Introduction to the Guide for Shoring/Reshoring of Concrete Multistory Buildings ACI 347.2R-17

Robert McCracken PE
EFCO Corp
Des Moines IA

Guide to Shoring/Reshoring

- First published in 2005
- Revised for 2017
- 12 years caused by busy committee agenda;
  - Surface Finish Guide 347.3R-13
  - Formwork Guide 347 R14
  - SP-4, 8th Edition, 2014
- Quick Summary; original content is mostly intact, numerous style and editorial changes, updated references.

ACI 347.2R17 Contents

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Simplified Method

- Definitions
- Assumptions

- Challenging the Assumptions

Definitions

- **Reshores** – shores placed snugly under a slab or structural member after the original forms and shores have been removed from a full bay, requiring the new slab or structural member to deflect and support its own weight and construction loads applied after installation of the reshores.

Additional Definitions

- **Back shores** – shores placed under a slab or structural member after the original formwork and shores have been removed from a small area without allowing the entire slab or member to deflect of support its own mass or existing construction loads.
- **Preshores** – added shores placed under selected panels of a deck forming system before primary (original) shores are removed.
- **Drop-head Shore** – shore with a head where part of the head can be lowered to allow removal of the horizontal forming components without removing the shore or changing its vertical support for the floor system.

Assumptions by Grundy and Kabaila, 1963

- “the principle assumption simplifying this analysis .. is that the shores are infinitely rigid in comparison with slabs in vertical displacement.”
- “the shores are spaced close enough to treat the shore reactions as a distributed load.”

- “With rigid shores all slabs connected by shores deflect identically. A load applied to the system is therefore distributed between slabs in proportion to their relative stiffness.”

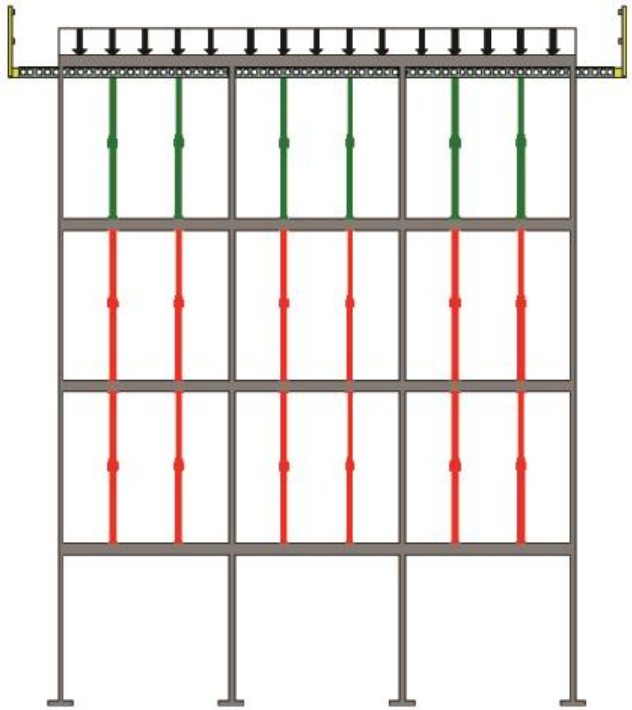
Added Assumptions, Hurd and Courtois, 1986

- “Slabs have equal stiffness and so added loads are shared equally by the interconnected slabs.”
- Ground level or other base support is rigid.”

Assumptions, SP-4, 2014 and 347.2R-17

- Reshores are installed snug tight without initially carrying the load.

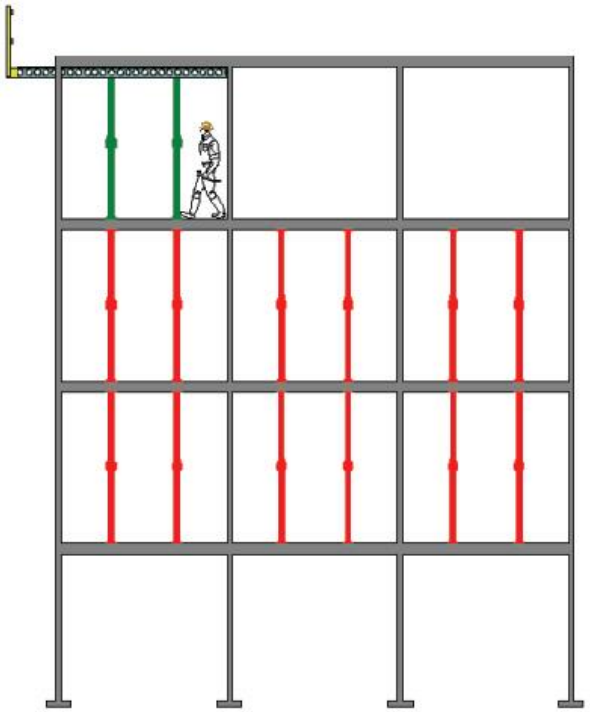
At Concrete Placement



PHASE 1: PLACEMENT OF CONCRETE

- The load on shores consists of concrete weight, live loads and form weight (P).
- Shore load = P
- Reshores distribute loads between lower floors.
- Reshore Slabs load = (1/3)P
- Top Reshore load = (2/3)P
- Bottom Reshore load = (1/3)P

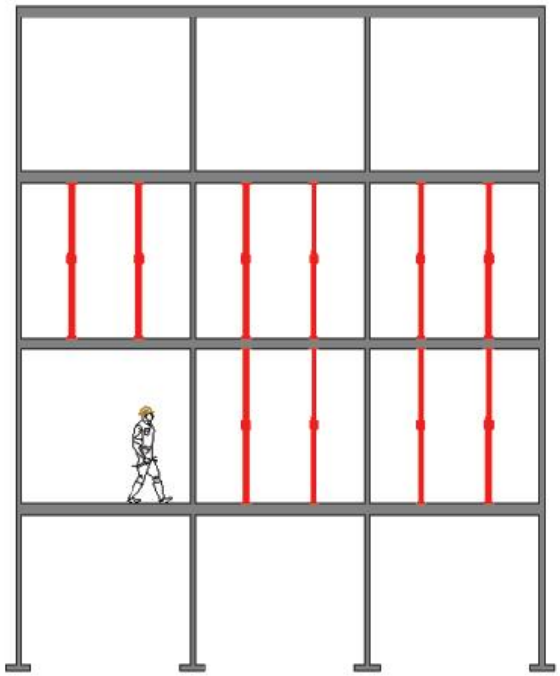
Remove Shores



PHASE 2: REMOVAL OF SHORES

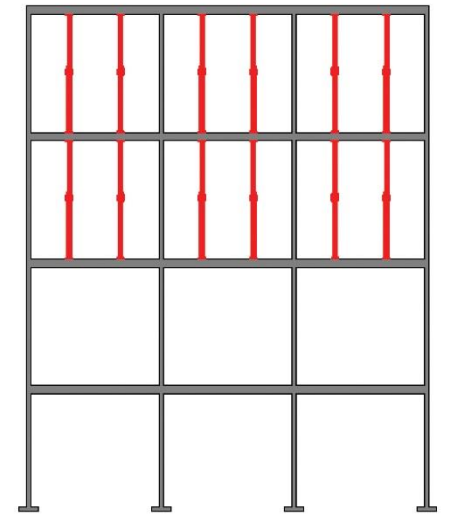
- Freshly cast slab supports itself plus any construction live load.

Remove Lowest Level Reshores



PHASE 3: REMOVAL OF LOWER LEVEL OF SHORES

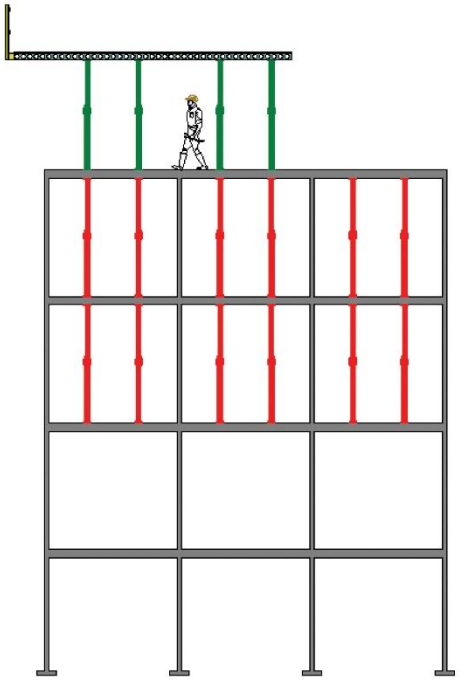
Install Reshores



PHASE 4: INSTALLATION OF RESHORES

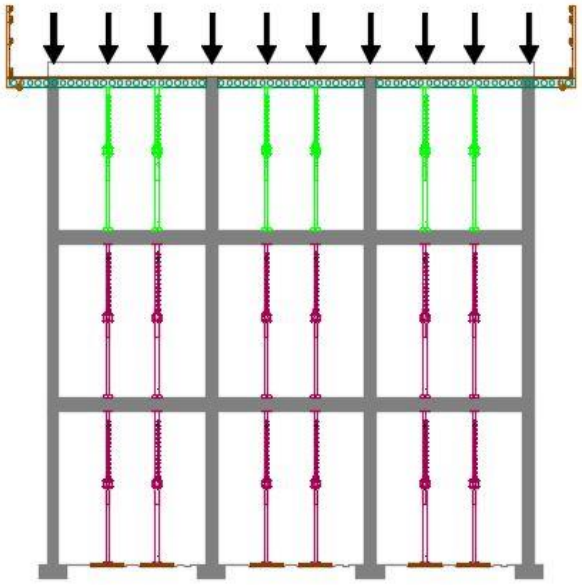
- Install reshores snug without taking weight of the top slab.
- Reshores are assumed to be infinitely stiff. Slabs share applied loads equally.

Install Shores and Forms



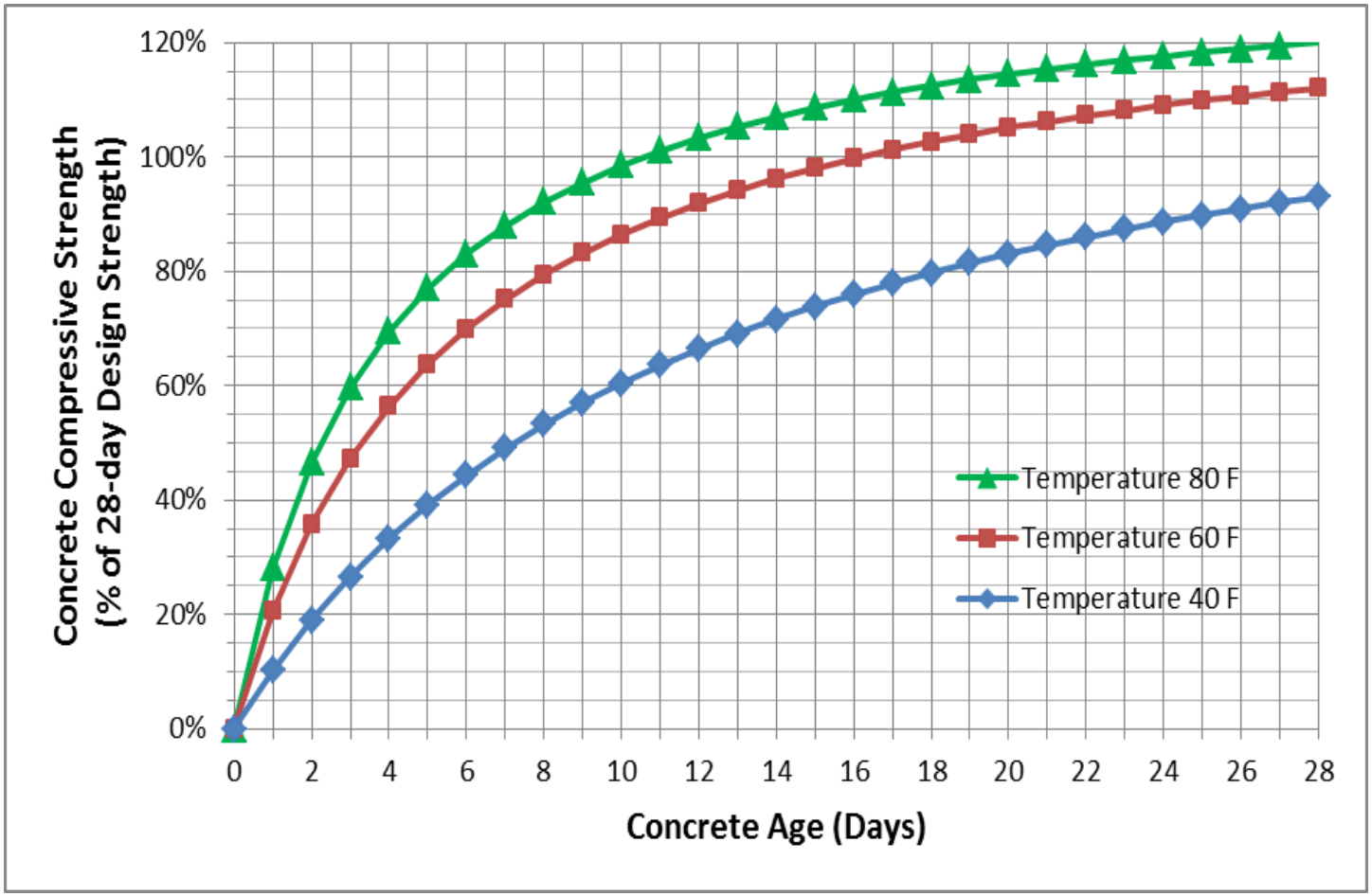
PHASE 5: INSTALL SHORES, FORMS, AND REBAR

Shoring and Reshoring at Ground Level



- Ground Support assumed rigid.
- Load from placement of top slab is transferred thru shores and reshores directly to the ground.
- Shore Load = P.
- Top reshore load = P
- Bottom reshore load = P

Concrete Strength as a Function of Age and Temperature
Figure 6.6, SP-4



Bending and Shear Strength of Slabs

- 28 day cylinder strength is specified by the Structural Engineer
- Early bending and shear strength is usually estimated from testing of field cured cylinders.
- Strength of slabs is usually compared to the ratio of cylinder test to 28 day strength (often expressed as percentage).

Bending and Shear Strength of Slabs ACI 347.2R-17 and Method B, SP-4(14)

- "Slabs having concrete at less than full specified compressive strength may conservatively be assumed to have an ultimate load capacity in proportion to the percentage of specified concrete strength developed at early ages." SP-4 (14) Section 6.7
- If 7 day cylinders break at 3500 psi for slab designed for 5000 psi concrete, the cylinder strength ratio is 70%. Method B estimates that the bending and shear strength of the slab is 70% of the 28 day slab strength.

Method C, SP-4

- “Slabs having concrete at less than full specified compressive strength may conservatively be assumed to have an ultimate load capacity in proportion to the square root of the percentage of specified concrete strength developed at different ages.” SP-4 (14) Section 6.7
- In the previous example where cylinder strength ratio is 70%, slab bending and shear strength would be 84% of 28 day slab strength.

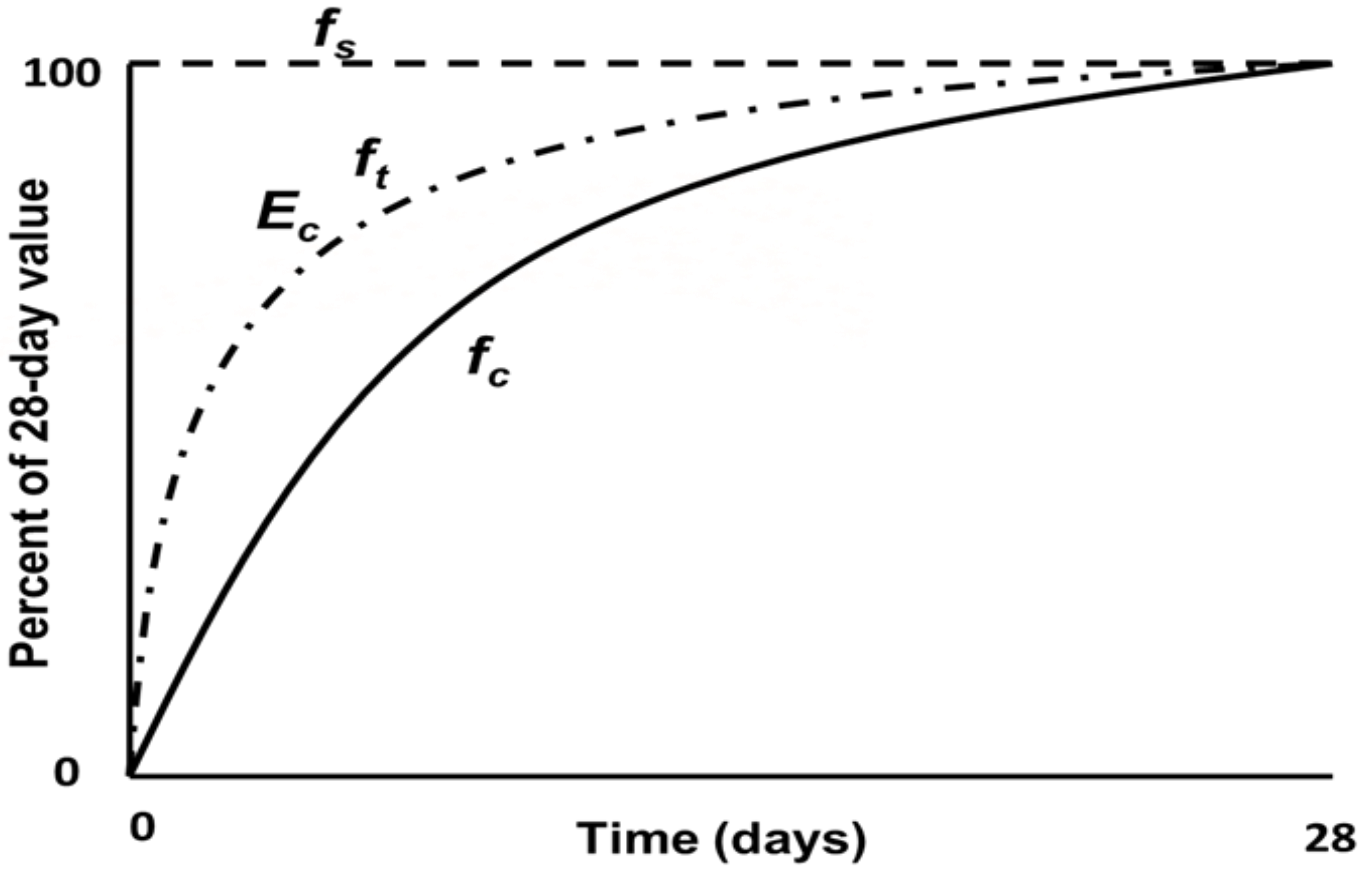
Options

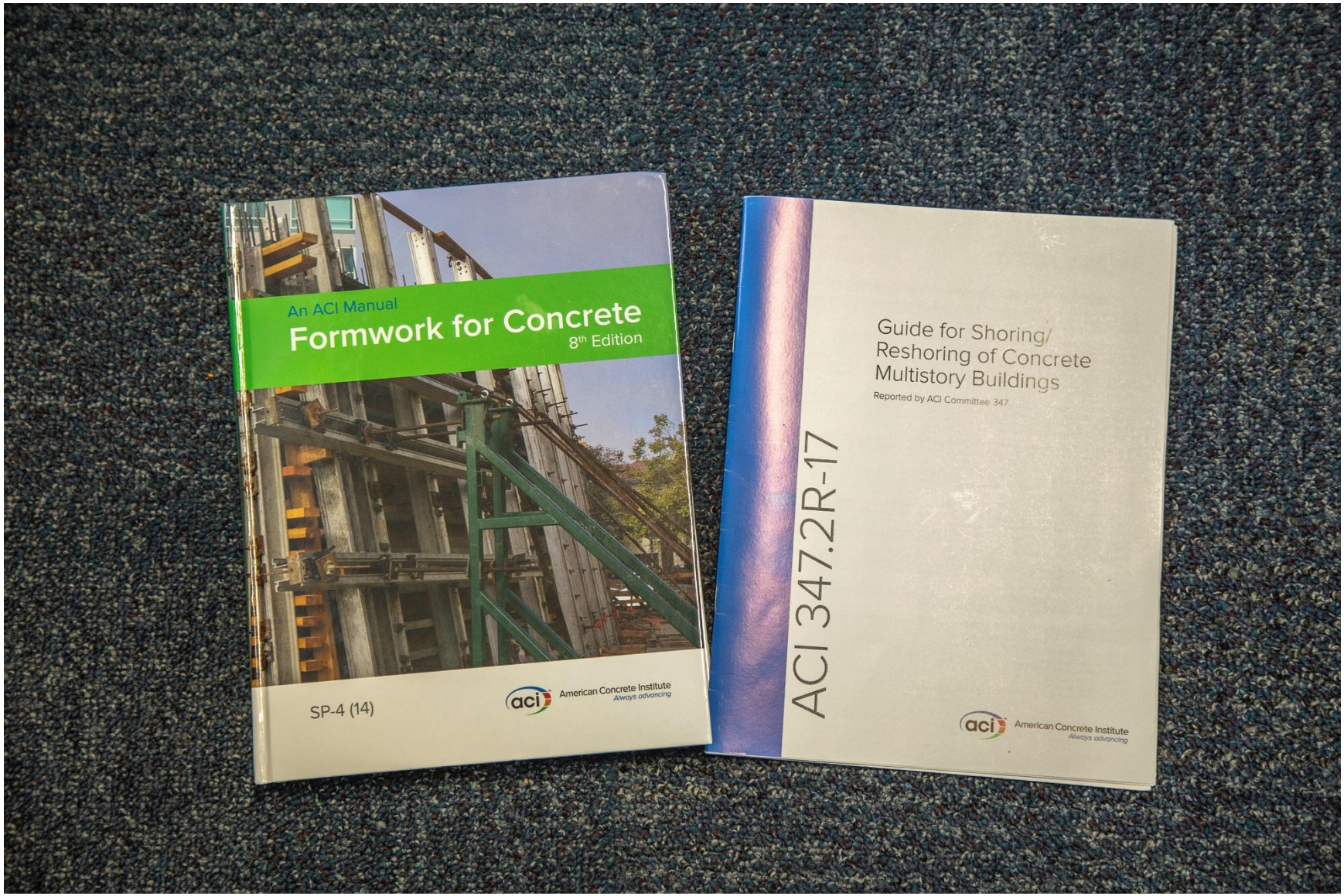
- Slow down.
- Add a third level of reshores to distribute load to four slabs.
- Increase strength of concrete.

Challenging Assumptions

- **Incompressible Reshores** – reshores may not be "infinitely stiff" per Grundy and Kabaila. Monette and Gardner, Concrete International, Sept. 2015
- **Slabs Have Equal Stiffness** – Assumption may have been good with 7 day construction cycle. Could be challenged with 3 and 4 day construction cycles. Pinto and Hover, 1999, SP-186

Rate of Development
Concrete Material Strength and Stiffness
Figure 6.7, SP-4




An ACI Manual
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8th Edition
SP-4 (14)
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