Concrete Roof Systems

Part II: Cast-In-Place Construction

The second type of roof system to be considered here includes a number of variations of cast-in-place concrete roof construction. Part I of the series on precast/prestressed roof construction appeared in CONCRETE CONSTRUCTION in January 1971, pages 13-14.

Pan joist construction refers to a one-way structural system using a ribbed slab formed with pans. The system achieves economy through the re-use of standard forming pans. Special design provisions for pan joists have been established through many years of construction experience.

Standard pan forms produce dimensions of 20 or 30 inches and depths range from 6 to 20 inches, although other sizes are available. Spans normally range from 15 to 50 feet, but may be extended by post-tensioning.

Joists may have openings in the ribs to accommodate mechanical systems. Slabs between the joists can readily accommodate duct openings or sleeves.

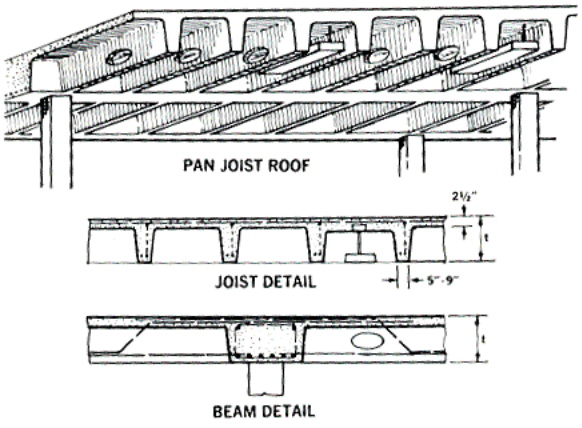
Waffles

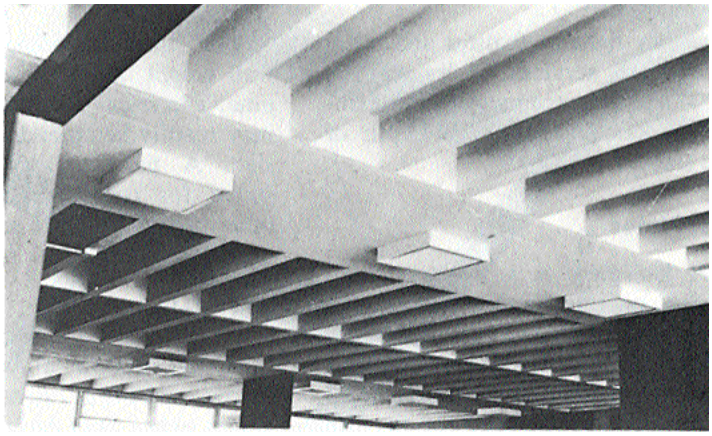
Waffle plates are coffered flat plates that result in a two-way structural system. Forming domes are available in standard sizes or may be custom-made to suit specific job requirements. Repetition of form use permits overall economy.

Standard 30-by-30-inch-square domes have depths of 8, 10, 12, 14,

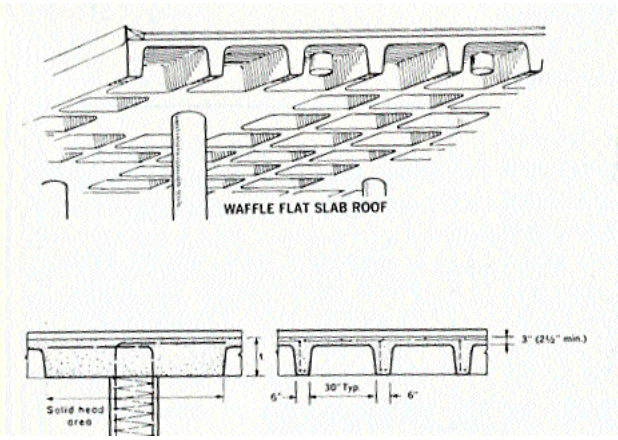
16 or 20 inches. They have 3-inch flanges from which 6-inch-wide joist ribs at 36-inch centers are formed. Standard domes 19 by 19 inch square have a depth of 6, 8, 10, 12, or 14 inches, and 5-inch-wide joist ribs at 24-inch centers are formed from 2½-inch flanges.

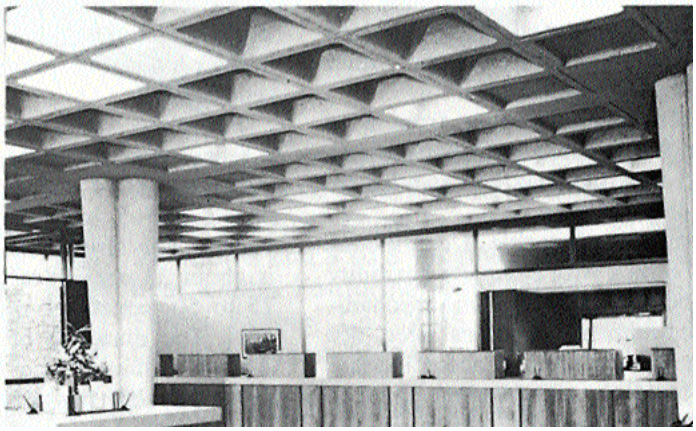
Waffle plates provide convenient two-way cantilevering. With standard dome sizes, waffles can provide an attractive patterned ceiling. Special finishes can be obtained through the use of precast concrete or plastic domes. Recesses formed by the domes provide convenient



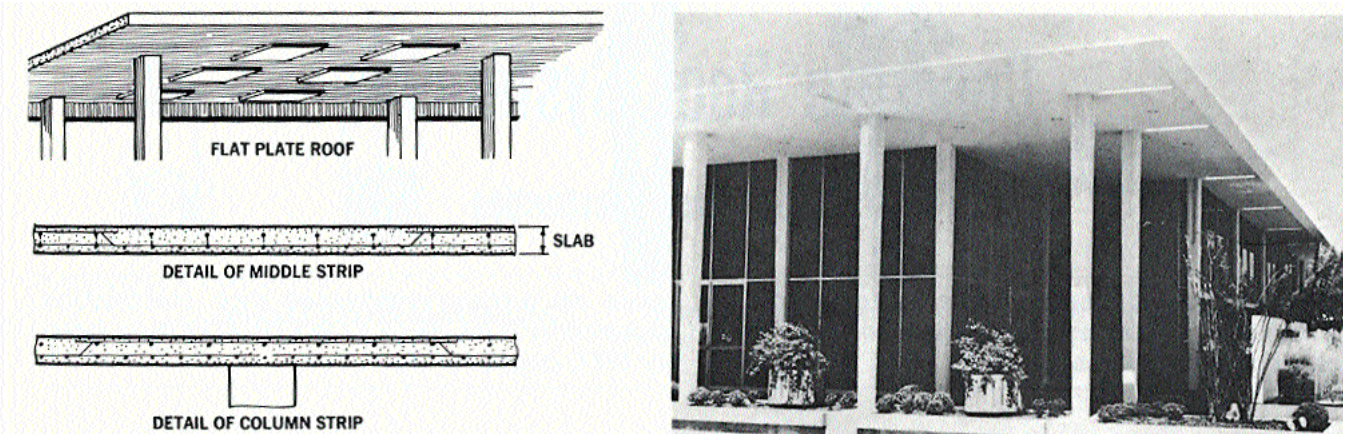


Pan joist one-way structural system

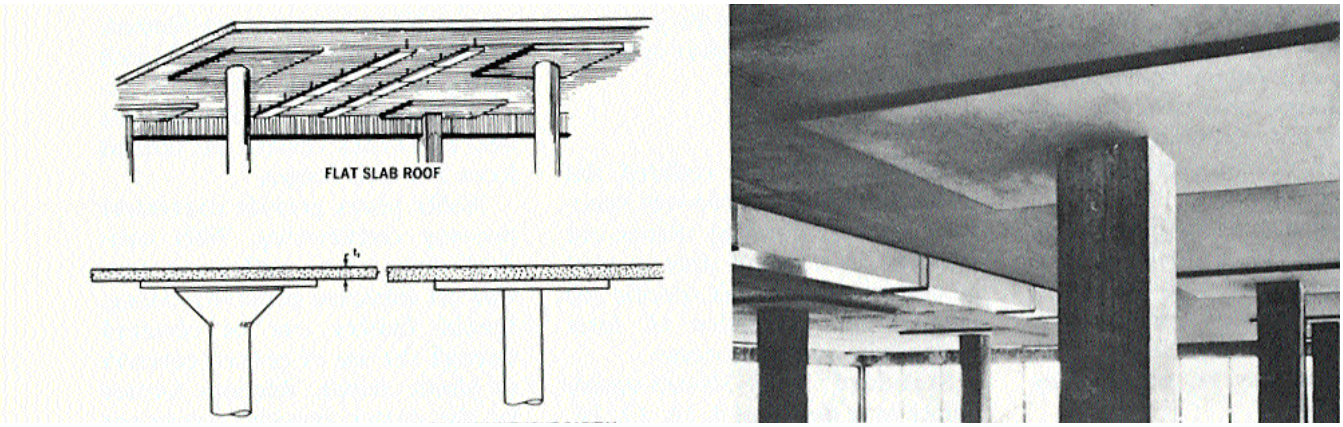




Waffle plate two-way structural system



Flat plate two-way reinforced framing system



Flag slab two-way reinforced structural system

space for lighting fixtures and other mechanical services. Holes may be provided to accommodate mechanical functions within the depth of the slab.

Flat Plates

A flat plate is a two-way reinforced concrete framing system utilizing the simplest of structural shapes—a slab of uniform thickness. The flat ceiling is economical to form and may be used for the finished surface without additional treatment. The simple forming and two-way structural action permit economical cantilevers and other architectural projections.

Slabs generally range from 5 to 14 inches in thickness. Spans are up to 35 feet, but may be extended by post-tensioning.

Flat plates provide a continuous solid ceiling with complete flexibility for locating partitions and mechanical equipment. Columns need not be in straight lines to accommodate the building arrangement. Only a minimum structural depth is required, thus providing savings in wall height and total enclosed volume. Electrical conduits and ducts may readily be embedded in the flat slab. A flat-plate system is well suited for roof parking or where other heavy loads are anticipated.

Flat Slabs

A flat slab is a two-way reinforced structural system that includes either drop panels or column capitals at columns. It is essentially a flat-plate roof with additional depth near the columns to resist heavier loads, thus permitting longer spans.

Flat-plate thicknesses, usually 2.5 or 3 percent of the span, are a minimum of 4 inches with drop panels and 5 inches without drop panels. The size of the drop panel is about 33 percent of the span and 25 to 50 percent of the slab thickness. The diameter of the column cap, if required, can be 8 to 10 times the slab thickness. Spans up to 40 feet are normal. Columns should be about equal distance apart.

Flat slabs are well suited for heavy roof loads and may be especially useful for roof-top parking. Use of post-tensioning extends the span range and may eliminate the need for roofing. Total structural depth is low and dead space is kept to a minimum. Electrical raceways and conduits may be embedded in the slab and lighting fixtures may be placed within the depth of the drop panel.

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