# SECTION 5. DESIGN OF WALLS FOR SHEAR

**Shear walls:**

Load-bearing walls are mostly designed to carry axial compression loads, however in many load bearing wall structures they are also designed to carry the lateral loads arising from wind, earthquake etc, i.e. they are designed as shear walls. Diagram 5-1 in this Section provides a means of quickly checking the capacity of a ***mortarless*** wall to take in-plane shear. It can readily be seen that the in-plane shear capacity of a wall increases as the height to length ratio decreases.

**Retaining walls:**

Load-bearing walls can also be subject to out of plane lateral loads, a typical example being a retaining wall designed to carry earth pressure loads. These walls may need to be checked for transverse shear loads at critical sections and Diagram 5-4 in this Section is provided to make this task very easy. It can readily be seen in the Diagram that the out-of-plane shear strength increases as the axial load increases but in the case of 140 ***mortarless*** walls only up to an axial compression load of 400kN/m. To use this Diagram it is necessary to establish the relevant shear stress capacity of the concrete and Diagram 5-5 is provided for this purpose.

**Beams:**

Reinforced ***mortarless*** is also often used as lintel beams and the like to span across openings. These members need to be designed for shear the same as any reinforced concrete beam and Tables 5.1 and 5.2 in this Section make it very easy to check the shear capacity of ***mortarless*** beams.

## DESIGN PROCEDURE: SHEAR

**IN-PLANE SHEAR (shear walls):**

**Step 1:** Calculate ultimate limit state design shear force on the wall panel.

**Step 2:** Determine the shear strength of the wall panel (excluding the contribution from reinforcement) using Diagram 5-1. Note that the value obtained from Diagram 5-1 is the shear strength per linear metre of the wall panel length so multiply the value obtained from the Diagram by the length in metres to obtain the total shear strength.

**Step 3:** Determine the contribution to shear strength of the wall reinforcement using Diagram 5-2. Again note that this gives the shear strength per linear metre and note that all reinforcement used when determining a value from this Diagram must be anchored beyond the critical section.

**Step 3:** Add the component shear strengths from Step 2 and Step 3 to get the total shear strength of the wall in kN/m and multiply this by the length of the wall in metres to get the total shear strength of the wall panel

**OUT-OF-PLANE SHEAR (retaining walls):**

**Step 1:** Calculate ultimate limit state design shear force on the wall.

**Step 2:** Use Diagram 5-3 or 5-4 to determine the shear strength of the wall and check that this is equal to or greater than the design shear force. Use Diagram 5-3 for walls that are subject to little or no axial compression load. Use Diagram 5-4 for walls that are subject to considerable axial compression load, and use Diagram 5-5 to obtain the correct $\tau_c$ for use with Diagram 5-4.

**Step3:** Check that the shear stress does not exceed the maximum allowable – refer 11.3 in Part 1 Section 11.

**Step 4:** Detail the wall reinforcement accordingly.

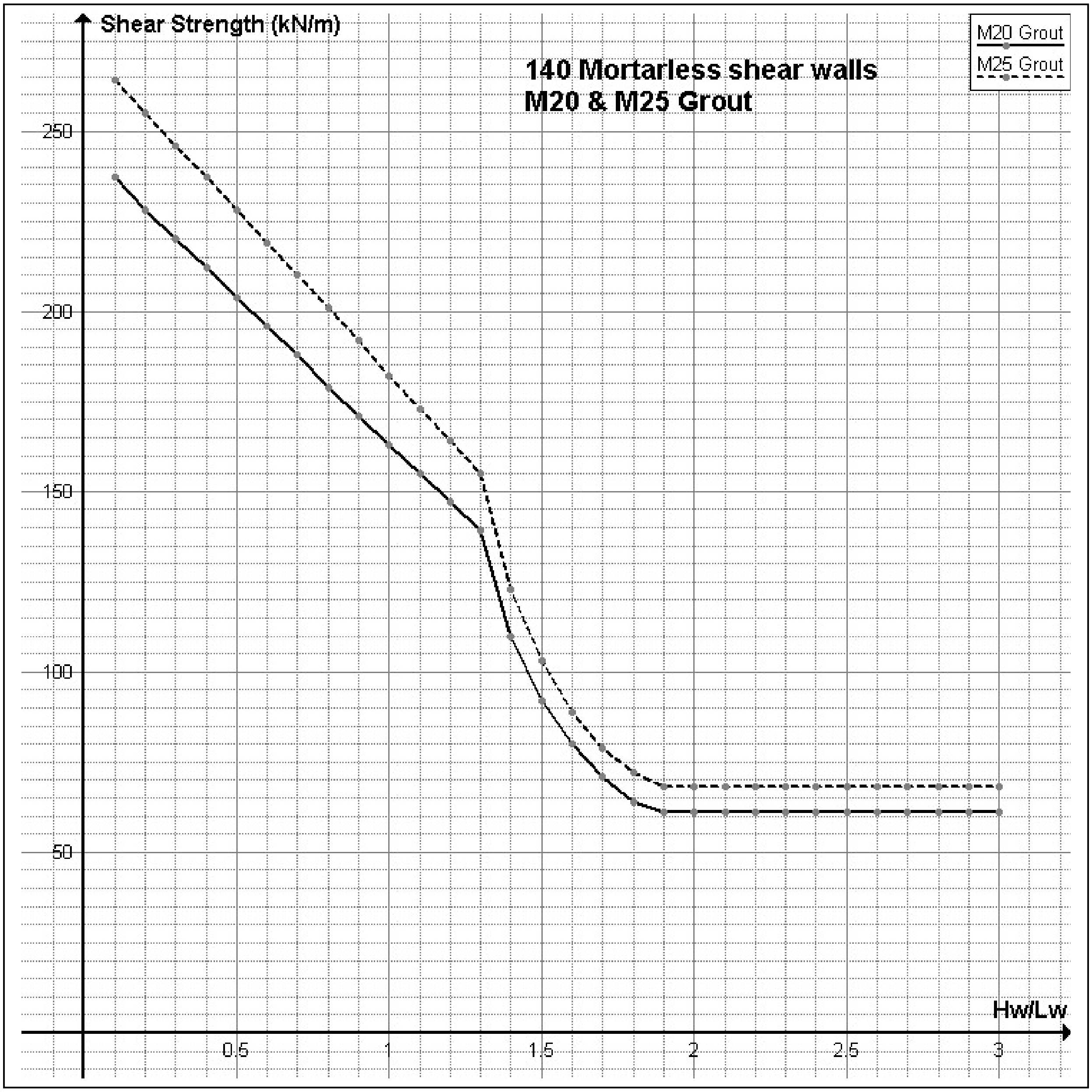
**IN-PLANE SHEAR (beams):**

**Step 1:** Calculate ultimate limit state design shear force on the beam at the critical section.

**Step 2:** Use Table 5.1 to determine whether the beam has adequate shear strength without the need for shear reinforcement. If not then proceed to Step 3.

**Step 3:** Use Table 5.2 to determine whether the beam has adequate shear strength with single leg R10 shear reinforcement. If not then select a deeper beam or use an alternative beam.

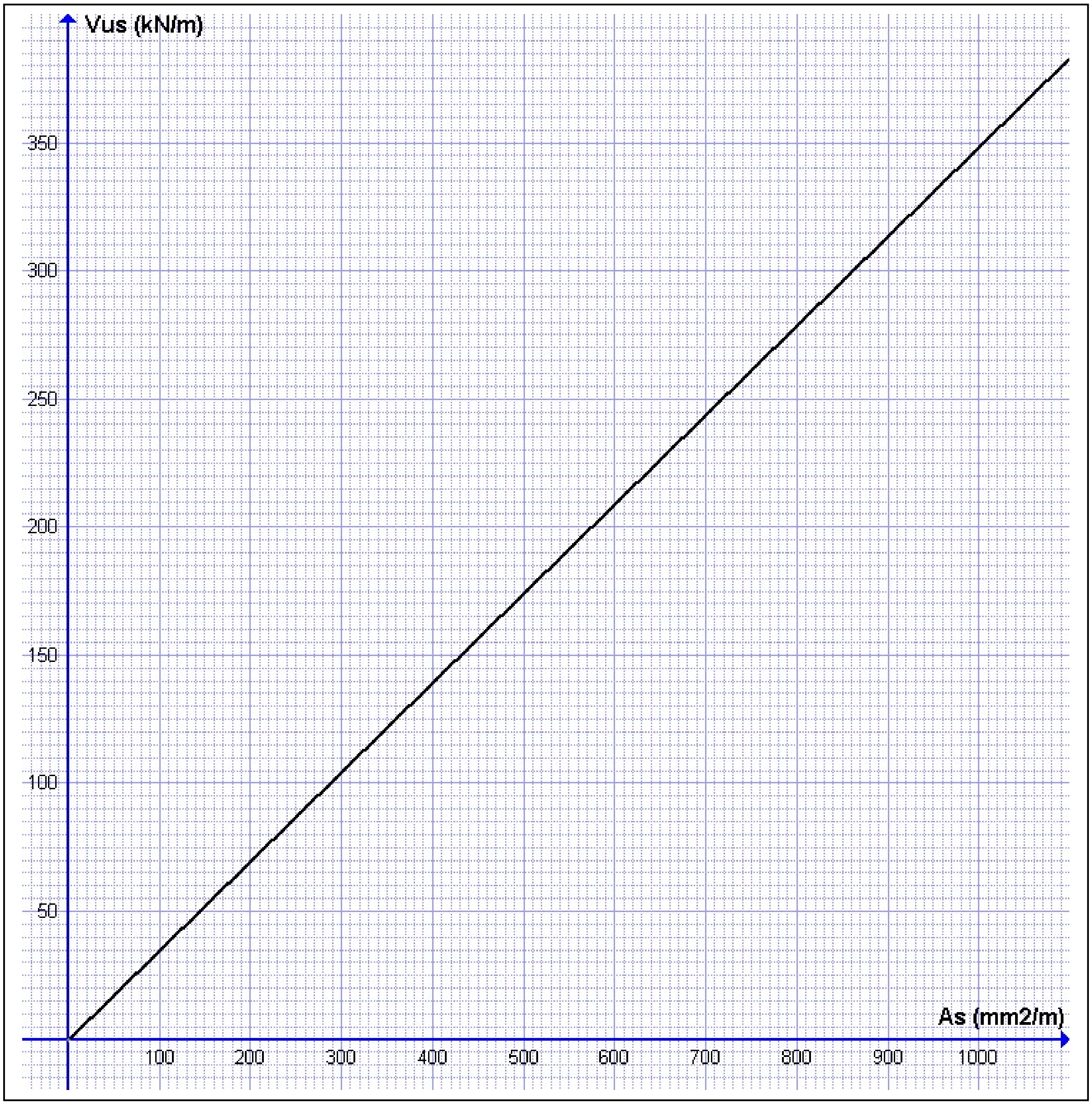
# DIAGRAM 5-1 - In-plane shear strength of 200 *mortarless* shear walls with no contribution from reinforcement




Notes:

Critical section for shear in shear wall is the lesser of $0.5L_w$ and $0.5H_w$ from the base (IS 456:2000 Clause 32.4.1)
Maximum design shear stress in wall is $0.17f_{ck}$ (IS 456:2000 Clause 32.4.2.1)
This chart takes no account of the contribution of the reinforcement to the shear strength.
Minimum 20MPa block strength is recommended with M25 grout.

# DIAGRAM 5-2 - Contribution of reinforcement to in-plane shear strength of 140 *mortarless* shear walls



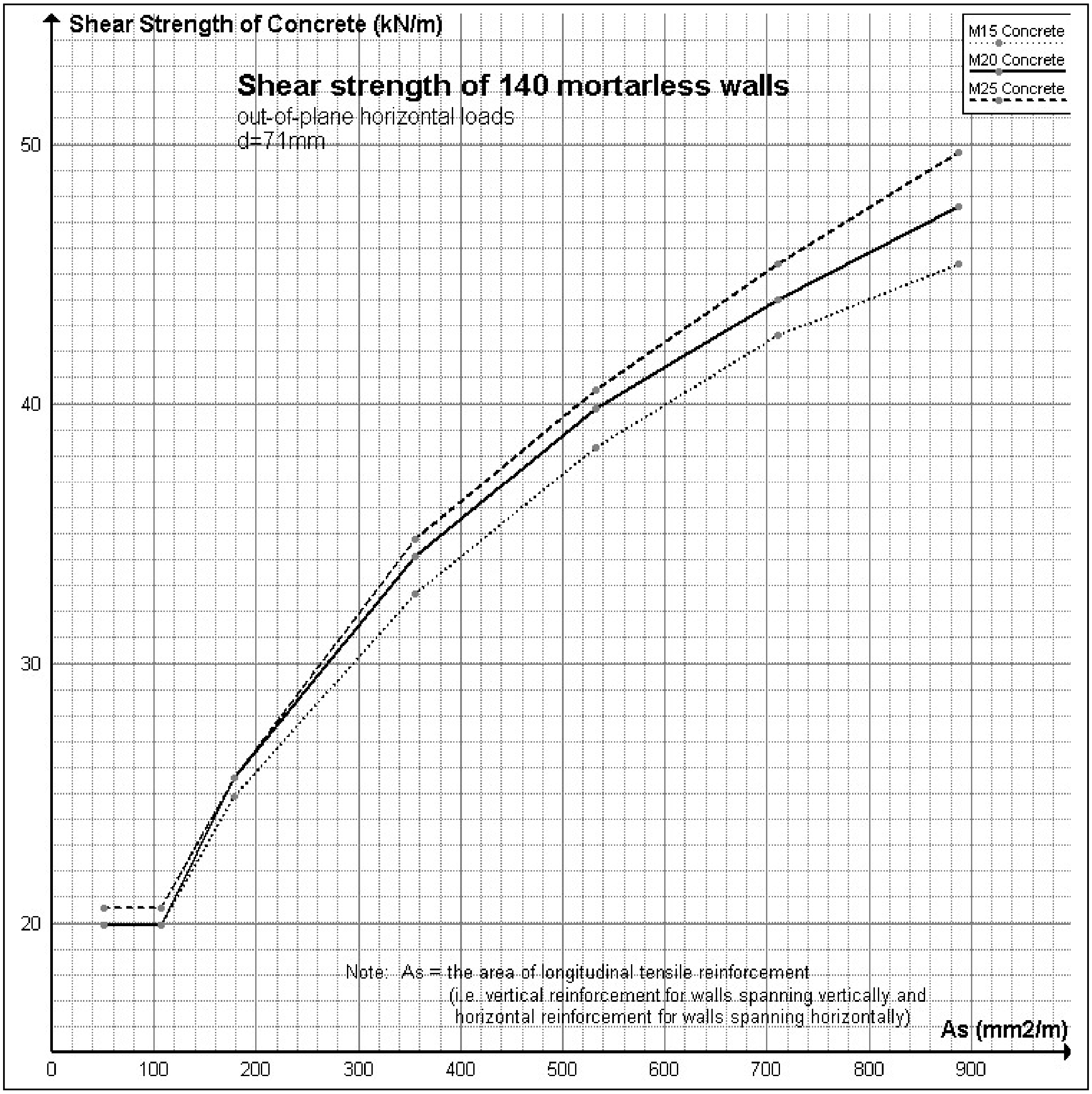

Notes:

$V_{us}$ in the above diagram is the portion of the shear strength derived from the wall reinforcement.
All vertical reinforcement must be fully anchored at both ends
$A_{sv}$ = the cross sectional area of the vertical reinforcement in $mm^2$ per metre length of wall
$A_{sh}$ = the cross sectional area of the horizontal reinforcement in $mm^2$ per metre height of wall

When using the above diagram:

- If $H_w/L_w \leq 1$ then $A_s$ is the lesser of $A_{sh}$ and $A_{sv}$
- If $H_w/L_w > 1$ then $A_s$ is $A_{sh}$

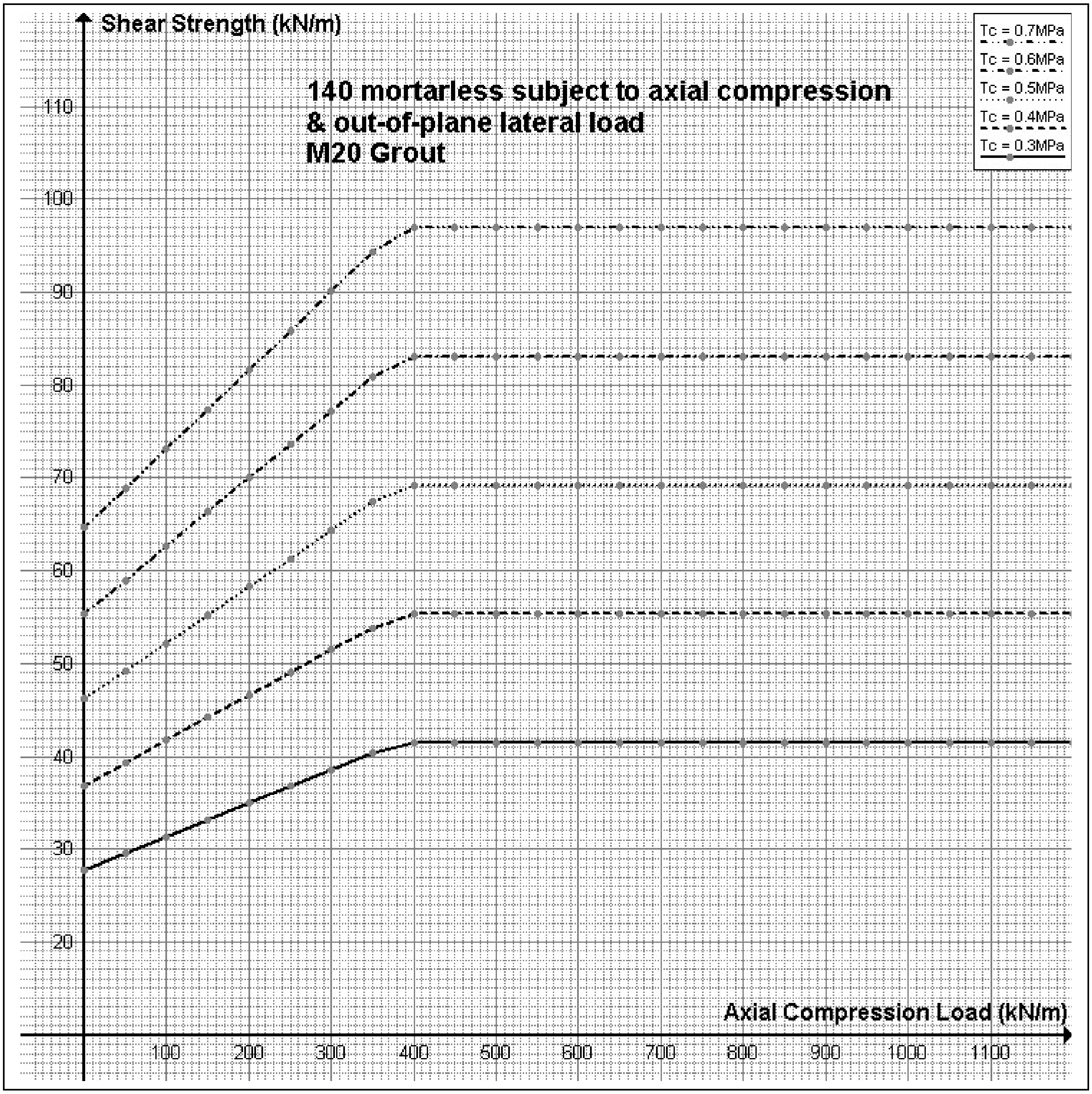
## DIAGRAM 5-3 - Shear strength of *mortarless* walls subject to out-of-plane horizontal loads




Notes:

This Diagram is a graphical representation of the values in IS 456:2000 Table 19 as they apply to 140 ***mortarless*** walls.
This Diagram shows the shear strength of the concrete in ***mortarless*** walls that don't contain shear reinforcement.

# DIAGRAM 5-4 - Contribution of reinforcement to in-plane shear strength of 140 *mortarless* shear walls




Notes:

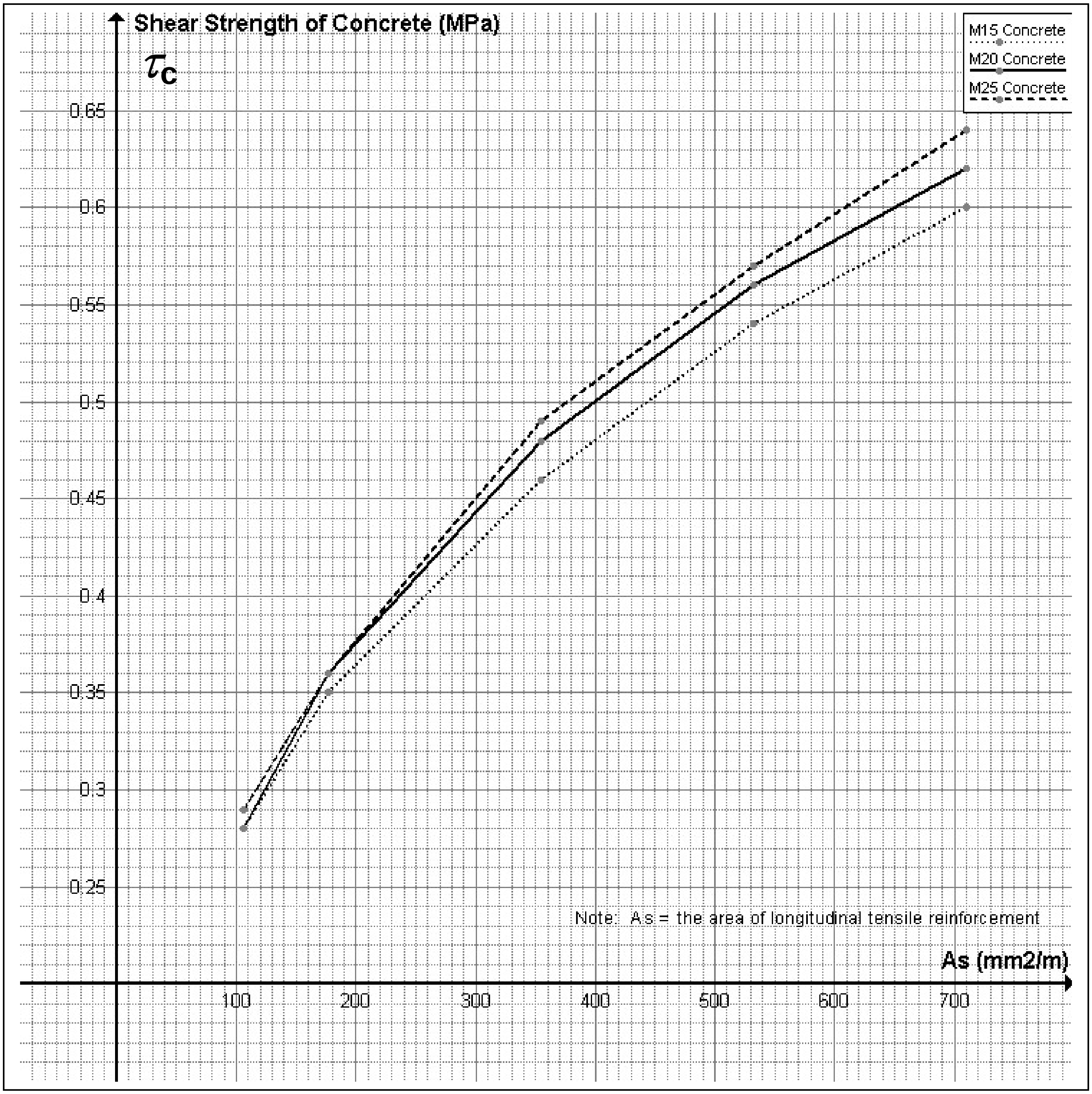
Shear capacities have been calculated using effective depth, not design thickness of the wall.

Use Diagram 5-5 to determine the applicable $\tau_c$.

If using this Diagram to determine shear strength be absolutely certain that the axial compression load is a sustained load. Deduct any part of the axial load that is transient.

Linear interpolation is permitted.

**DIAGRAM 5-5 - Shear strength of 140 *mortarless* wall subject to out-of-plane bending**



## Table 5.1 - Shear capacity of 140 mortarless beams without shear reinforcement

Shear reinforcement: nil

| | Dimensions D x B | Effective Depth d | Maximum $V_u$ without shear reinforcement (kN) | |
|---|---|---|---|---|
| | | | 1T12 bottom | 1T16 bottom |
| 2 course beam | 400 x 200 | 230 | 4.6 | 6.3 |
| 3 course beam | 600 x 200 | 430 | 6.9 | 8.8 |
| 4 course beam | 800 x 200 | 630 | | 10.8 |

## Table 5.2 - Shear capacity of 140 mortarless beams with shear reinforcement

Shear reinforcement: R10-200

| | Dimensions D x B | Effective Depth d | Maximum $V_u$ with R10-200 shear reinforcement (kN) | |
|---|---|---|---|---|
| | | | 1T12 bottom | 1T16 bottom |
| 2 course beam | 400 x 200 | 230 | 24.6 | 26.3 |
| 3 course beam | 600 x 200 | 430 | 44.3 | 46.2 |
| 4 course beam | 800 x 200 | 630 | | 65.6 |