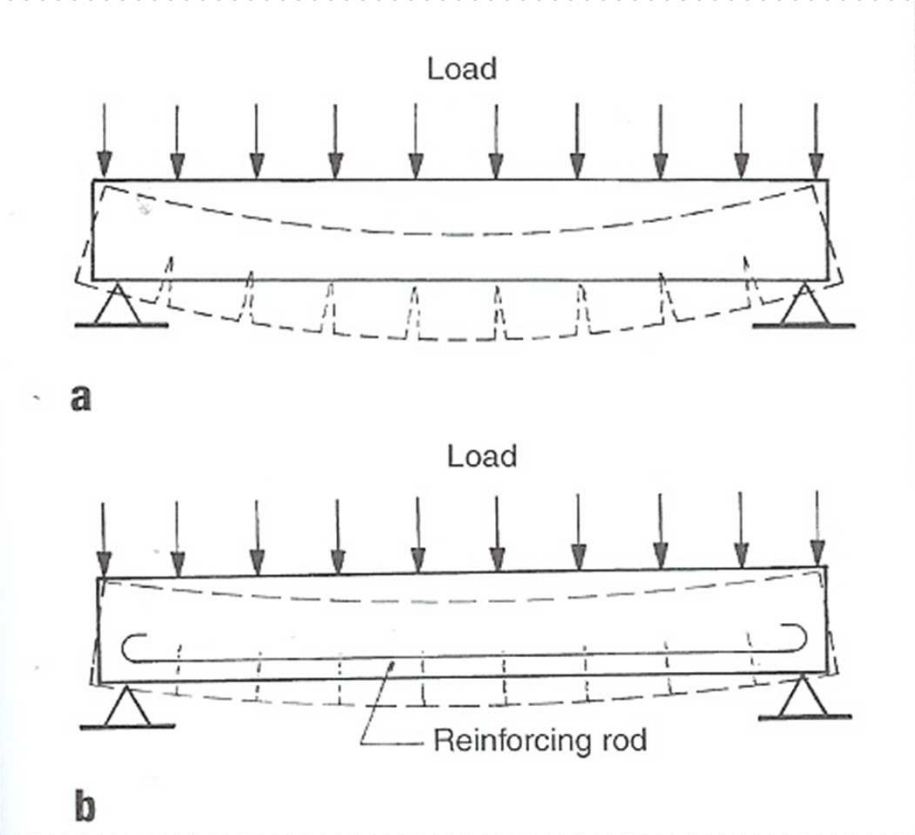
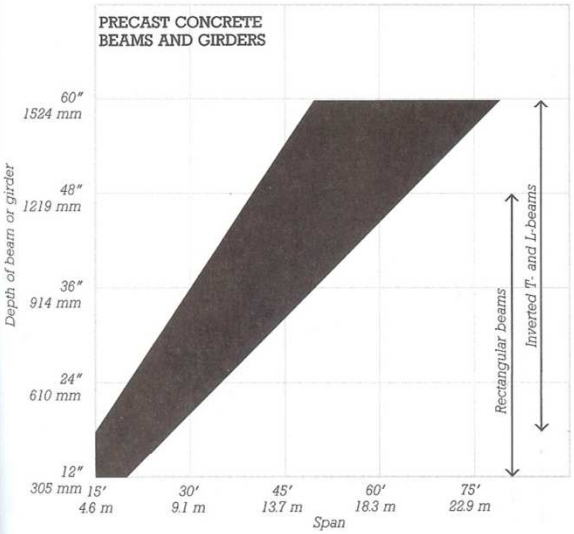
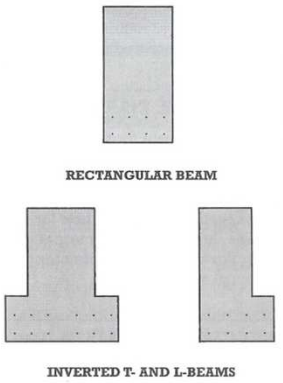
Precast Concrete Beams and Girders



PRECAST CONCRETE BEAMS AND GIRDERS





This chart is for precast concrete beams and girders. For light loads or close beam spacings, read toward the right in the indicated area. For heavy loads and large beam spacings, or for girders, read toward the left.

SIZING THE STRUCTURAL SYSTEM

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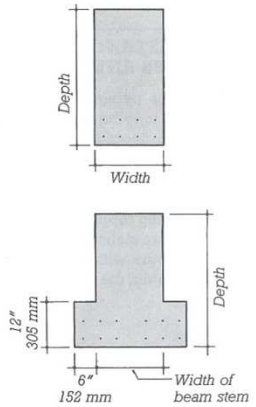
COMMON SIZES OF PRECAST CONCRETE BEAMS AND GIRDERS

Rectangular beams commonly range in depth from 18 to 48 in. (457 to 1219 mm). Widths range from 12 to 36 in. (305 to 914 mm).

Inverted T- and L-beams commonly range in depth from 18 to 60 in. (457 to 1524 mm), although sections deeper than 48 in. (1219 mm) may be subject to shipping or handling restrictions. Widths of the beam stem (not including the ledges) range from 12 to 30 in. (305 to 762 mm).

Standard dimensions for beam ledges are 6 in. (152 mm) wide and 12 in. (305 mm) deep.

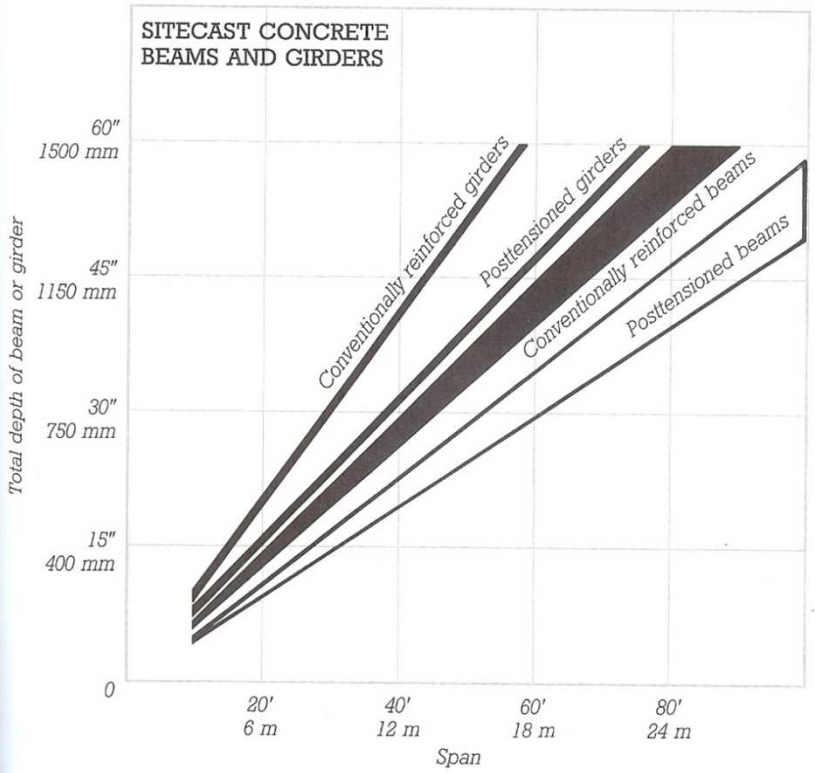
Beam sizes typically vary in increments of 2 or 4 in. (50 or 100 mm). Availability of sizes varies with suppliers.

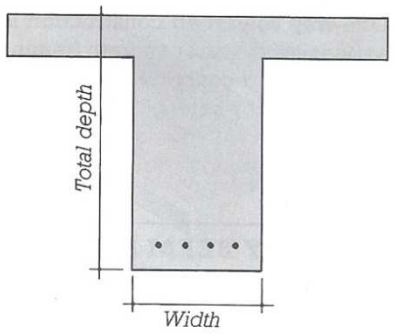


Structural Systems - Concrete

Concrete Beams and Girders

SITECAST CONCRETE BEAMS AND GIRDERS

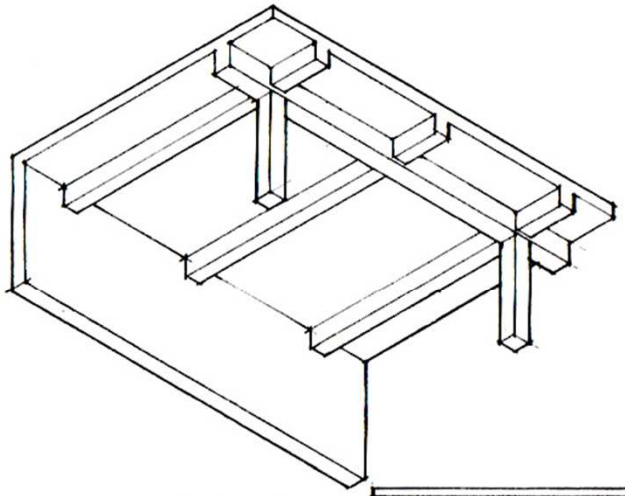




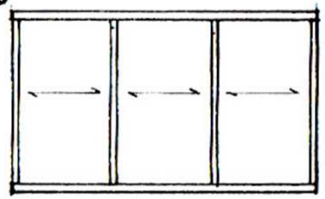
This chart is for sitecast concrete beams and girders, either conventionally reinforced or posttensioned. For lightly to moderately loaded beams, read toward the right in the indicated areas. For heavy loads or simple spans, read toward the left.

- For girders, read on the lines indicated.
- Size beam depths in even 2-in. (50 mm) increments.
- *Total depth of beam or girder* is measured from the bottom of the beam to the top of the slab.
- Normal beam widths range from one-third to one-half of the beam depth. Use beam widths in multiples of 2 or 3 in. (50 or 75 mm).

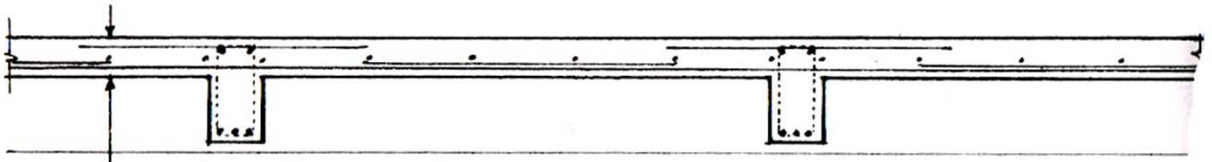
Concrete Systems – one way slab



ONE-WAY SLAB



6' to 12' spans



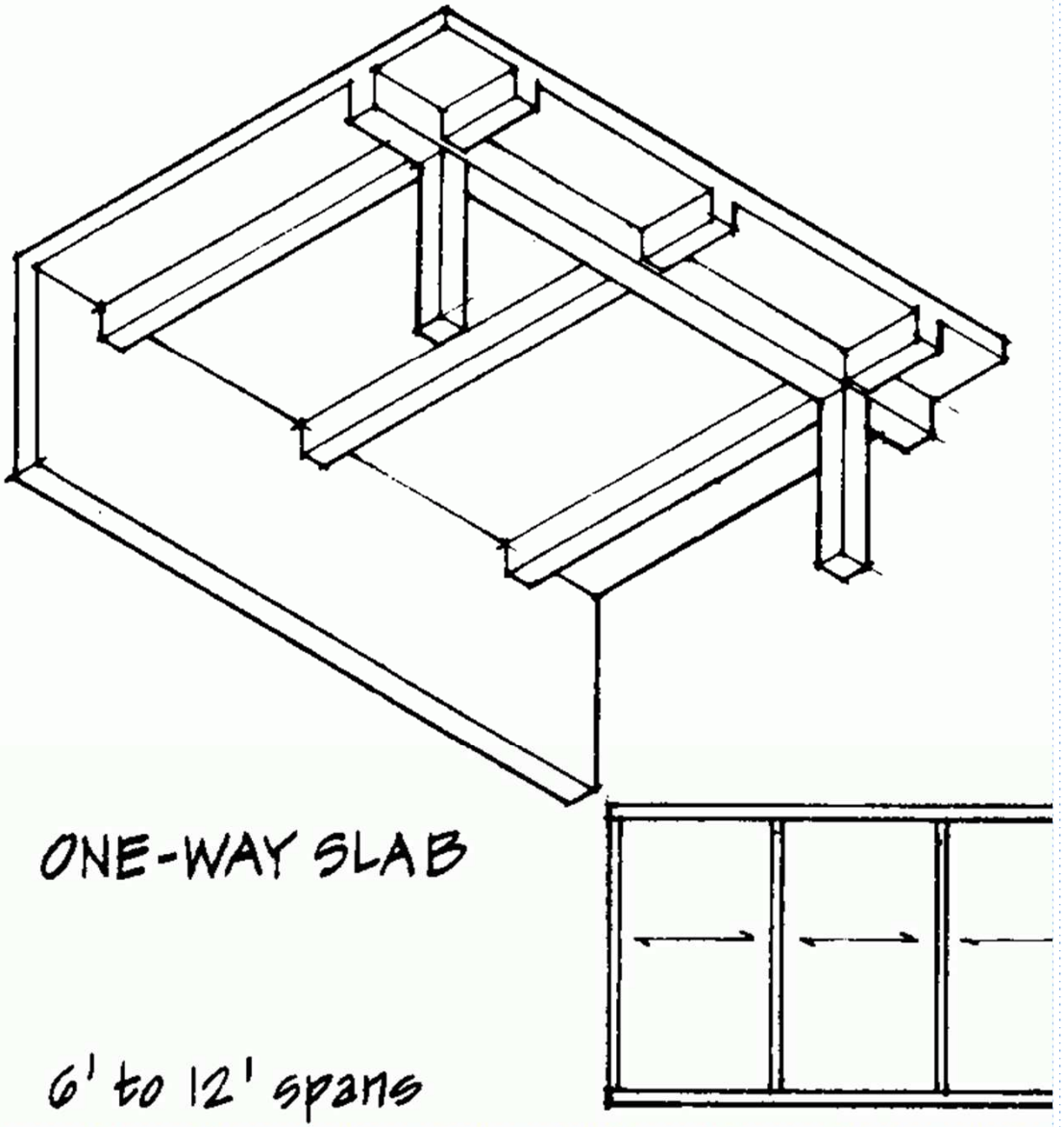
Span/30 for floor slabs; 4" min.
Span/36 for roof slabs

- Slab is supported on two sides by beams or bearing walls; beams, in turn, may be supported by girders or columns.

- One-way slabs are used for light to moderate loads over relatively short spans.
- Large module size is not as flexible for defining irregular bays as smaller modules of waffle slab.

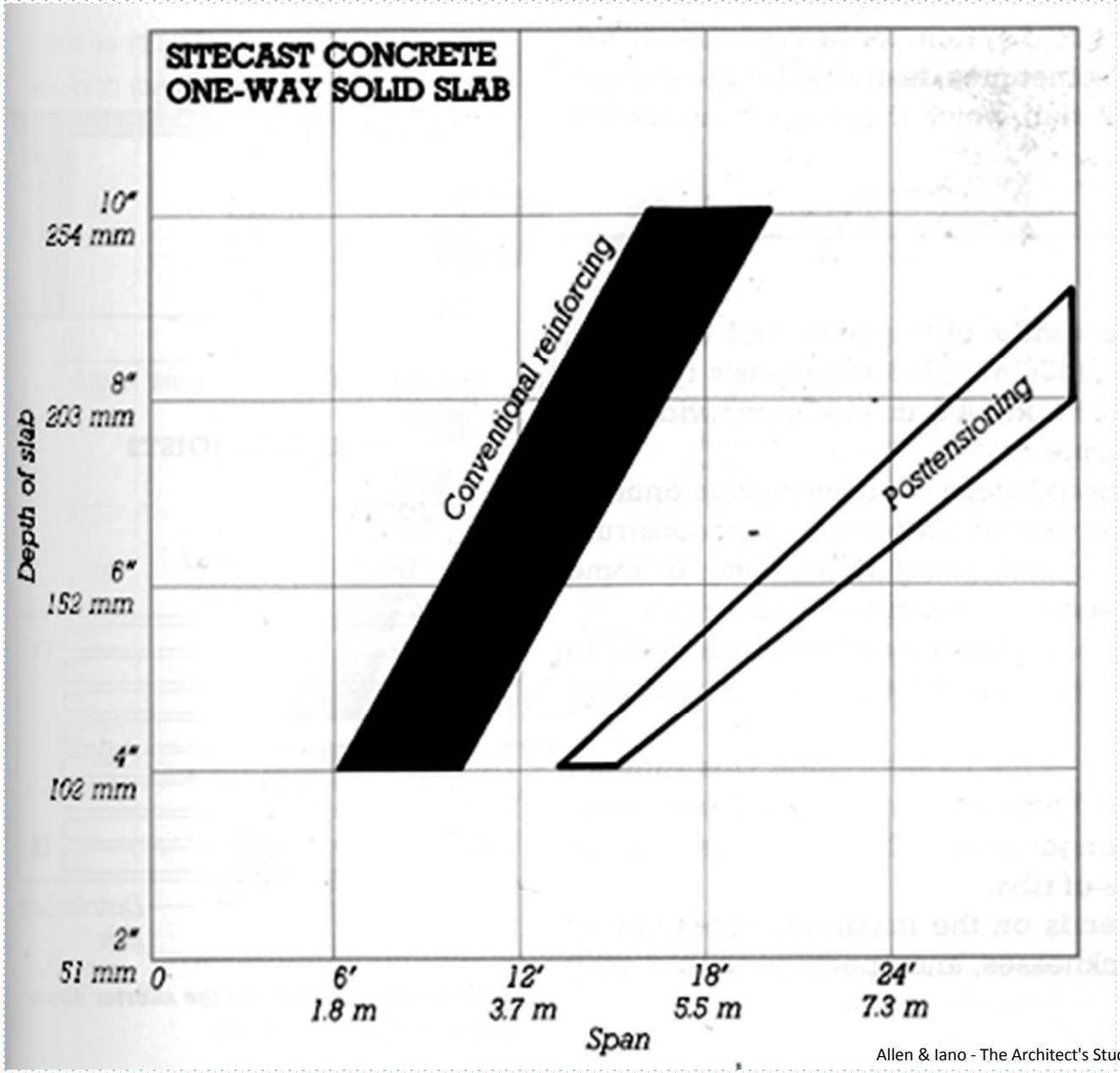
Concrete Slabs

- **One way slab**
- Two way slab
- Flat plate slab
- Waffle slab



One way slab – spans a distance much greater in one direction then in the other

Concrete Systems – one way slab



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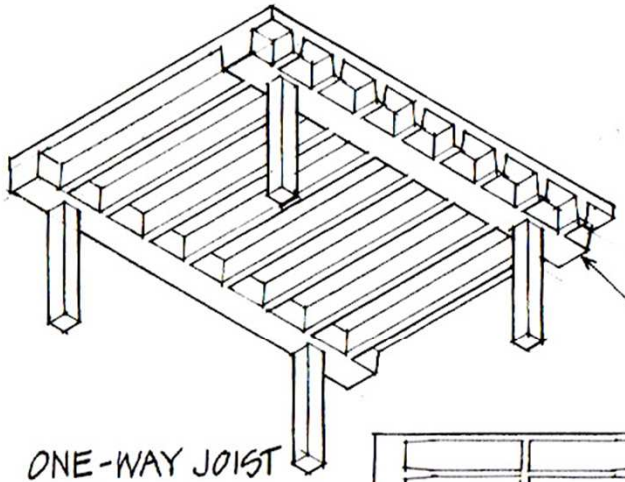
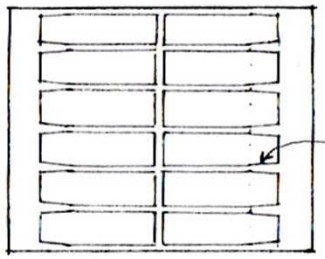
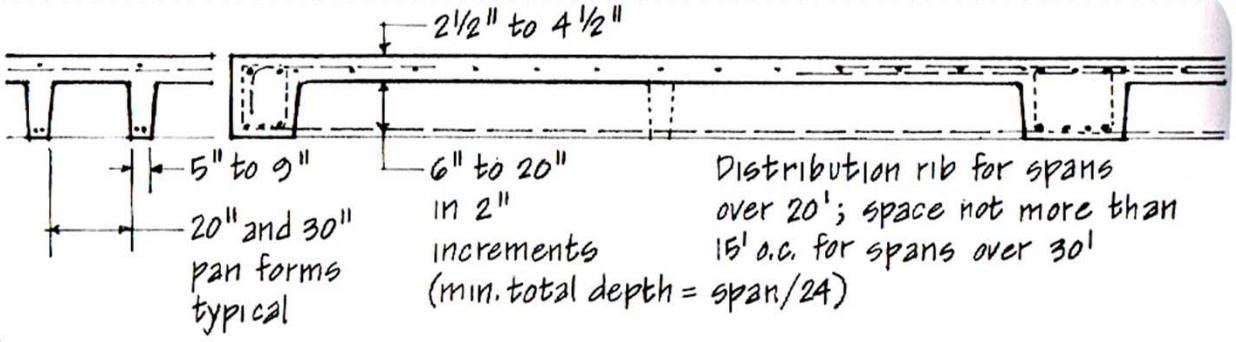
Concrete Systems – one way joist



ONE-WAY JOIST SLAB

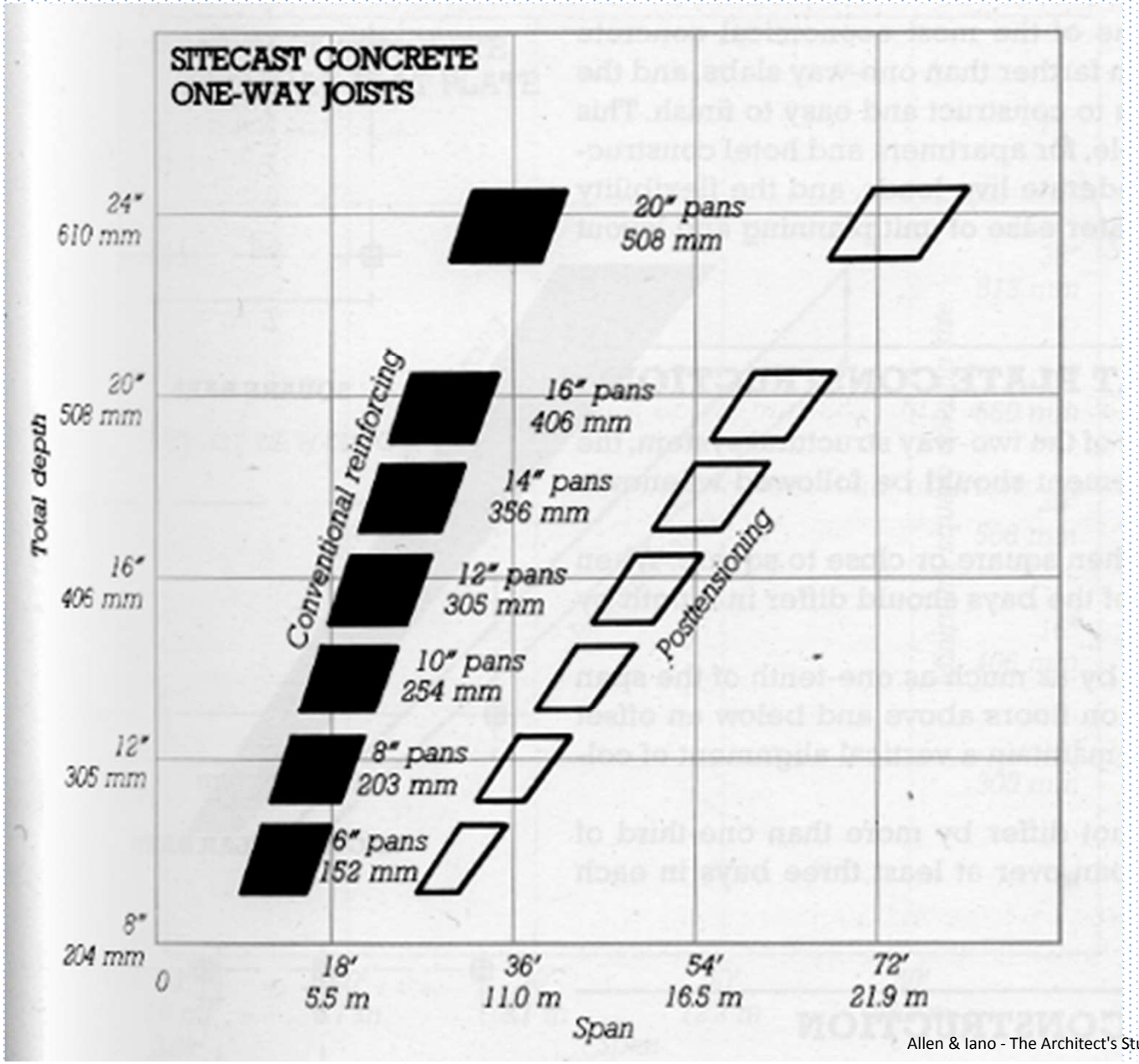
15' to 36' spans





- Joist band is an economical alternative to conventional beams; it has the same depth as the joists but is broader.
- One-way joist slabs are used for longer spans and heavier loads than practical for one-way solid slabs; not as suitable for large concentrated loads.
- Joists may be flared at the beam supports for greater shear resistance.

Concrete Systems – one way joist



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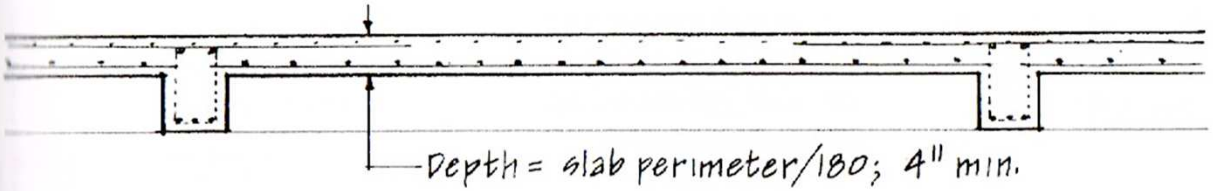
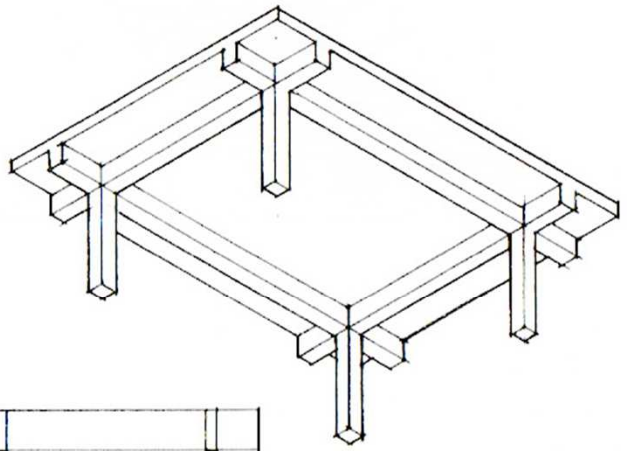
Concrete Systems – two way slab



- Two-way slab is supported on four sides by beams; bay should be as nearly square as possible.
- Two-way slabs with beams are used for long spans and heavy loads, or when a high resistance to lateral forces is required. Two-way slabs, however, are usually made without beams. See below.

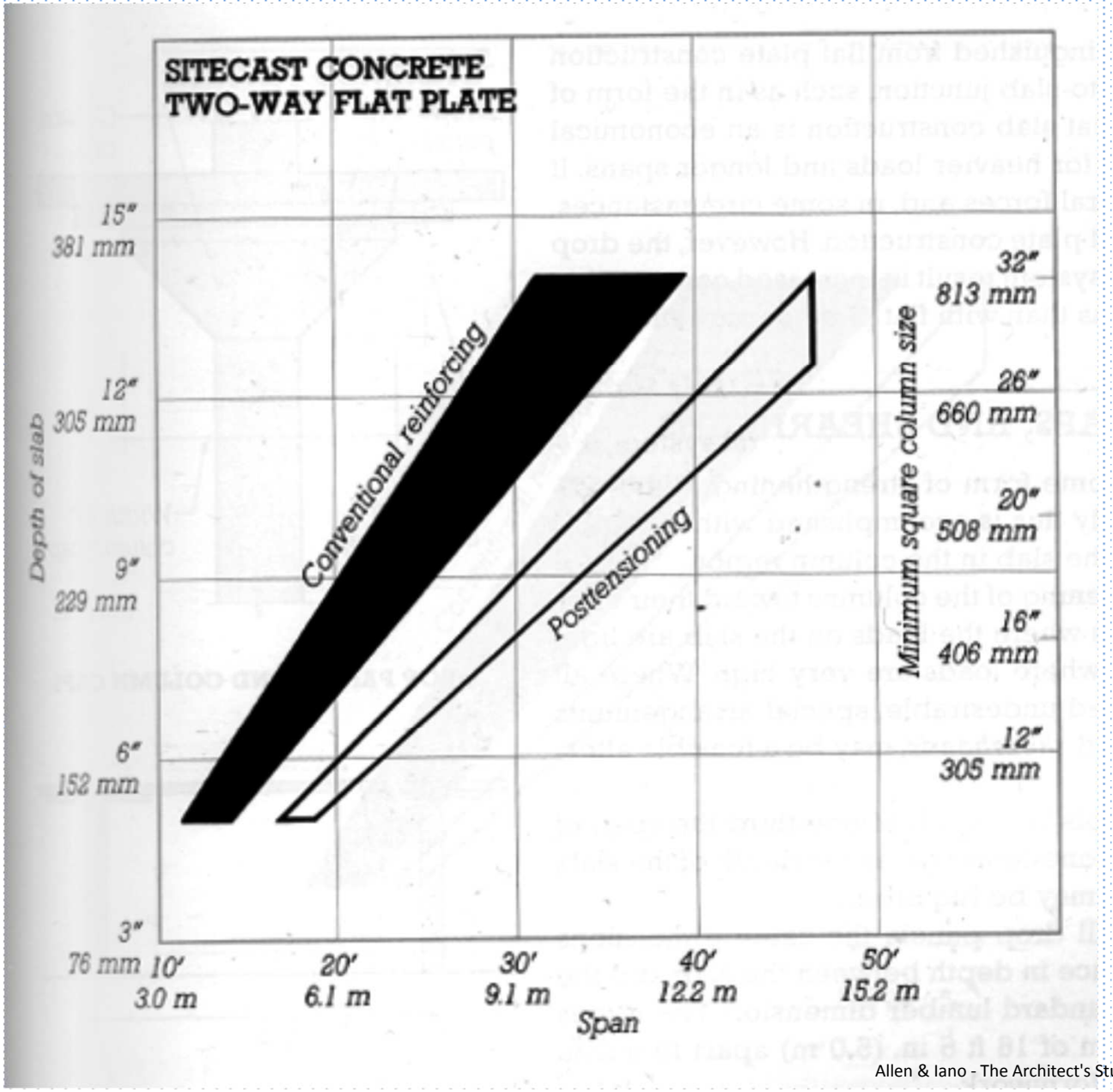


TWO-WAY SLAB WITH BEAMS

15' to 40' spans

Ching – building construction illustrated

Concrete Systems – two way slab



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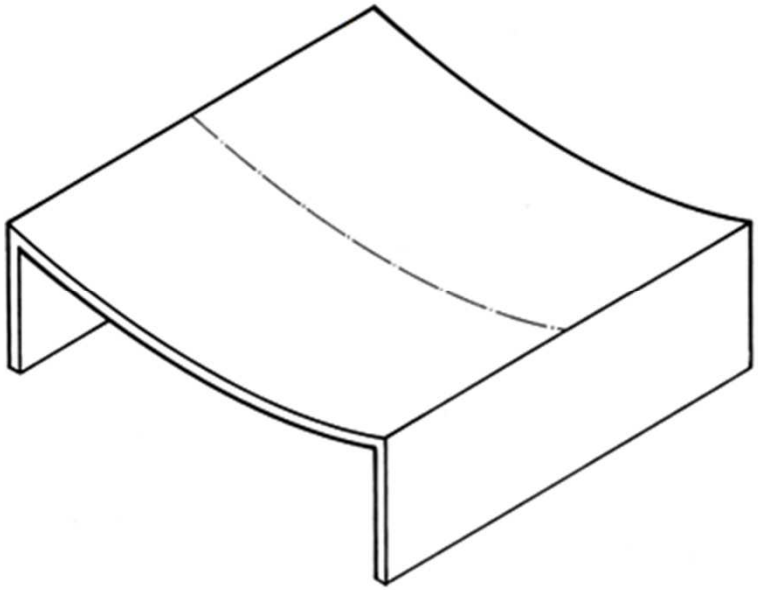
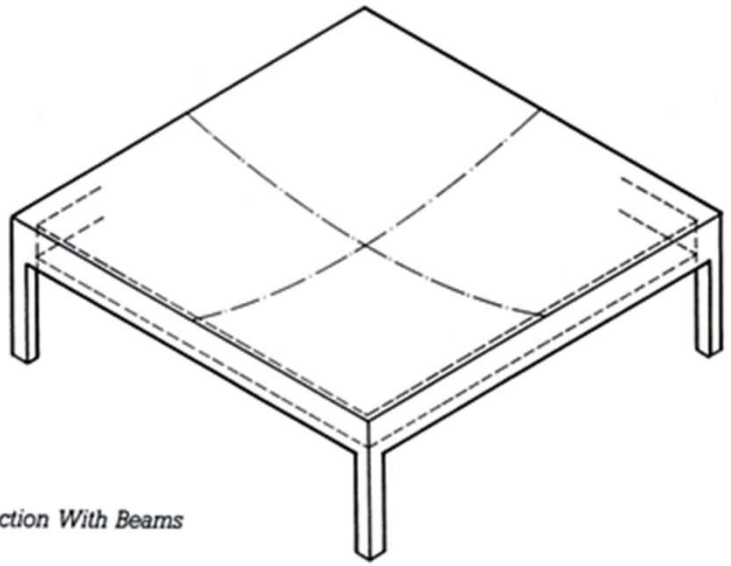
Remember one way slabs need to nearly square

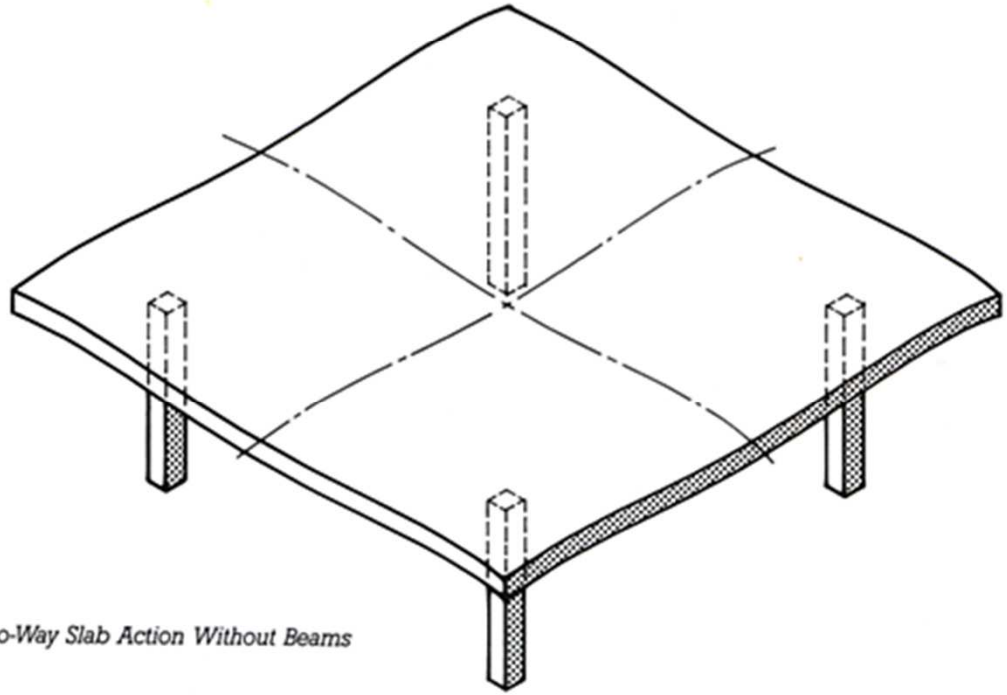
One-way and two-way slab action, with deflections greatly exaggerated.



One-Way Slab Action



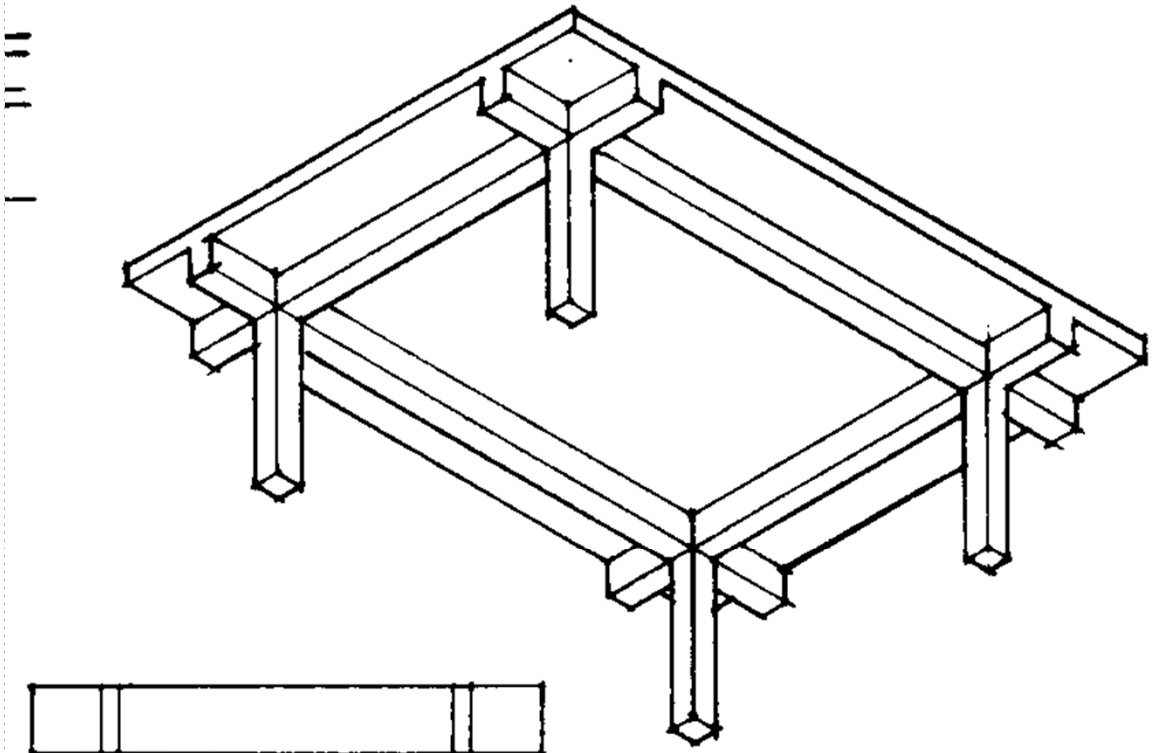
Two-Way Slab Action With Beams

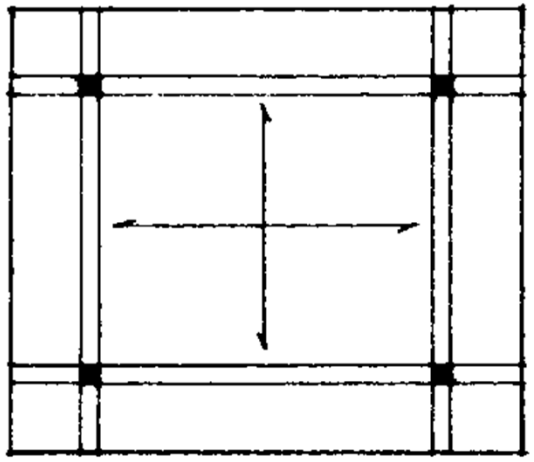


Two-Way Slab Action Without Beams

Concrete Slabs

- One way slab
- **Two way slab**
- Flat plate slab
- Waffle slab





TWO-WAY SLAB WITH BEAMS

15' to 40' spans

Two way slab – create a(n almost) square column spacing

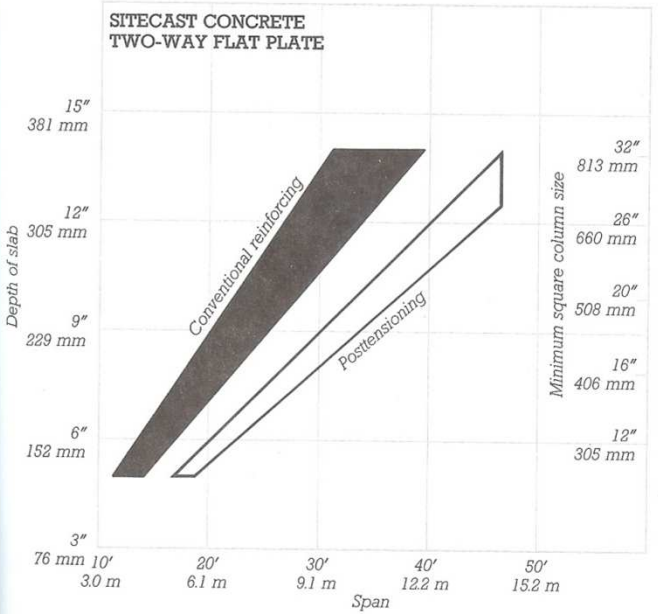
Structural Systems - Concrete

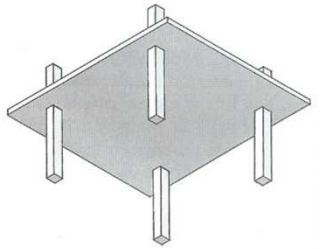
Concrete Slabs

- One way slab
- Two way slab
- **Flat plate slab**
- Waffle slab

Simple to construct and easy to finish

SITECAST CONCRETE TWO-WAY FLAT PLATE





This chart is for sitecast concrete flat plate construction, either conventionally reinforced or posttensioned. For medium to light loads, read toward the right in the indicated areas. For heavy loads, read toward the left.

- For rectangular column bays, use the span of the longer of the two sides of the bay in reading from this chart.
- Size slab depth to the nearest ½ in. (10 mm).

COLUMN SIZES FOR FLAT PLATE CONSTRUCTION

The shallow depth of the junction between the slab and the column in flat plate construction restricts the minimum column size in this system. The right-hand scale on the chart above provides minimum square column sizes for various slab thicknesses. The required minimum column sizes for this system also depend on the applied loads on the structure. For light loads, reduce the indicated column size by 2 in. (50 mm). For heavy loads, increase the column size by 2 to 4 in. (50 to 100 mm).

- For rectangular columns, use a column whose area is equal to that of the square column indicated. For round columns, use a column diameter one-third greater than the square column size indicated. Column sizes may also need to be increased at the edges of a slab.
- For columns in multistory buildings, or for columns over 12 ft (3.7 m) tall, column size should also be checked using the charts on pages 108–109.
- If smaller column sizes are desired, consider two-way flat slab construction as an alternative construction system. See pages 120–121.

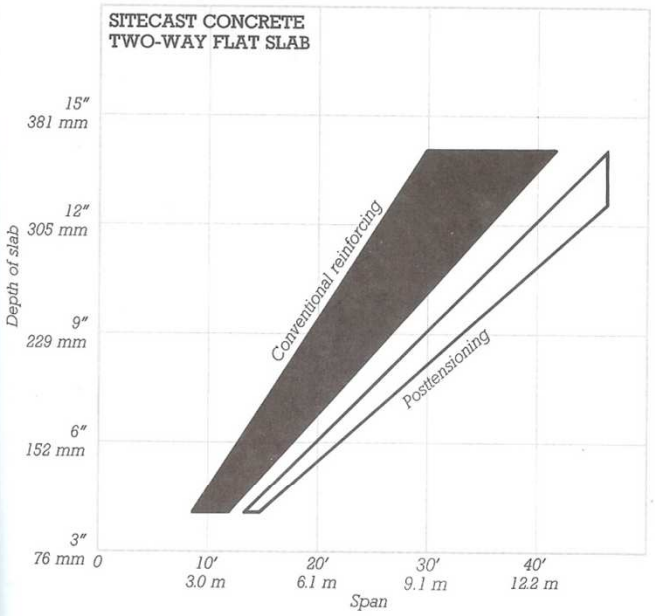
Two way flat plate slab – create a(n almost) square column spacing

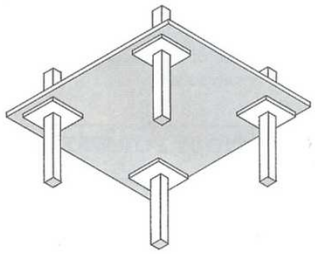
Concrete Slabs

- One way slab
- **Two way slab**
- Flat plate slab
- Waffle slab

Column caps

SITECAST CONCRETE TWO-WAY FLAT SLAB





This chart is for concrete two-way flat slab construction, either conventionally reinforced or posttensioned. For light loads, read toward the right in the indicated areas. For heavy loads, read toward the left.

- For rectangular column bays, use the span of the longer of the two sides of the bay in reading from this chart.
- Size slab depth to the nearest ½ in. (10 mm).

COLUMN SIZES AND LAYOUTS FOR FLAT SLAB CONSTRUCTION

For light to moderate loads, use a minimum square column size of 12 in. (300 mm) for preliminary design. For heavier loads, larger columns or the addition of column caps may be required. Column size may be increased by 4 to 12 in. (100 to 300 mm) for extremely heavy loads.

For rectangular columns, use a column whose area is equal to that of the recommended square column size. For round columns, use a column diameter one-third greater than the recommended square column size. Column sizes may also need to be increased in multistory buildings or for columns taller than 12 ft (3.7 m). See pages 108–109 for checking column sizes for these conditions.

For maximum economy and efficiency of the two-way structural system, column layouts for flat slab construction should adhere to the same guidelines as those described for flat plate construction. Column bays should be approximately square, and column offsets from regular lines should be minimized. See page 118 for a complete discussion of these guidelines.

Two way flat plate slab – create a(n almost) square column spacing

Concrete Slabs

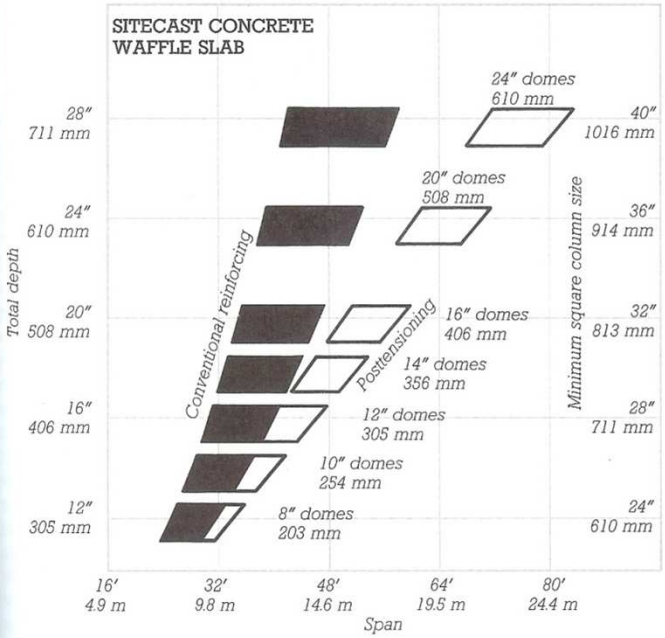
- One way slab
- Two way slab
- Flat plate slab
- **Waffle slab**

Structural Systems - Concrete

Concrete Slabs

- One way slab
- Two way slab
- Flat plate slab
- **Waffle slab**

SITECAST CONCRETE WAFFLE SLAB



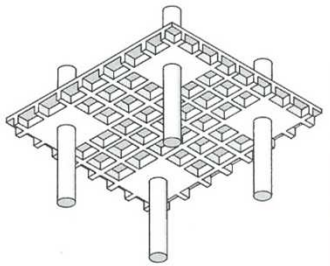
COLUMN SIZES AND LAYOUTS FOR WAFFLE SLAB CONSTRUCTION

In waffle slab construction, minimum column size is dependent on the overall thickness of the slab. The right-hand scale on the chart above provides minimum square column sizes for various slab thicknesses. For light loads, reduce the indicated column size by 2 to 4 in. (50 to 100 mm). For heavy loads, increase the indicated column size by 4 to 12 in. (100 to 300 mm).

For rectangular columns, use a column whose area is equal to that of the square column indicated. For round columns, use a column diameter one-third greater than the square column size indicated.

For columns in multistory buildings or for columns over 12 ft (3.7 m) tall, column size should also be checked using the charts on pages 108–109.

For maximum economy and efficiency of the two-way structural system, column layouts for waffle slab construction should adhere to the same guidelines as those described for flat plate construction. Column bays should be approximately square, and column offsets from regular lines should be minimized. See page 118 for a complete discussion of these guidelines.

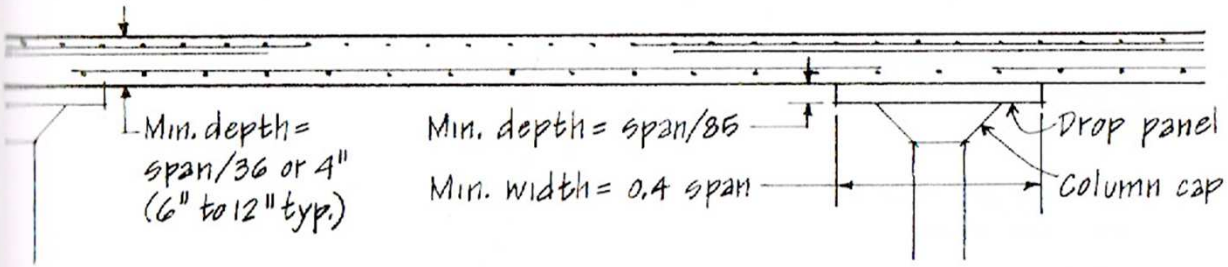


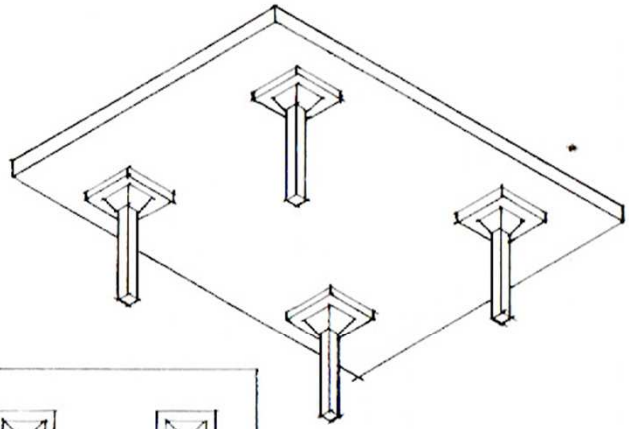
This chart is for concrete waffle slab construction, either conventionally reinforced or posttensioned. For light loads, read toward the right in the indicated areas. For heavy loads, read toward the left.

- For rectangular bays, use the average of the spans of the two sides of the bay when reading from this chart.
- *Total depth* is the sum of the depth of the ribs and the slab. (See the diagram on the facing page.) Depths are indicated on the chart for slabs from 3 to 4½ in. (76 to 114 mm) deep with standard pan sizes. The choice of the slab depth usually depends on the required fire-resistance rating for the system. See the facing page for fire-resistance information.

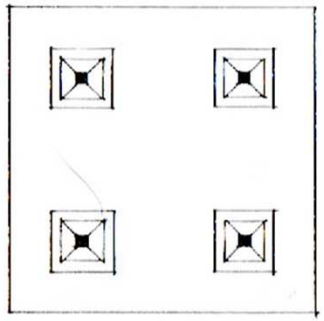
Structural Systems - Concrete

Concrete Systems – two way flat slab





- Two-way slab is supported by columns without beams.
- Drop panels and/or column caps reinforce slab at column supports.
- Reinforcing steel is arranged to handle varying stresses within a slab of uniform thickness; this also applies to flat plates below.

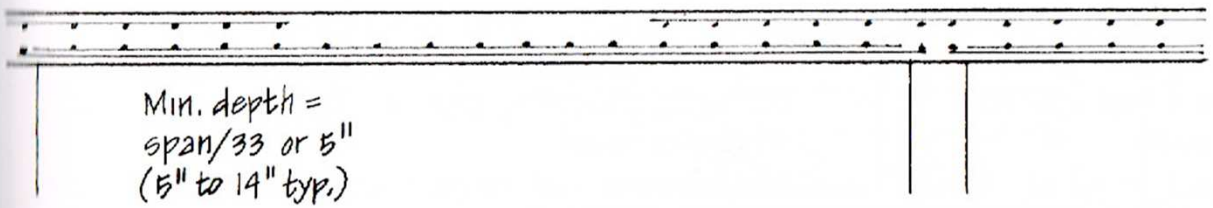


TWO-WAY FLAT SLAB

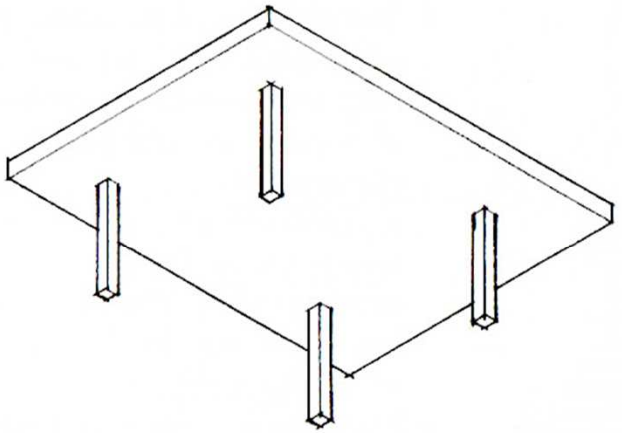
15' to 40' spans

Ching – building construction illustrated

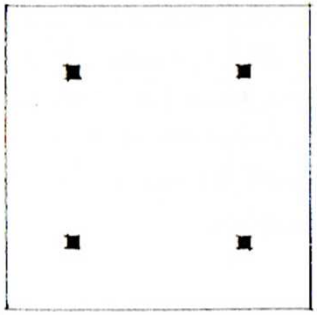
Concrete Systems – two way flat slab



- Minimal construction depth can minimize building height.



- Two-way flat plates are similar to two-way slabs but have no drop panels.
- Flat plates are suitable for moderate loads.
- They are simple to form, and permit some flexibility in column placement.

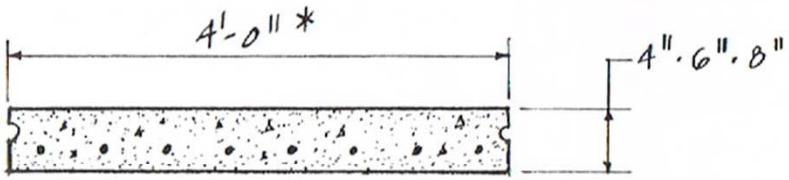
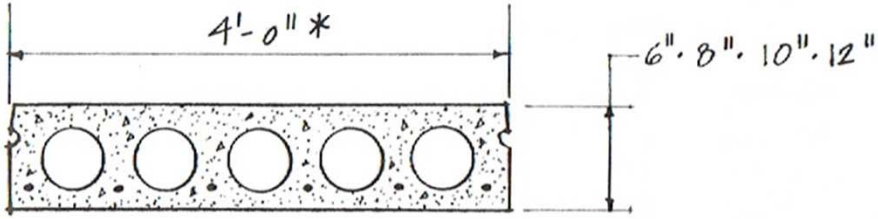


TWO-WAY FLAT PLATE

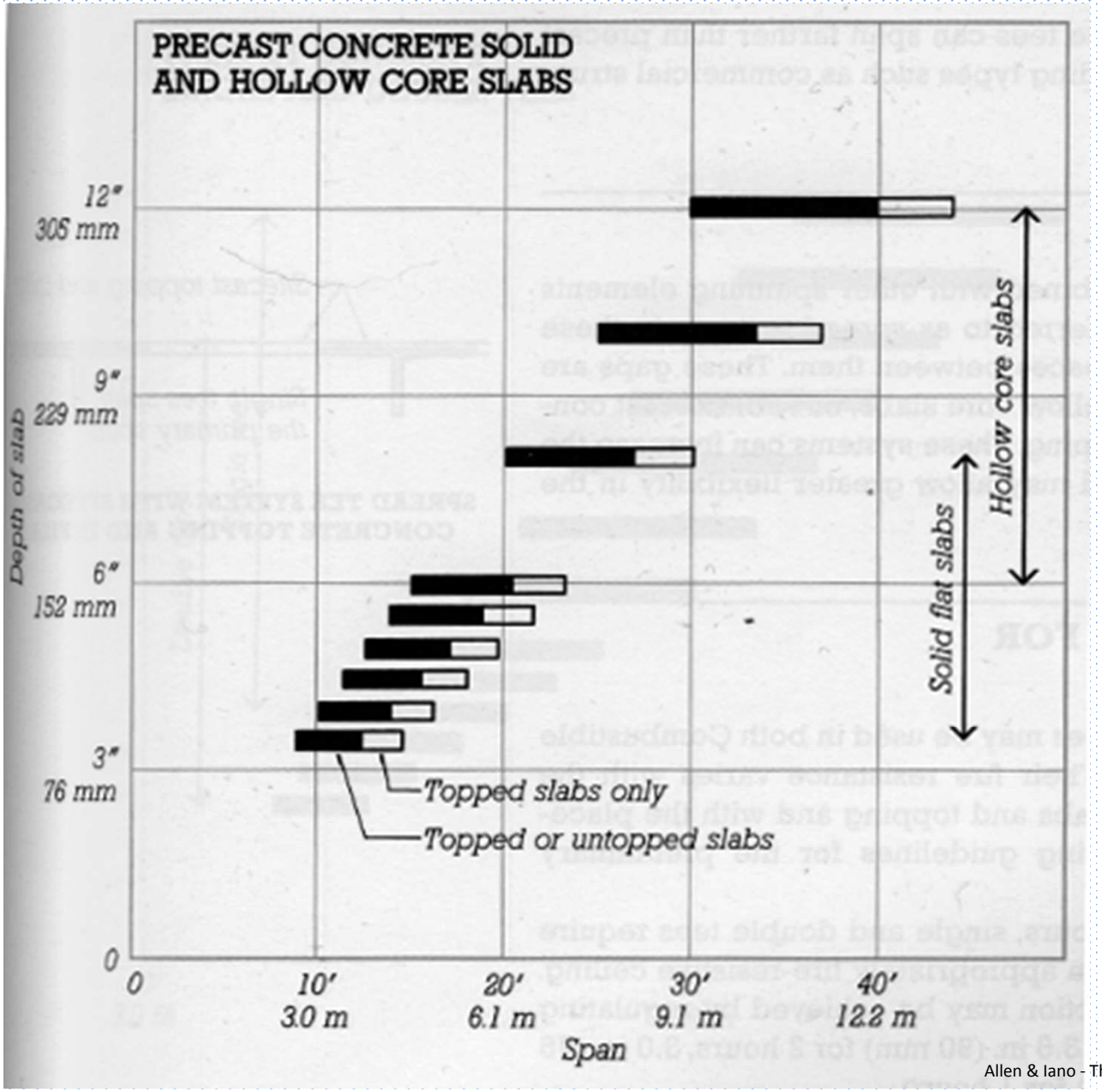
15' to 36' spans

Ching – building construction illustrated

Concrete Systems – Precast Units

TYPE OF PRECAST CONCRETE UNIT	THICKNESS or DEPTH in inches	SPAN RANGE in feet
 * Exact dimension varies to allow space for reinforcement and grouting. SOLID FLAT SLAB	4	12 - 16
	6	14 - 24
	8	18 - 30
 * Also available in 1'-4", 2'-0, 3'-4", and 8'-0 widths. HOLLOW CORE SLAB	6	14 - 22
	8	20 - 32
	10	24 - 40
	12	30 - 44

Concrete Systems – Precast Units



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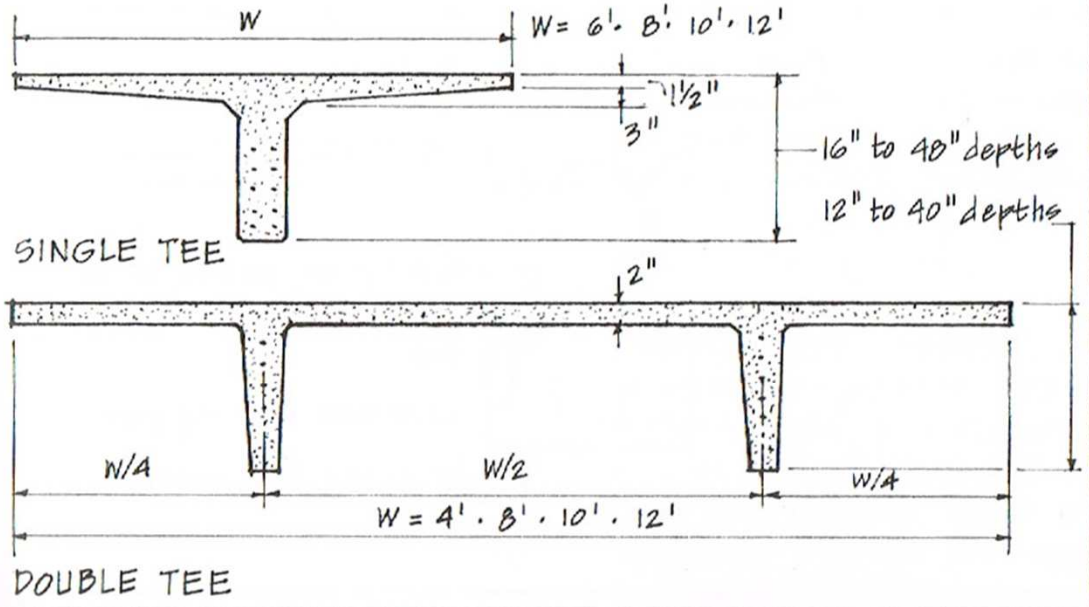
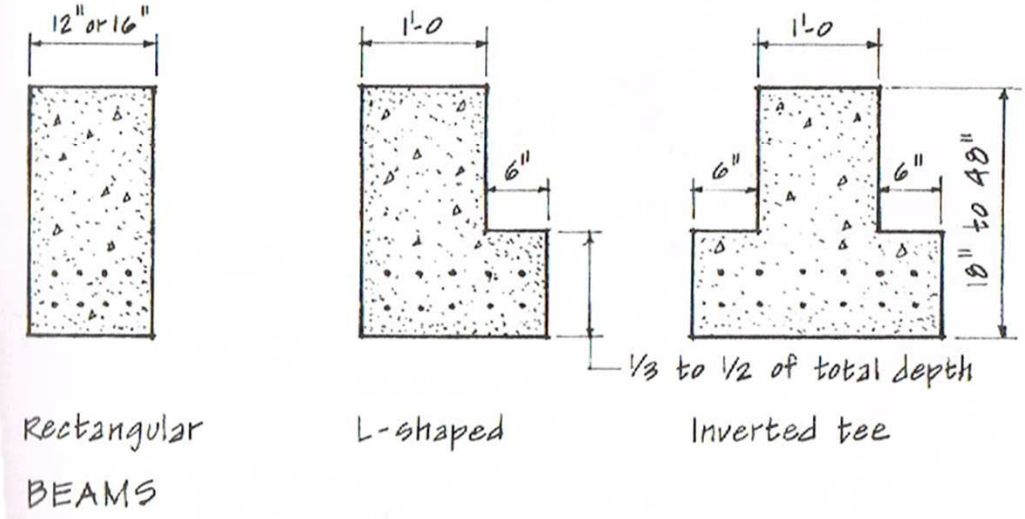
Concrete Systems – Precast Units

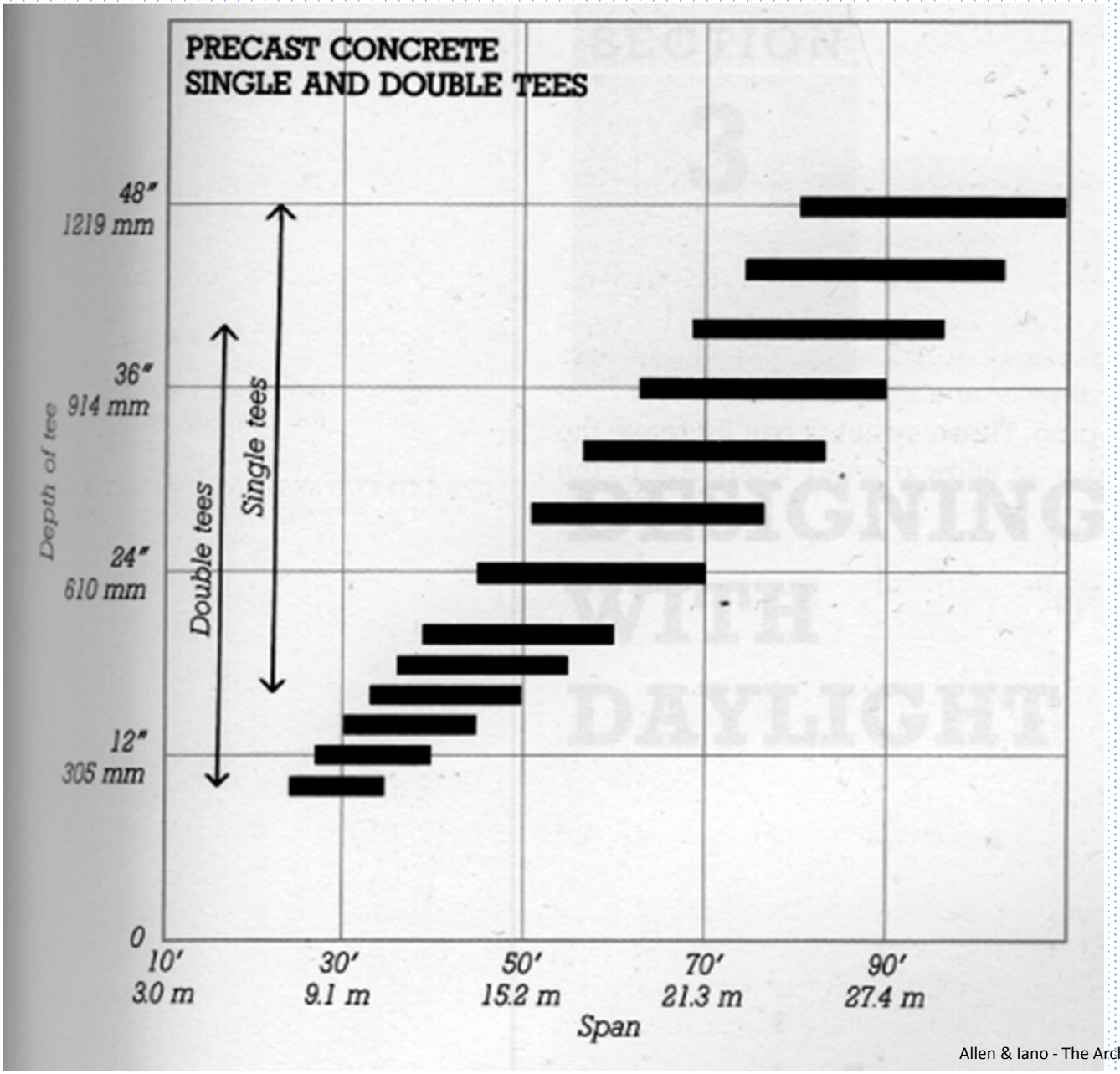


12	28 - 40
18	36 - 50
24	45 - 70
32	54 - 80
36	62 - 90
48	80 - 110



20	18 - 30
28	22 - 40
36	26 - 50
44	30 - 56
52	34 - 70
60	42 - 80

Concrete Systems – Precast Units



Allen & Iano - The Architect's Studio Companion: Rules of Thumb for Preliminary Design