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BUILDING PRACTICE NOTE

THE USE OF VAPOUR BARRIERS UNDER CONCRETE SLABS ON GROUND

ANALYZED

by

R.G. Turenne

Division of Building Research, National Research Council of Canada

Ottawa, August 1978

THE USE OF VAPOUR BARRIERS UNDER CONCRETE SLABS ON GROUND

by

R.G. Turenne

The Division has received a number of inquiries regarding the possible weakening effect of placing concrete for floor slabs on plastic sheets instead of directly on the subgrade. These inquiries have been prompted by the interpretation given to a recent research paper,[1] i.e., that this practice, which deprives the concrete of much needed moisture from the soil, can cause excessive shrinkage, cracking, and loss of strength.

Description of California Tests

In these tests, which were conducted in southern California, concrete slabs, 76 to 92 mm thick, were placed on different substrates, subjected to various curing treatments and their behaviour observed over a period of one year. Concrete slump at the time of placing varied between 200 and 229 mm (8 to 9 in.).

The substrates used were the following:

a) 6 mil thick polyethylene placed on the ground

b) a 76 mm thick dampened sand bed on native soil

c) a pervious non-compacted 76 mm thick bed of dampened cement-treated sand mixture.

An area of slab over each of the three substrates received no curing treatment. Other areas were treated as follows:

1) sprayed-on membrane-forming curing compound

2) rolled-on wax-base curing compound

3) trowelled-in colour and rolled-on wax-based curing compound.

Of special interest is that "the slabs were cast on a hot and windy day not uncommon in southern California," and were left totally unprotected for a period of one year except for the curing treatments just described.

Following the one year exposure, the researchers reported that the slabs cast directly on polyethylene showed excessive cracking, while those placed on dampened sand or dampened cement-treated sand had one shrinkage crack each. Core and cube compression tests indicated that the concrete placed on sand was 30 per cent stronger after one year than the concrete placed on the polyethylene.

Discussion of California Tests Results

These results must be examined in the light of various design considerations and the present construction requirements and practice in Canada.

Present practice in Canada is to place, between the natural soil and the concrete slab, a dampproofing layer of granular fill. These granular fills are used under most concrete slabs on grade to provide for subsurface drainage, to control moisture diffusion or as a replacement for undesirable materials. Granular fills are also an ideal material to set smooth grades and prepare an area to receive a uniform thickness of concrete. These fills can be used with or without a polyethylene film depending on design or building code requirements.

Several features of the California tests make a direct comparison with the Canadian practice difficult, such as the constant exposure to sun and wind in the California test, and the apparent absence of proper moist curing at least during the first few days -- conditions that normally do not apply in Canada.

In residential and even commercial and industrial construction in Canada, floors on ground are often placed after the walls and roofs are erected. This prevents their exposure to direct solar heat and protects them from the drying effect of the wind. Good practice in Canada requires that the surface of fresh concrete be kept continuously moist for a minimum of 3 days and that the concrete be subjected to moist curing for at least 7 days. To be conclusive the California tests would have to be repeated under Canadian climatic conditions and the procedure closely follow recommended Canadian practice. It would also be necessary to have the same test condition, e.g., dampened sand beneath one of the samples.

Although the study would seem to demonstrate that casting a concrete slab on a pervious base minimizes shrinkage cracking, the conditions under which the tests were conducted hardly justify the elimination of granular fill and polyethylene film as a means of controlling subsurface moisture.

The California study also shows the possible effect of the water/cement ratio on the ultimate strength of concrete. Although much of the excess water (220 to 229 mm slump) used in mixing concrete placed on a dampened

sand bed or a cement-treated sand bed in the tests could bleed into the substrate (thus lowering the water/cement ratio of the mix), this was not the case for concrete placed on a polyethylene film. In this case all the excess water (that is, water not required for hydration) had to evaporate, which would account for the lower strengths and the excessive shrinkage. If anything, the study demonstrates the importance of using as low a water/cement ratio as possible in concrete floors on grade and, if greater workability is required, consideration of the use of plasticizers.

CONCLUSIONS

The decision to place a vapour barrier under a concrete slab on ground should be based on design factors and performance requirements.

The water/cement ratio should be kept as low as possible consistent with workability requirements.

Recommended curing methods should be followed to ensure that the concrete develops the desired strength and finish.

REFERENCE

1. Job conditions affect cracking and strength of concrete in-place by Richard H. Campbell, Wendell Harding, Edward Misenhimer, Geo. P. Nicholson and Jack Sisk. ACI Journal, January 1976.