CONCRETE SLAB CRACKING

PROBLEM: *Cracks in Concrete Slab Surfaces*

There are two basic causes of cracks in concrete:

1. Stress due to applied loads
2. Stress due to drying shrinkage or temperature changes.

Stress Cracks - can be eliminated by having a proper sub base and proper concrete design for the load.

Shrinkage Cracks - Drying shrinkage is an inherent, unavoidable property of concrete. Shrinkage of plain concrete drying is .72 inches per 100 feet from the plastic state to a dried state with 50% relative humidity, this shrinkage will take place when the moisture leaves the concrete. To minimize these cracks we need proper placement of saw cuts, and proper curing to hold the moisture in the concrete long enough to get adequate tensile strength gain in the concrete before the moisture leaves and the concrete shrinks. With adequate strength the concrete should pull together and crack in the saw cut and not in between them. Shrinkage during drying and cooling causes concrete to crack. Some shrinkage cracking can be prevented. Cracking that cannot be prevented can be controlled. Concrete, contracts and expands with changes in moisture content and temperature and deflects depending on load and support conditions. Some forms of common cracks are:

- Plastic Shrinkage cracking
- Cracks due to improper jointing
- Cracks due to continuous external restraint (Example: a cast-in-place wall restrained along the bottom edge of footing)
- Basement or house floor cracks
- D-Cracks from Freezing and Thawing
- Craze cracks
- Settlement cracks

Cracks rarely affect structural integrity. Most random individual cracks look bad and although they permit entrance of water they do not lead to progressive deterioration. They are simply unsightly. Closely spaced pattern cracks or D-Cracks due to freezing and thawing are an exception and may lead to ultimate Deterioration.

CAUSE: *Why does concrete crack?*

The majority of concrete cracks usually occur due to improper design and construction practices, such as:

- Low strength mix
- Use of High Slump concrete or addition of water on the job.
- Improper Finishing Premature floating or troweling
- Improper placement of reinforcement Poor sub grade preparation
- Too great a distance between control joints or omission of isolation and control joints
- Inadequate or improper curing
- Insufficient depth of control joints
- Freeze-thaw action causing scaling
- Chemically initiated expansion

CURE: *How to reduce concrete surface cracks*

"TO REDUCE CRACKING, REDUCE THE AMOUNT AND RA TE OF SHRINKAGE "

- All concrete has a tendency to crack and it is not possible to consistently produce completely crack-free concrete. However, cracking can be reduced and controlled if the following basic safeguards are observed:
- Sub grade and formwork - All topsoil and soft spots should be removed. Regardless of its type, the soil beneath the slab should be compacted soil or granular fill, well compacted by rolling, vibrating or tamping.
- The sub grade should be sloped for proper drainage.
- If a vapor barrier is to be used, cover it with a layer of 1 to 2 inches of damp sand.
- Immediately prior to concrete placement,
- dampen the sub grade, formwork and reinforcement.
- Concrete - Use concrete with a moderate slump (not over 5 inches). Avoid Re-tempering on the job. Higher slump concrete needs proportions changed to avoid, excessive bleeding, segregation and Low Strength.
- Finishing. DO NOT perform finishing operations with water present on the surface.

- Initial screeding must be promptly followed by bullfloating. Exterior surfaces should be broom finished.
- If evaporation is excessive reduce it by some means to avoid plastic shrinkage cracking.
- Cover the concrete with wet burlap or polyethylene sheets in between finishing operations if conditions are severe.
- Curing - Start curing as soon as possible.
- Spray the surface with liquid membrane curing compounds or cover it with damp burlap and keep it moist for at least 3 days. A second application of curing compound the next day is a good quality assurance step.
- Joints - Provisions for contraction and expansion movements due to temperature And / or moisture change should be provided with construction of control joints by sawing, forming or tooling a groove about 1/4 the thickness of the slab, no further apart than 30 times the thickness. Often closer spacing will be necessary for thin slabs. The length of the area should not exceed about 1.5 times the width. Isolation joints should be provided whenever restriction to freedom of either vertical or horizontal movement is anticipated; These are full depth joints and are constructed by inserting a barrier of some type to prevent bond between the slab and the other elements.

PREVENTION / SOLUTION: *To minimize surface cracking*

- Design the members to handle all anticipated loads.
- Provide proper control and isolation joints. Space joints close enough to prevent intermediate cracking. In plain concrete, joint spacing in feet shouldn't exceed 2 1/2 times the slab thickness in inches. Place joints so the panels are as close to square as possible. In slab-on-grade work:
- Prepare a stable sub grade.
- Place and finish according to established rules.
- Saw as soon as the concrete is hard enough that no raveling will occur.
- Protect and cure the concrete properly.

REFERENCES:

1. ACI Standard Recommended Practice for Concrete Floor and Slab Construction ACI 302, ACI manual of Concrete Practice.
2. "Cracks in Concrete: Causes, prevention, Repair, "Concrete Construction Magazine, June 1973.
3. "Why and How: Joints for Floors on Ground," PCA, RP026.0 I B