Historic Overview

Jack Moehle
University of California, Berkeley
Concrete Design, Codes, Events

- **1900**: Concrete building construction begins
- **1920**: First UBC
- **1940**: Blume, Newmark, Corning book published
- **1960**: San Fernando earthquake
- **1976**: UBC
- **1980**: Imperial County earthquake
- **2000**: FEMA 273
- **1920**: Northridge earthquake

(Note: The timeline and events are represented in a visual format with images and text labels for each year and event.)
Ductile detailing today
General Trends in Construction Practices

1900-1910
- earliest construction
- structural systems
  - frames
  - bearing walls
- concrete quality
- interior and exterior infills

1910-1920
- development of specialized systems
- flat slabs
  - drop panels and capitals
  - reinforcement arrangements
- joist and waffle slabs
  - steel pan or hollow clay tile void formers
- bearing walls
General Trends in Construction Practices

1920-1930
- Era of improved construction quality
- Improvements in gravity load design
- Seismic design still in its infancy

1930-1950
- Slight progress in concrete construction
General Trends in Construction Practices

1950-1960
- rapid change in systems, design methods, and construction practices
- more open interiors and lighter cladding
- some seismic development
- prestressed and precast concrete
- formal use of shear walls

1960-1970
- improvement seismic design, but lack of attention to concrete detailing requirements
- designated lateral load systems
- lightweight aggregate concrete

Beam-column frame

Slab-column frame
General Trends in Construction Practices

1970-1980
- 1971 San Fernando earthquake
- 1976 UBC ductile concrete provisions
- 1979 Imperial Valley earthquake

1980-present
- continued improvement and consolidation in design, code provisions, and construction
- gravity framing
- 1994 Northridge earthquake
- FEMA 273/356
Materials

Typical range of column concrete strengths

Compressive strength, ksi

- 1900-1919: 10
- 1920-1949: 8
- 1950-1969: 6
- 1970-present: 4

LWC
Materials

◆ Non-prestressed Reinforcement
  ■ Early proprietary systems
  ■ Plain bars, twisted bars
  ■ Deformed reinforcement
    ◆ prominent use starting in 1950’s

◆ Prestressed Reinforcement
  ■ prominent use starting in 1950’s
  ■ corrosion
  ■ lack of non-prestressed reinforcement
# Materials - Reinforcement

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Transition to ductile detailing – 1960s onward

- 1961 - Blume, Newmark, Corning published
  - Many fresh concepts
    - confined concrete
    - flexural ductility concepts
    - plastic hinge length
    - capacity design for shear
  - Many aspects not considered
    - column/beam strength ratios
    - lap splices
    - joint design
ELEVATION OF TYPICAL COLUMN & GIRDER

S.T. = stirrup ties.
Transition to ductile detailing

- **Concrete buildings**
  - 1900
  - 1920
  - 1940
  - 1960
  - 1971 Blue Book
    - **1965 Blue Book**
      - highrise
      - ductile moment frame
      - wall confined boundaries
    - **1967 Blue Book**
      - commentary
    - **1968 Blue Book**
      - discontinuous wall provisions
  - **1976 UBC**
    - requirements for all buildings, not just highrise
    - gravity frames
    - LWC limits
  - **1980**
  - **2000**
Columns

3 OR 4 EXTRA TIE SETS SOMETIMES ADDED TOP & BOTTOM

TIE SETS @ 0.6 D TO 1.0 D

30 diam.

ALTERNATE INTERIOR TIE CONFIGURATIONS

Older

Today
Beam-column connections

Older

Today
Gravity columns
Walls

Older

Post-1976
Modern framing systems
Research today
Historic Overview

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