CONCRETE MASONRY CURVES

CONCRETE MASONRY IS IDEAL FOR CURVING WALLS

STRUCTURAL
DECORATIVE & DRAMATIC

TRADE SKILL LEVEL: ★★★★★

SOME RULES OF THUMB

The effects of greater perpend thickness on structural strength has been taken into account.

TRADE SKILL LEVEL: Peter Hunt Architect Hornsby Aquatic Centre, NSW

SOME OTHER CONCRETE MASONRY CURVES WE LOVE

NOTE: Although the principles contained within this factsheet can be applied to designing the walls below, the principles described are intended for designing the curved wall featured in the forefront above.

TRADE SKILL LEVEL: MAKE Architecture Perimeter House, VIC

TRADE SKILL LEVEL: Baldasso Cortese Mary Chapel ST Joseph’s College, VIC

- Seek advice and input from a Structural Engineer.
- Keep in mind that faceting of the surface becomes more pronounced as the radius of the curve is reduced.
- Header bond is recommended when the concrete masonry curve is less than 2000 mm radius. Stretcher bond is recommended for curves that exceed this radius.
- Consider if the wall will be visible on both sides and the level of finish that is desired.
- Standard mortar joints are 10 mm. Recommended curved wall mortar joints should not exceed 17 mm for the outer face and not go below 6 mm on the inner face.
- Construction of concrete masonry curves requires more advanced workmanship skills as string lines cannot be used. This takes more time and as such can be costly.
This flyer raises some of the issues that an engineer may need to consider when consulting design of a curved masonry wall.

Curved walls are generally used for their unique structural and aesthetic benefits. For instance, in comparison to a straight wall, curved walls will exhibit added stability and resistance to out of plane lateral loading as compared to a straight wall due to the increased moment of inertia (which in turn increases the bedded section modulus) achieved by their curved nature. This geometric characteristic also applies to serpentine walls.

Engineers should exercise a greater amount of caution when designing and detailing curved masonry walls, as compared to a typical straight masonry walling structure.

**STRUCTURAL CONSIDERATIONS:**

Although curved walls fall within the scope of AS 3700 'Masonry Structures', greater care is required when interpreting and applying the provisions for structural design and loading.

However, if the radius produced by the curve is greater than or equal to twice the length of the arc, the wall can be assessed and designed as if it were a typical straight wall. For shorter radii curved walls, the following structural considerations need to be made.

- When calculating the vertical bending capacity (according to section 7.4.2), the section modulus of the bedded area (Zd) will be based off the curved bedding cross-sectional area of the wall.
- Due to its short radii, the wall's geometry can be assumed to provide enough lateral support at both vertical ends. As such, the assessment for horizontal bending will not necessarily be required, and when designing against compression (according to section 7.3), only apply equation 7.3.4.3(4) for the slenderness ratio.
- To assess the stability of a curved wall, consult with AS 1170.0 'Structural design actions: General Principles' referring to section 4.2.1 and section 7.2.1 for the loading combinations on the stability limit states.
- When assessing the magnitude of the imposed wind pressure on a curved wall section, refer to AS 1170.2 'Structural design actions: Wind Actions' taking care to acknowledge the circular geometry when deriving the associated shape factor as per section 5 of the standard.
- When designing against shear (according to clause 7.5.4.1), the total lateral force has to be resisted by the shear capacity of the critical bed joint, which is located at or near the base of the wall.

**DETAILING CONSIDERATIONS:**

Curved walls will produce an ‘overhanging’ effect (masonry edges sticking out of the wall) as the perpend joints will have varying thicknesses dictated by the magnitude of the radius of curvature. For instance, a shorter radius would influence a greater overhang. Quarter-lapped bonds (eg: Flemish bonds, header bonds etc.) are used in such circumstances (generally ≤ 2 m radii) to reduce the ‘overhang’ effect. Stretcher bonding is recommended for designs that exceed this radius to further improve the structural strength of the wall.

The smaller the radius of curvature, the greater the bedding joint width will vary from the usual 10 mm used on straight masonry wall. Commonly, 16-17 mm would be regarded as an acceptable upper limit (Generally occurs on the outer face) and 6-7 mm as a lower limit (Generally occurs on the inner face). Curved walls give an enhanced resistance to lateral loads, hence wider variations of widths are able to be used over the nominal 10 mm requirement for straight walling.

**OTHER CONSIDERATIONS:**

**MOVEMENT JOINTS:**

Volumetric expansion (due to thermal and moisture effects) should be considered during design. This expansion will cause both axial (in plane) and tangential stresses in curved walls.

Notably, the incorporation of a control gap in a wall will destroy the continuity of the wall at that location and thus the effects of this on structural strength and stability must be considered.

- For curved walls, the principles set by AS 3700 for control joints (in accordance with section 4.8) should be considered along its arc length.
- For serpentine walls, control joints should be placed at full wavelength intervals, where there is a reverse in curvature.
- At junctions between a straight wall and curved wall sections, a control joint should be introduced to accommodate the differing planes of expansion by the units in that connection.