SECTION 4. DESIGN OF WALLS FOR AXIAL COMPRESSION COMBINED WITH OUT-OF-PLANE BENDING

Section 2 deals with the design of walls for axial compression loads and in that Section the axial load capacity is determined in accordance with the simplified design method outlined in Clause 11.5. The tabulated values in Section 2 take into account both the design eccentricity of the axial load and the additional eccentricity resulting from slenderness.

Walls can also be subjected to out of plane lateral loads however that may increase the design bending moments. While axial compression loads can increase the moment capacity of a wall it is important to check that the increased design compressive stress in the extreme fibre of the concrete section does not exceed the permissible stress when the wall is subjected to the combined action.

In this Section of the design manual interaction diagrams are provided for the purpose of checking combined bending and compression. These diagrams can be used to determine whether or not a critical section is over stressed due to the combined action.

There is no provision in AS 3600 for checking combined bending and compression using the simplified design method. The simplified design method takes into account the design bending moment due to eccentricity of the applied load at the top of the wall panel and it also takes into account the additional design bending moment due to slenderness effects but there is no provision for adding in any additional bending moment resulting from of out-of-plane lateral load.

When using the interaction diagrams it is very important to remember that the minimum design bending moment at any cross section is N^* times $0.05t_d$, i.e. the bending moment that corresponds to a minimum 5% design eccentricity.

The reinforcement requirements for the wall panel can be determined using the interaction diagrams.

<u>DESIGN PROCEDURE</u>: COMBINED AXIAL COMPRESSION AND BENDING (ONE-WAY BUCKLING)

This design procedure is for walls spanning vertically.

Step 1: Select a ***mortarless*** block size and strength (grade) based on local availability and price, and any other requirements (architect's requirements, fire rating, sound rating, thermal rating etc).

Step 2: Carry out a structural analysis for all applicable load combinations to determine the ultimate limit state design compression load on the wall and the ultimate limit state design bending moments at the critical sections including the bending moments from slenderness effects and the bending moments from out-of-plane lateral loads.

Step 3: Use the interaction diagrams (Diagrams 4-1 and 4-2 on the following pages) to check that the selected reinforcement is adequate. Enter the interaction diagram with the design axial load (N^*) on the Y axis and read off the maximum design bending moment (M^*) on the X axis. Check that the actual design bending moment is less than or equal to the maximum design bending moment.

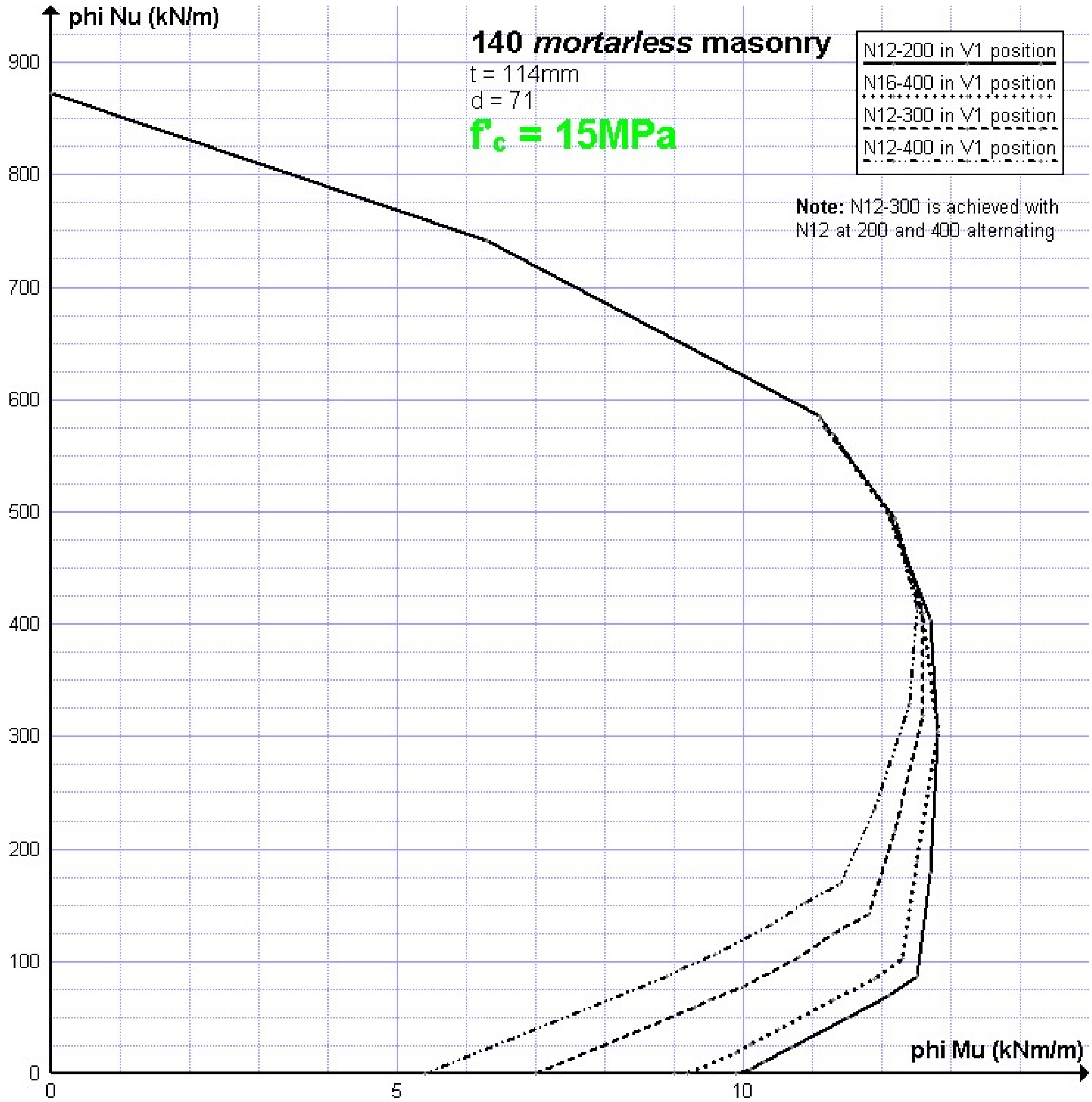
Step 4: If the wall is subject to in-plane lateral load check the adequacy of the wall for shear – refer to Section 5. It might also be necessary to check the wall panel for in-plane bending - Refer 9.1 in Part 1.

Step 5: If the wall is subjected to substantial out-of-plane lateral load check the out-of-plane shear stress – refer to Section 5

Fire, sound attenuation etc:

Step 6: Check that the wall satisfies all other requirements in terms of durability, slenderness, thickness etc.

DIAGRAM 4-1: 15MPa blocks with min. 20MPa grout



Notes:

This interaction diagram is to be used for checking the adequacy of any critical cross section for the combined action of compression and out-of-plane bending.

A compressive stress of 0.85f'_c was used for the rectangular stress block when calculating the values in the above diagram. This is not compatible with the values in Tables W1-200U – W4-200U that were prepared using the simplified design method for walls in vertical compression and in which the compressive stress in the rectangular stress block was just 0.6f'_c.

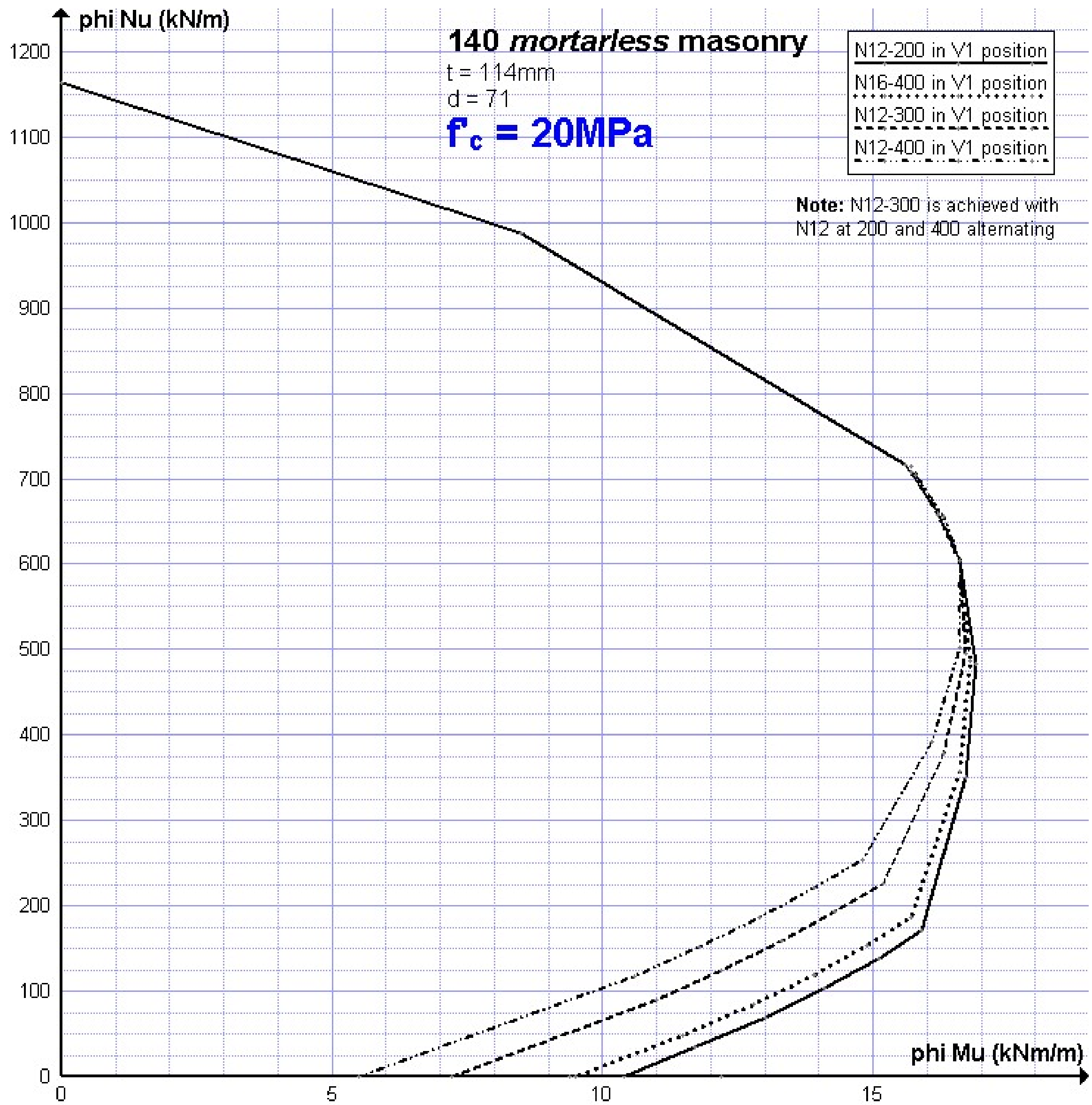
When using this diagram use bending moments derived from a structural analysis which include the additional bending moments due to slenderness effects. Do not use the bending moments calculated using the simplified approach.

Always ensure that the axial compression load used when checking for reinforcement requirements is the minimum sustained design axial compression load.

When using the chart enter with the design axial compression load N^* and read off the maximum design bending moment $M^*=\Phi M_u$.

Ensure that the vertical reinforcement is placed in the tension face of the wall in all cases.

DIAGRAM 4-2: 20MPa blocks with min. 20MPa grout



Notes:
This interaction diagram is to be used for checking the adequacy of any critical cross section for the combined action of compression and out-of-plane bending.
A compressive stress of 0.85f'_c was used for the rectangular stress block when calculating the values in the above diagram. This is not compatible with the values in Tables W1-200U – W4-200U that were prepared using the simplified design method for walls in vertical compression and in which the compressive stress in the rectangular stress block was just 0.6f'_c.
When using this diagram use bending moments derived from a structural analysis which include the additional bending moments due to slenderness effects. Do not use the bending moments calculated using the simplified approach.
Always ensure that the axial compression load used when checking for reinforcement requirements is the minimum sustained design axial compression load.
When using the chart enter with the design axial compression load N^* and read off the maximum design bending moment $M^*=\Phi M_u$.
Ensure that the vertical reinforcement is placed in the tension face of the wall in all cases.