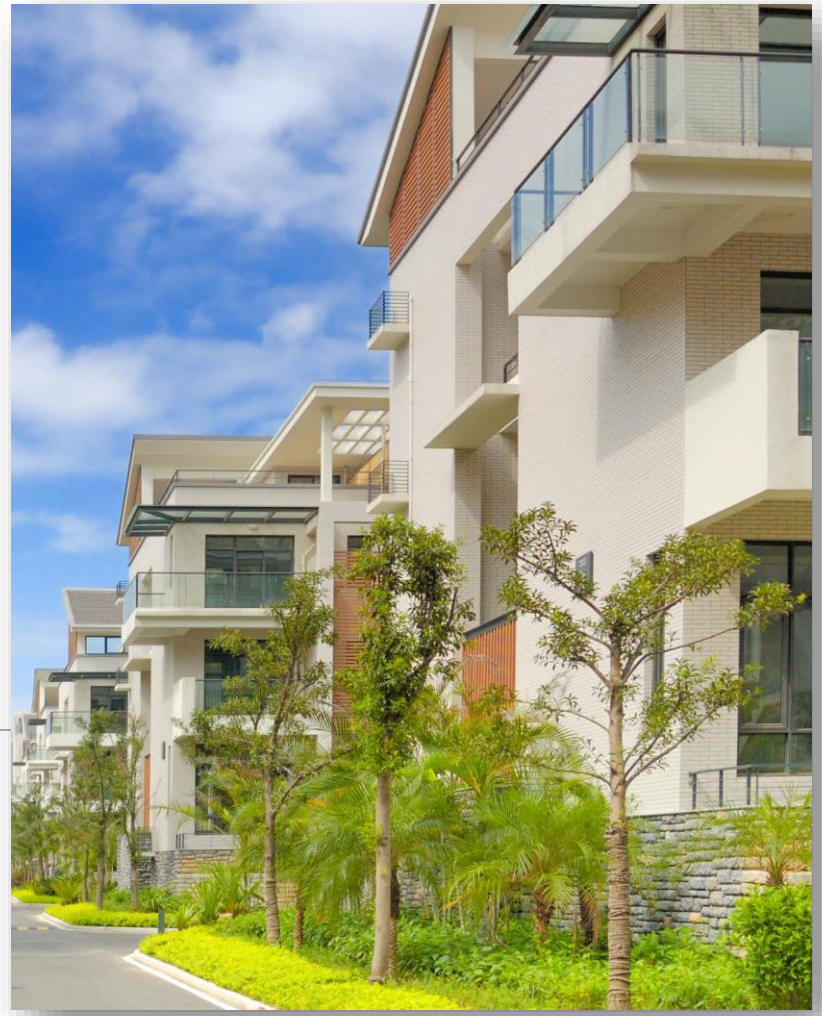
CRSI - Building Value with Reinforced Concrete

Rob Kinchler, PE
Greater Southwestern Regional Manager



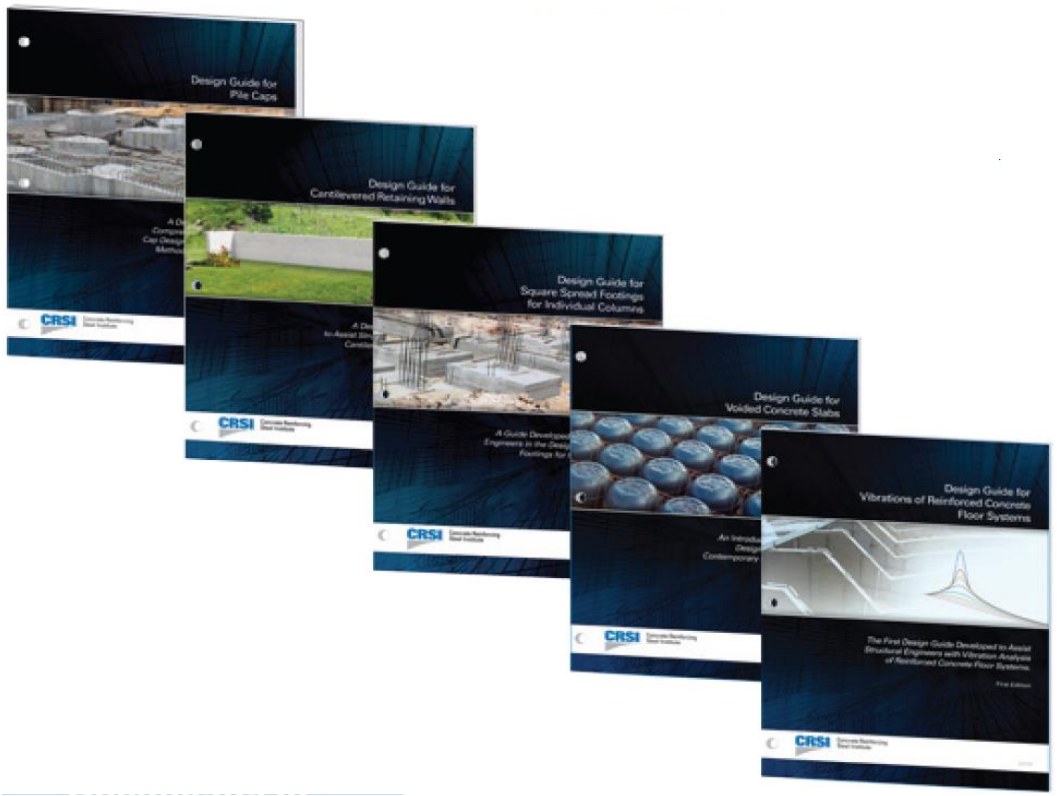
CRSI

Founded in 1924

Industry Publications

Design and Construction Support

CRSI Design Guides



Pile Caps
Spread Footings
Retaining Walls
Economical Design
Voided Slab
Floor Vibrations

Available on

www.crsi.org

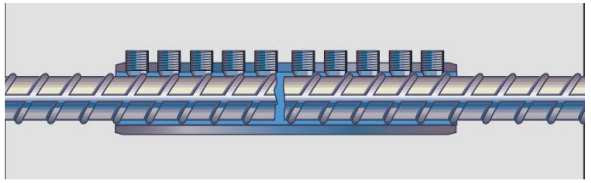
Electronic PDF

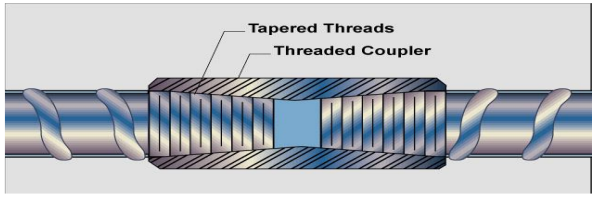
Hardcopy also available

CRSI – Tech Notes

CRSI - Members

- Producers of Reinforcing Steel
- Fabricators of Reinforcing Steel
- Placers of Reinforcing Steel
- Suppliers of related products & services





CRSI Honor Awards

CRSI Assistance

Topics for Discussion

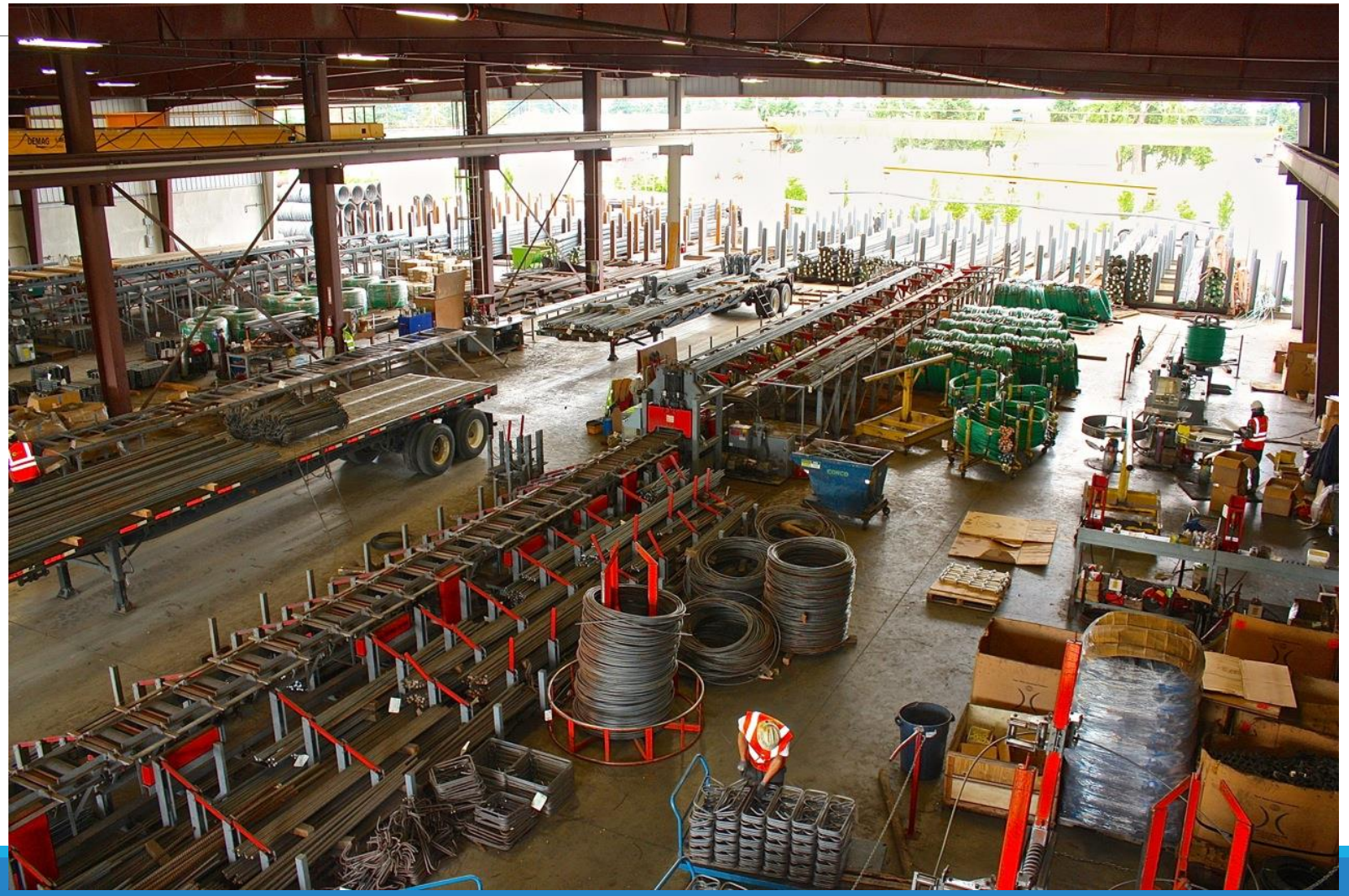
Rebar Fabrication

Fundamentals of Reinforced Concrete

Economics of Concrete Buildings

Innovative Systems

Rebar Fabrication



Inventory

Shear Line

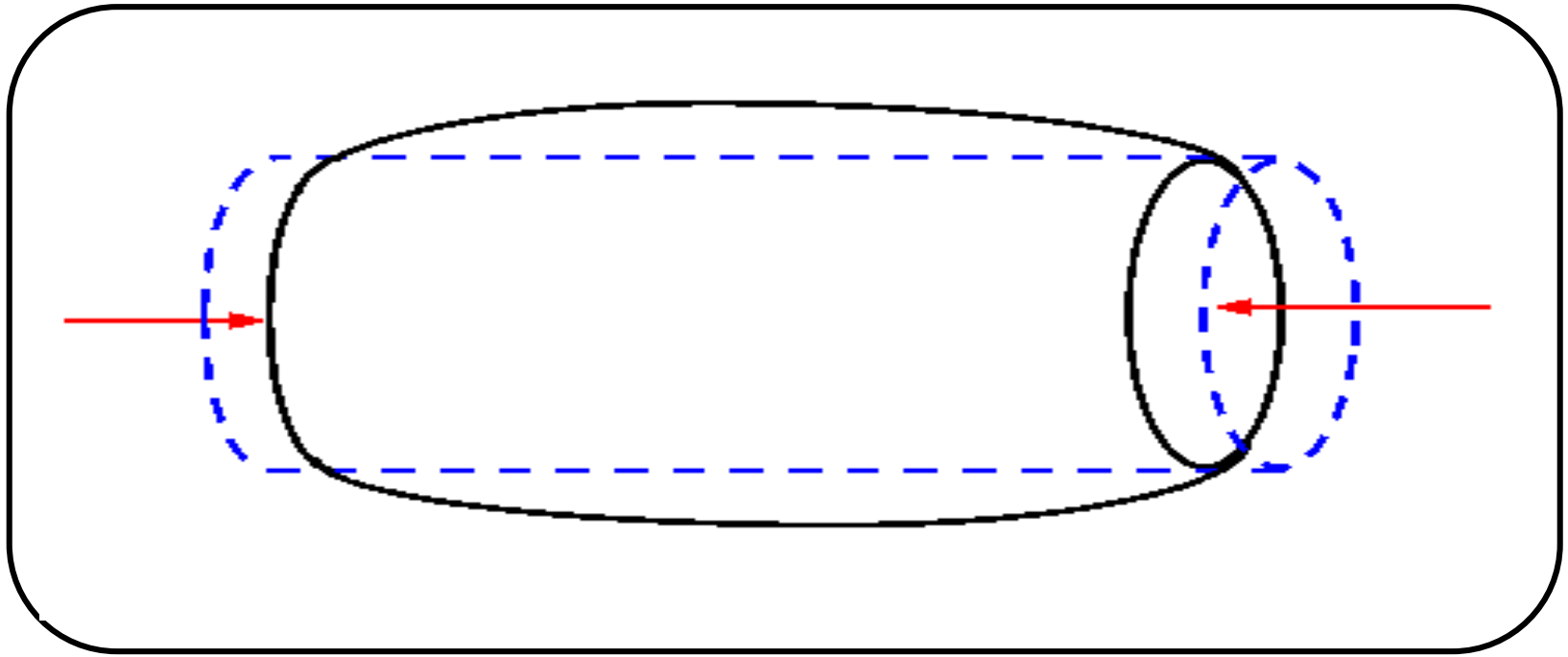
Table Bending

Manual Bending

Auto Bending

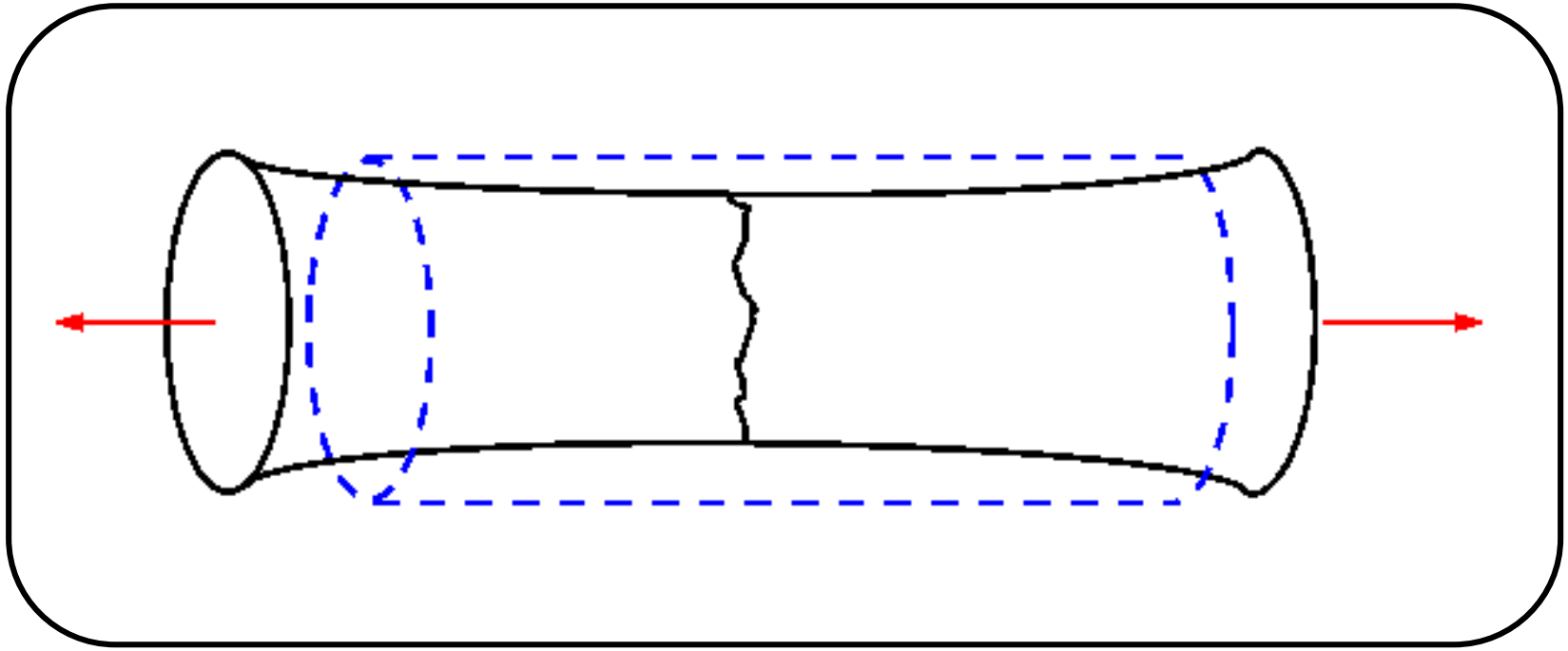
Automatic (Coil) Bender

Unreinforced Concrete



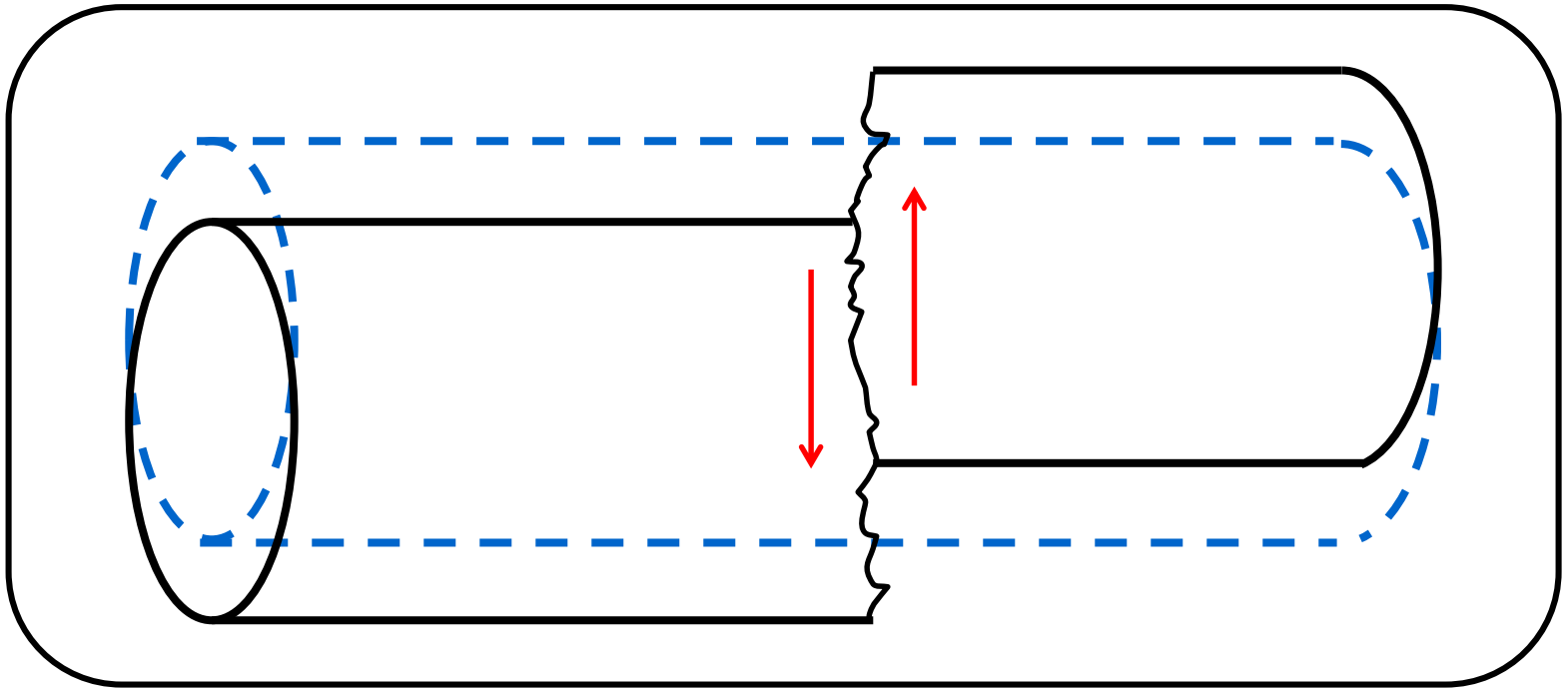
Strong in compression

Unreinforced Concrete



Weak in tension

Unreinforced Concrete



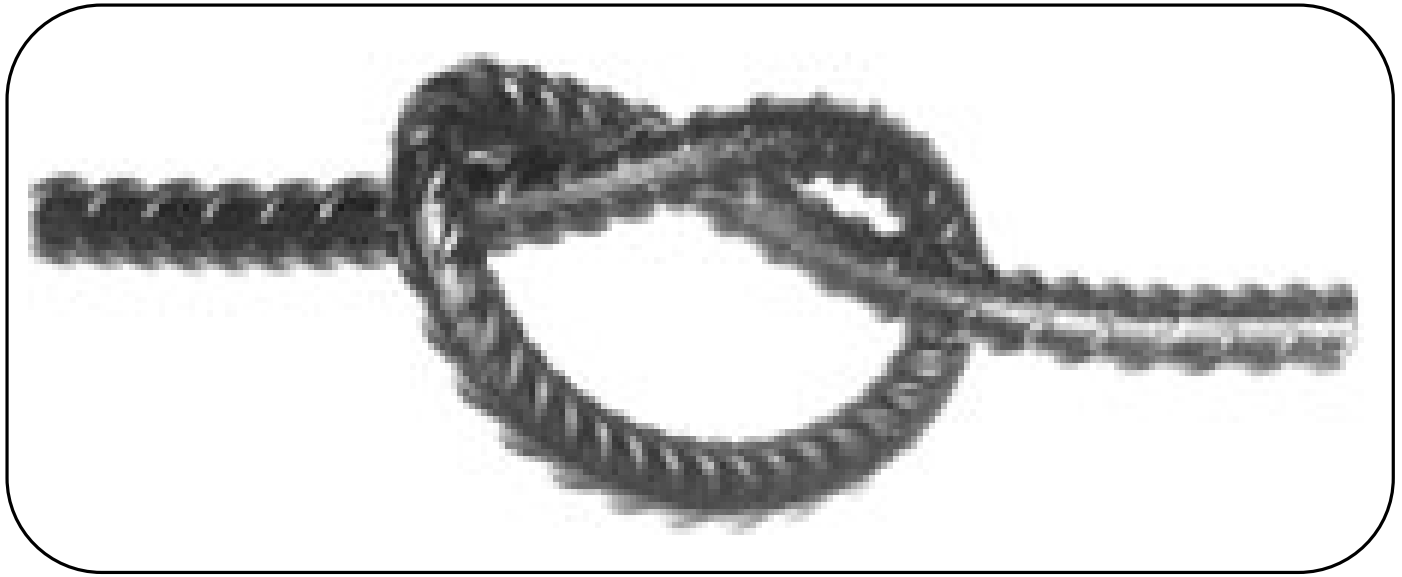
Weak in shear

Reinforcing

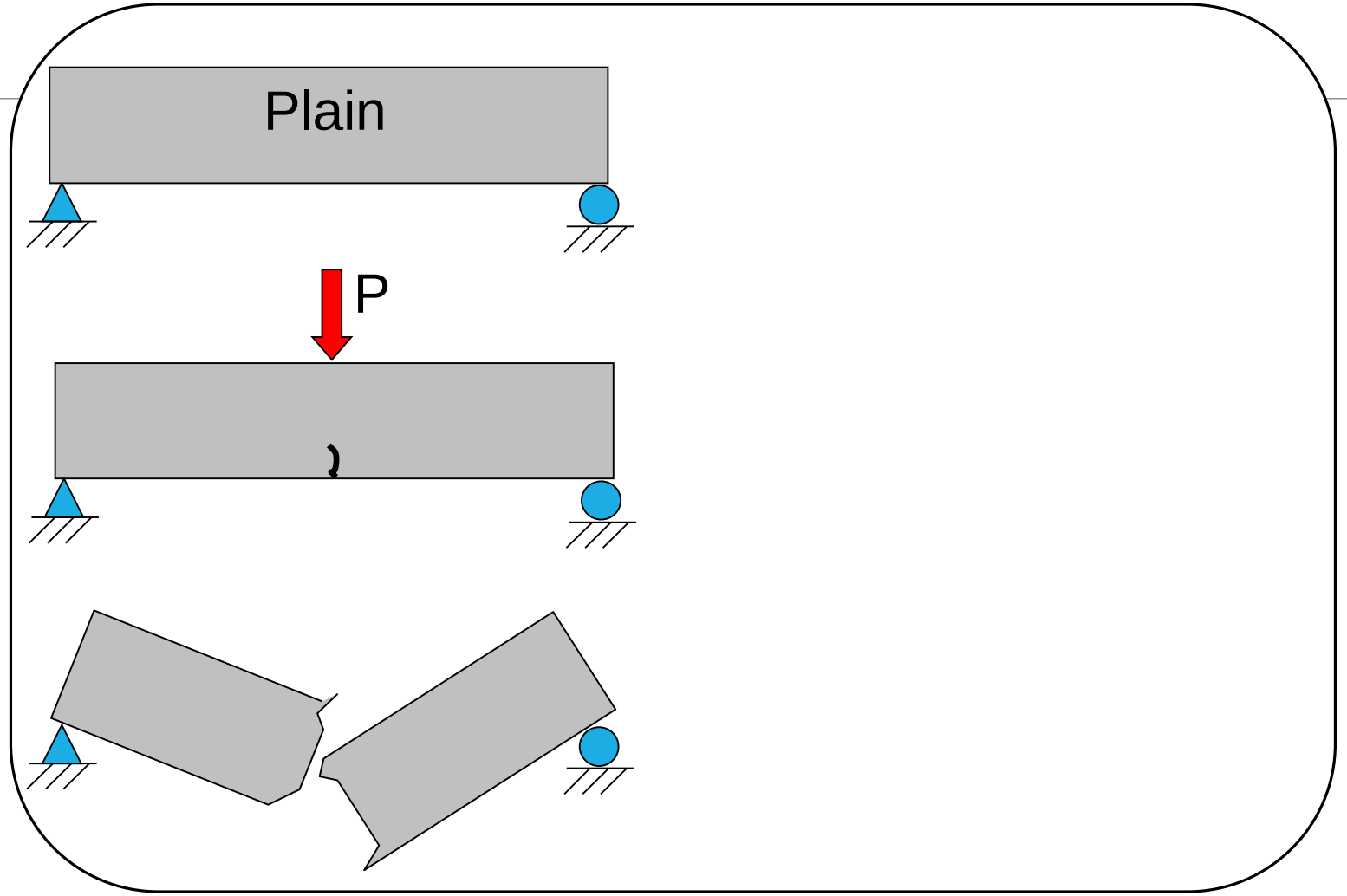
Performs in compression
- Must be properly confined

Excellent in tension

Extremely ductile

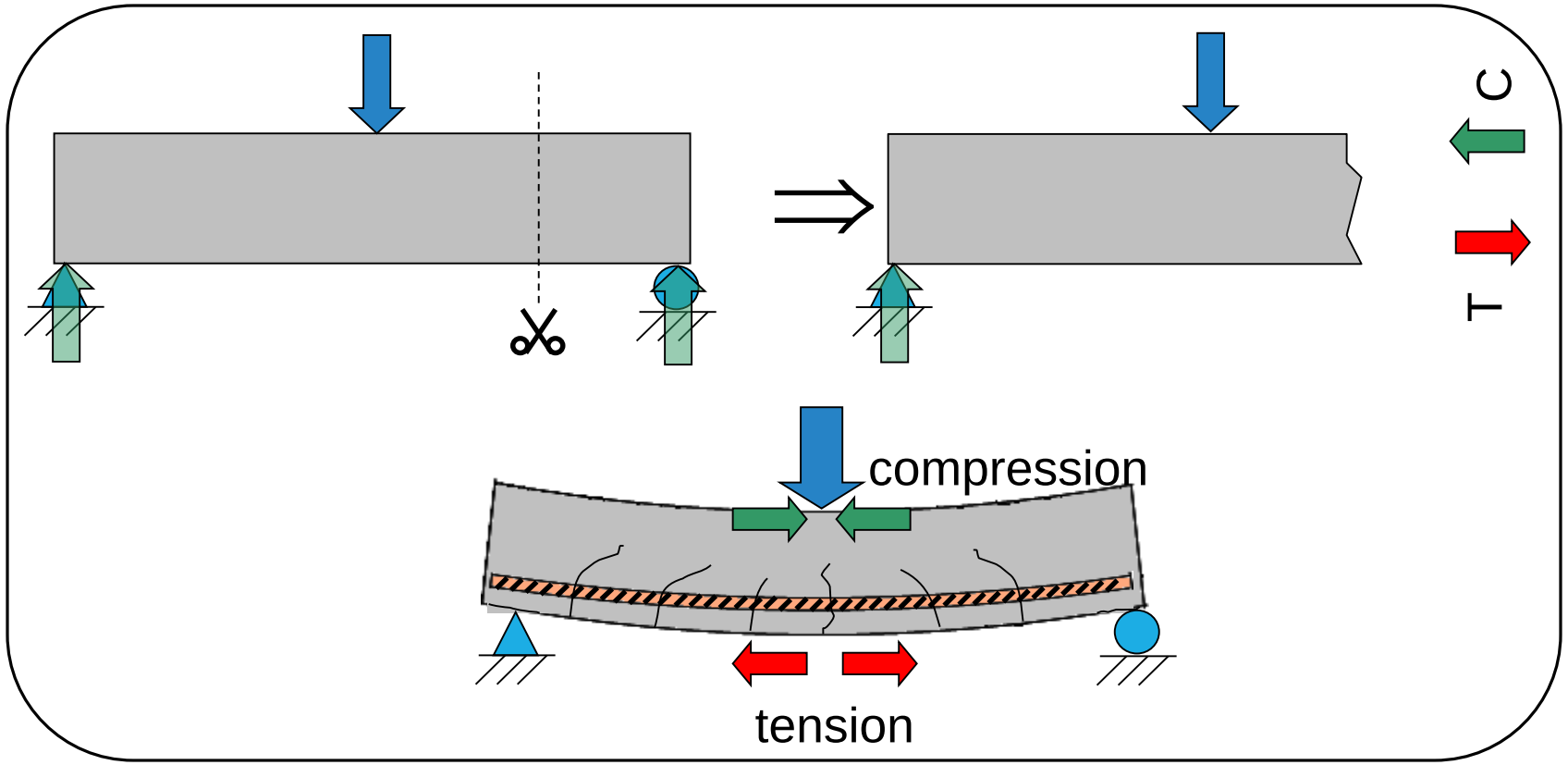


Basic Beam Theory



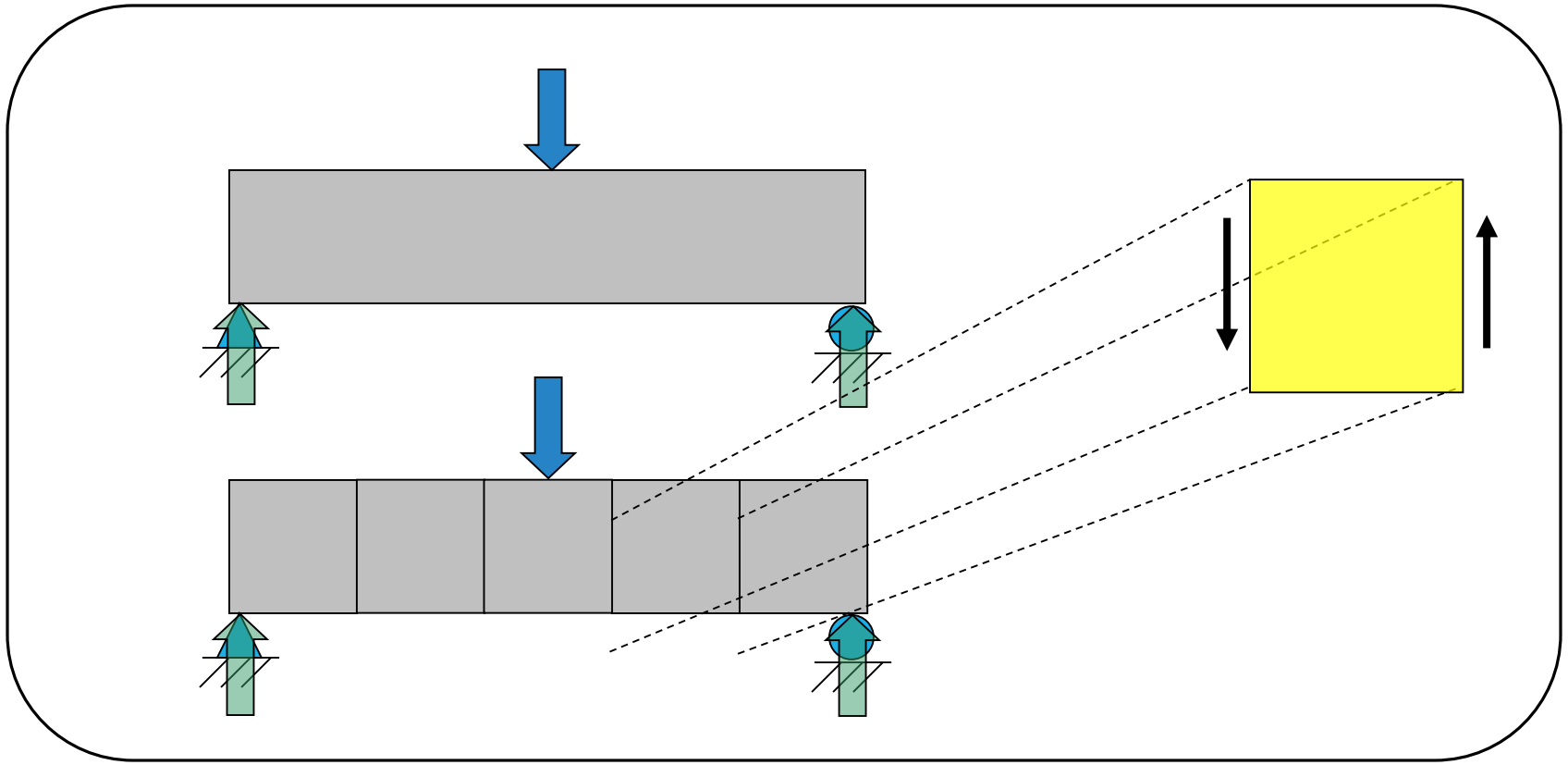
Placement of Reinforcement

Anywhere concrete might be in tension ► FLEXURE



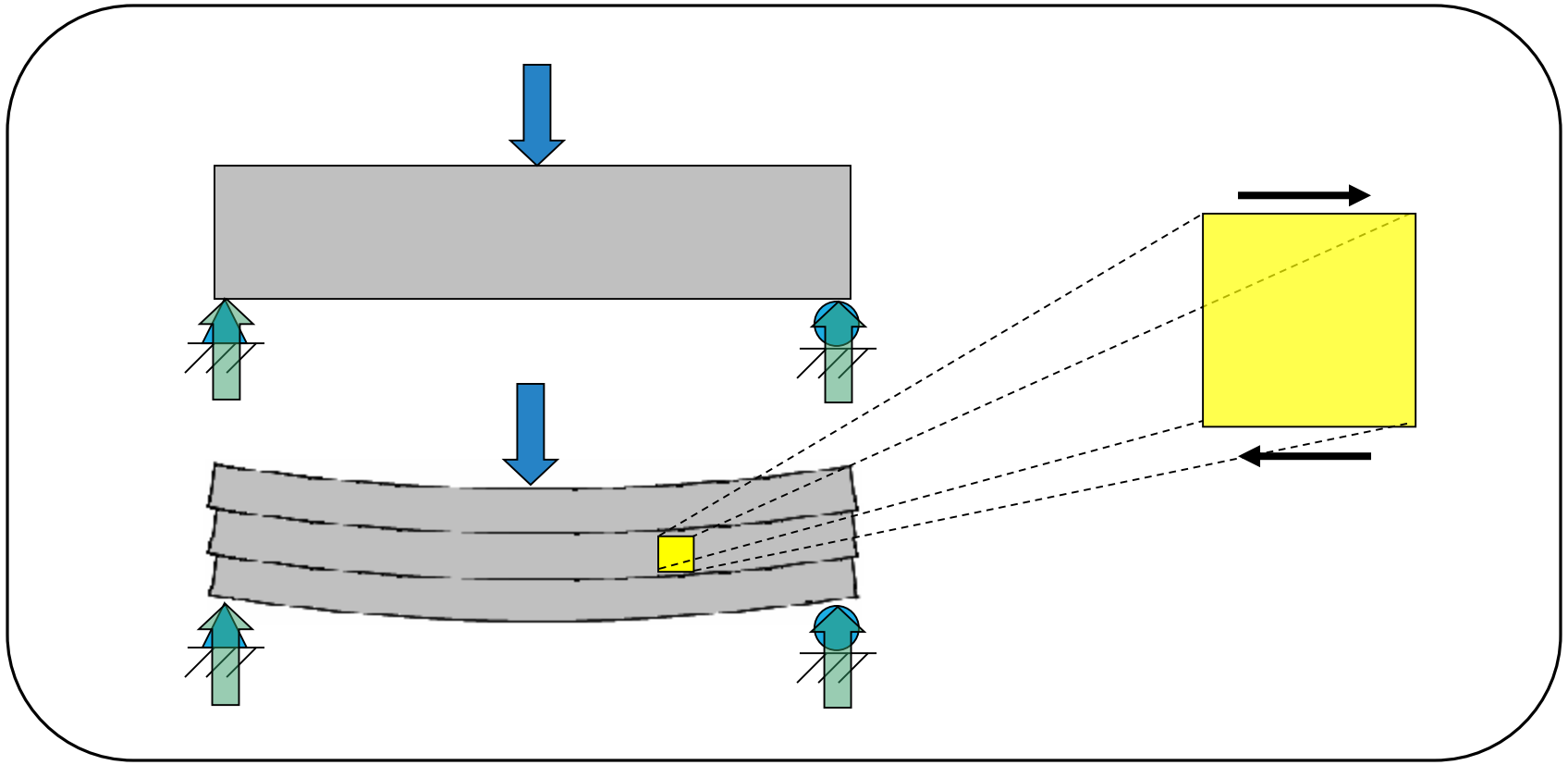
Placement of Reinforcement

Anywhere concrete might be in tension ► VERTICAL SHEAR



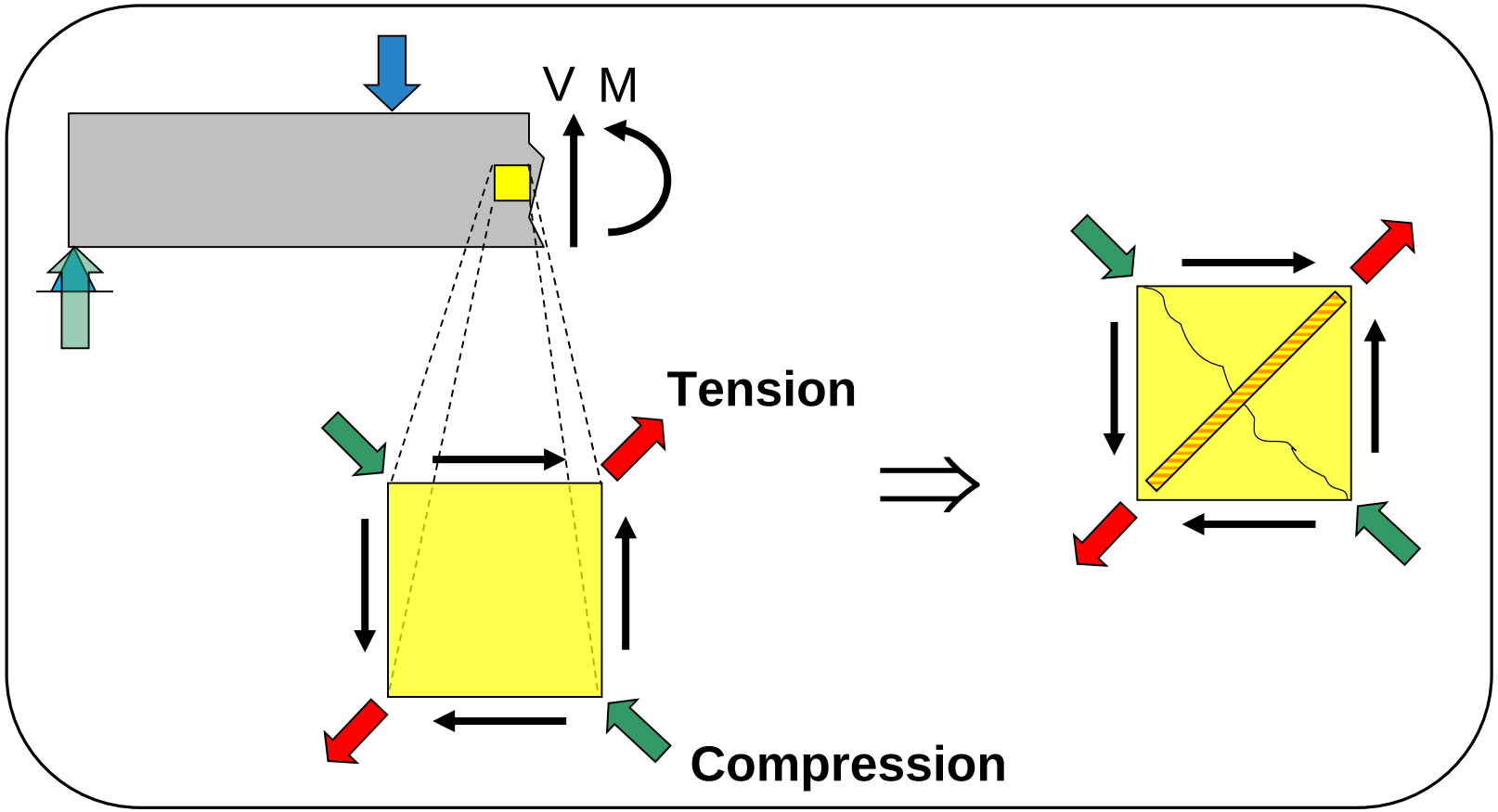
Placement of Reinforcement

Anywhere concrete might be in tension ► HORIZONTAL SHEAR



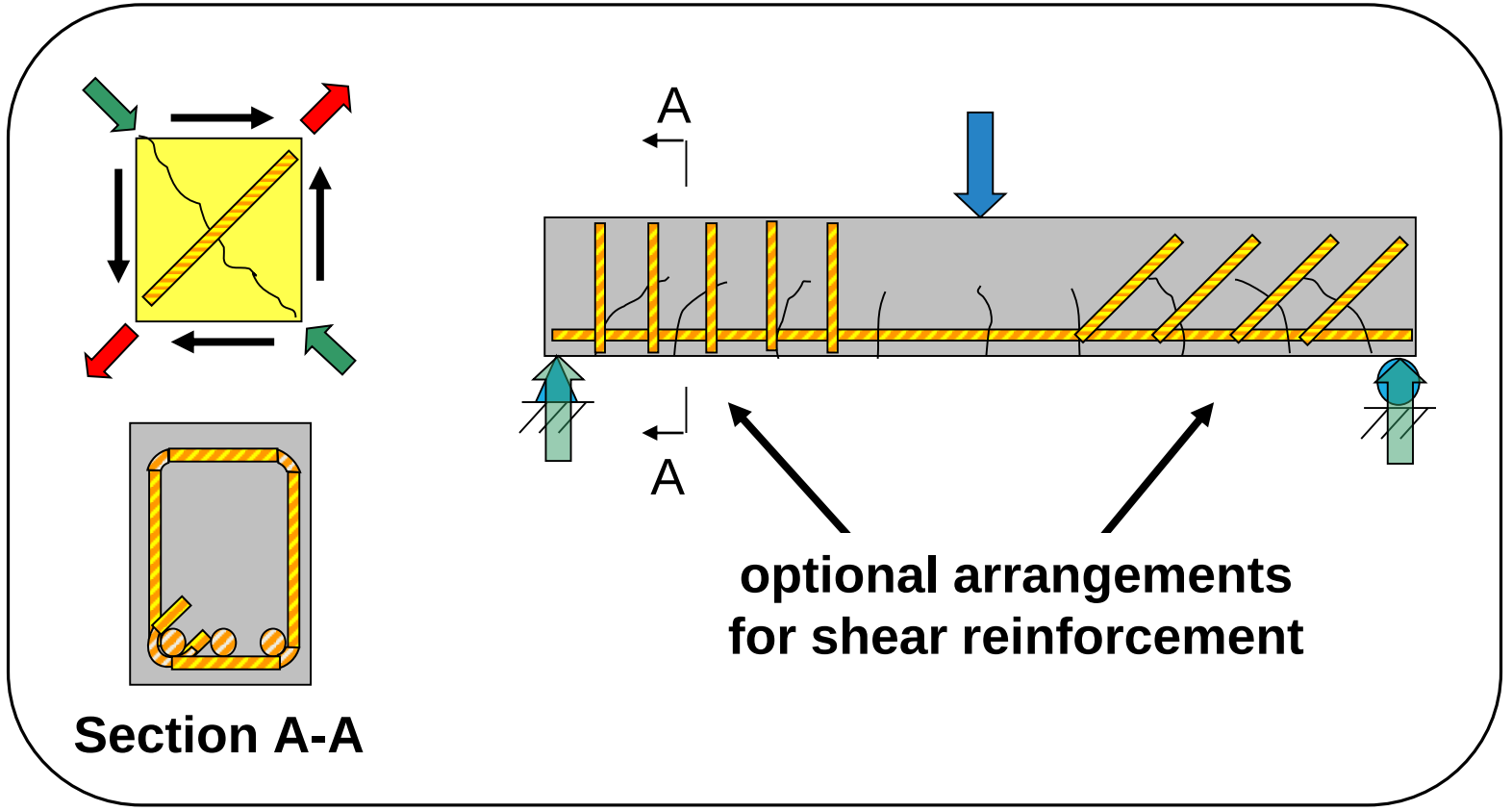
Placement of Reinforcement

Anywhere concrete might be in tension ► COMBINED SHEAR

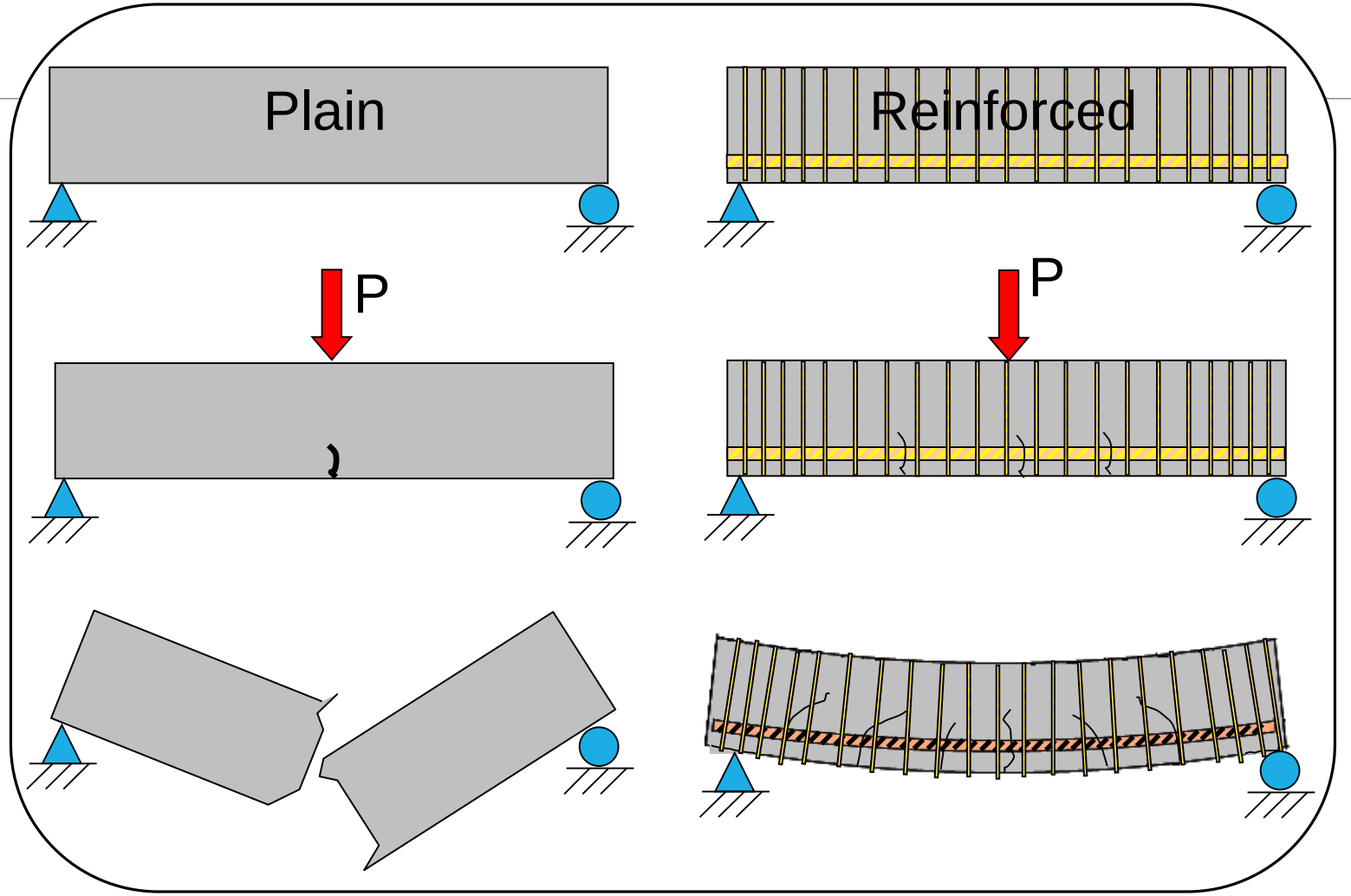


Placement of Reinforcement

Anywhere concrete might be in tension ► COMBINED SHEAR

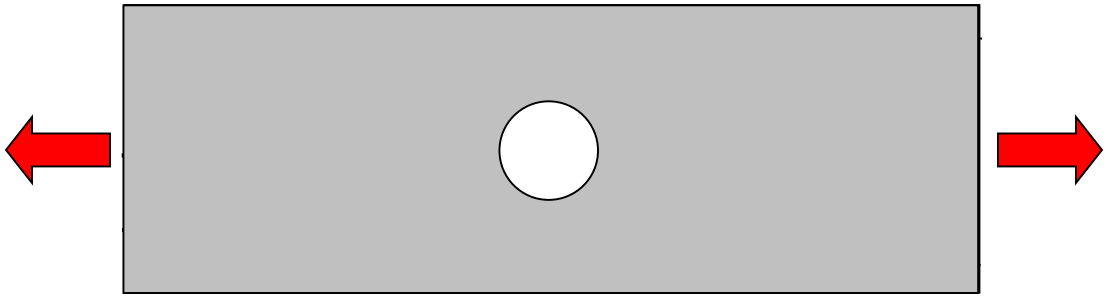


Basic Beam Theory

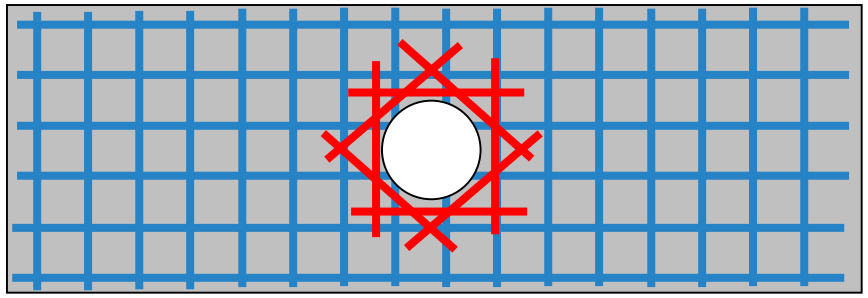


Placement of Reinforcement

Anywhere concrete might be in tension ► OPENINGS



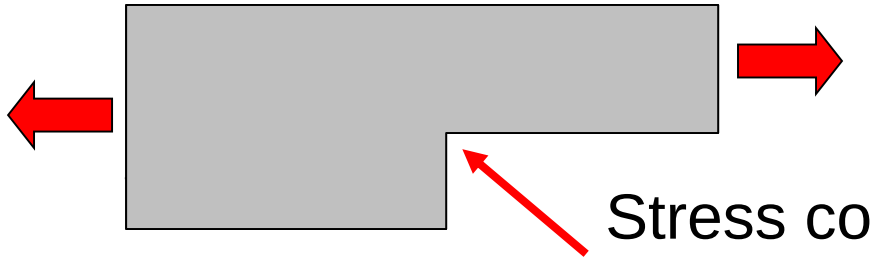
Stress concentration
- cracking



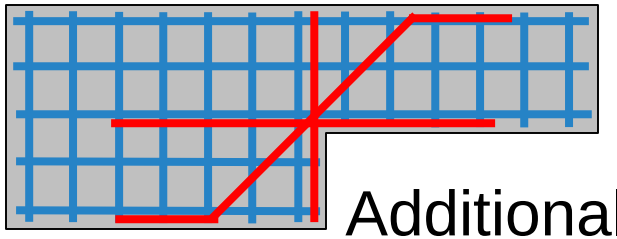
Additional reinforcement around opening

Placement of Reinforcement

Anywhere concrete might be in tension ► CHANGE IN SHAPE

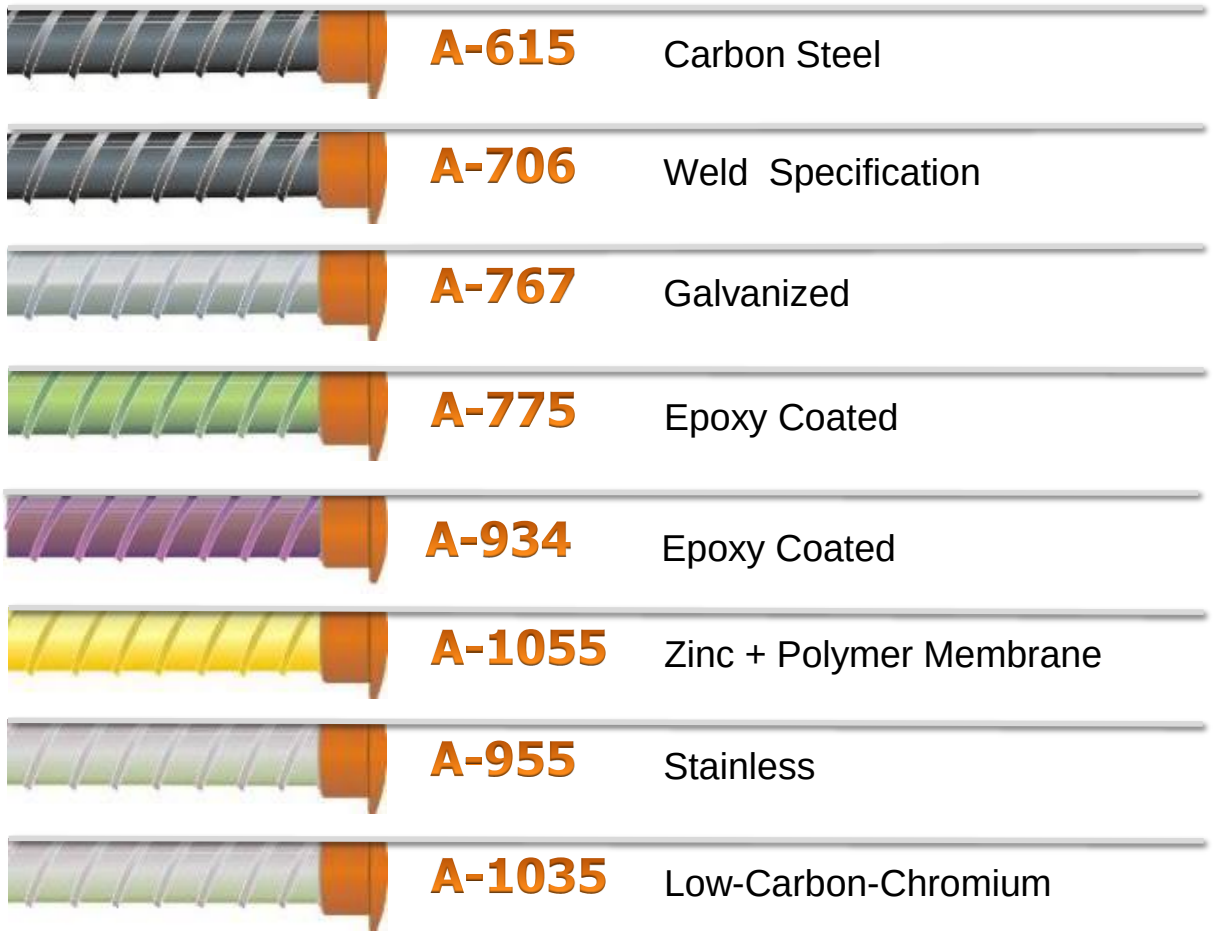


Stress concentration
- cracking



Additional reinforcement
where stress concentration occurs

Reinforcing Steel Today



A-615	Carbon Steel
A-706	Weld Specification
A-767	Galvanized
A-775	Epoxy Coated
A-934	Epoxy Coated
A-1055	Zinc + Polymer Membrane
A-955	Stainless
A-1035	Low-Carbon-Chromium

High Strength Steel

Grade 60
vs.
Grade 80
vs.
Grade 100

Reinforcing Steel Specifications

Grade 60

- **A615 – Plain carbon steel**

  ACI 318-19 Change Ultimate to 80 to match A706

  Change T/Y to be 1.10 to insure ductility

- **A706 – Low alloy steel**

High Strength Reinforcing

Grade 80

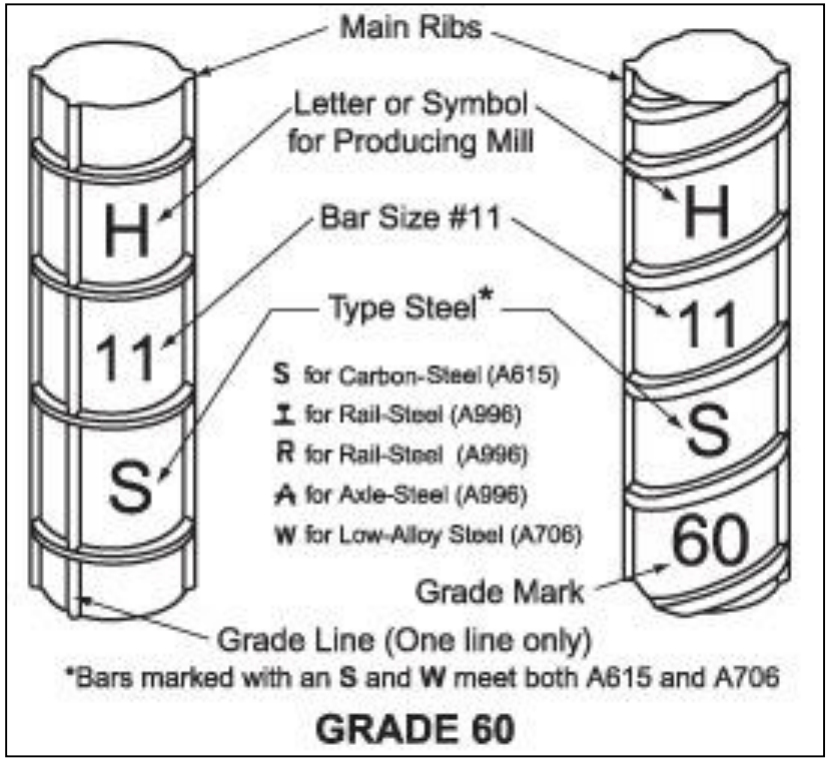
- **ASTM A615**
  - Only in non-seismic applications
- **ASTM A706**
  - ACI 318-19 Allows for Special Moment Frames
  - No Shear
  - T/Y Ratio of 1.25

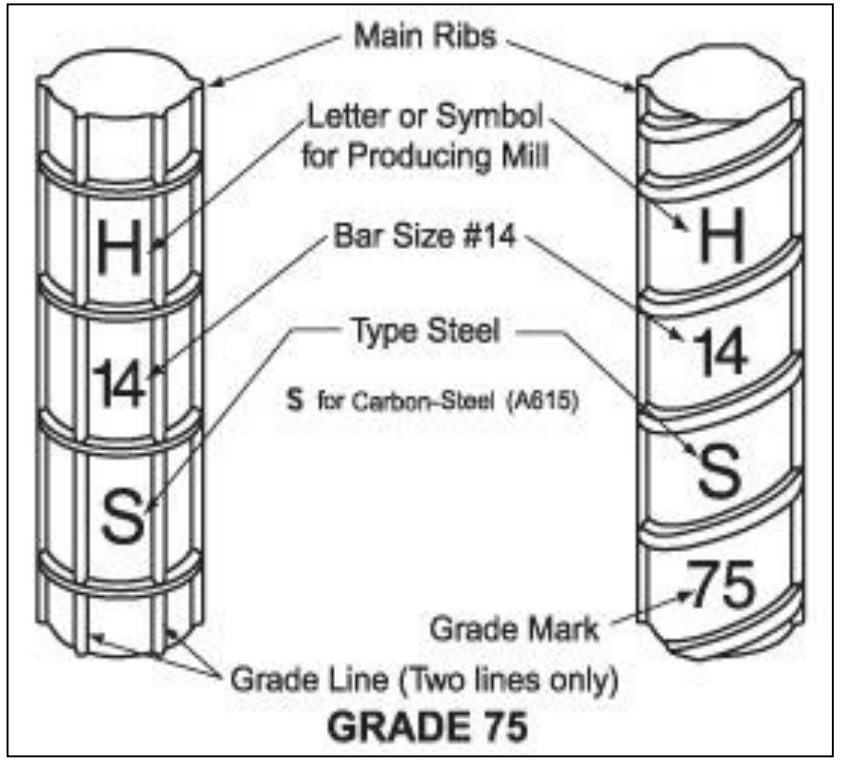
High Strength Reinforcing

Grade 100

- **ASTM A615 (2019)**
- **ASTM A706 (2019)**
  - ACI 318-19 will allow for seismic design
  - T/Y Ratio of 1.17
  - Gravity and Wind, Confinement, Special Str. Walls, Won’t be weldable

Reinforcing Bar Markings



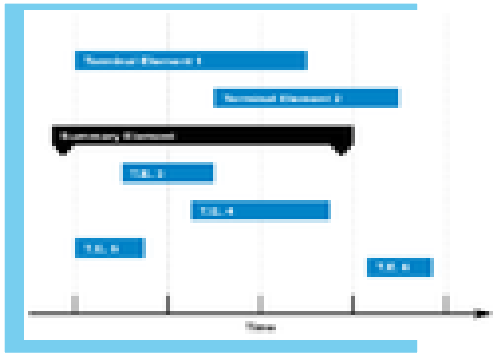


- **New radius vs height of deformation ratio of 1.5, ACI 318-19 adopted, ASTM working on.**

Economics of Concrete Buildings

COST

SCHEDULING



CONSTRUCTION PROJECT

Economics of Concrete Buildings

Three elements of structure cost

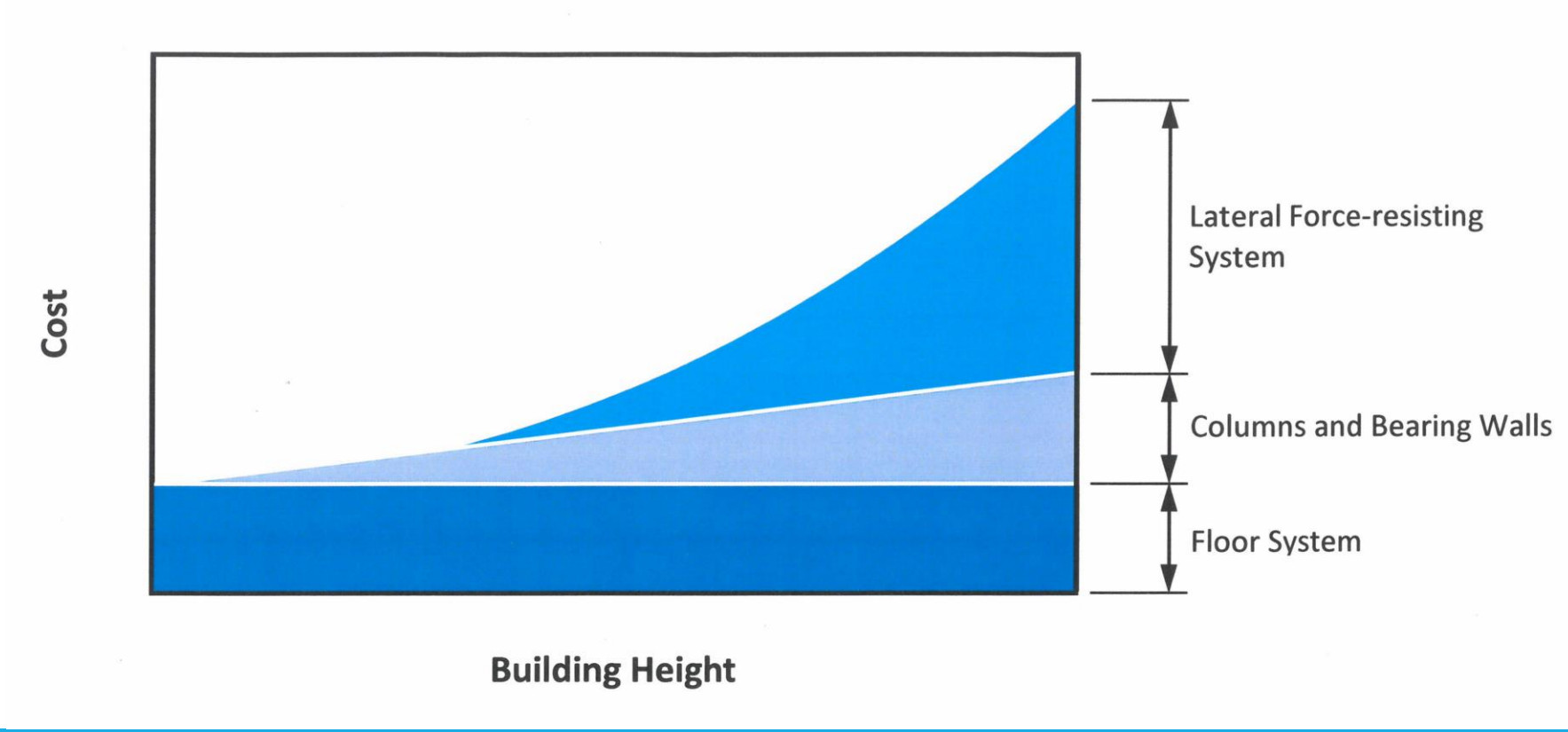
Floor systems

Columns and bearing walls

Lateral force-resisting systems

Economics of Concrete Buildings

Structure cost versus building height



Economics of Concrete Buildings

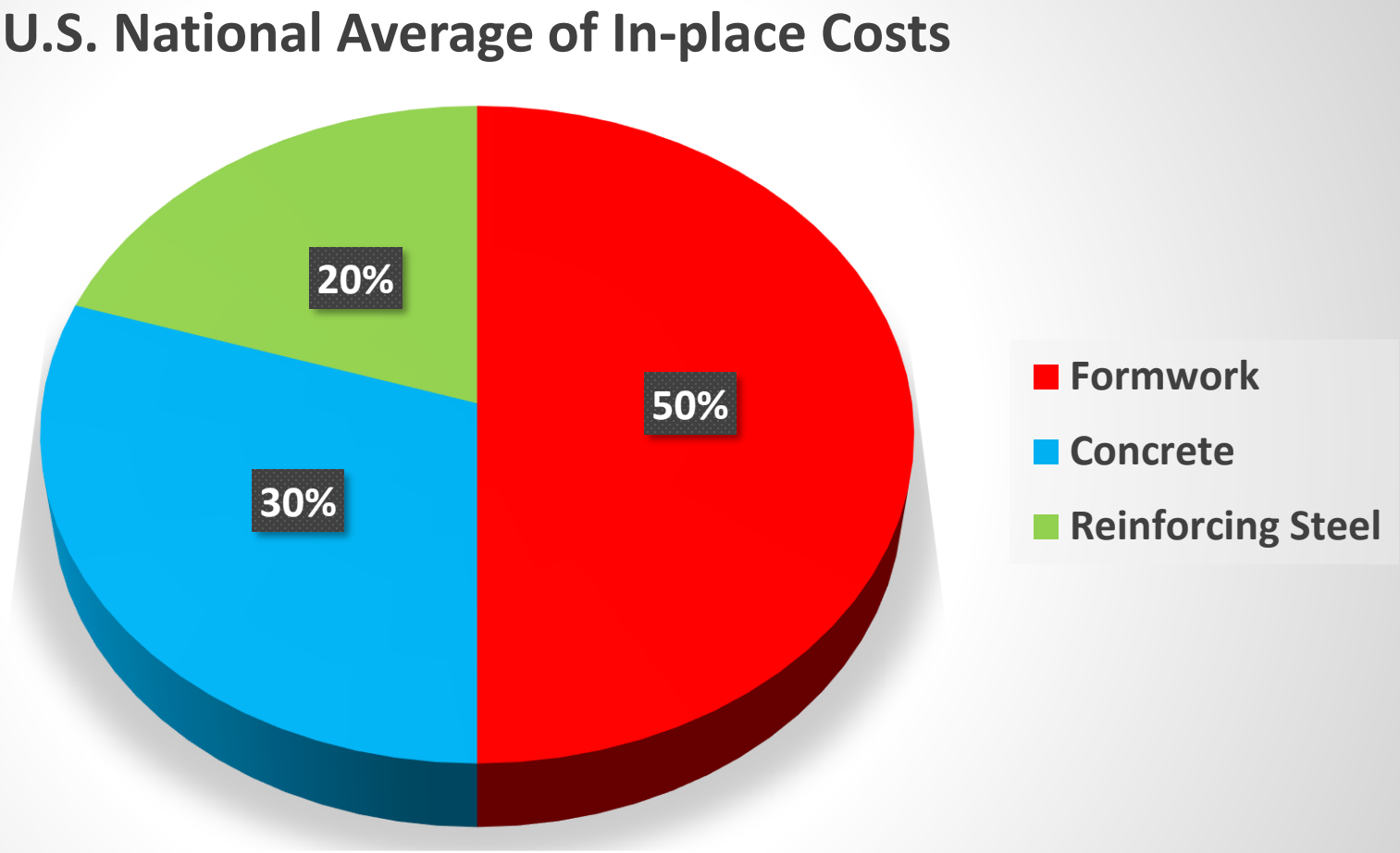
Main Component Costs

Formwork

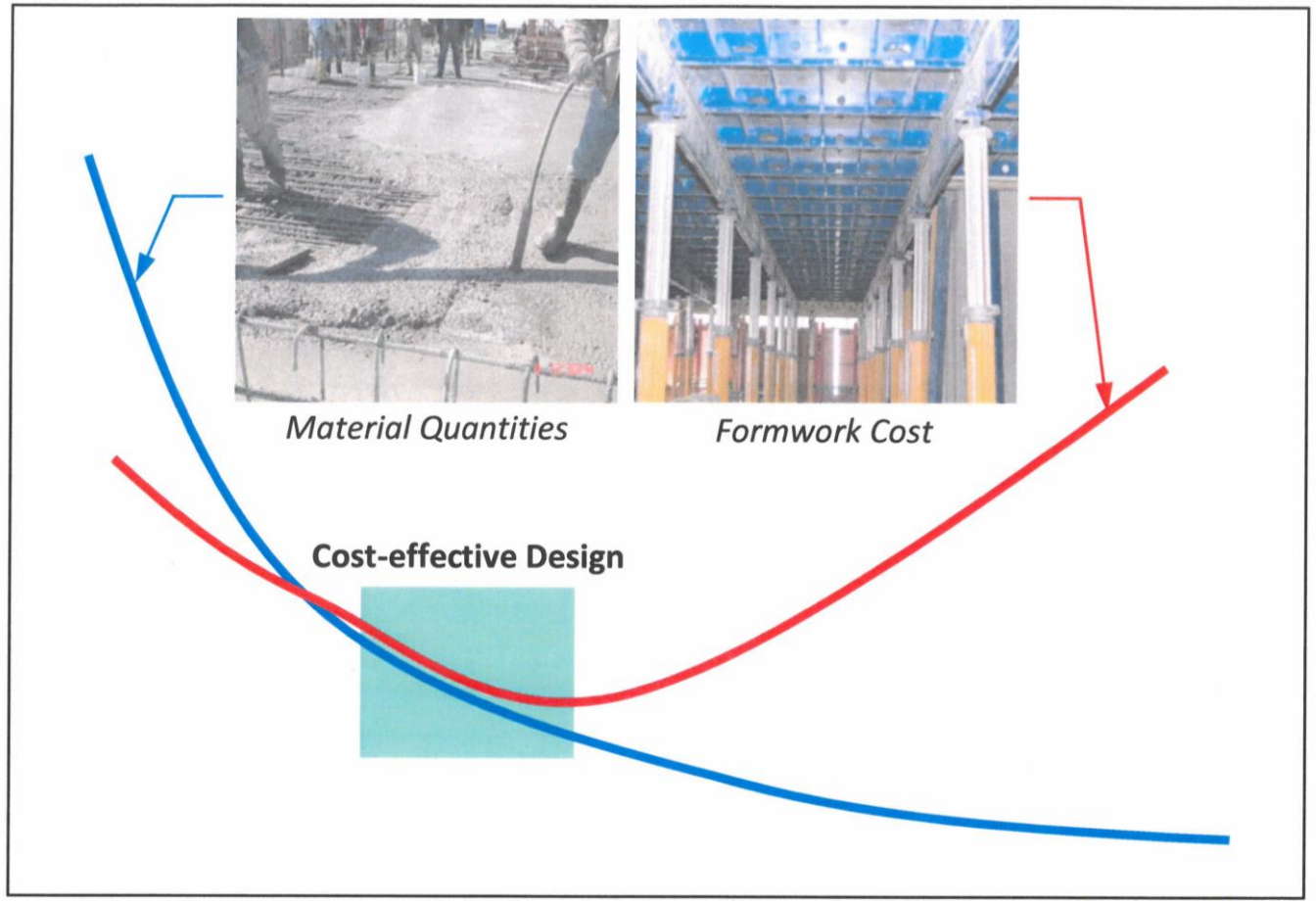
Concrete

Reinforcing steel

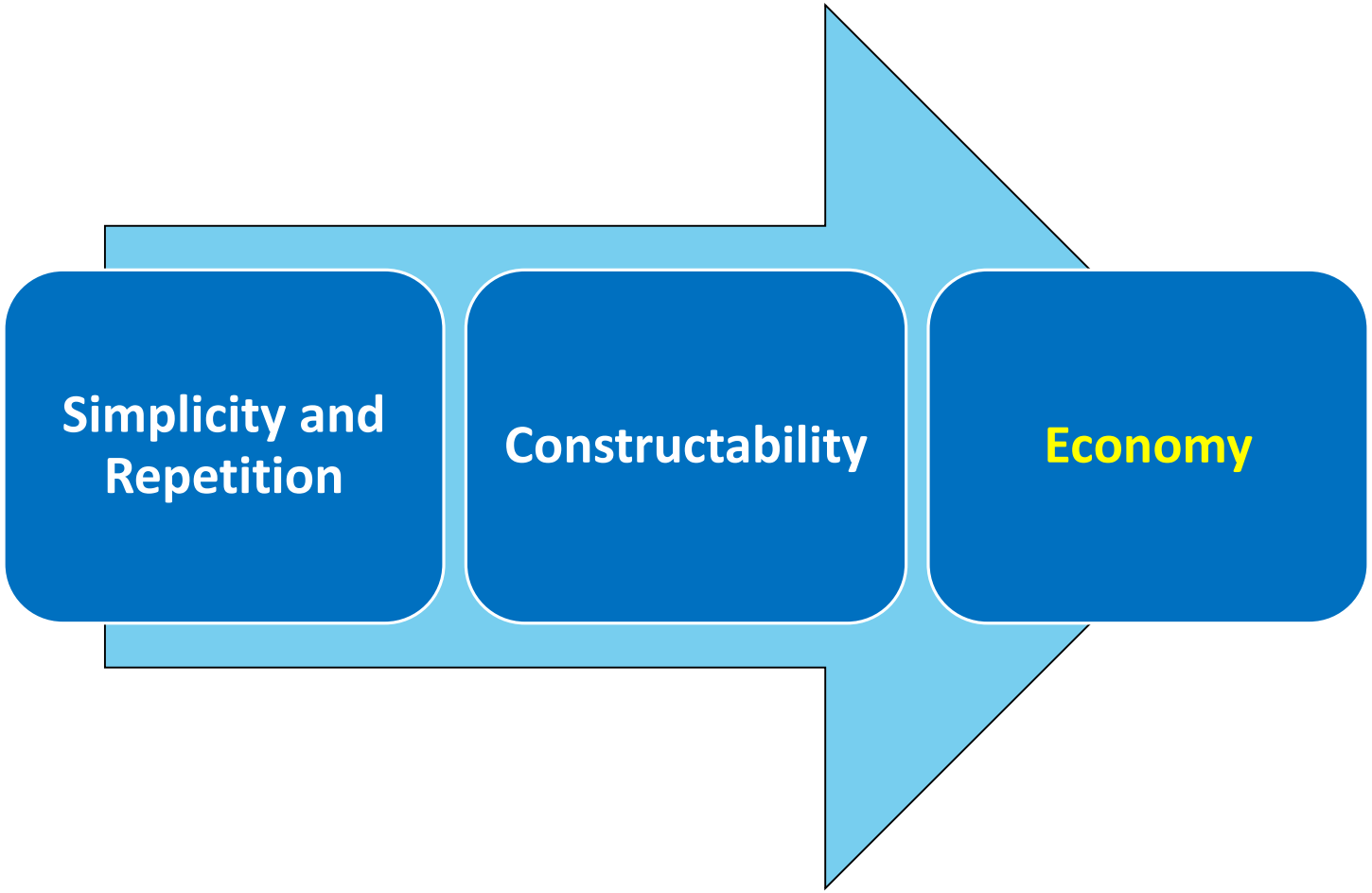
Economics of Concrete Buildings



Economics of Concrete Buildings



Economics of Concrete Buildings

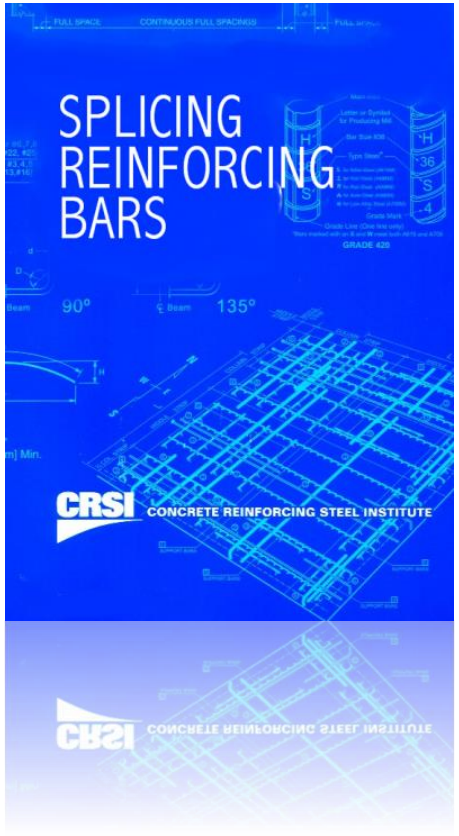


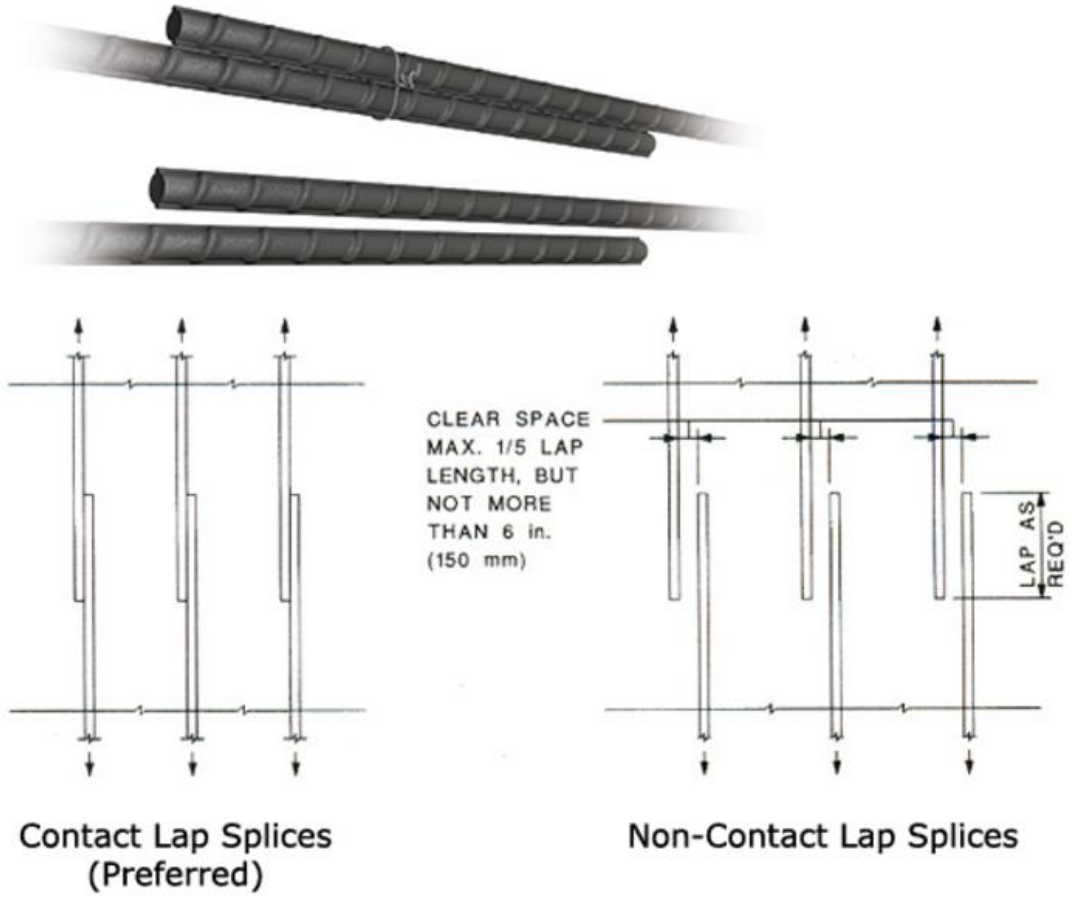
Constructability

Placing

Splicing

- Lap Splices
- Welded Splices
- Mechanical Splices
  - Deformation Dependent
  - Non-Deformation Dependent



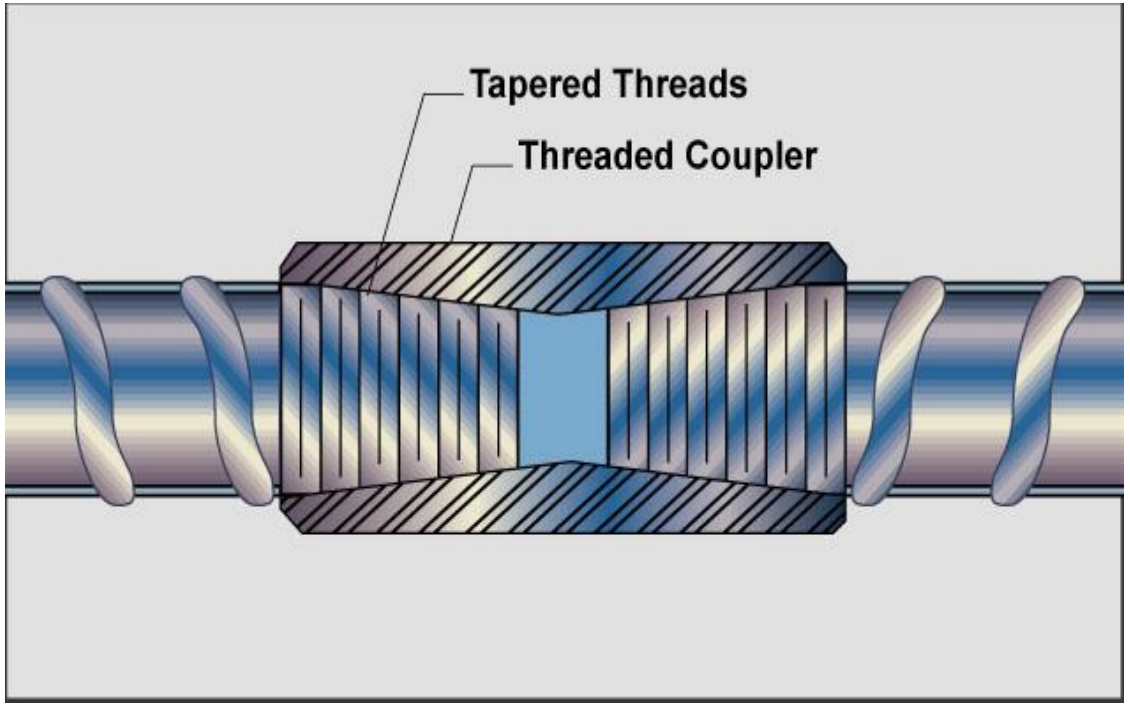


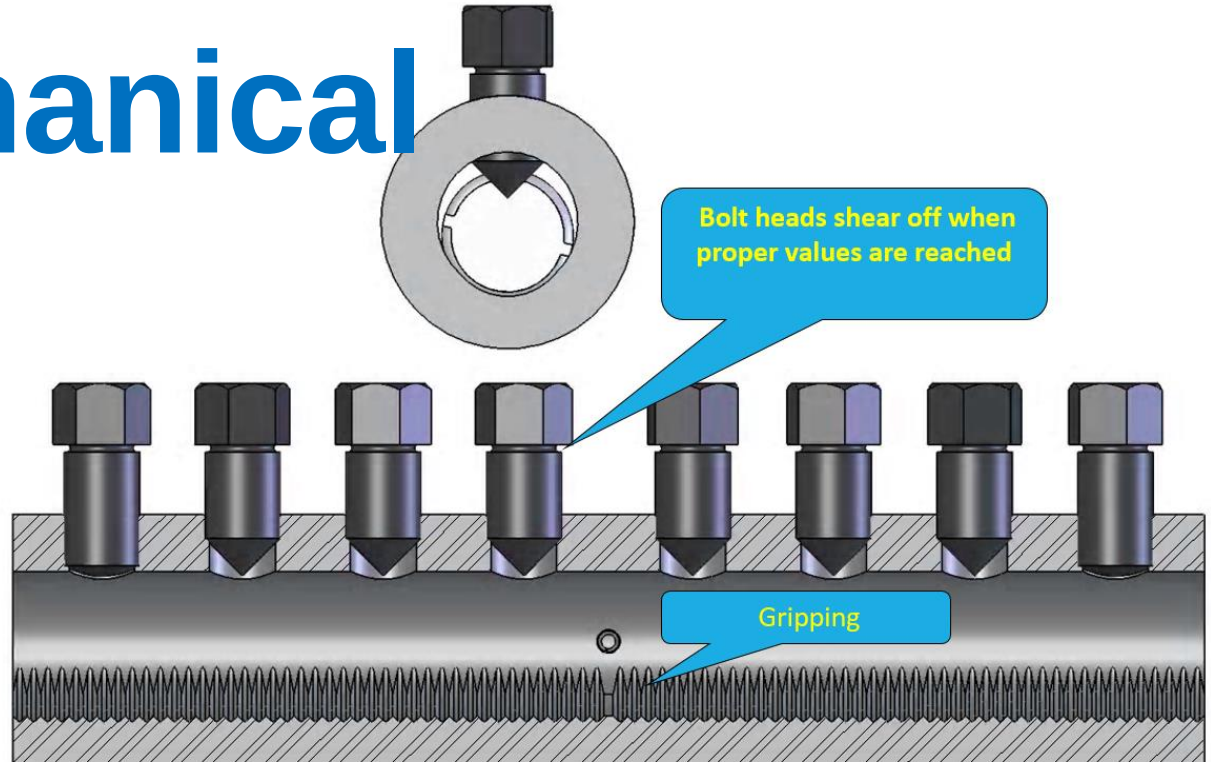
Contact Lap Splices
(Preferred)

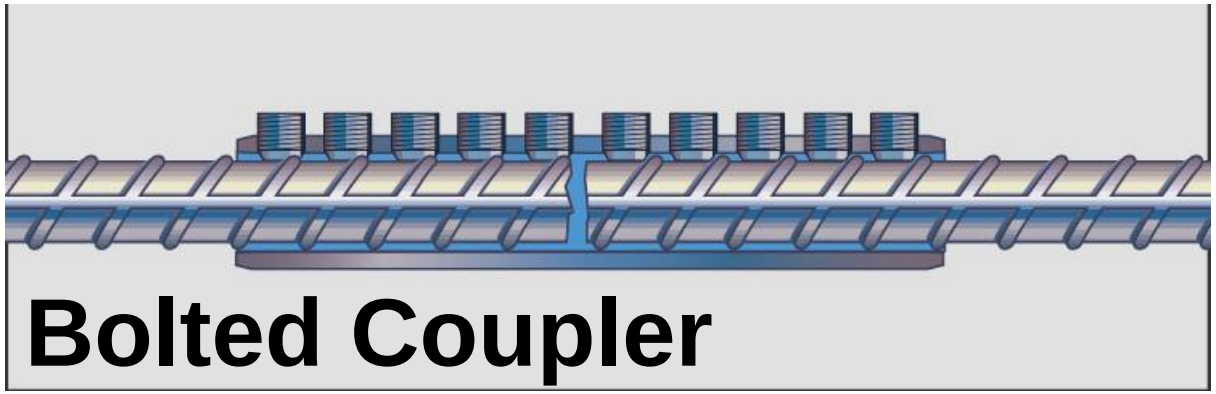
Non-Contact Lap Splices

Splicing - Mechanical

Threaded Coupler







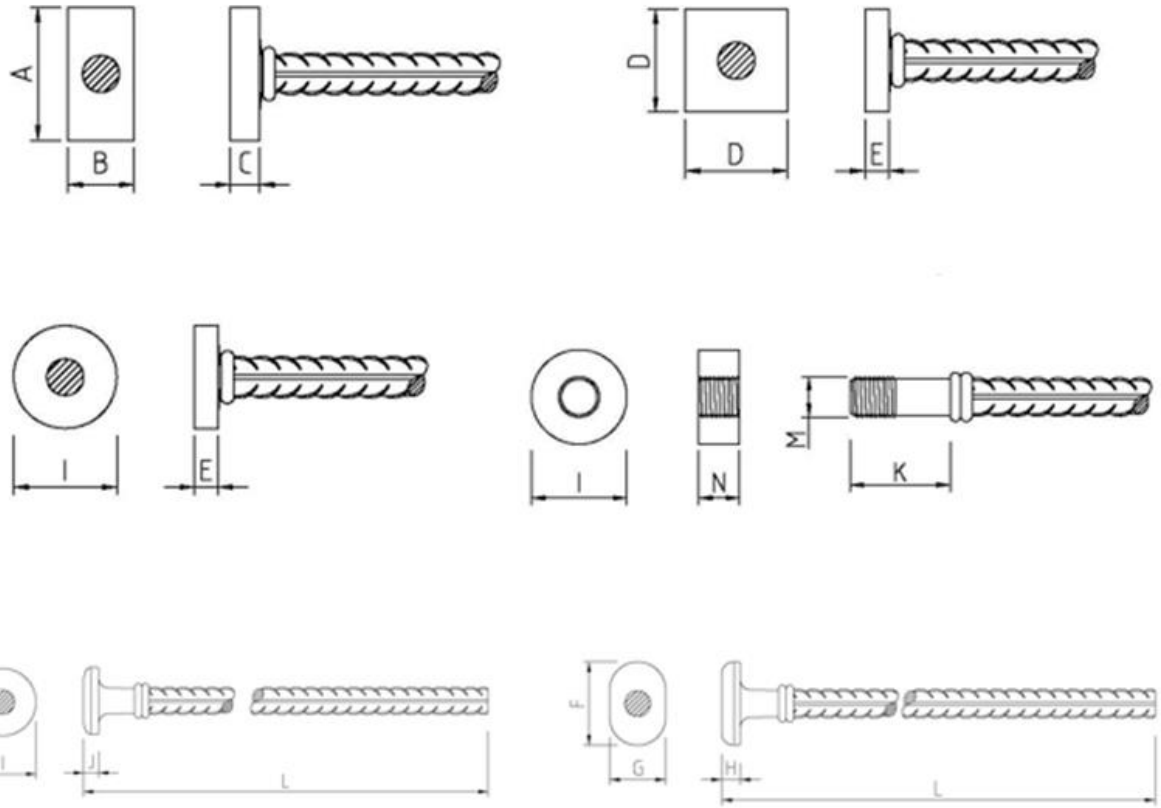
Bolted Coupler

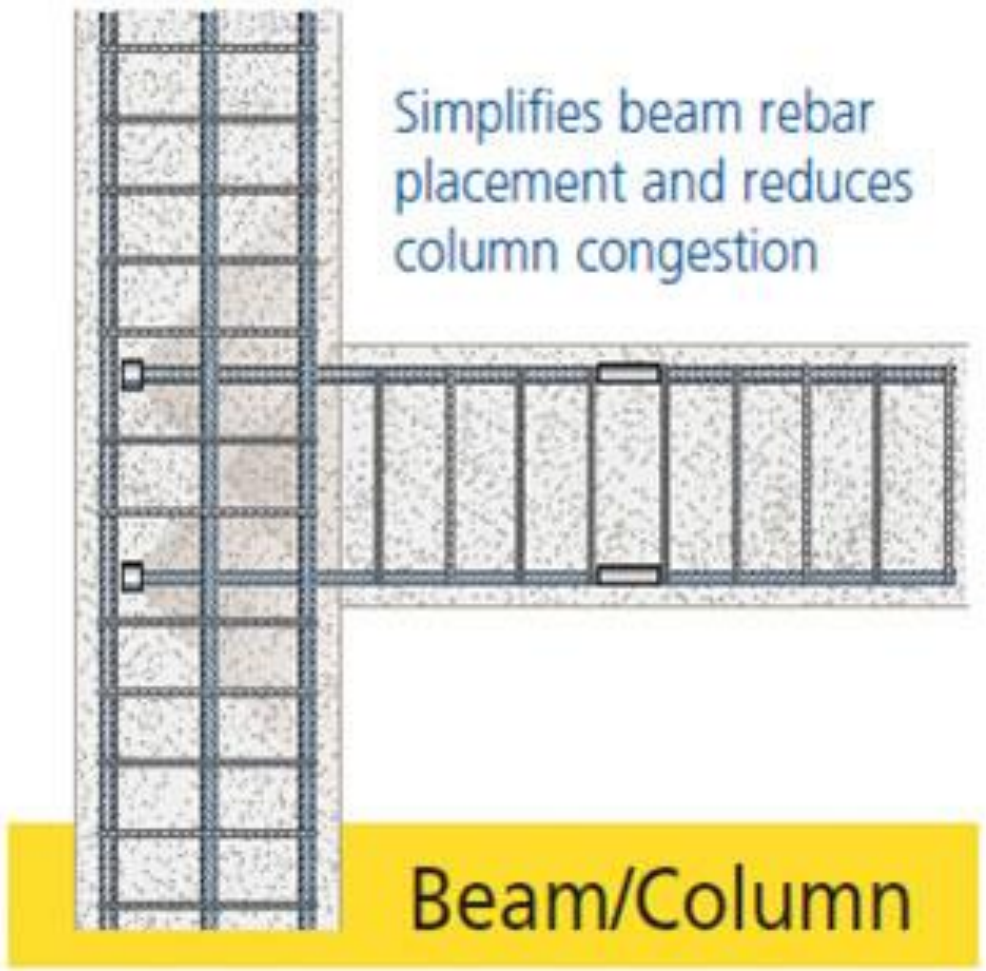
Anchorage

Headed Bars

- Reduce Congestion
- Come in Various Shapes
- Threaded or welded on

Anchorage


A
B
C
D
D
E
I
E
I
N
M
K
I
J
L
F
G
H
L


Simplifies beam rebar placement and reduces column congestion
Beam/Column

Economics of Concrete Buildings

Economics of Concrete Buildings

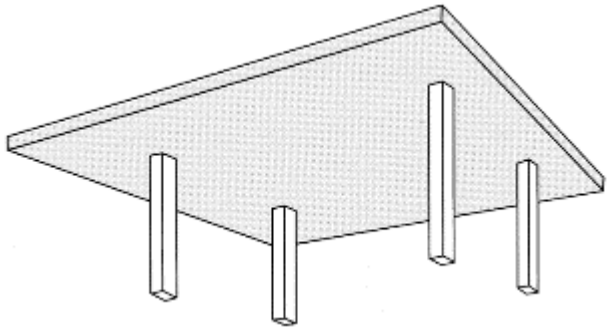
Span	Live Load (psf)	Floor System			
		Flat Plate	Flat Slab	Wide-module Joist	Two-way Joist
Up to 20 ft	40, 65, 100	X			
21 – 25 ft	40	X			
	65	X	X		
	100		X	X	
26 – 30 ft	40, 65, 100		X	X	
31 – 40 ft	40, 65, 100			X	X
41 – 50 ft	40, 65, 100				X

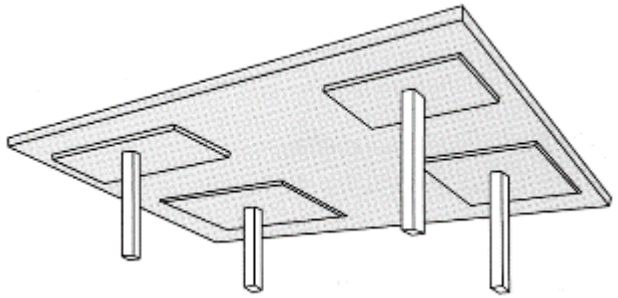
Innovative Concrete Forming/Framing Systems

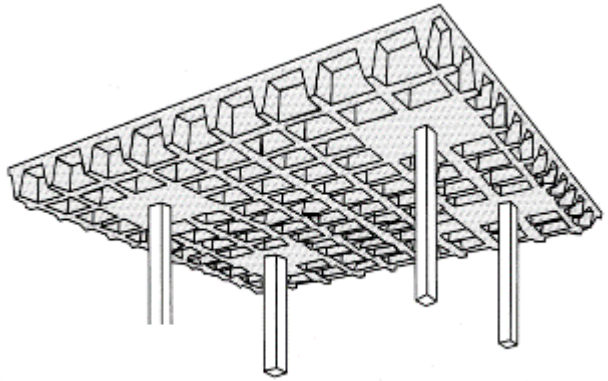
An Innovative forming system for every application

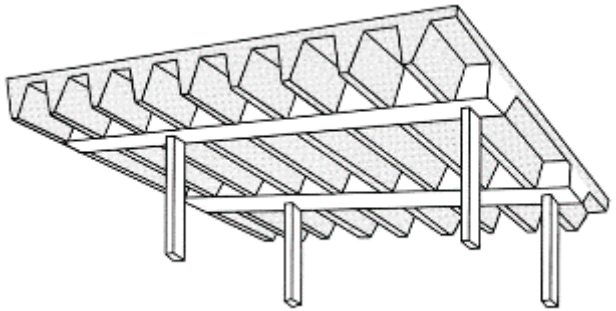
1. **Traditional**
2. **Voided Slab**
3. **Tunnel Form**
4. **Insulated Concrete Forms**

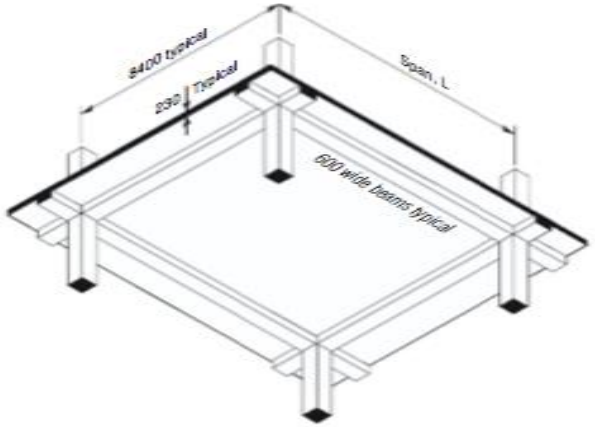
Traditional Formed Floor Systems



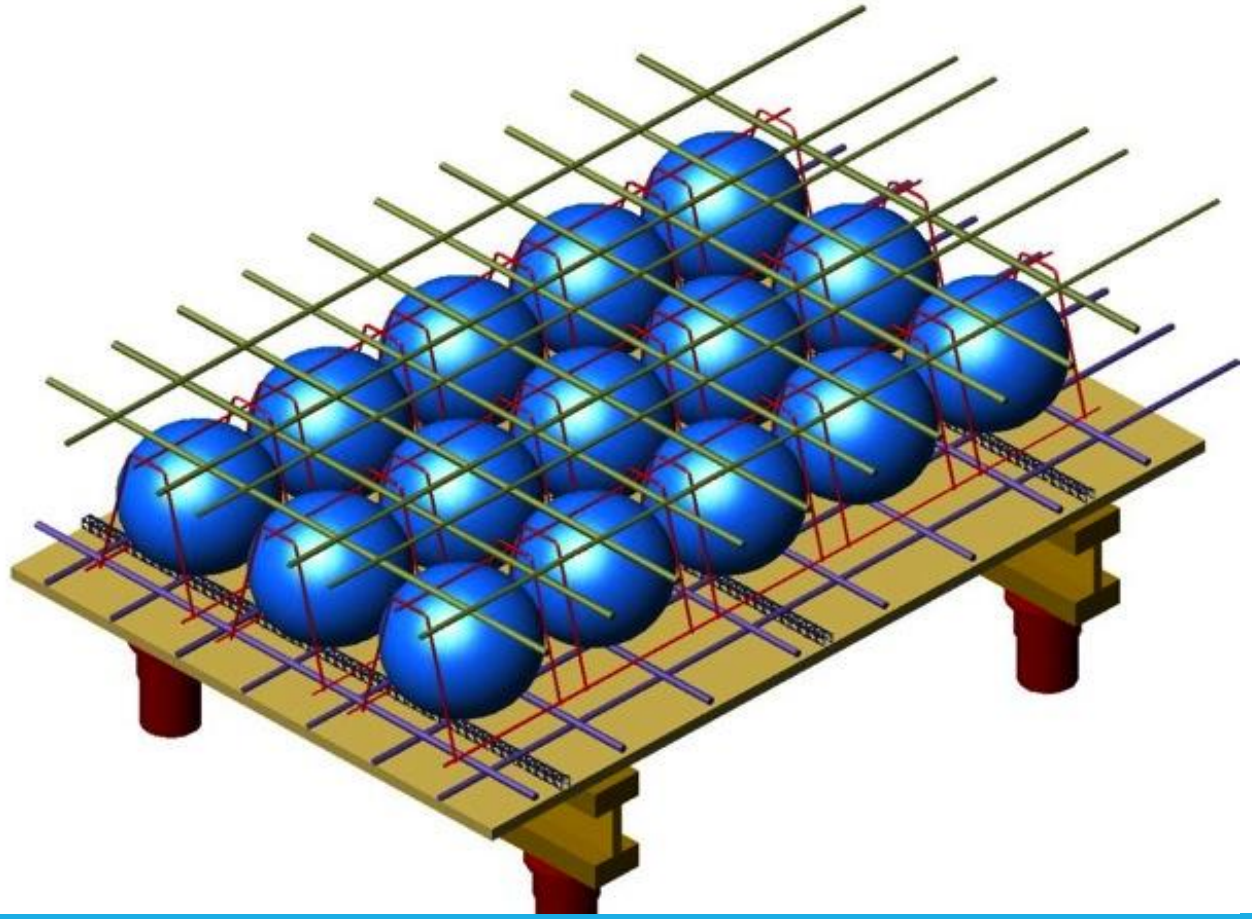




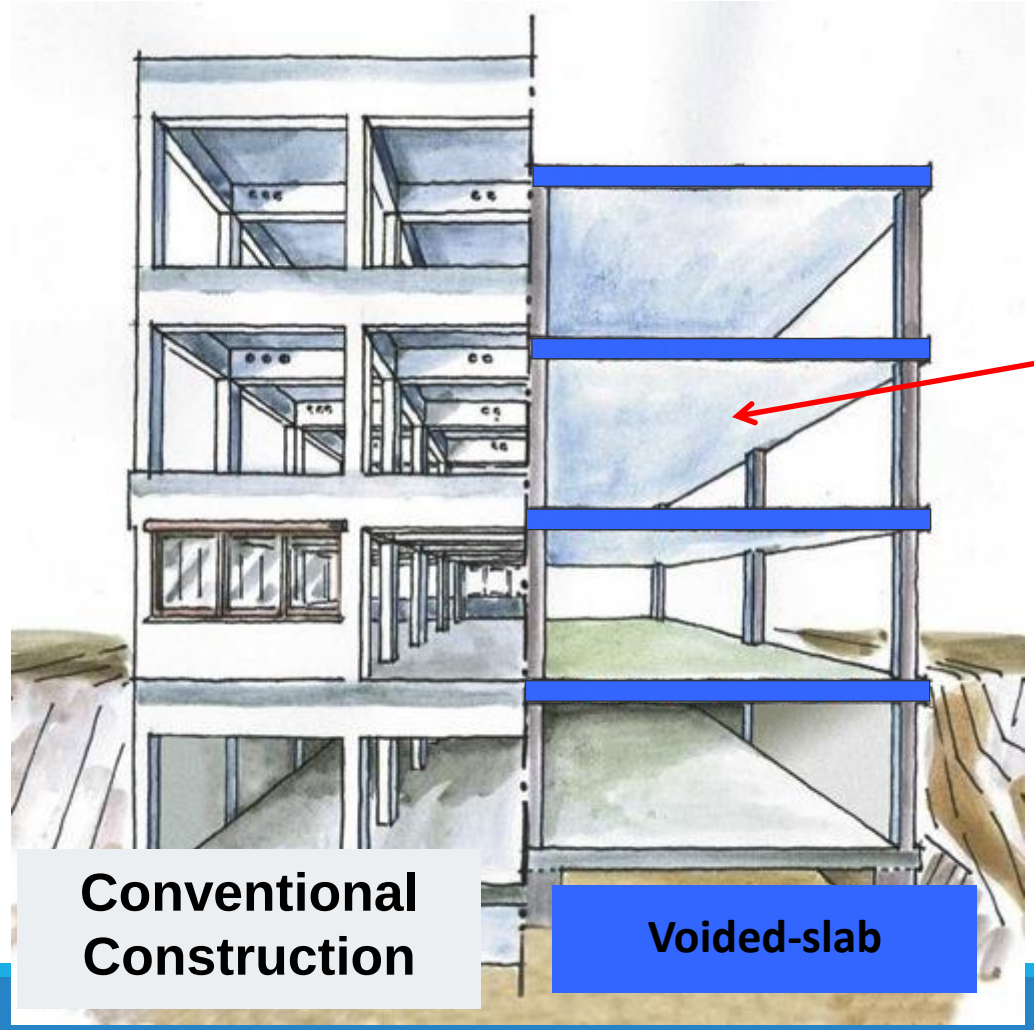




Voided Flat Plate – The Concept

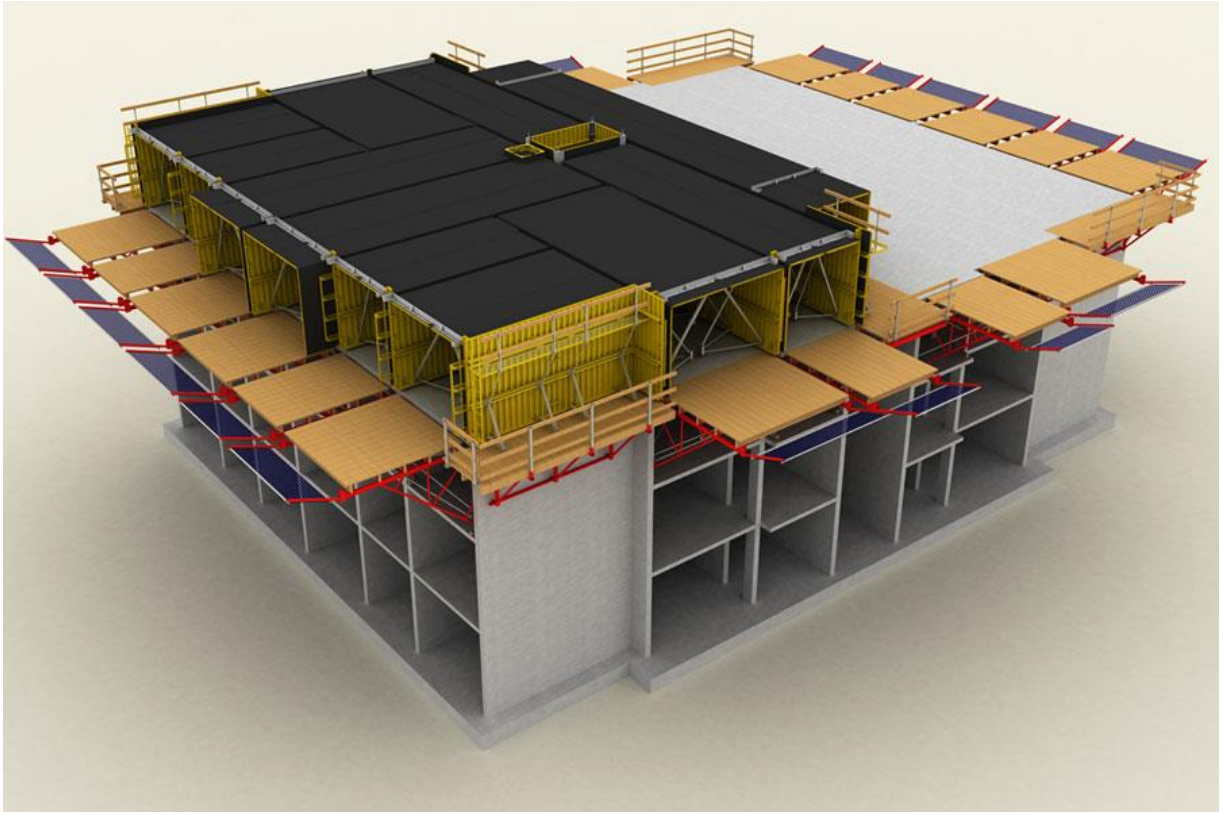


Voided Flat Plate - Benefits



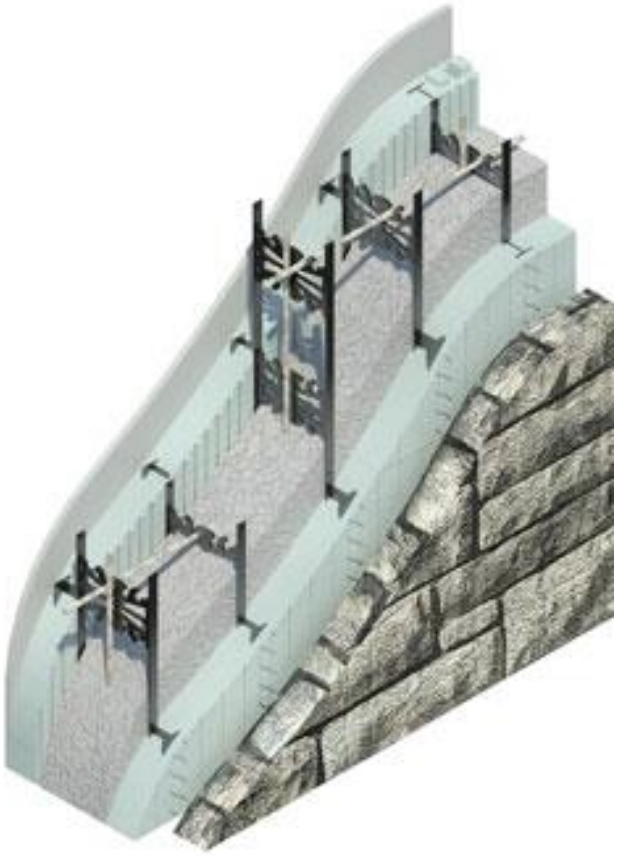
Long Spans
Reduced Dead Load
No Beams
Lower Flr to Flr Height

Tunnel Form – Low Rise to High Rise Floor and Wall System



1. Fast and Economical
2. Superior Acoustic Performance
3. Energy Efficient
4. Easy finishing
5. Popular in Texas and Florida
6. Competes with 2 way PT Flat Slab

Insulated Concrete Formwork (ICF)



Good for low to mid-rise construction

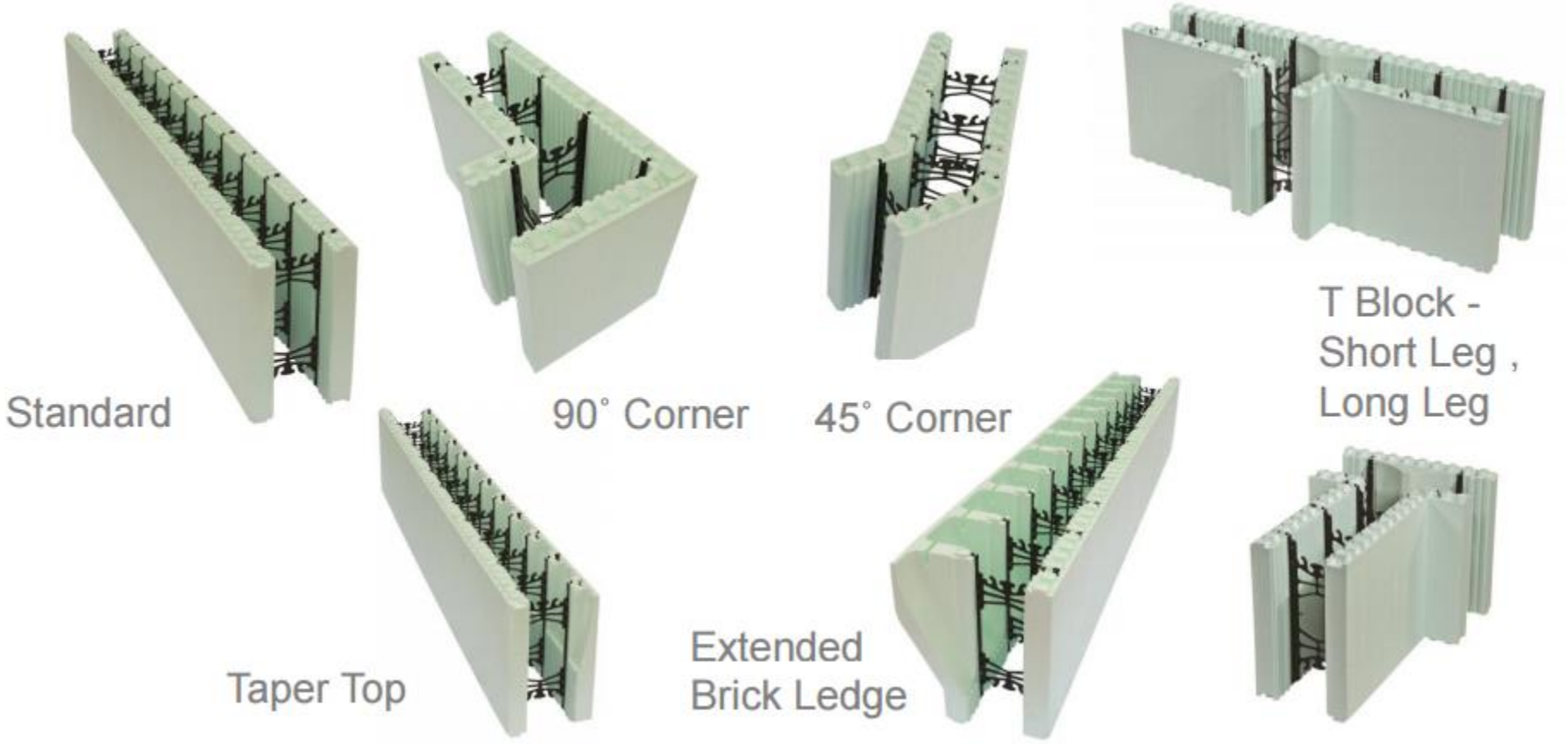
6 componenets in 1-system:

- **Concrete**
- **Reinforcement**
- **Insulation**
- **Air Barrier**
- **Vapor Barrier**
- **Studs/Strapping**

ICF Benefits

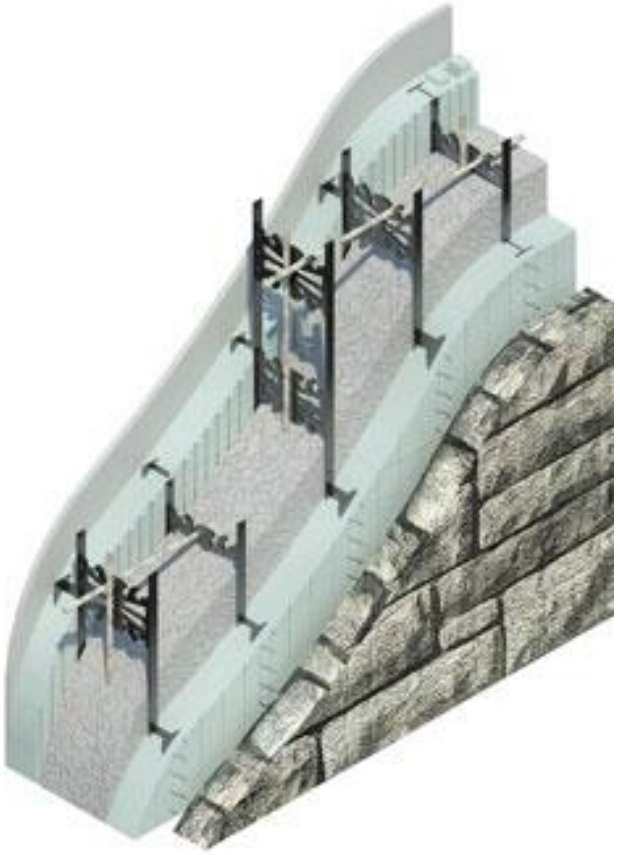
1. Fast and Economical
2. Superior Acoustic Performance – 6” core STC 50, with Gyp STC 71
3. Energy Efficient
4. Easy finishing
5. Competes with Wood and Cold Formed, but more resilient
6. Faster than Block & Plank
7. Can be used as exterior wall only or with interior non-structural
8. Resists 250 mph tornado/hurricanes

ICF Components



Innovations - HoleDeck

Innovations - ICF



Good for low to mid-rise construction

6 componenets in 1-system:

- **Concrete**
- **Reinforcement**
- **Insulation**
- **Air Barrier**
- **Vapor Barrier**
- **Studs/Strapping**

Look to CRSI for more…

Thank You!