Technical Bulletin
Curling

The Concrete Floor Contractors Association of Ontario was founded in 1971 to represent the concrete finishing industry.

Technical Bulletins are designed to provide state of the art information to owners, specifiers and contractors to both improve quality and reduce problems.

We hope that this information will assist you in this goal.

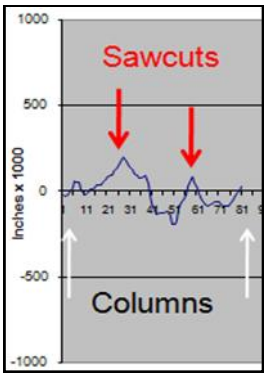
If you have any questions, or comments, please feel free to contact us at 905-582-9825 or by e-mail at info@concretefloors.ca

The Best Floors Start With Our Finish !

Concrete Floor Contractors Association

February 13, 2009

Background



All concrete shrinks as it dries due to moisture loss. Concrete floors also curl upward at all interior floor joints when they dry due to due to temperature and humidity differences between the top and bottom of the slab (dry and warm on top versus damp and cool on the bottom). Curling occurs in all jointed, non-continuously reinforced floors and varies in amplitude based upon the shrinkage potential of the concrete and the volume of reinforcing in the slab.

Concerns:

Tolerance losses of up to 50% can occur over the first year which can significantly alter the appearance and performance of a concrete floor surface.

Fully unreinforced floors are subject to unrestrained curling and differential vertical joint movement which may create materials handling problems, tripping hazards, hard tile application problems and concerns over the final appearance of both exposed concrete and concrete with thin applied finishes. Other problems associated with curling include cracking due to the lack of underlying support from the granular base and joint deterioration from the impact of forklift traffic.

The is no mathematic formula to predict the height of curling in a concrete floor.

Curing does not play a significant role is curling—even well cured floors will curl as they dry !

Recommendations:

Owners should exercise caution when designing floors slabs to employ sufficient reinforcing to restrain this curling to meet their particular needs. Tolerance specifications should include an allowance for tolerance losses due to curling.

Clause 6.4.2.2.3 of CSA A23.1-09 states:

> "Owners shall specify low shrinkage concrete mixes, appropriate curing, or suitable reinforcing, or a combination of these, as necessary to minimize curling to suit their intended usage."

Further References:

- CSA A23.1-2009 Concrete Materials & Methods of Concrete Construction.
- See page 2 for curling case study.

Continued on page 2 ...

Project Case Study
Concrete Curling

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Elevation measurements were taken from a four year old industrial slab on grade to review the extent of curling which had taken place.

The floor was a 6" thick slab on a well compacted granular base reinforced with one layer of 6x6 6/6 welded wire mesh. The concrete was designed for a 25 MPa compressive strength, with water reduction and a plasticizing admixture. The water:cement ratio was approximately 0.6.

The concrete was placed by truck, screeded with a laser guided screed, pan floated and trowel finished. The concrete was sawcut at 3.8m (12.5').

12 panels were measured in a 3 x 4 panel configuration. The 3D graph below shows the results (red = low & purple = high).

Observations:

- The elevation at the uncurled centre of the sawcut panels varied by ±6mm (which is an excellent result).
- The average upward curl from the centre of the sawcut panel to the adjacent sawcut intersection was 13 mm (over 2.7 m)
- The greatest elevation from the centre of the panel to an adjacent sawcut intersection was 23 mm and the lowest was 5 mm.
- The elevation difference between the lowest point and the highest point was 27 mm.