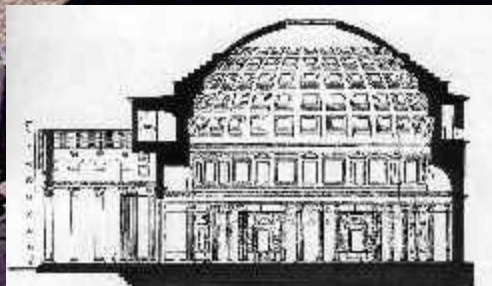


# Architectural Technology V

|



**CONCRETE !**



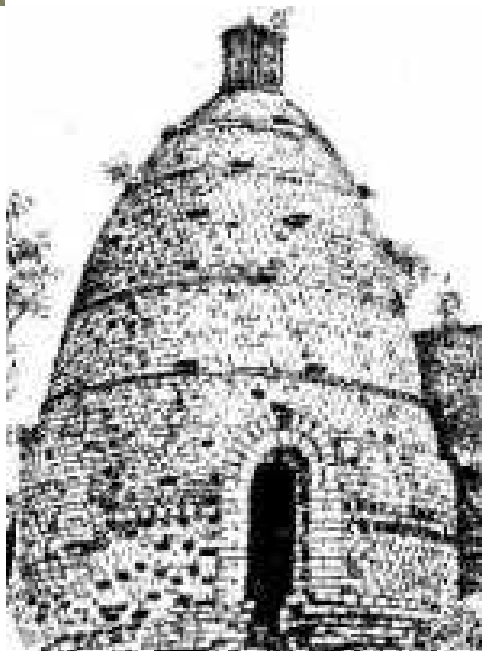


# Architectural Technology V

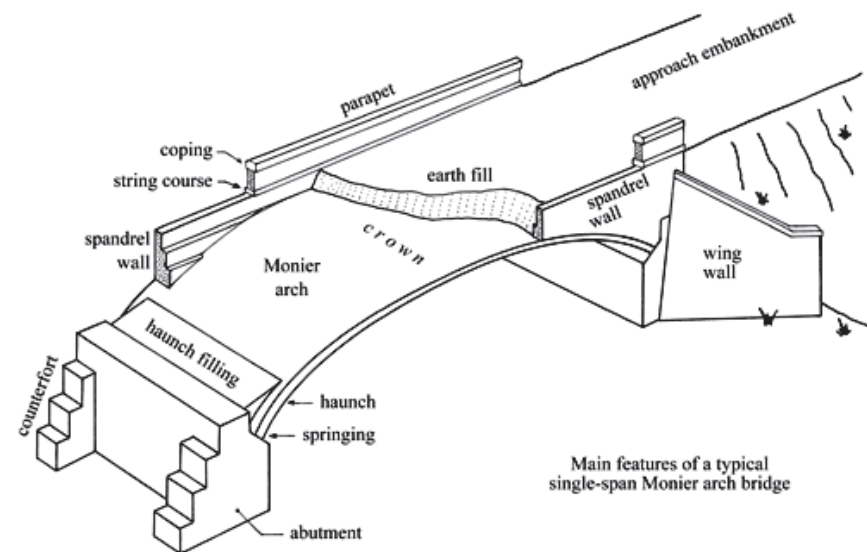
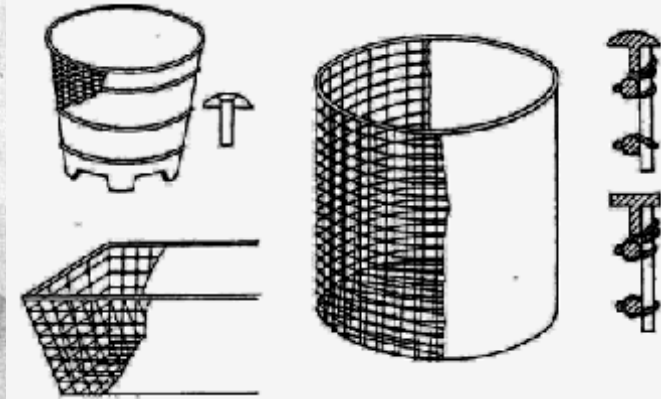
Joseph Aspdin (1778-1855)



Patent for Portland Cement  
1824



Joseph Monier (1823-1906)

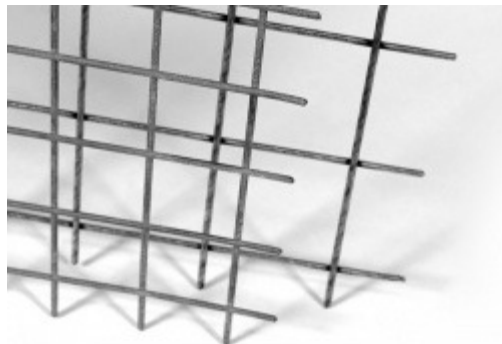
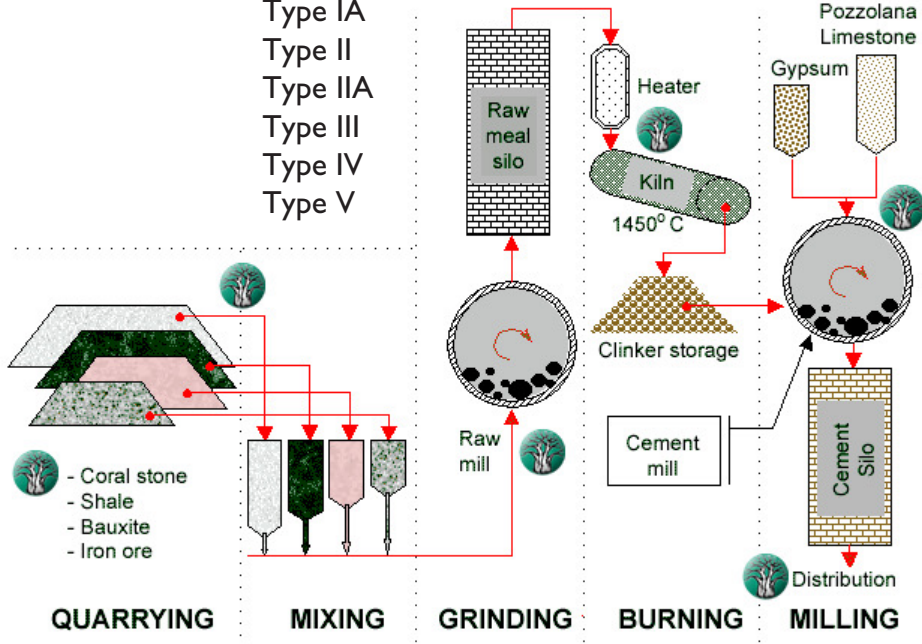




## What is Concrete?

### Cement

- Type I
- Type IA
- Type II
- Type IIA
- Type III
- Type IV
- Type V



### Aggregates and Water

Size Matters!



### Admixtures

- Air-entraining;
- Water-reducing;
- Superplasticizers;
- Accelerating;
- Fly Ash;
- Silica fume;
- Slag;
- Pozzolans;
- Workability Agents;
- Corrosion Inhibitors;
- Fibrous Admixtures;
- Freeze Protection;
- Coloring Agents.



... Reinforcing

## Sustainability in Concrete Construction

### Negative Characteristics:

*Largest consumer of natural resources;*

*Cement manufacture is a significant polluter;*

*Quarrying for concrete effects large impact on existing landscapes;*

*Formwork and Reinforcing require additional resources;*

*Significant on-site waste;*

### Positive Characteristics:

*Useful as a thermal mass;*

*Reinforcing uses recycled steel;*

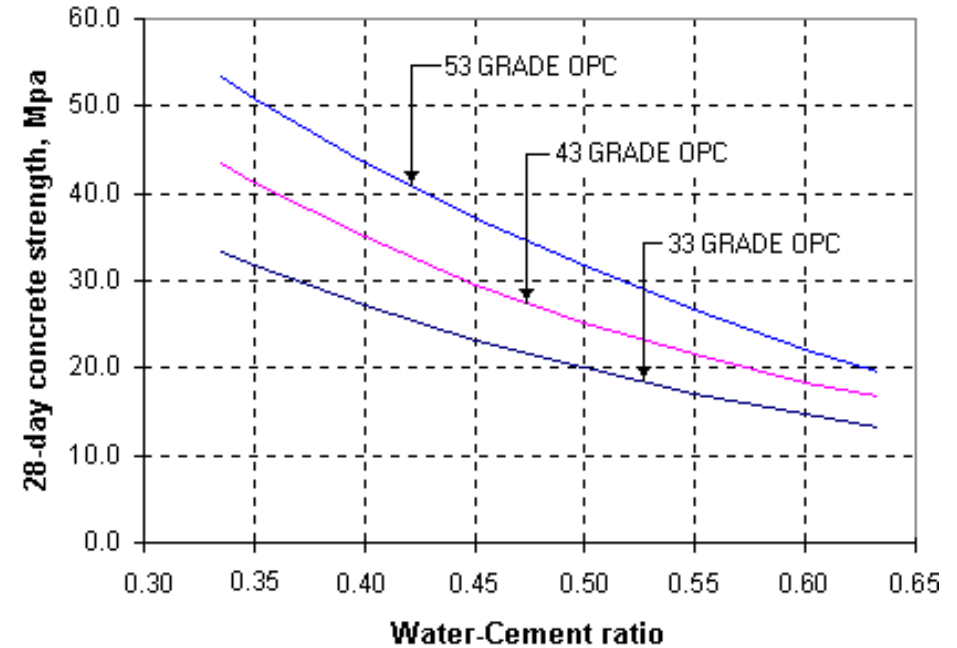
*May integrate waste products (fly-ash) in manufacture;*

*May be recycled for aggregate;*

*Longer life-span for concrete structures.*

## Making and Placing Concrete

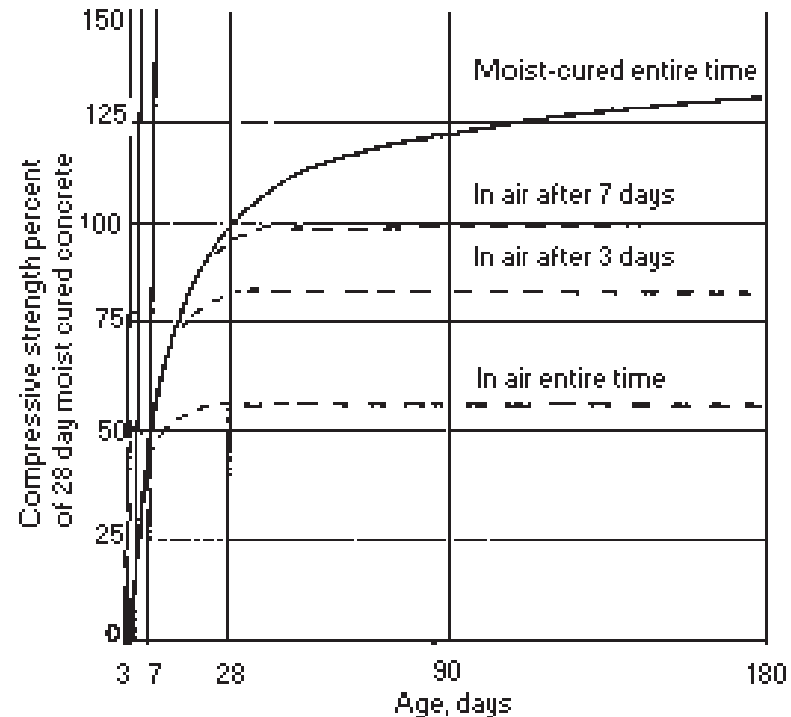
### Proportioning Concrete Mixes (Water-Cement Ratio)



## Handling and Placing Concrete

Drop Height / Slump;  
Consolidation / Vibration

## Curing Concrete







Pouring (Concrete Pump)



Consolidation (Vibration)



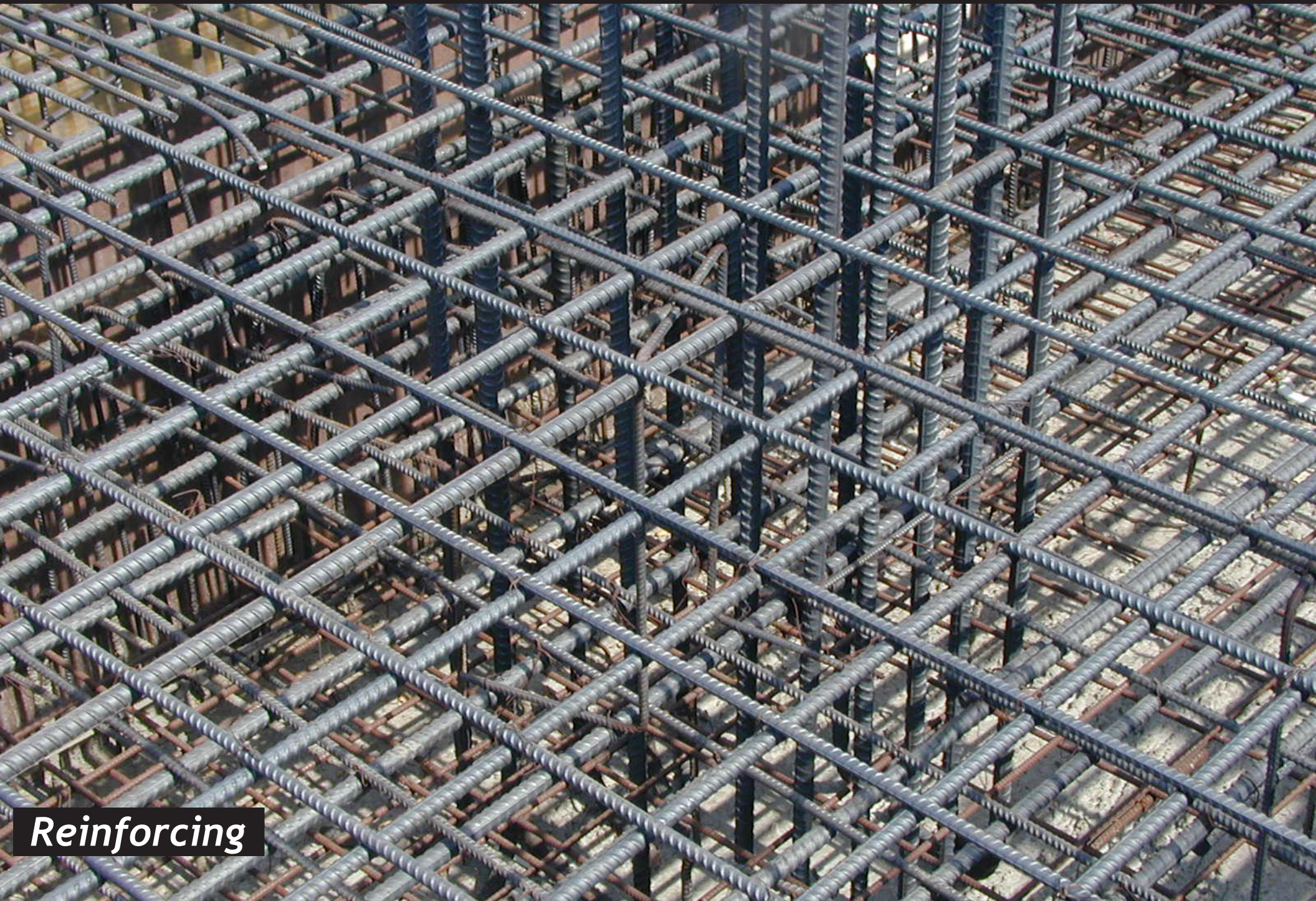
Bracing During Curing



Maintaining Moist Curing

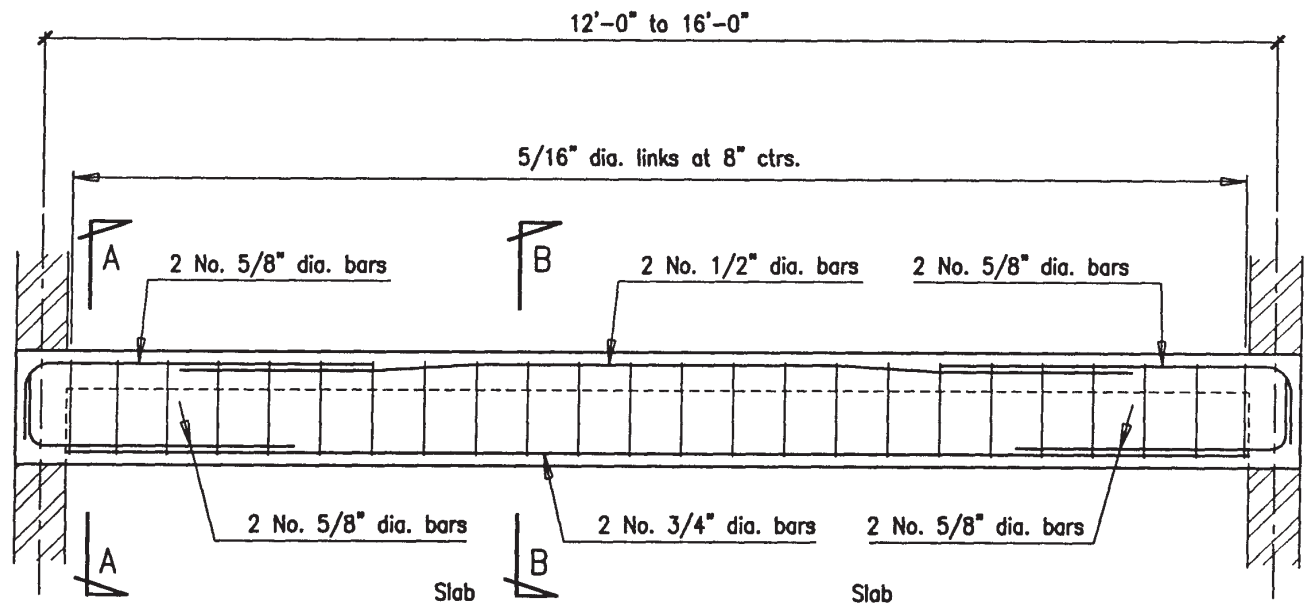
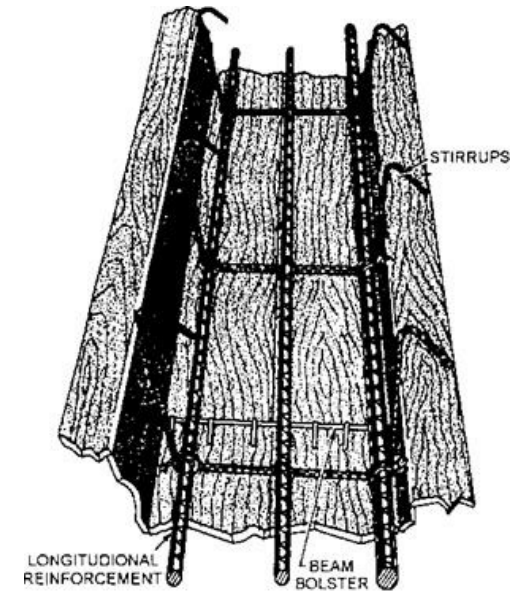
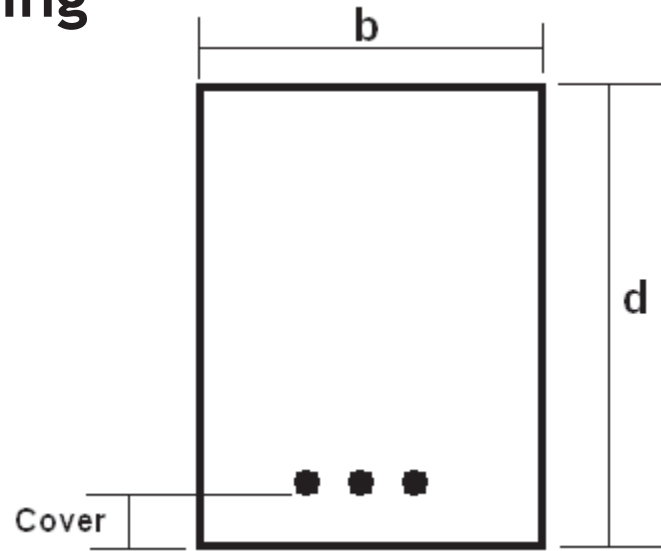
*Formwork*





**Reinforcing**

## Concrete Beam Reinforcing



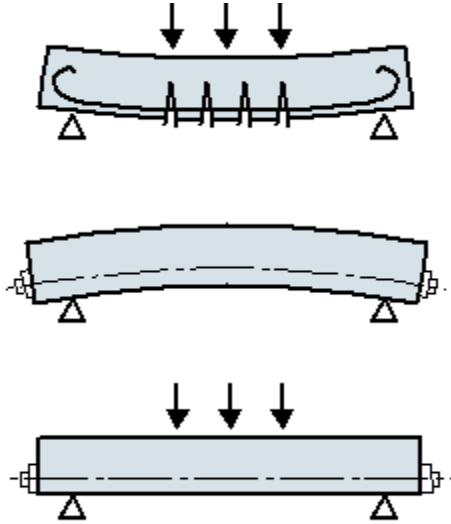
## Concrete Slab Reinforcing



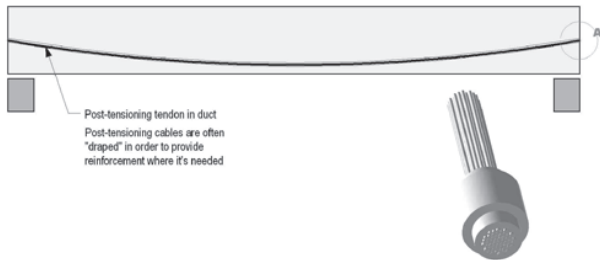


**Concrete Column Reinforcing**

## PreStressing



## Posttensioning





**Precast/Prestressed + Cast-in-place**



## ACI 301: Specifications for Structural Concrete in Buildings

Formwork; Reinforcement; chairs and bolsters; concrete mixtures, handling and placing of concrete; lightweight concrete; prestressing; the use of concrete in exposed Architectural Surfaces.

*(ACI = American Concrete Institute)*

## CSI Masterformat Section Numbers for Concrete Construction

03100	[03 10 00]	Concrete Formwork
03200	[03 10 00]	Concrete Reinforcement
03210	[03 21 00]	<i>Reinforcing Steel</i>
03220	[03 22 00]	<i>Welded Wire Fabric</i>
03230	[03 23 00]	<i>Stressing Tendons</i>
03300	[03 30 00]	Cast-in-place Concrete
03400	[03 40 00]	Precast Concrete



## **Some Examples of Concrete Buildings from Recent Architectural History**

## Chapter 14 SiteCast Concrete Framing Systems

Why does this chapter use the term “sitecast” concrete?

## Chapter 14 SiteCast Concrete Framing Systems

### *Casting a concrete slab-on-grade*

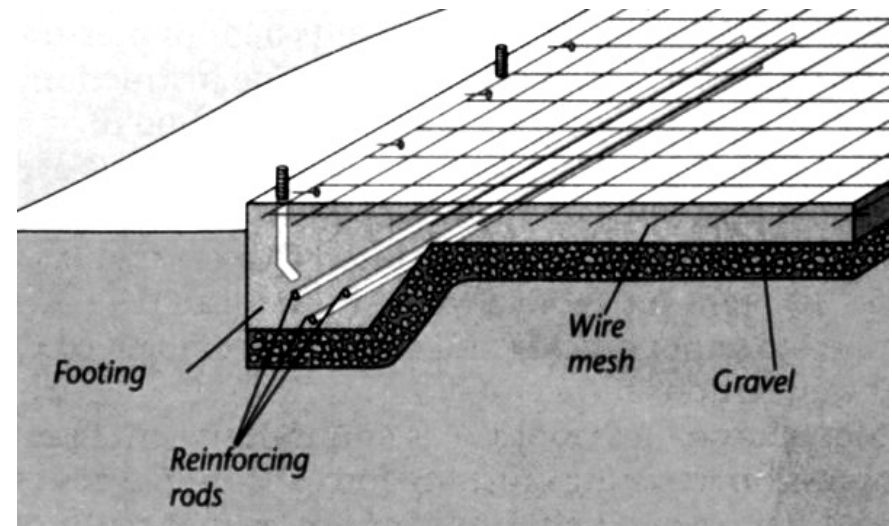
Soil Prep and Gravel Base

Moisture Barrier

Reinforcement: WWF

Concrete

Construction Joints; Control Joints



### *Pouring and Finishing a Slab on Grade*

Strike off to level

Float

Shake-on Hardeners

Finishing: Trowled, Broomed, or Helecopter

### *Curing*

## Chapter 14 SiteCast Concrete Framing Systems

### *Casting a concrete wall*

Reinforcing

Forming and bracing

(Wood, Metal, Finishes, &c.)

Ties

Stripping

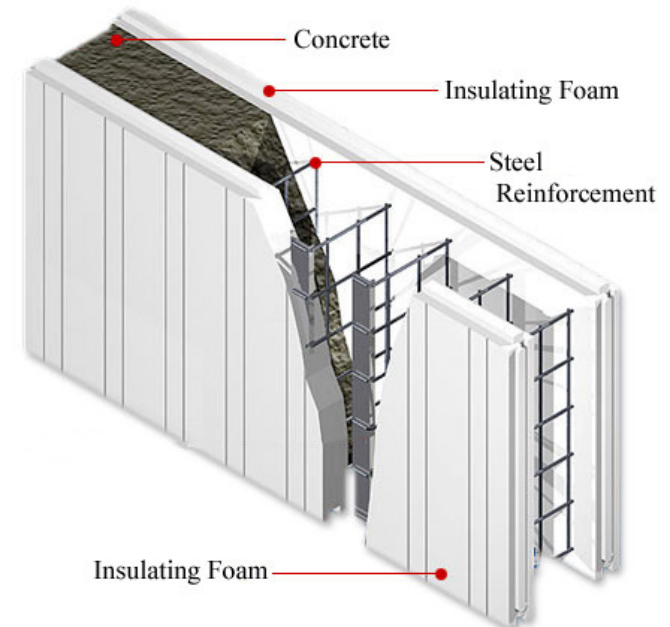


### *Insulating concrete forms*

### *Casting a concrete column -- just like a wall...*

Prefabricated Column Forms:

Cardboard, Fiberglass, Metal



## Chapter 14 SiteCast Concrete Framing Systems

### *One-way floor and Roof Framing Systems (Girder / Beam / Slab)*

*Allen, pp. 516-524*

- One-way solid slab system (Short Span)
- one-way concrete joist system (ribbed slab)
- Wide-module Concrete joist system

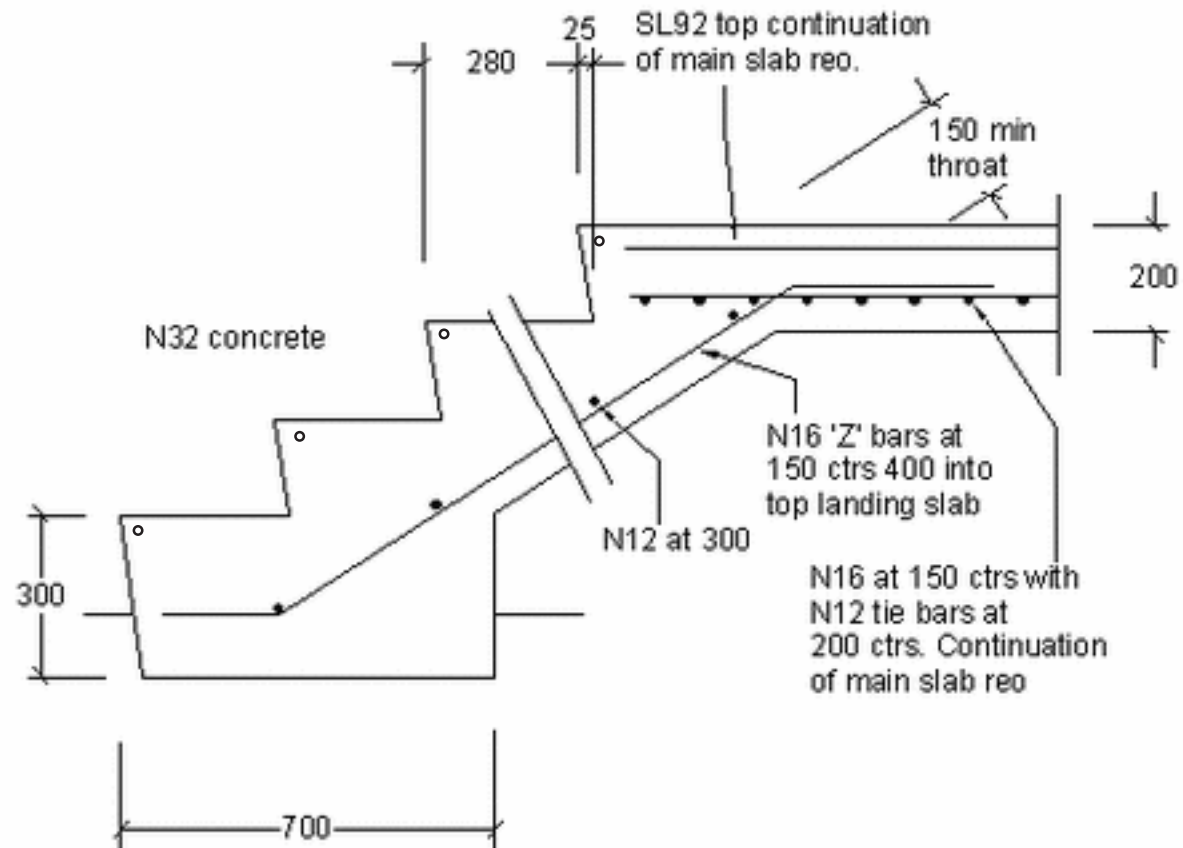
### *Two-way floor and roof framing systems (Column / Plate)*

*Allen, pp. 525-529*

- Two-way flat slab and flat plate systems
- Two way waffle-slab system

## Chapter 14 SiteCast Concrete Framing Systems

### Concrete Stairs





## *Sitecast posttensioned framing systems*



## Chapter 14 SiteCast Concrete Framing Systems

Selecting a system (Allen, pp. 534-535)

Are both bay modules equal (square)? (Two way)

How Long are the Spans? <25': Two-way plate

>25': One-way joist or waffle slab

How Heavy are the Loads? Heavy Loads: Thick Slabs, large beams.

Regular Loads: Flat plate or joists/

Will there be a finish ceiling?

Does the lateral stability of the building against wind/seismic have to be provided by the rigidity of the frame?

Flat plate may not be sufficiently rigid; one-way might afford deeper and more rigid connections.

*Postensioning adds span potential for all systems.*

## Chapter 14 SiteCast Concrete Framing Systems

### *Innovations in Sitecast Concrete Construction*

Lift-slab Construction; ganged forms; slip forming; tilt-up; Shot-crete...

### *Architectural Concrete*

### *Longer Spans in Sitecast Concrete: Shells and Trusses*

### *Sitecast Concrete and Building Codes: Inherent Fire Resistance*

### *Uniqueness of Sitecast Concrete:*

Plasticity, Identity of Form and Structure

**Case Study I: Building with Concrete in India**

**Case Study II: Making the Modern (Tadeo Ando)**

**Next Week: READ Chapter 15 -- Precast Framing Systems**

**DO: Exercise 14.1, 14.2**