

## CODE

**13.3.4** *Two-way combined footings and mat foundations*

**13.3.4.1** The design and detailing of combined footings and mat foundations shall be in accordance with this section and the applicable provisions of **Chapter 8**.

**13.3.4.2** The direct design method shall not be used to design combined footings and mat foundations.

**13.3.4.3** Distribution of bearing pressure under combined footings and mat foundations shall be consistent with properties of the soil or rock and the structure, and with established principles of soil or rock mechanics.

**13.3.4.4** Minimum reinforcement in nonprestressed mat foundations shall be in accordance with **8.6.1.1**.

**13.3.5** *Walls as grade beams*

**13.3.5.1** The design of walls as grade beams shall be in accordance with the applicable provisions of **Chapter 9**.

**13.3.5.2** If a grade beam wall is considered a deep beam in accordance with **9.9.1.1**, design shall satisfy the requirements of **9.9**.

**13.3.5.3** Grade beam walls shall satisfy the minimum reinforcement requirements of **11.6**.

**13.3.6** *Wall components of cantilever retaining walls*

**13.3.6.1** The stem of a cantilever retaining wall shall be designed as a one-way slab in accordance with the applicable provisions of **Chapter 7**.

**13.3.6.2** The stem of a counterfort or buttressed cantilever retaining wall shall be designed as a two-way slab in accordance with the applicable provisions of **Chapter 8**.

**13.3.6.3** For walls of uniform thickness, the critical section for shear and flexure shall be at the interface between the stem and the footing. For walls with a tapered or varied thickness, shear and moment shall be investigated throughout the height of the wall.

**13.4—Deep foundations****13.4.1** *General*

## COMMENTARY

**R13.3.4** *Two-way combined footings and mat foundations*

**R13.3.4.1** Detailed recommendations for design of combined footings and mat foundations are reported by **ACI 336.2R**. Also refer to **Kramrisch and Rogers (1961)**.

**R13.3.4.2** The direct design method is a method used for the design of two-way slabs. Refer to **R6.2.4.1**.

**R13.3.4.3** Design methods using factored loads and strength reduction factors  $\phi$  can be applied to combined footings or mat foundations, regardless of the bearing pressure distribution.

**R13.3.4.4** To improve crack control due to thermal gradients and to intercept potential punching shear cracks with tension reinforcement, the licensed design professional should consider specifying continuous reinforcement in each direction near both faces of mat foundations.

**R13.3.6** *Wall components of cantilever retaining walls*

**R13.3.6.2** Counterfort or buttressed cantilever retaining walls tend to behave more in two-way action than in one-way action; therefore, additional care should be given to crack control in both directions.

**R13.3.6.3** In general, the joint between the wall stem and the footing will be opening under lateral loads; therefore, the critical section should be at the face of the joint. If hooks are required to develop the wall flexural reinforcement, hooks should be located near the bottom of the footing with the free end of the bars oriented toward the opposite face of the wall (**Nilsson and Losberg 1976**).

**R13.4—Deep foundations****R13.4.1** *General*