

# Who is Responsible When Concrete Cracks?

## A Practicing Engineer's Perspective

By:

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# My Background

- Principal structural engineer: medium size regional practice with national reach
- 37 years of design experience
- Emphasis on commercial buildings
- Dispute resolution and peer reviews
  - Broad understanding of current practices, both good and bad
- Risk management responsibilities

# Who is Responsible When Concrete Cracks?

# Who is Responsible When Concrete Cracks?

This question is usually  
extremely difficult to answer,  
maybe even impossible.

# Why?

- Reinforcing type
- Reinforcing location
- Reinforcing amounts
- Framing restraint
- Concrete mixture characteristics
- Curing method selected
- Curing execution
- Size of concrete placement
- Spacing of control joints
- Time between adjacent concrete placements
- Formwork/reshoring cycle

*We will not be discussing obvious design or construction errors today!*

# Our Goals in This Session

- Explore cracking that can be expected in a typical building structure *that can lead to conflict*
- Discuss strategies to reduce the risk of conflict
  - Let's work towards eliminating the need to always assign blame

# What is “Expected”?

ACI 302 Guide to Concrete Floor and Slab Construction

“This guide contains recommendations for controlling random cracking caused by normal volume change. Present technology only permits a reduction in cracking, not elimination. Even with the best floor designs and proper construction, it is unrealistic to expect completely crack-free floors. Every Owner should be advised that it is completely normal to expect some amount of cracking on every project....”

# Some Straightforward Advice

- **COMMUNICATE**
  - Especially with new clients
  - To the extent reasonably possible, set expectations for cracking
  - Minimize surprises
  - What does the Owner expect?
    - “crack free” or “very low maintenance”



# Should I Spend the Owner's Money?

- What is the risk profile?
  - Floor coverings/raised floor systems
  - Durability exposure
  - Exposed to view surfaces
    - In an area where it matters
    - In an area where it probably won't matter
  - Crack read through risk (terrazzo finish, others)
- Don't spend the Owner's money without their knowledge and consent

# The Usual Sources of Conflict

- Elevated Slabs
  - Reinforced concrete (suspended slab)
    - ACI 318
  - Slabs on metal deck
    - Steel Deck Institute: Standard for Composite Steel Floor Deck Slabs
- Slabs on Ground
  - Portland Cement Association
  - Wire Reinforcement Institute
- Walls
  - ACI 318

# Elevated Slabs

- Early age cracking
  - Volume change (shrinkage, temperature)
  - Random locations
  - Most common cause for conflict
- After removal of formwork
  - Mostly volume change plus “self-weight stresses”
  - Can be located at points of max flexural stress
- In-service/load induced
  - Rarely a cause for conflict

# Elevated Slabs Expectations

- From ACI 302 for suspended slabs:
  - “...the minimum amount of steel required by the building code may not be sufficient to meet the owner’s expectations for crack widths...”
- From SDI-C
  - “...reinforcement is intended to result in a larger number of small cracks in lieu of a fewer number of larger cracks. It is unrealistic to expect crack-free floors. Every owner should be advised...”
- This is “normal” expected performance. What if that is not acceptable?

# What Can the Designer Change?

- Reinforcing type
- Reinforcing location
- Reinforcing amounts
- Framing restraint
- Concrete mixture characteristics
- Curing method selected
- Curing execution
- Size of concrete placement
- ~~Spacing of control joints~~
- Time between adjacent concrete placements
- ~~Formwork/reshoring cycle~~

*The above changes often spend someone else's money!*

# Slabs on Ground/ Walls

- Early age cracking
  - Volume change (shrinkage, temperature)
    - Random crack locations
    - Curling of slab edges/corners
  - Most common cause for conflict
- In-service/load induced
  - Rarely a cause for conflict

# Slabs on Ground Expectations

- From ACI 302 for slabs on ground:
  - “Some random cracking should always be expected. It is reasonable to expect random visible cracks to occur in 0 to 3 % of the surface area...”
- This is “normal” expected performance. What if that is not acceptable?

# What Can the Designer Change?

- Reinforcing type
- Reinforcing location
- Reinforcing amounts
- Framing restraint
- Concrete mixture characteristics
- Curing method selected
- Curing execution
- Size of concrete placement
- Spacing of control joints
- Time between adjacent concrete placements
- ~~Formwork/reshoring cycle~~

*The above changes will spend someone else's money!*



# Minimize Risk of Conflict

- **COMMUNICATE**
- Don't embed conflict within contract documents
  - Be fair and reasonable

# This is from a Real Specification!

“Repairing Formed Surfaces: Surface defects include color and texture irregularities, **cracks in excess of 0.01 inch**, spalls, air bubbles exceeding surface finish limits, honeycombs, rock pockets...”

1. Are all cracks objectionable? Do all need repair?
2. 0.01 inches = less than 1/64”; 2 sheets of paper
3. How does one quantify this risk on bid day?

Is this fair and reasonable? What usually happens?

Questions?  
Comments?