Design Factors for E'GRID Products:

Connection to Keystone® Blocks

1: Introduction:

In many countries, a popular use of integral geogrids such as E'GRID products is on the construction of dry block-faced reinforced soil walls. Often the block system used for these walls is from the Keystone company or one of its licensees. There are also smilar block systems in some countries from other manufacturers.

With these block systems the connection of the geogrid to the block facing is largely by friction. Therefore it is necessary for design to now how much connection strength is mobilised and how it varies with wall height above the connection and between products in the range.

To investigate this tests in accordance with ASTM D6638 Standard Test Method for Determining Connection Strength using E'GRID 50R and E'GRID 170R and Keystone® Compac Blocks at TRI/Envionmental Inc., Austin, Texas, USA. (ref)

2: Test Results:

The results of the tests are shown in the Chart below:

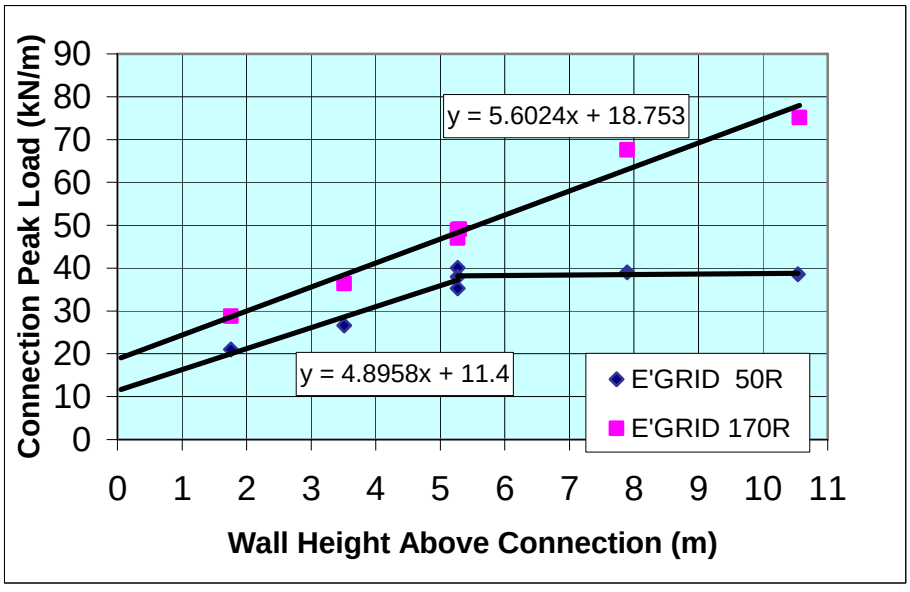

Figure 1: ASTM D6638 Tests with E'GRID Products and Keystone® Compac Blocks.

For the tests with E'GRID 170R all samples pulled out of the test wall, rupturing only in the transverse bars where they had passed behind the pins that locate one layer of blocks relative to the next.

For the tests with E'GRID 50R the geogrid ruptured at wall heights above the connection of 5.3m and greater at a load of about 39kN/m. In view of the slow speed of these tests this is approximately the rupture load that would be expected of this product. At lower wall heights all samples pulled out of the test wall, rupturing only in the transverse bars where they had passed behind the pins that locate one layer of blocks relative to the next.

3: Connection Strengths for use in Design

In figure 1 it can be seen that the equations for the two plots are of the form:

$$C = A + BxH \qquad \textbf{(1)}$$

Where: C = Connection peak load
H = Height of wall above connection

In equation 1, the fixed element A, is largely due to the trapping and rupture of transverse bars of the geogrid behind pins between block layers. As this element of the load is rupture-dependant then it will also be creep dependant. Therefore, for long-term design connection strengths this factor must be reduced to allow for creep. As the overall creep strength of E'GRID products is about 40% of their short-term strength, then it is reasonable to reduce A to 40% of its short-term value to allow for creep.

The element BxH in equation 1 is the friction element of the connection. This is not creep dependant. Therefore, it does not need to be factored when determining long-term strengths.

Thus, from equation 1 the long-term connection strength for design of a product can be calculated as:

$$C_D = 0.4xA + BxH \qquad \textbf{(2)}$$

The only question then left is how to interpolate between the two plots for E'GRID 50R and E'GRID 170R for the intermediate products in the range.

There is, in fact very little difference between the two plots. Therefore a simple form of interpolation is appropriate. This can be done on the basis of the thickness of the products as the variations in factors A and B of equation 1 are certainly related to this. From such an interpolation the set of equations shown in the table below were generated:

Product	Design Connection Strength (kN/m)
E'GRID 50R	C_D = 4.6 + 4.9xH
E'GRID 65R	C_D = 5.0 + 5.0xH
E'GRID 90R	C_D = 5.6 + 5.1xH
E'GRID 130R	C_D = 6.7 + 5.4xH
E'GRID 170R	C_D = 7.5 + 5.6xH

Note: H = Height of wall above connection (m)

Table: Design Connection Strength of E'GRID Products with Keystone® Compac Blocks

From the equations of the above table the plot below was produced:

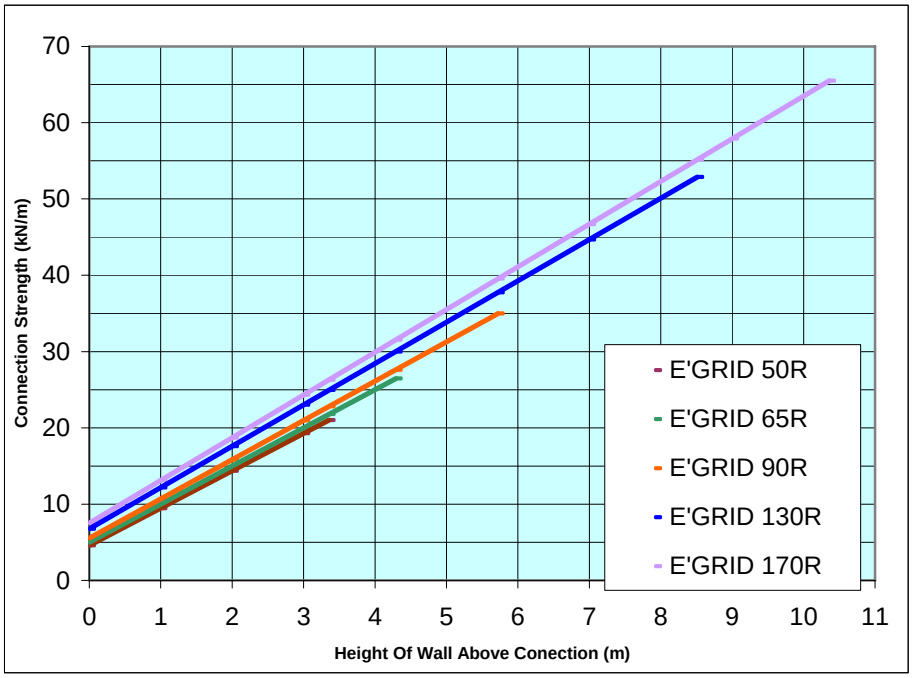

Figure 2: Design Connection Strength of E'GRID Products with Keystone® Compac Blocks

In Figure 2 the plot for each product has been terminated at a connection strength equal to the Creep Strength of the product. This indicates the minimum height of wall above a connection for each product that will guarantee a full-strength connnection between the grid and blocks.

Reference:

- TRI/Environmental Inc: Connection Strength Reports (Log#2161-59-07) Keystone Compac/E'GRID 50R and Keystone Compac/E'GRID 170R, Austin, Texas, USA, September 7th 2003.