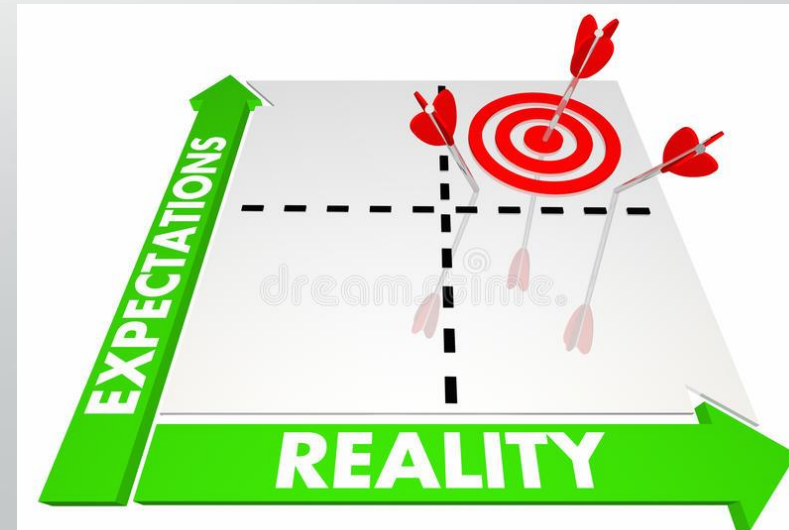


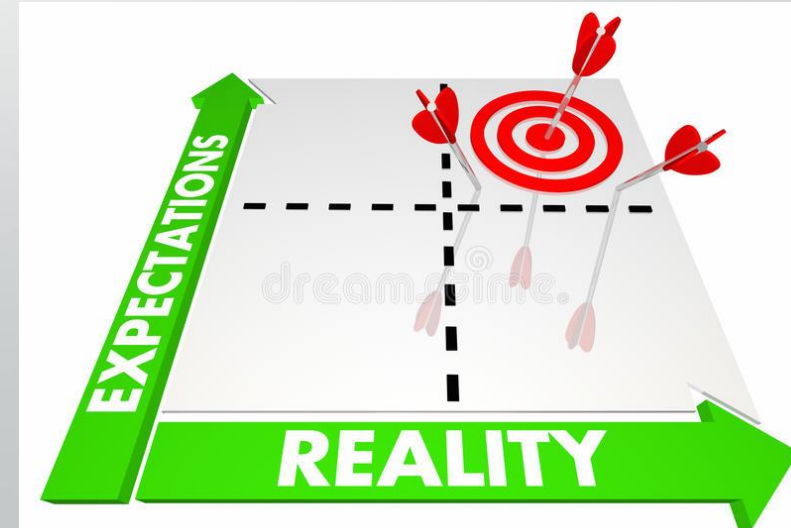
Cracking Expectations

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~~Cracking Expectations~~ Expecting Concrete to Crack

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Cracks in Concrete

- Separation of concrete
- Tensile stress in concrete exceeds tensile strength of the concrete
- Concrete has excellent compressive strength properties
- Tensile strength is about 10% of compressive strength
- External tensile forces—Loads inducing tensile forces
- Internal tensile forces—Shrinkage

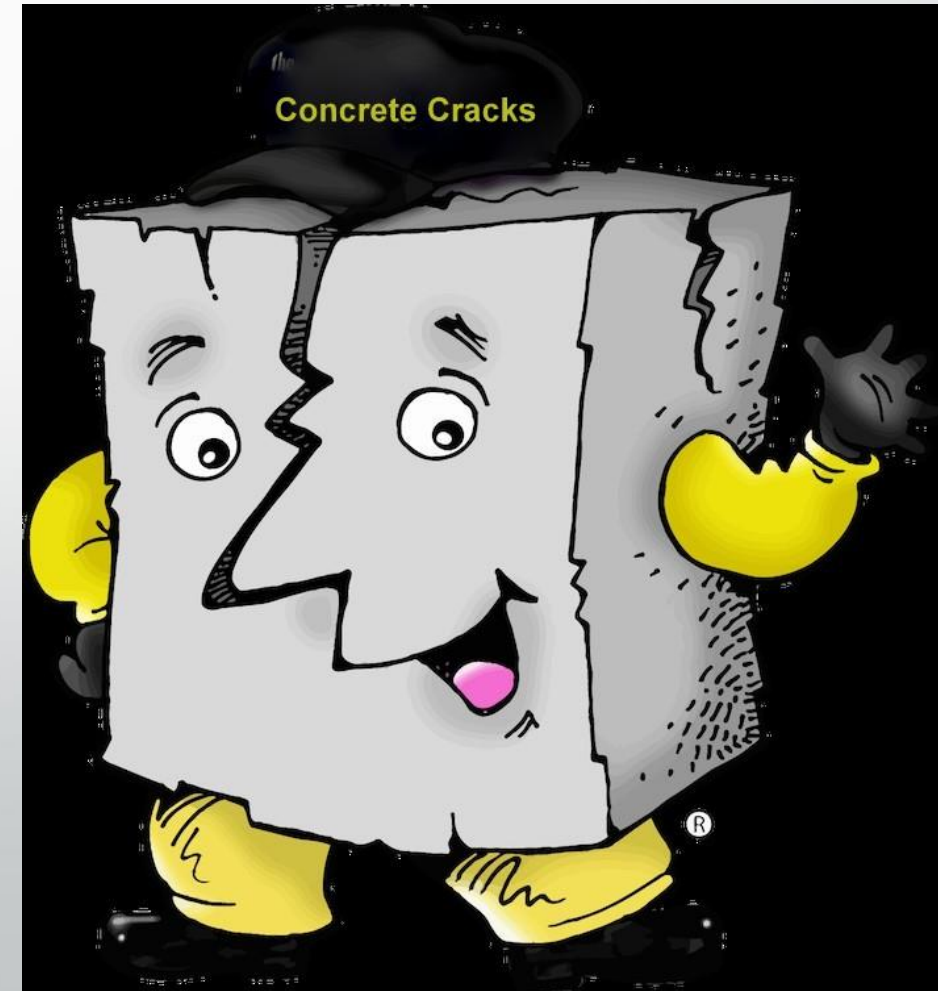
Description of Cracking

- Full Depth
- Partial
- Directional
 - Diagonal
 - Longitudinal
 - Transverse
- Corner
- Hairline
- Wide
- Isolated
- Multiple Isolated
- Map
- Plastic cracking
- Shrinkage Cracking
- Thermal cracking
- Faulted cracks
 - Vertical displacement
 - Structural
 - Slab failure
 - Curling
- Non faulted cracks
 - No vertical displacement
 - Shrinkage
 - May not be structural

How about architectural cracking

Everyone Knows that Concrete Cracks

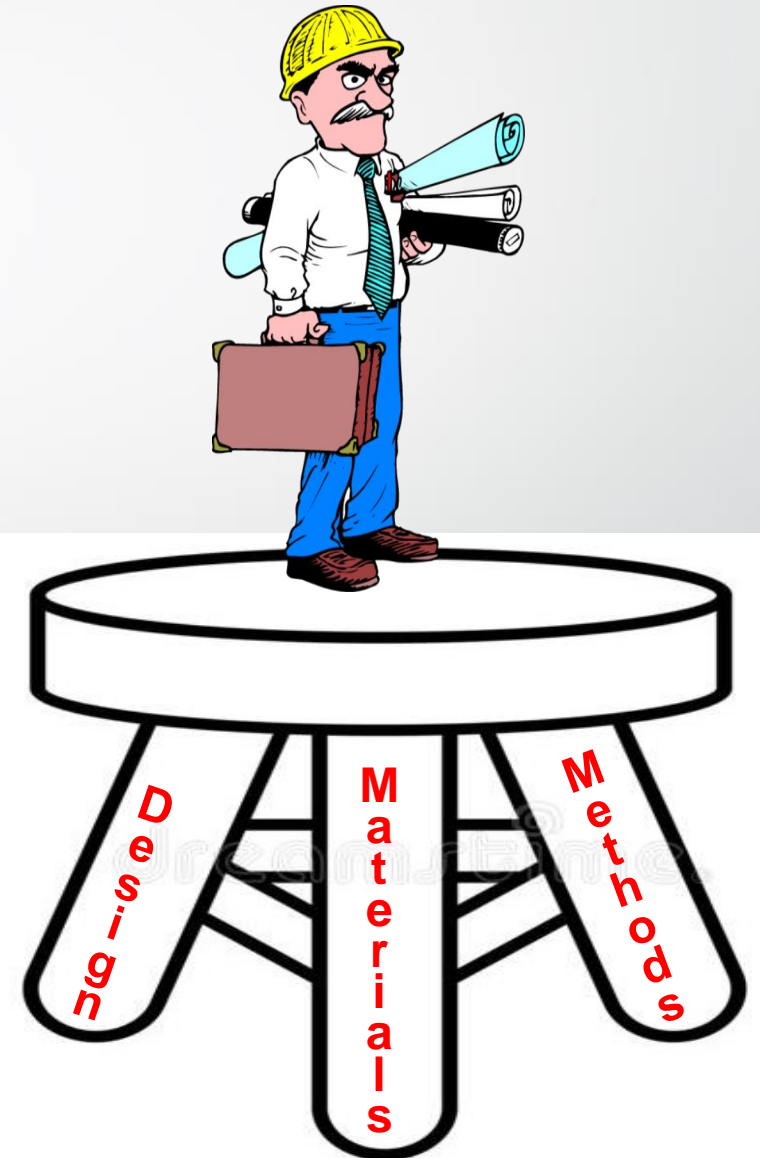
- What do you do
 - Cut joints to locate cracks
 - Use reinforcement to control crack width
 - Use prestress concrete to keep concrete in compression
 - Do nothing and let it crack randomly
- Concrete is going to crack!



Managing Cracking Expectations

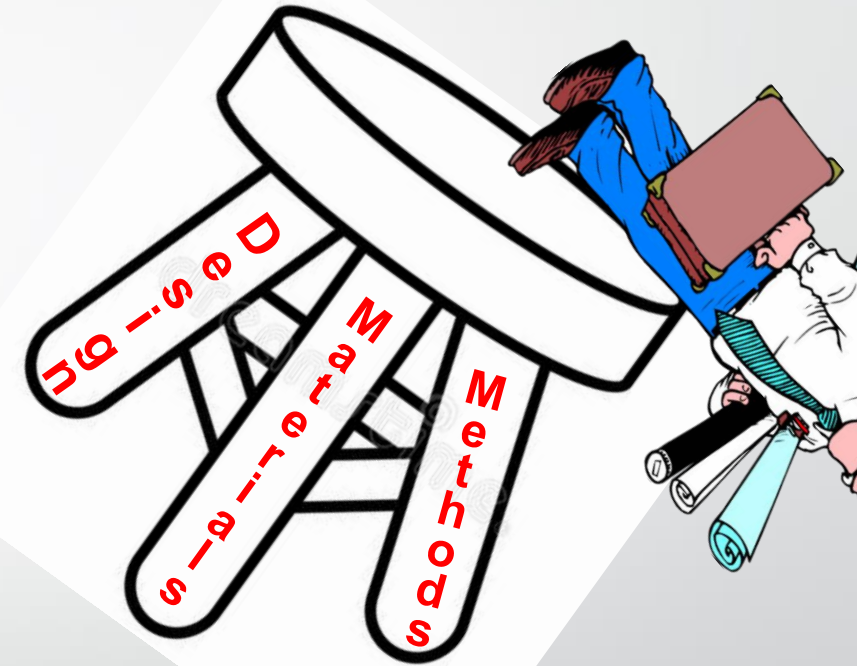
Three Legged Stool

- **Designer**
 - Determines Owner's desires
 - Prepares construction document that will meet Owner's desires and local codes
 - Should the Engineer discuss cracks with the Owner
- **Contractor(s)**
 - Construct in accordance with construction documents
 - Specifications require cracks to be repaired
- **Concrete supplier**
 - Supply what is in the purchase order



Why We Are Having this Seminar—The Stool Falls

- Everybody expects some cracking but
- Too many cracks
- Cracks are too wide
- Is the structure safe?
- Who is going to fix the cracks?
- Who caused the cracks?
- It is not me

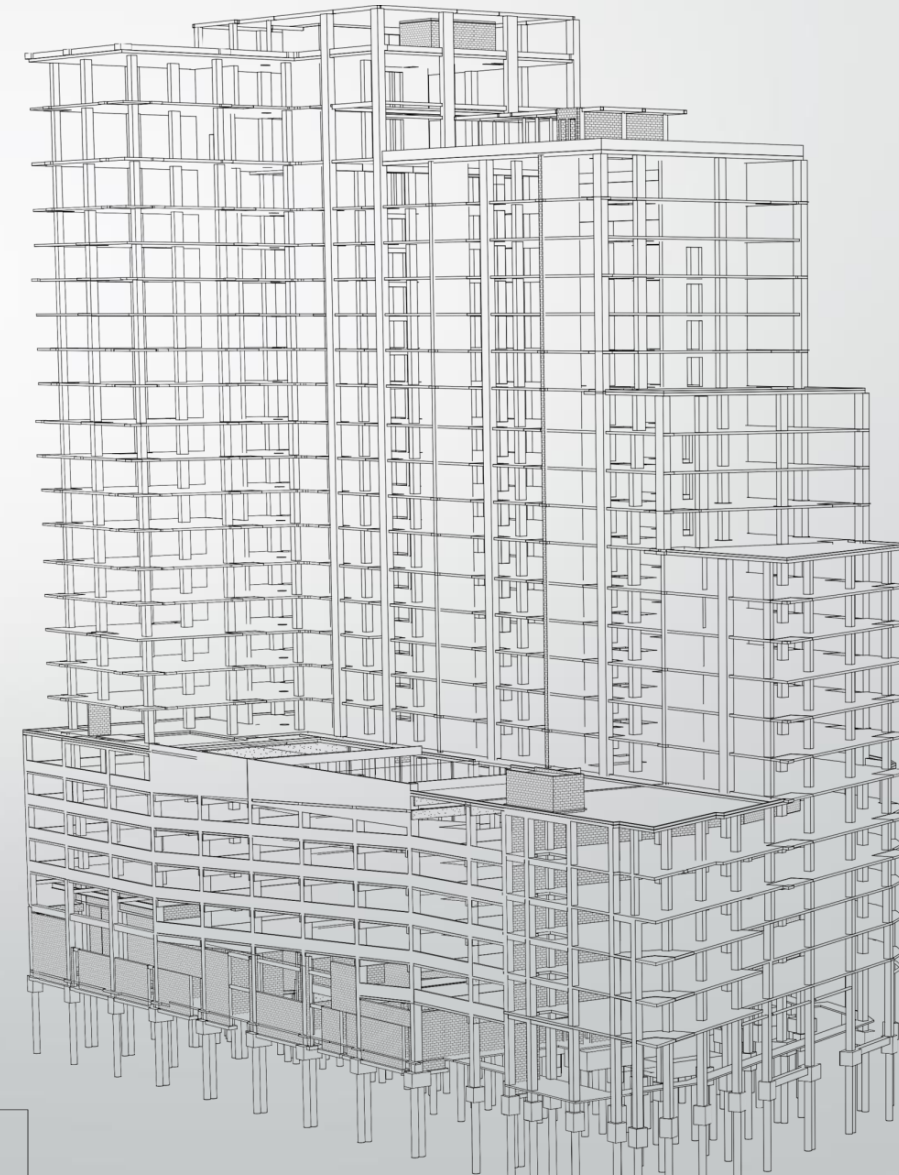
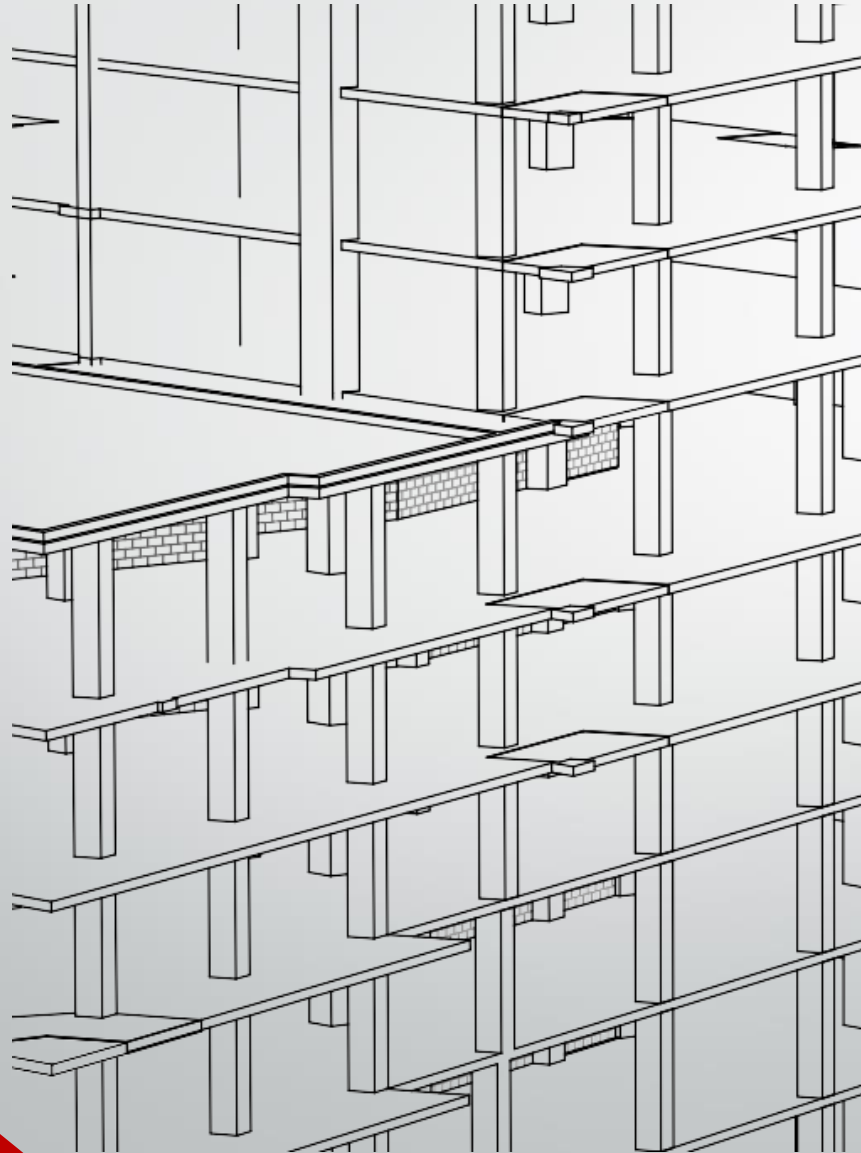


Is the Concrete Industry Insane?

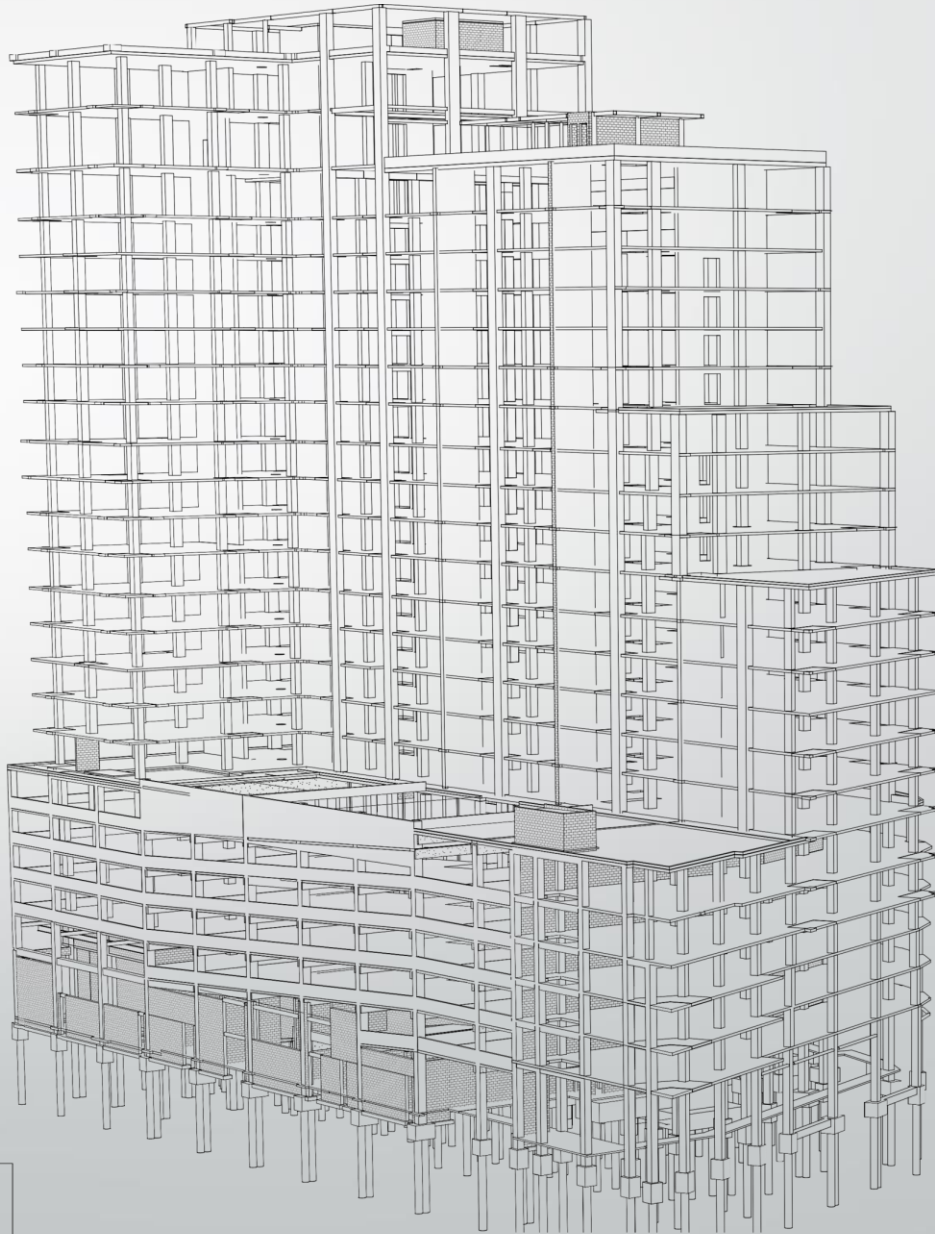
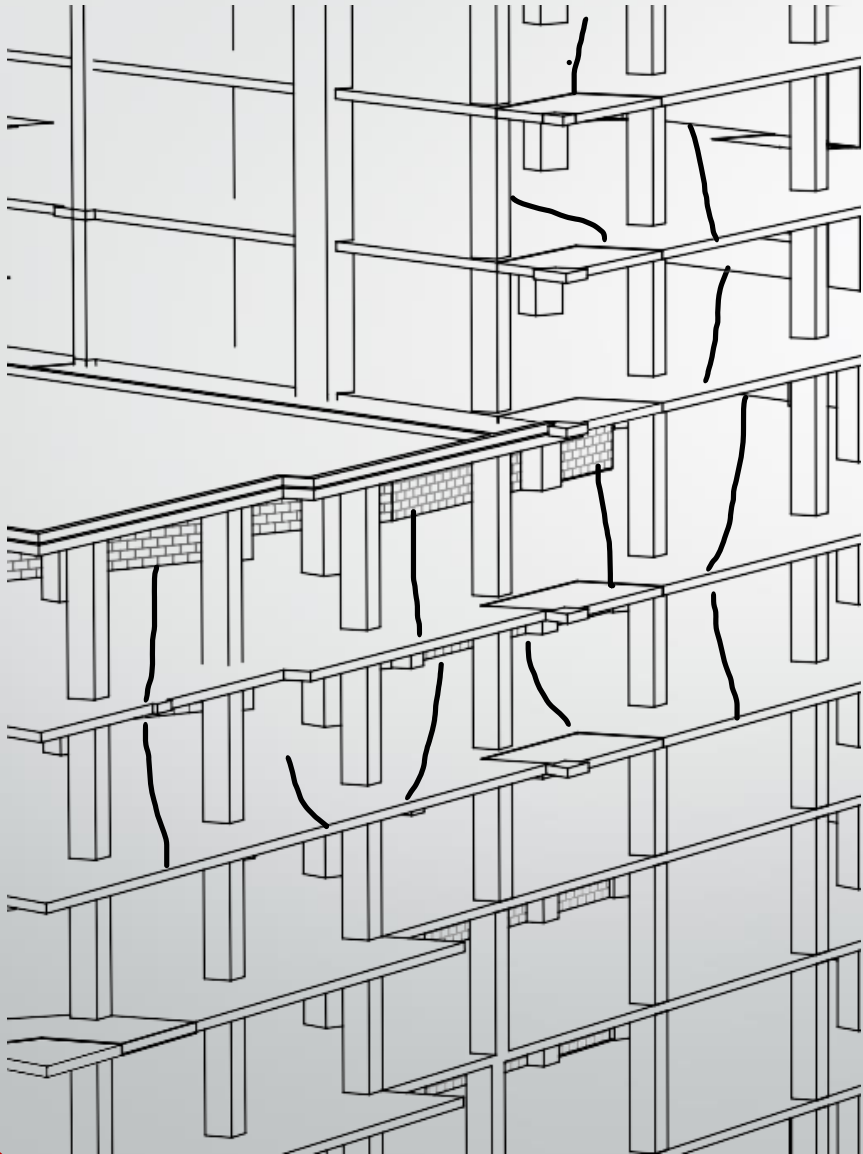
- Has anyone been involved in a cracking dispute?
- Has anyone been involved in more than one cracking dispute?
- Doing the same thing over and over and expecting different results – this is the definition of insanity.



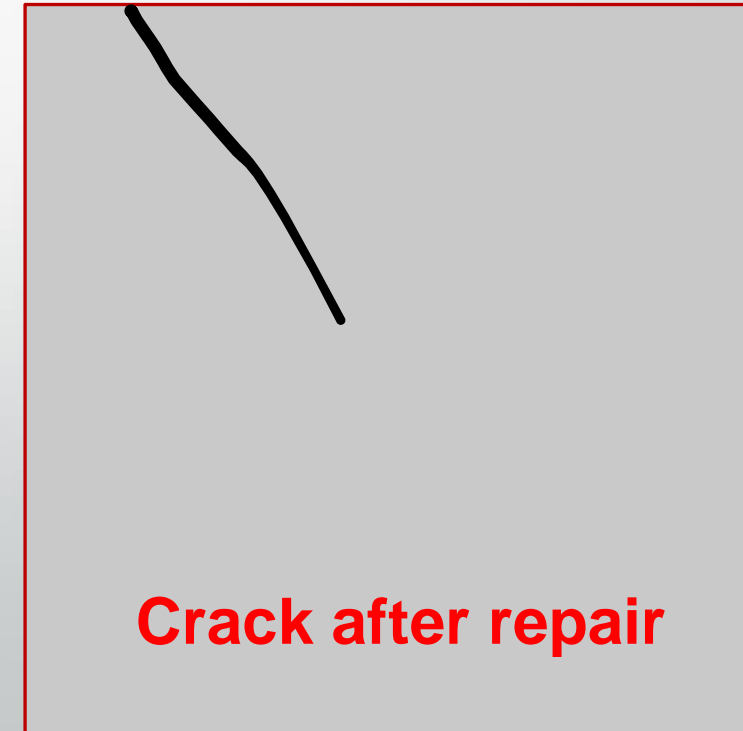
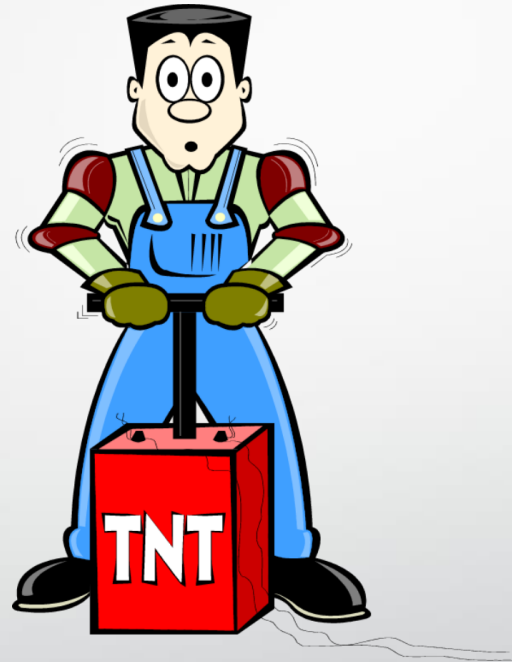
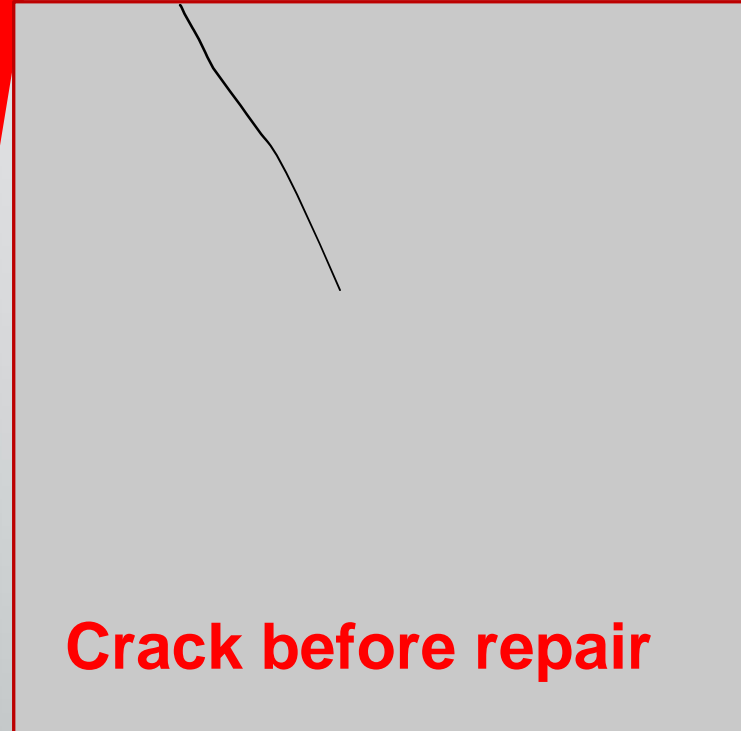
Presumed Look



Actual Look



If you do not like cracks,
you may not like repaired cracks



**The Solution--
TEAR IT OUT**

Cracking Expectations

- Who knows the Owner's cracking expectations?
- Do we tell the Owner that concrete will crack?
- Do we give the Owner an option to have a design that will minimize cracking?
- Do we tell the Owner it may cost more?
- What if the Owner states "I do not want cracks and I am not willing to pay more"?
- This typically does not end well.



What if the Owner is not Happy?

- No one on the project team will be happy
- The Owner will not accept the building
- The Owner will not share the gold
- The Owner brings up this nasty term called “liquidated damages”



Bottom Line

- **No body likes to tell the Owner “You got what you paid for”**



Owner's Opinion

- **The Owner thinks and demands that the finished concrete should be as they presumed it would be even if it is built according to their specifications.**

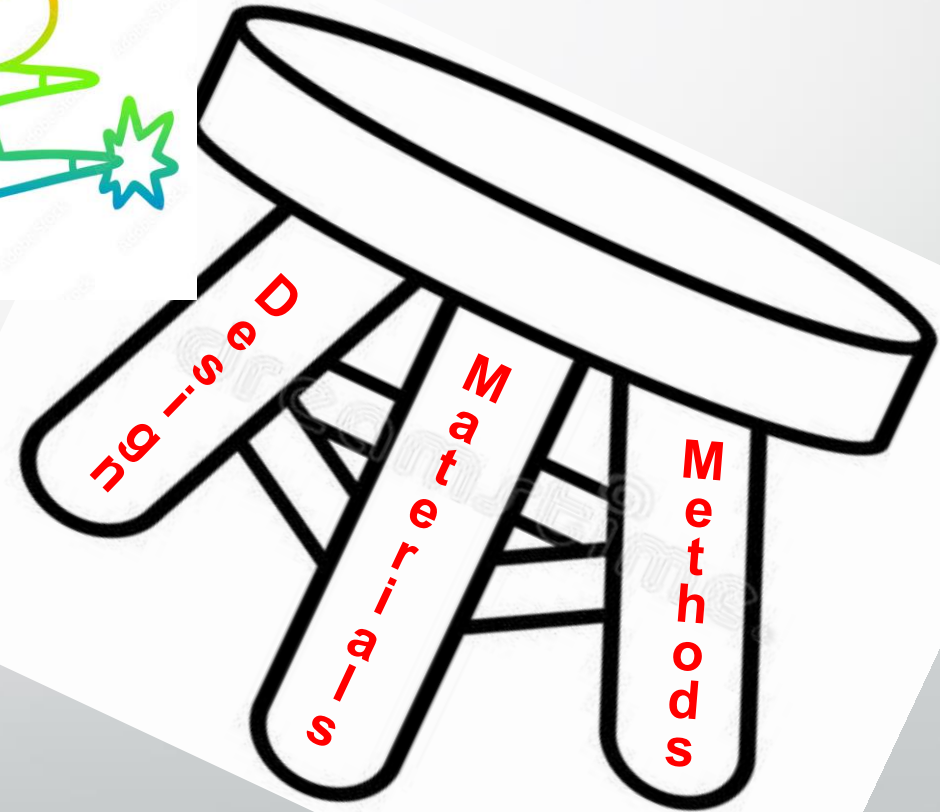


Sometime the Owner kicks the stool over

- This is not what I want
- I cannot accept this
- Fix it at no cost with no schedule impact



Three Legged Stool



Costco Mentality

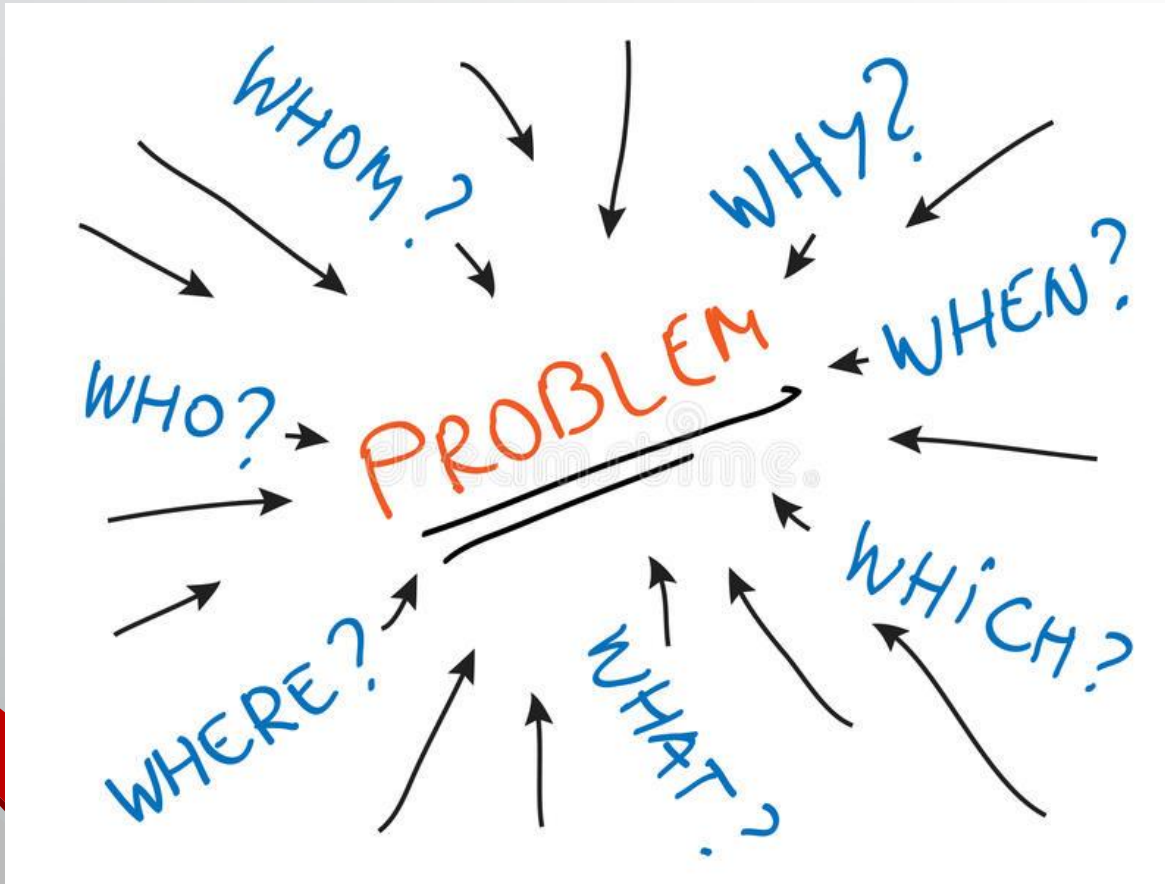
- Anything that is bought from Costco can be returned
- No questions asked
- You get a refund



Problem Resolution

- Who pays
- How do I get someone else to pay

All problems roll downhill



Why Did it Crack—Owner

- I did not buy cracked concrete
- The cracks look bad
- Everybody knows that you can't have this many cracks and this wide
- Somebody screwed up and it is not me



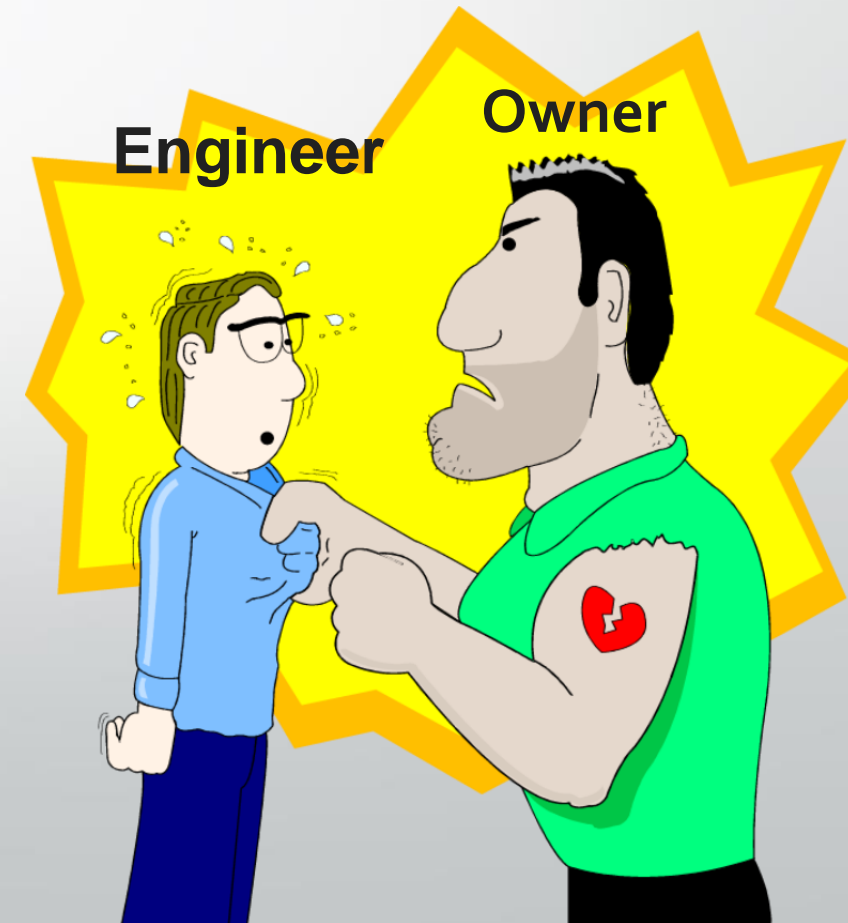
Resolution Process—Engineer

Big Question

- Was the structure designed to be crack free?
- Can I see your calculations?
- Did you specify joint spacing?
- Very seldom does the Engineer have the privilege of participating in the solution.

Golden Rule

He who has the gold makes the rules



Resolution Process—Contractor

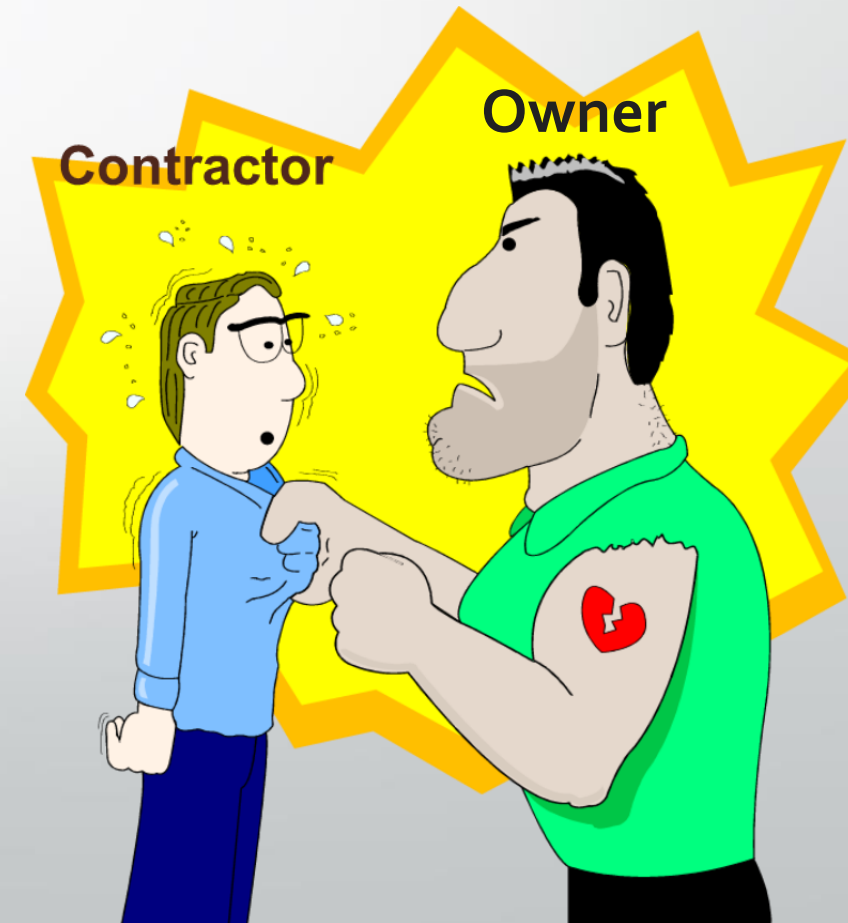
- Don't look at me—I followed the drawings and specifications, maybe
- I knew it was going to crack
- All concrete cracks

You are not getting the gold

No more Projects for you

Golden Rule

He who has the gold makes the rules



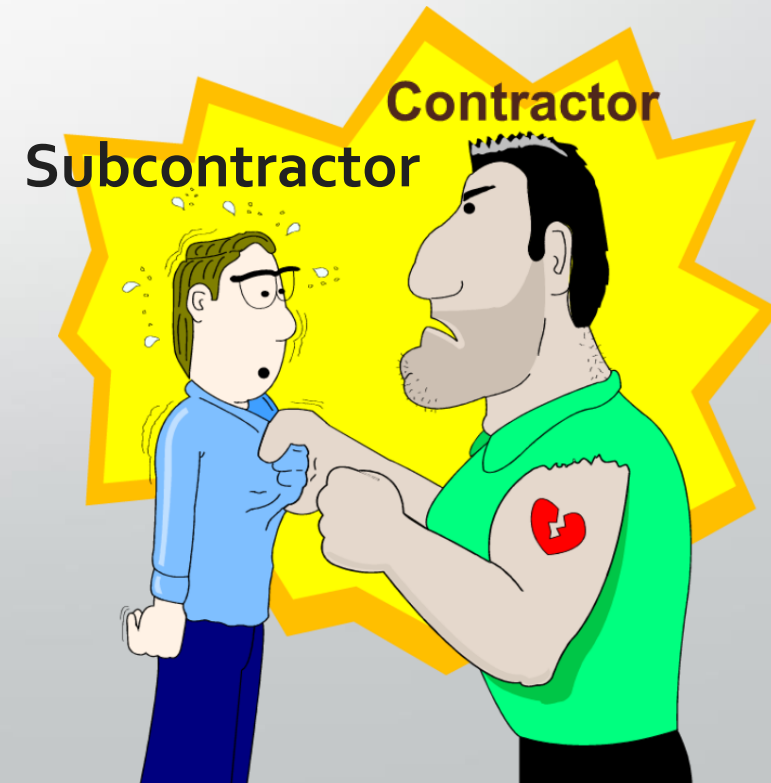
Resolution Process—Subcontractor

- Don't look at me—I followed the drawings and specifications, maybe
- Hey I did what you told me to do
- I knew it was going to crack
- All concrete cracks
- It is bad concrete—blame the concrete supplier

I am not asking Owner to accept cracked concrete
Tear it out

Golden Rule

He who has the gold makes the rules



Resolution Process—Concrete Supplier

- I provided what was required
- The concrete meets strength
- The concrete exceeds strength
- We did not put the cracks in the concrete
- Nobody requested low shrinkage concrete
- Nobody is willing to pay for low shrinkage concrete
- Low shrinkage concrete still cracks
- The concrete was not cracked when it left the plant

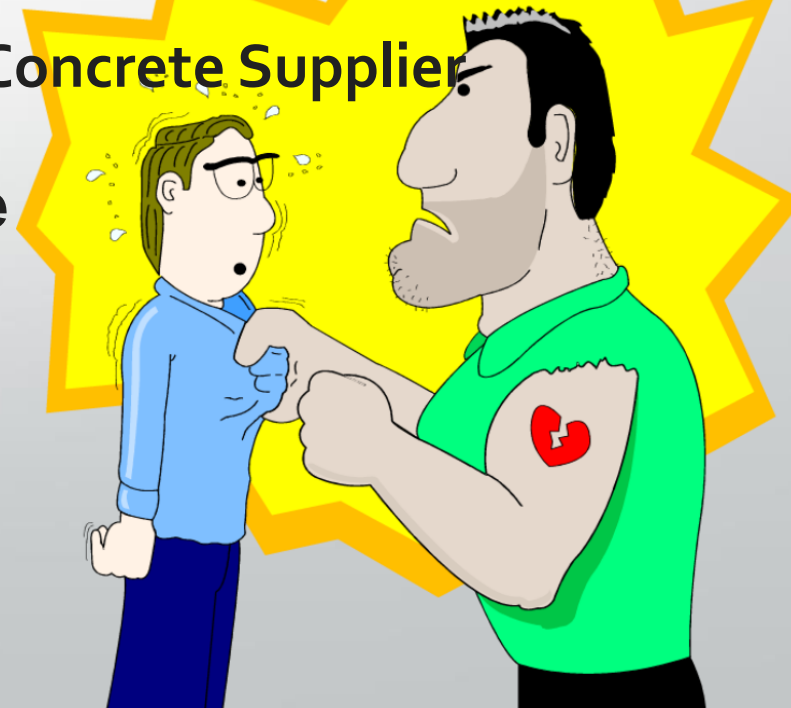
Last person standing says
“I met strength, what more do
you want?”

Golden Rule

He who has the gold makes
the rules

Contractor or
Sub Contractor

Concrete Supplier



Partial Solution to Cracking Grievances

- Educate the Owner
- Provide a design that will meet the Owner's cracking expectation
- Build the structure in accordance with design
- Supply materials that meet the design
- Still expect some cracking but that is not a surprise to anyone in the concrete industry



In The End

- May the Cracks be *architectural* or *Invisible* and
- the Retainage be Paid

