Structural Calculation Procedures

Walls subject to bending and shear

Stepoc Reinforced Block, Anderton Concrete

November 1, 2021

1 Introduction

This document outlines the calculation procedure for using the Stepoc design charts. It can be read in conjuection with the Anderton Concrete design example.

The derivation of the design charts are presented in the Structensor document 'Derivation of design equations', report 6057-R01. The user of these chart should satisfy themselves that they are in agreement with such recommendations.

It is assumed in the preperation of design guidance that such guidance is a tool to give confidence in assessment. It is further assumed that the assessment is being undertaken by a qualified structural engineer who has experience in the design of reinforced masonry and who is responsible, in entirety, for the structural design of the wall.

The axial capacity of the Stepoc section is not considered in this procedure. The axial capacity of the section can be calculated in accordance with BS EN 1996-1-1. The axial capacity is not usually critical in typical Stepoc wall designs.

The provision of for thermal movement is not considered in this report. Seek advice from Anderton Concrete on movement joint provision. It is assume that the horizontal reinforcement is for continuity and crack control and as such the as a minimum, the minimum steel

requirements of BS EN 1996-1-1 should be adopted. This report assumes the wall undergoes one dimensional bending generating forces resisted by the reinforcement that is placed in the vertical concrete filled pockets.

2 Structural design procedure

The recommended design procedure is given below:

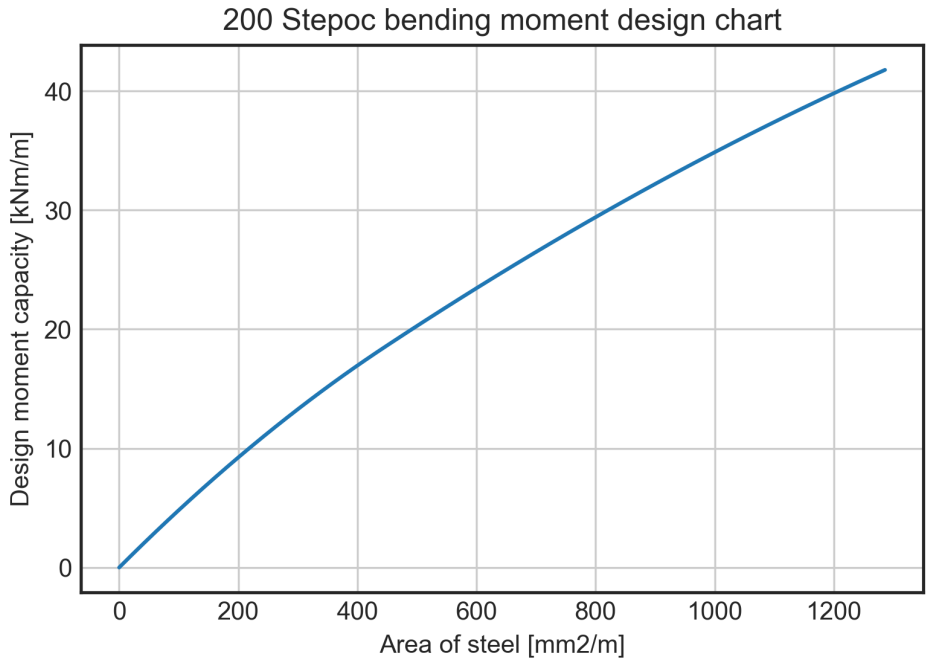
2.1 Area of longitudinal reinforcement to resist bending

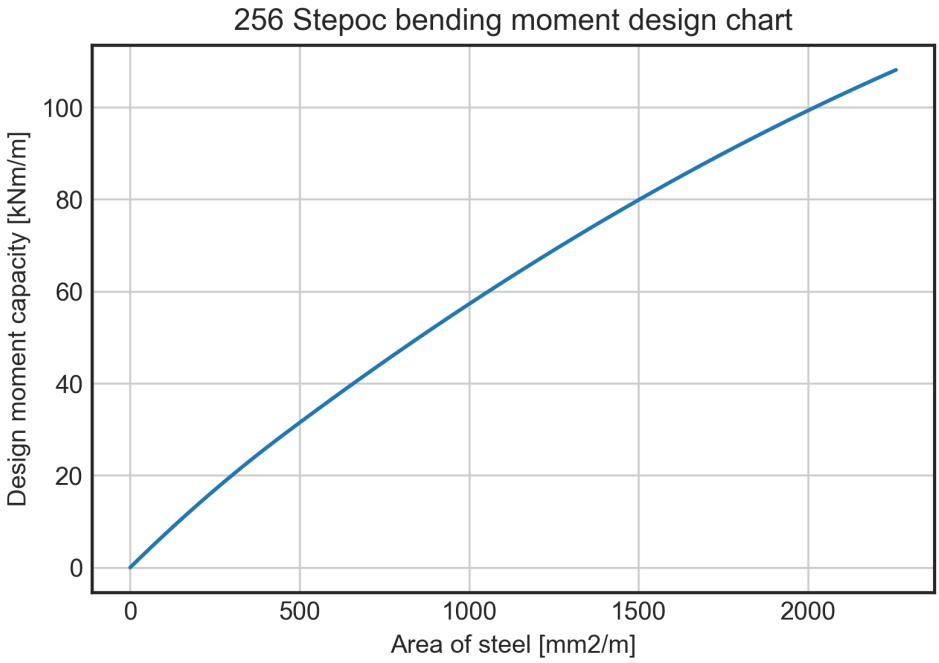
The design maximum bending moment for the wall should be calculated adopting the principles of BS EN 1990.

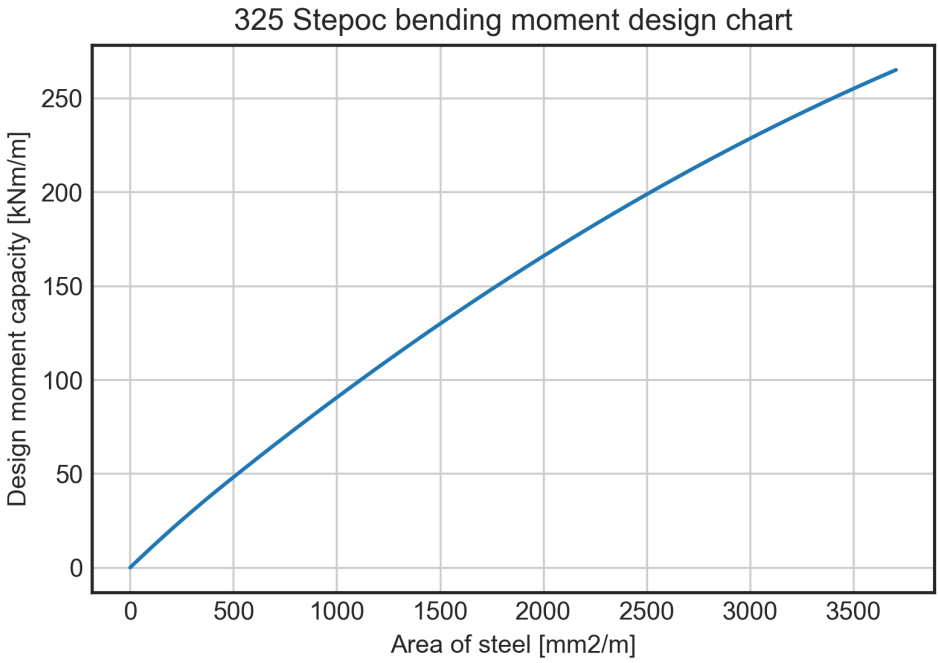
Chose a Stepoc section based on the serviceability requirements given in Table 5.2 of BS EN 1996-1-1 expressed as a limiting span to depth ratio. For a cantilevered retaining wall this limit is 18 giving the following maximum heights:

- 200 mm Stepoc maximum height = 2070 mm
- 256 mm Stepoc maximum height = 3000 mm
- 325 mm Stepoc maximum height = 4300 mm

Using the applicable graphs below (based on choice of Stepoc block size) read off the area of bending steel required for the calculated maximum design moment.







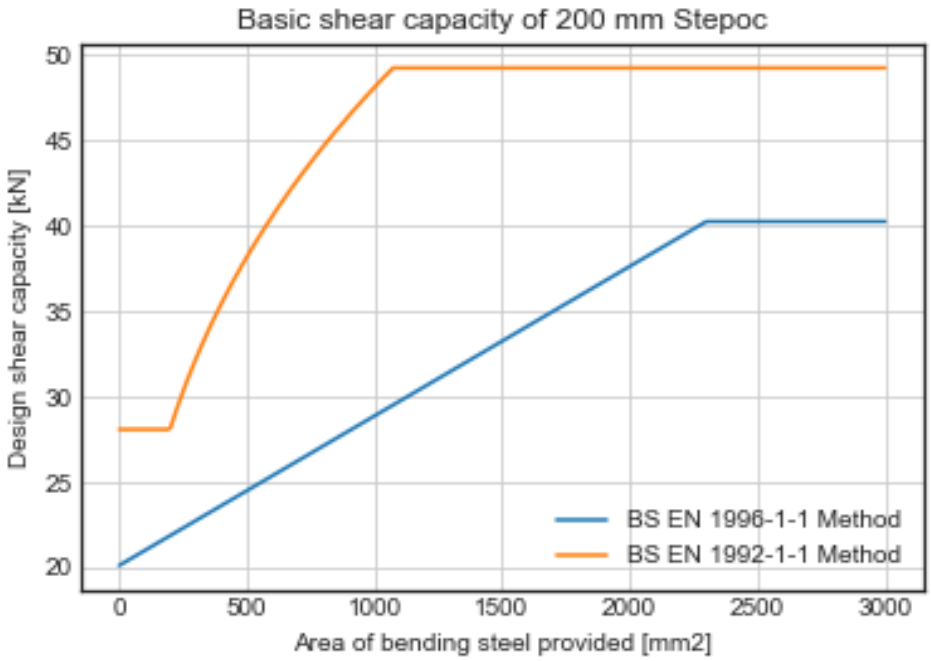
If the design moment is greater than that the maximum in the graph then chose a larger Stepoc unit and repeat the process.

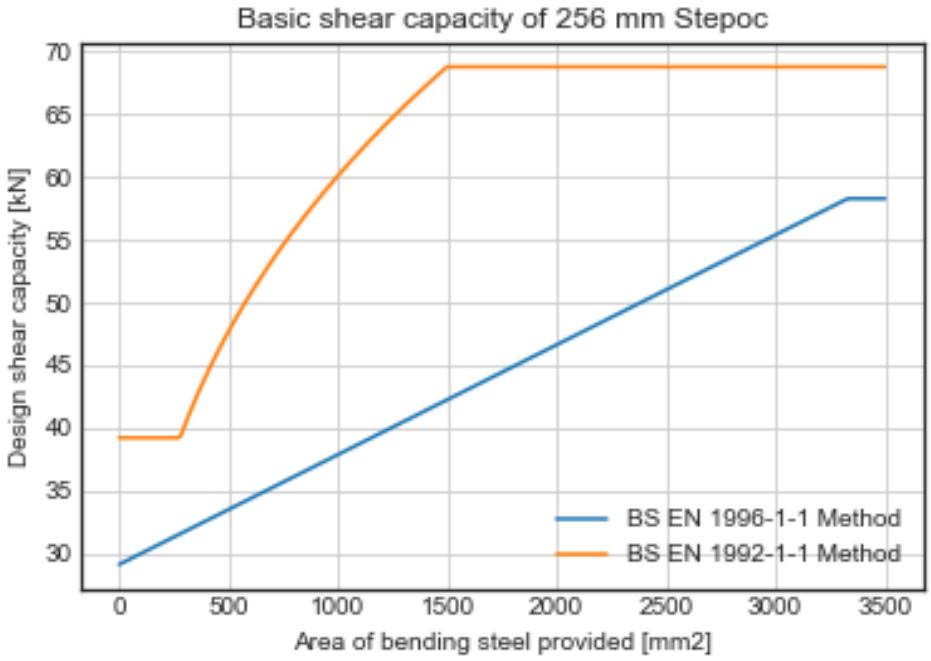
2.2 Check the shear capacity of the section

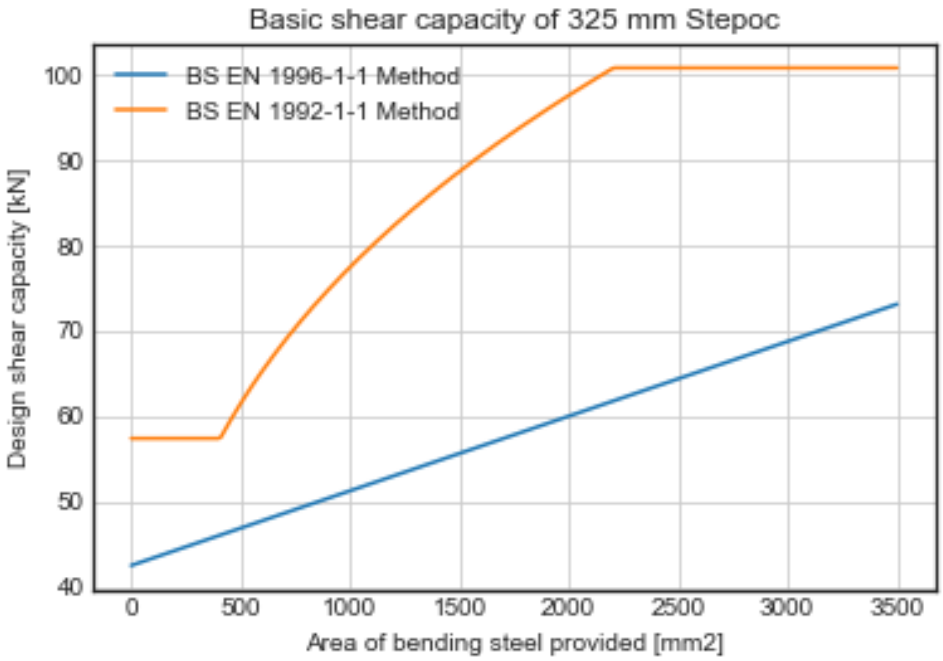
Calculate the maximum design shear force applied to the wall adopting the principles of BS EN 1990.

For the area of reinforcement established in 2.1 read off from the graph belows (for the relevant

Stepoc block) the shear capacity. In doing so, chose whether to treat the wall as a reinforcement masonry element or as a concrete wall formed with a shuttering block.



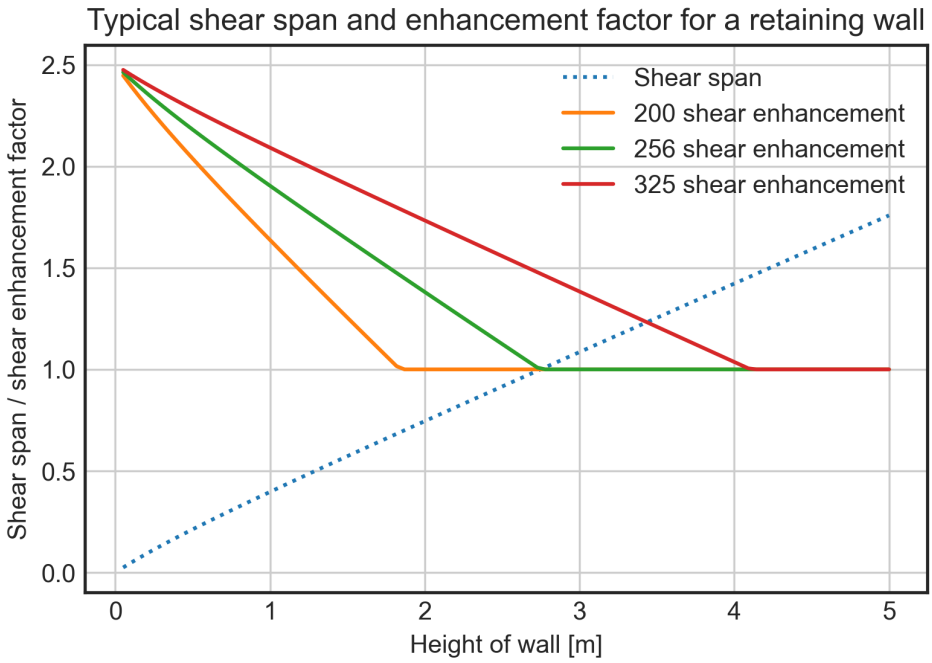




If the shear capacity is greater than the design shear force then shear is satisfactory and the structural design of the Stepoc is complete. If an increased shear capacity is required consider increasing the area of vertical reinforcement or increasing the block size.

If the reinforced masonry solution has been chosen as the method of establishing shear capacity consider whether a shear enhancement factor can be applied (typically if it is a retaining wall - refer to Annex J of BS EN 1996-1-1).

As a first estimate, the shear enhancement factor for retaining walls may be read off the chart below:



For example, for a 325 mm Stepoc retaining wall 3 m tall the shear enhancement factor is circa 1.4. In this condition the shear capacity taken from the masonry method of the 325 mm Stepoc shear chart may be multiplied by 1.40. For example, if 1500 mm2 of reinforcement is provided then the design shear capacity is circa 56 kN x 1.4 = 78.4 kN. This is less than the shear capacity treated as a net concrete section that, from the same chart, would be circa 89 kN. If the shear capacity is greater than the calculated design shear force then the design is satisfactory.