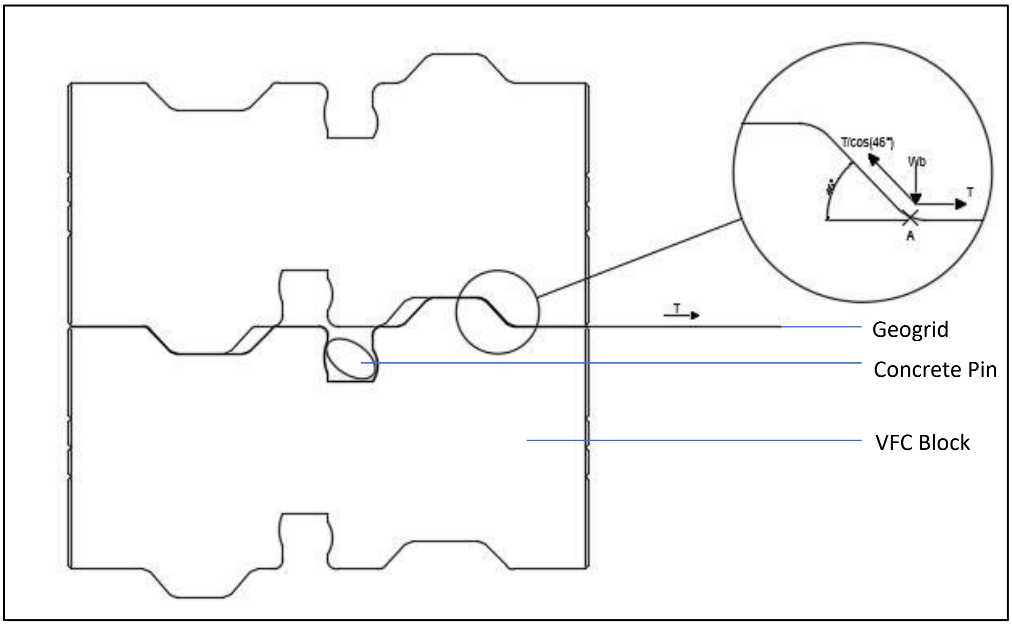
* Tema technologies and Materials, 2014, XGrid PET-PVC-0 40/20, Rev 3

- Damage Factor RF_{ID} not added on peak connection strength as this is already experienced in the D6638 testing procedure as shown in the Figure 1.

2.3.1 Further short-term tensile strength reductions at the block connection

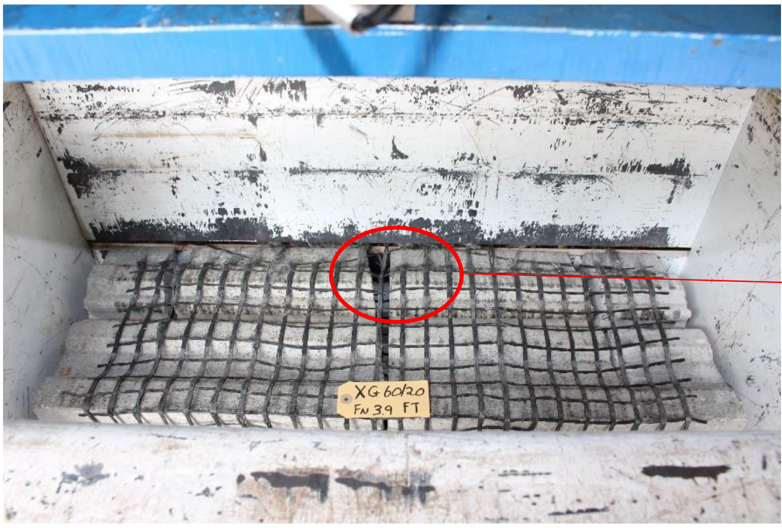
Due to static equilibrium that needs to be achieved between the block and the grid over various angles inside the block, the wide width short-term capacity would at least be expected to be reduced by a factor of up to 1.41 over the nibs. This is due to the development of increased force component over a 46° frictional plane (Figure 1) when compared to the horizontal tensile load from behind the block.

Figure 1: Geogrid interaction with the nib inside the VFC block system



2.3.2 Further short-term tensile reduction due to relaxed yarns

Figure 2: Visual test results sample of inside the VFC block system after completion



A further reduction in tensile capacity of XGrid per meter due to the joints between blocks when packed straight can be expected

Relaxed yarns do not contribute much to capacity

2.3.3 Further short-term tensile reduction due to the pin connection

The rest of the damage may be from mobilisation strain of friction between Xgrid and blocks, behind the pin, damaging the grid.

3. Results

The Bosun VFC concrete retaining block was used in conjunction with the XGrids. An independent source, C-AIM Consult (Enterprises University of Pretoria), performed a series of testing according to the requirements of ASTM D6638-01.

$T_{charconn}$ - the short-term test results from the D6638 pull-out testing conducted. RF_{ID} (damage factor) is already included in this result.

$T_{Dconn} = \frac{Tcharconn}{RF_{CR}.RF_W.RF_{CH}.f_s}$, which is the long-term design connection strength (120 years, 5≤ph≤ 8, 20°).

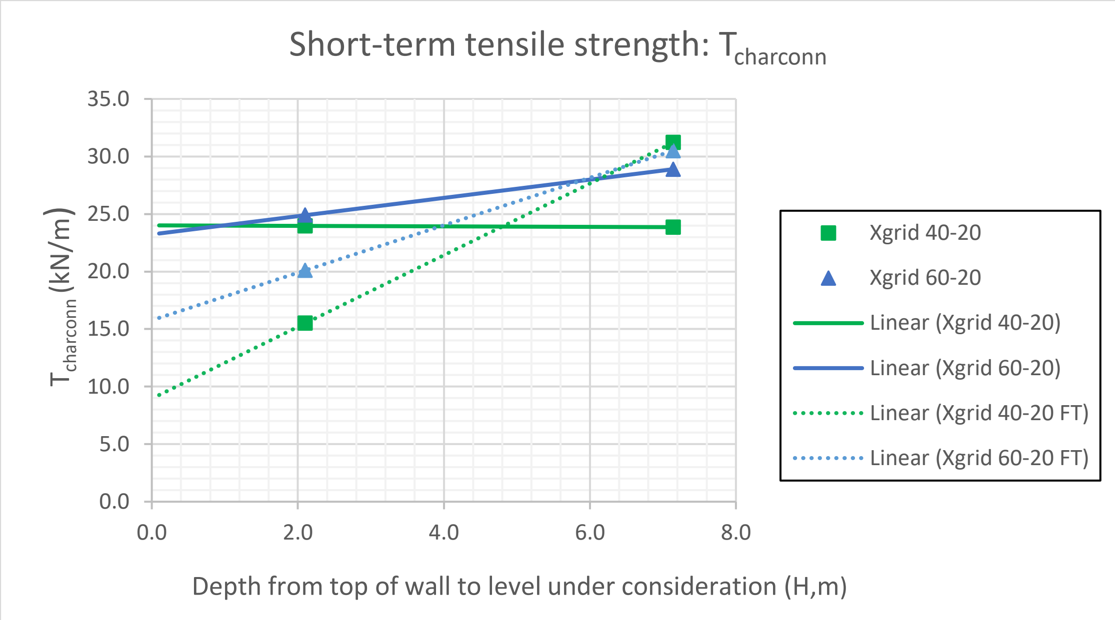
Where,

RF_{CR} - Long-term creep reduction factor

RF_{CH} - Long-term environmental reduction factor

RF_W - Long-term weathering reduction factor

f_s - Safety factor (1,0)



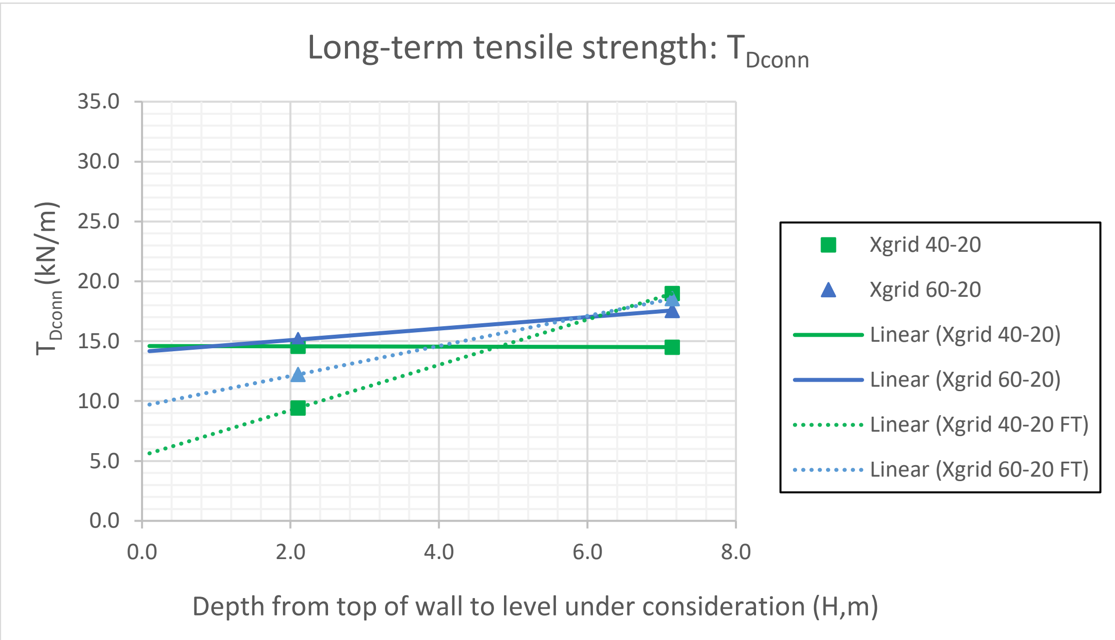


Table: Short-term ($T_{charconn}$) and Long-term (T_{Dconn}) connection strength for Kaytech XGrids

Grid	Wall Height (m)	Fixed Connection			Friction Connection		
		$T_{charconn}$ (kN/m)	T_{Dconn} (kN/m)	T_{Dconn} (kN/m)	$T_{charconn}$ (kN/m)	T_{Dconn} (kN/m)	T_{Dconn} (kN/m)
XG 40-20	2.1	24.0	14.6	T_{Dconn} = -0.013H +14.60	15.5	9.4	T_{Dconn} = 1.89H + 5.45
	7.14	23.9	14.5		31.2	19.0	
XG 60-20	2.1	24.9	15.1	T_{Dconn} = 0.48H + 14.12	20.1	12.2	T_{Dconn} = 1.2548H + 9.59
	7.14	28.9	19.6		30.5	18.5	