DATAsheet

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CONCRETE Retaining Walls

INTRODUCTION

As the supply of level building sites diminishes, the need to create level building platforms for house construction on sloping sites will increase. Also, on many developed sites there is often a need to level the front and/or back yards to fully utilise the space for carports, gardens, play and entertainment areas.

Cut-and-fill is a common method of achieving level areas but if a batter is used between the level areas so created, a maximum usable area of level ground will not be achieved. Furthermore, on some sites suitable fill may have to be imported and on others spoil disposed of, both of which will add to the cost. The alternative is to use retaining walls.

Apart from retaining the soil, retaining walls can also help protect against erosion on susceptible sites. The requirements of a functional retaining wall include: structural stability, durability against the exposed environment, and provision of drainage. Appearance will also usually be important.

Concrete retaining walls provide a durable solution that is required of a structure in contact with soil and exposed to constant wetting and drying. Concrete does not rot and is resistant to termites. The wide range of available options ensures that a suitable solution can be found for any situation.

IMPORTANT CONSIDERATIONS

The first step in any retaining-wall project is to check with the local authority to see if planning approval is required. This varies between authorities and is usually related to wall height and drainage provisions. Authorities may require drawings showing a site plan and structural details accompanied by a consultant's design certification. Except for minor low-rise garden walls, up to, say, 600 mm high, engineering advice should be sought on the wall design for the given site.

Drainage is an important aspect of any retaining-wall project. Water must not be allowed to build up behind the wall. Retaining walls are designed to resist earth pressures exerted by only the weight of soil retained. These are much less than the hydrostatic pressure exerted by water trapped behind the wall.

The following parameters influence the design of the retaining wall:

- Wall height
- Soil type
- Sloping land below and/or above the retaining wall
- Loads above and behind the retaining wall, eg parked cars.

CONCRETE RETAINING WALLS provide a durable solution that is required of a structure in contact with soil and exposed to constant wetting and drying.

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GENERAL DESIGN PRINCIPLES

Soil restrained by a vertical or near-vertical retaining wall exerts a lateral pressure against the wall. This pressure tends to cause sliding and /or rotation of the wall which must therefore be designed to resist these forces over the intended design life. Apart from structural design, durability and drainage must also be given particular attention. The design should suit the particular building site and should be undertaken by a professionally qualified consultant in accordance with the Australian Standard AS 4678 *Earth-retaining structures*.

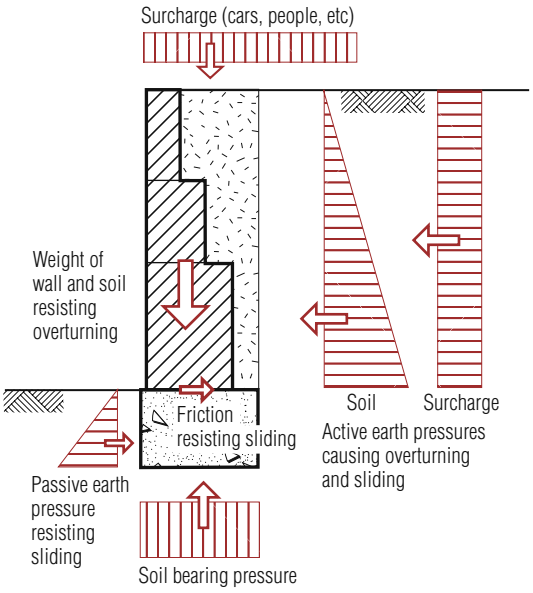

Figure 1: Gravity retaining wall

TYPES OF RETAINING WALLS

Retaining walls can be grouped into three distinct categories by considering the way in which they resist the lateral pressure exerted by the soil and any surcharge.

- Gravity retaining walls These walls use their own weight and any captured soil/fill weight to resist the lateral soil pressure **Figure 1**.
- Piled retaining walls These walls use the embedded depth of vertical posts and the strength of the posts to resist lateral soil forces **Figure 2**.
- Cantilever retaining walls These walls cantilever vertically from the concrete footing and typically resist overturning by the mass of the soil/material on the heel of the footing **Figure 3**.

Within these three categories a number of different and innovative concrete retaining wall types are available. Some manufacturers offer technical support, in the form of brochures showing engineer-designed details, for their particular wall type.

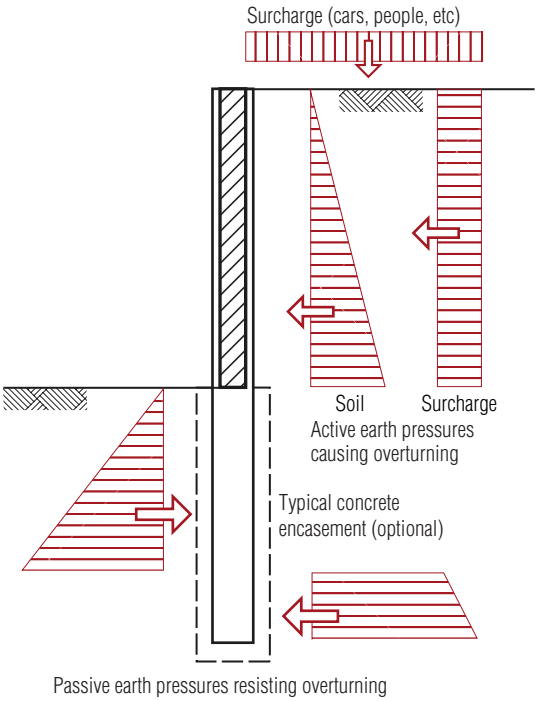

Figure 2: Piled retaining wall

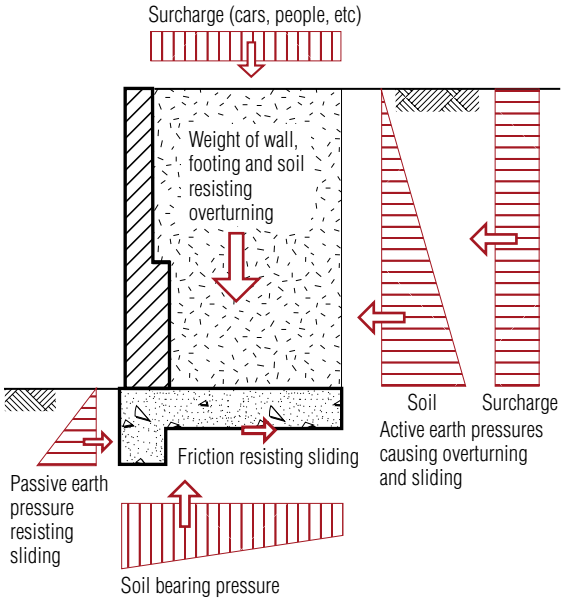

Figure 3: Cantilever retaining wall

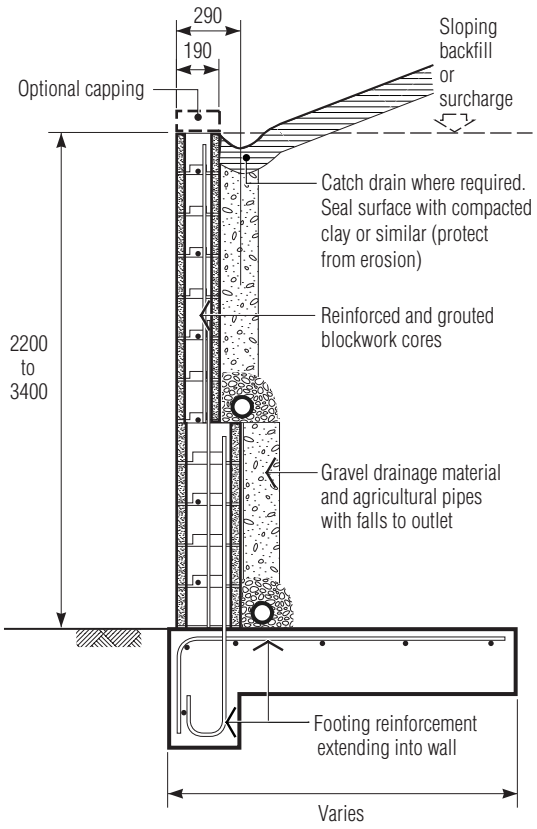

Figure 4: Reinforced concrete masonry cantilever retaining wall

RETAINING WALL SYSTEMS

Reinforced concrete masonry walls

Reinforced and core-filled hollow concrete blocks are laid on a reinforced concrete footing to form a cantilever retaining wall **Figure 4**. This is an extremely popular system offering benefits that include zero lot lines, a vertical wall face and a range of possible finishes. They are economical to around 3 m in height. Full details of masonry wall construction are provided in *Reinforced Concrete Masonry Cantilever Retaining Walls – Design and Construction Guide* (MA51) available from the Concrete Masonry Association of Australia.

Reinforced concrete walls

Cantilever retaining walls can be constructed entirely from reinforced concrete. The wall can be either cast insitu **Figure 6**, or precast **Figure 7**. The exposed vertical face can be treated in many ways, including the use of textured form liners to give particular patterns or motifs **Figure 8**.

Dry-stacked segmental concrete masonry walls

Low-height retaining walls (generally 1.2 m and less) can be constructed from dry stacking specially-manufactured interlocking segmental concrete masonry units. The walls behave as a gravity wall. The face of the wall may be vertical, stepped or sloped depending on the units used. The

Figure 5: Examples of reinforced concrete masonry cantilever retaining walls

Figure 6: Insitu concrete retaining wall with decorative off-form finish

Figure 7: Precast concrete retaining wall

Figure 8: Examples of formliners used to create decorative off-form finishes

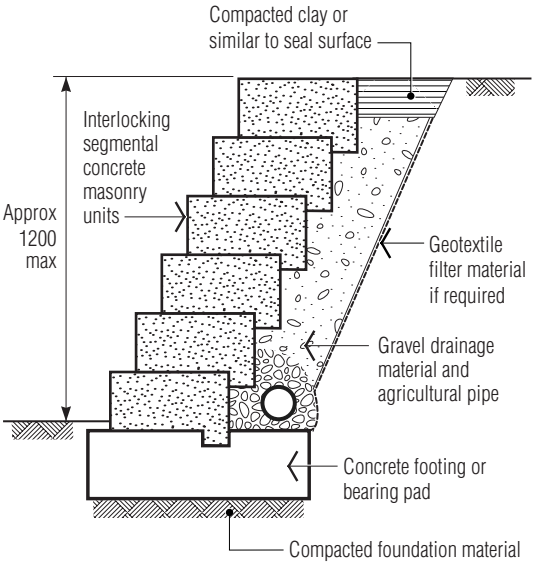

Figure 9: Cross section of typical segmental concrete masonry gravity retaining wall

Figure 10: Examples of segmental concrete masonry gravity retaining walls

units are available in a variety of colour and face finishes **Figure 10**. They are extremely popular for DIY installations as they are easy to erect. Full details for this system are provided in *Segmental Concrete Gravity Retaining Walls* (MA53) available from the Concrete Masonry Association of Australia.

Local concrete masonry suppliers should be contacted for specific system details.

Dry-stacked segmental concrete masonry with soil reinforcement walls

Walls of similar appearance to dry-stacked segmental concrete masonry walls but without the height limitation can be constructed by connecting the masonry units to layers of horizontal geo-synthetic soil reinforcement placed in the backfill behind the wall units **Figure 11**. As with all concrete masonry walling units, a variety of shapes, texture and colours are available **Figure 12**. These walls are a gravity system. However, unlike the earlier segmental walls, they utilise the soil mass behind the wall to help resist the lateral soil forces. This is usually referred to as 'reinforced soil technology'. It is an engineered system and should be installed under engineering supervision by a competent contractor. Full details for this system are provided in *Segmental Concrete Reinforced Soil Retaining Walls – Design and Construction Guide* (MA52) available from the Concrete Masonry Association of Australia.

Local concrete masonry suppliers should be contacted for specific system details.

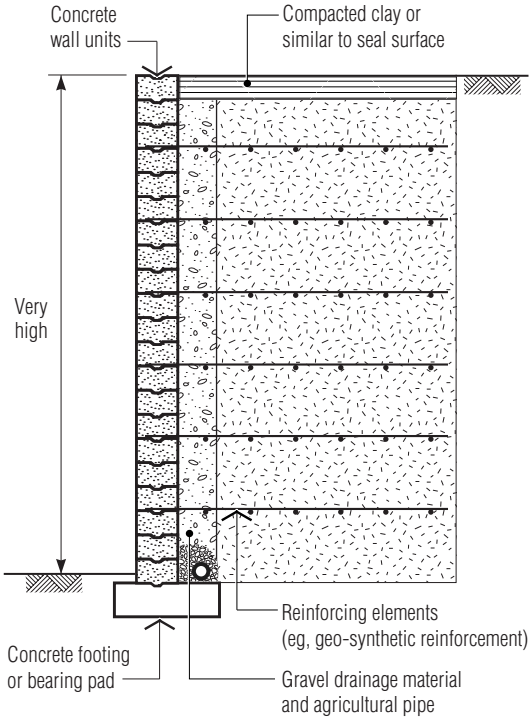

Figure 11: Cross section of typical segmental concrete masonry reinforced soil retaining wall

Figure 12: Examples of segmental concrete reinforced soil retaining walls

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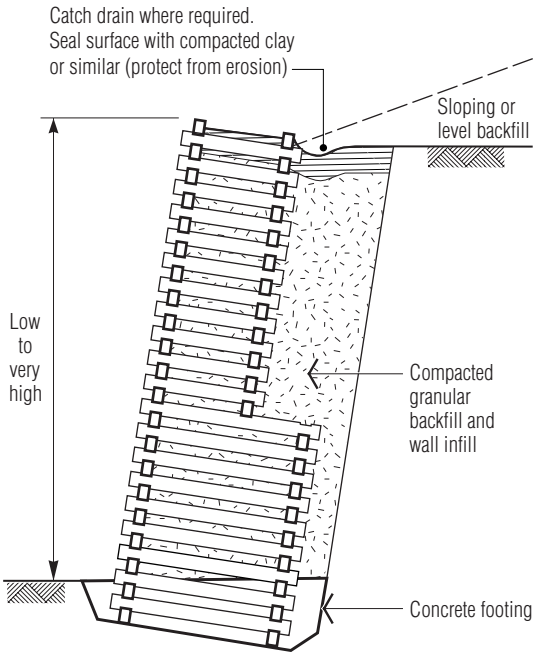

Figure 13: Cross section of typical crib wall

Crib walls

Crib walls are constructed from precast concrete components that interlock to form an open grid **Figure 13**. The spaces between the units are filled with gravel making the system free draining. Crib walls can be economically designed and built for a wide range of wall heights. Wall aesthetics can be enhanced by measures such as using coloured concrete, landscaping and planting vines on top of the wall and in the spaces above the cribs to drape down over and soften the appearance of the wall face **Figure 14**.

Figure 14: Examples of crib retaining walls
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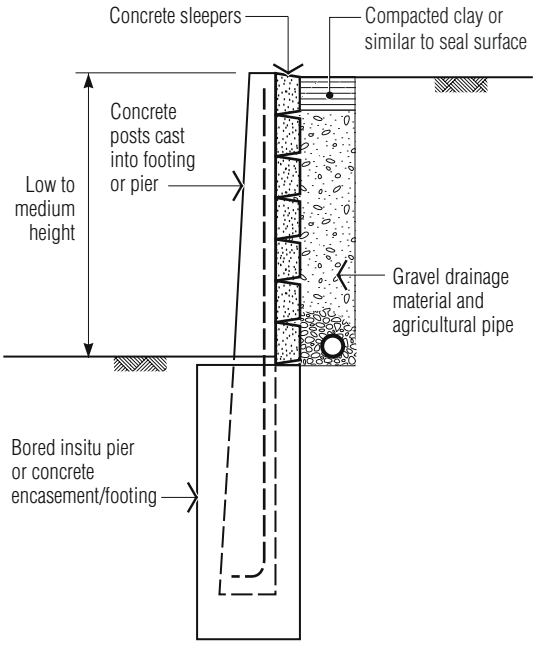

Figure 15: Cross section of typical concrete sleeper retaining wall

Concrete-sleeper walls

Precast concrete sleepers span horizontally between vertical precast concrete posts that are embedded into the ground **Figure 15**. The posts are usually cast into a bored insitu concrete pier. This is a piled system that relies on the embedment and strength of the post and sleeper units to resist lateral soil forces. It is a low-cost system and can achieve 'zero-lot-line construction'. Posts and sleepers can be coloured and face textured to resemble timber grain, slate, etc.

SUMMARY

Concrete offers a wide range of retaining wall options to suit a particular project's requirements. For the various manufactured systems, check with the suppliers for details and advice. Remember that for all walls, foundation preparation, drainage and good workmanship are essential. Engineering advice should always be sought and council requirements ascertained prior to retaining wall construction.

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