repairing spalled joints in concrete floors

1. introduction

Spalling of joints is the cracking, breaking or chipping in the immediate vicinity of joints (usually within 100 mm of the joint). A spall usually does not extend vertically through the slab but extends to intersect the joint at an angle. Spalling at joints usually results from:

- Excessive stress at the joint, caused by accumulation of incompressible material in the joint and subsequent expansion of adjoining slabs in concrete pavements
- Weak concrete at the joint
- Poorly designed or constructed load-transfer devices or failure of such devices
- Poorly constructed joints

Spalling is typically a localized distress warranting a localized repair procedure for cost-effective restoration. Repair of this distress is needed to improve serviceability, deter further deterioration and provide proper edges so that the joints can be resealed effectively.

2. repair method

1. Carry out a survey to determine the actual repair boundaries. During the survey all areas of delamination should be determined using a sounding technique. This may be done by striking the existing concrete surface with a steel rod or by tapping lightly with a hammer. When using a steel rod or hammer, a sharp metallic ring will indicate sound concrete, while a dull or hollow sound will indicate delaminated areas.

2. Mark out a rectangular area around the defect at least 100 mm wide, parallel to the joint, and extending a minimum of 50 mm beyond the defect. Repair areas less than 500 mm apart may be combined to improve appearance.

3. Using a concrete saw, saw around the perimeter of the patch area to a minimum depth of 35 mm. See Figure 1. This will provide a vertical face at the patch edges and provide sufficient depth to give integrity to the patch.

4. Provide an additional sawcut in the joint to a depth of 25 mm below the bottom of the patch and extending at least 75 mm laterally beyond each end of the prepared patch boundaries. The width of the sawcut should be equal to that of the existing joint. See Figure 1.

5. Remove the concrete inside the patch area to a minimum depth of 35 mm with a hammer and sharp cold chisel or light pneumatic tool until sound and clean concrete is exposed and the patch area is more or less uniform in thickness. It is important that tools of the appropriate size are used. Using a pneumatic hammer which is too large will cause damage and fracture the concrete below. Heavy jack hammering should not be used! The maximum allowable pneumatic hammer size should be 12 kg.

6. Clean out the repair area using oil-free compressed air to remove all dust and loose concrete. Partially loose concrete should be removed by wire brushing after which the area should again be cleaned out with compressed air. Finally remove all loose particles and dust by means of an industrial vacuum cleaner.

7. Insert bond-breaking compressible joint filler (e.g. expanded polystyrene foam of density 16 kg/m^3) into the existing joint against the existing slab, to fill the sawcut provided (as described in step 4), flush with the surface of the slab.

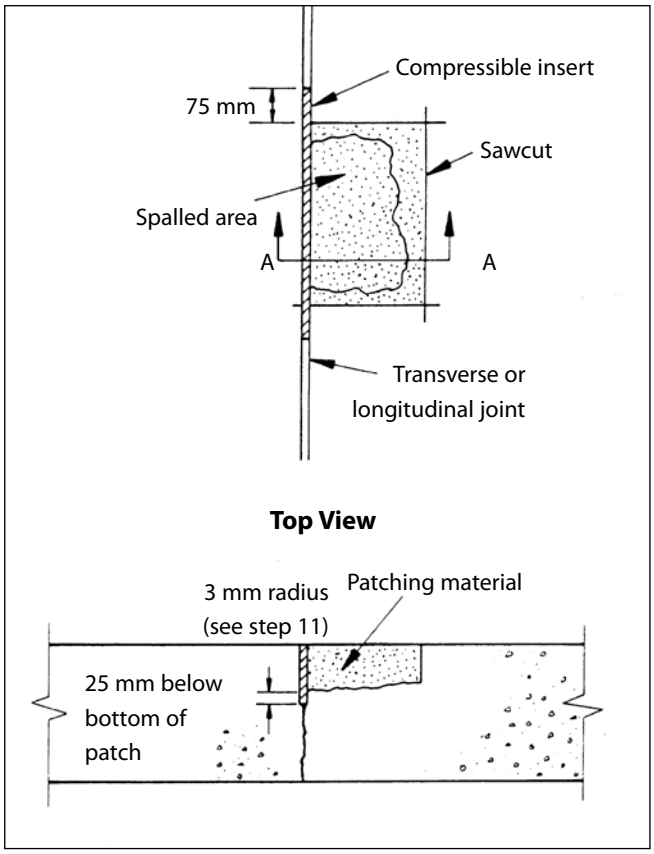

Figure 1: Saw cutting at spalled joint

8. Apply an approved wet-to-dry epoxy resin as bonding agent to the entire area, including patch sides, in strict accordance with the manufacturer's instructions.

9. Patch the hole with concrete of appropriate compressive strength and stone size. The concrete mix should be designed by an approved concrete testing laboratory to suit the aggregates available and the desired time of opening to traffic. The required minimum compressive strengths are 30 MPa for vehicles with pneumatic tyres, and 40 MPa for vehicles with solid tyres. The recommended minimum strengths should be achieved with a cement content not exceeding 500 kg/m^3. A water reducer may be used. Preferred stone size is 9,5 mm or approximately one quarter of patch thickness.

   Where circumstances do not permit a designed concrete mix, trial mix proportions in accordance with Table 1 may be used. These proportions will permit opening to traffic with pneumatic tyres after 3 days, and to traffic with solid tyres after 4 days, provided that the joints can be sawn and sealed within this time. Advice regarding sealant installation should be obtained from the supplier of the sealant proposed for use.

   Small poker vibrators (maximum diameter of 25 mm) should be used for compaction. The repair area should be slightly over-filled to compensate for compaction.

10. Finish the patch flush with the level of the surrounding slabs. The recommended finishing procedure is to screed from the centre of the patch out to the patch boundaries to promote good bond with vertical concrete faces.

11. Hand steel trowel to match the finish on the adjacent floor surfaces and carefully round off the edge of the repair area adjacent to the joint to 3 mm radius.

12. Cure immediately by covering the patch with polyethylene sheeting sealed at the edges and maintained in place until removal of the polystyrene filler.

13. Remove the polystyrene filler in the joint opposite the patch by sawing.

14. Reseal the joint using liquid or preformed joint sealant as appropriate in strict accordance with the recommendations of the manufacturer of the sealant.
    [Aspects to be observed include the need for clean and dry joint interfaces prior to sealing; priming of joint sides for certain liquid sealants; provision of the proper joint shape factor for liquid sealants; provision of a bond-breaking cord (consisting of closed-cell expanded polyethylene foam) and a bond breaker for liquid sealants, and the desirability of undersealing joints (usually 3 to 5 mm).]

15. When all work has been completed the floor should be swept clean.

Table 1: Details of concrete mix

	Quantities of materials			
	Using cement directly from bags	Approximate yeild[2] of concrete per 100 kg of cement	Per m^3 of concrete in place[3]	Per batch on small jobs only – materials in loose state[4] measured in a small container
Cement[1]	100 kg	200 litres	500 kg	1
Sand[5]	130 litres	200 litres	0,65 m^3	1,5
Stone(9,5 mm)	110 litres	200 litres	0,55 m^3	1,5
Water[6]		200 litres		

(1) Cement complying with SANS 50197-1; strength class 42,5 or higher. Where opening to traffic is not urgent, cements of other strength classes may be used. **Note:** *SANS 50197-1 specifies a number of properties and performance criteria. Composition and strength are required to be displayed by the manufacturer on the packaging of each cement produced. Bags contain 20, 25 or 50 kg of cement. Cement should be preferably be batched by the bag.*

(2) Mixers should be power-driven and have rated capacities exceeding the yield per batch.

(3) Allowance for waste should be made: say 5% on cement and 10% on aggregates.

(4) Materials measured by pouring into a container and struck off flush. The method lacks accuracy.

(5) Concrete sand. (Allowance made for 5% moisture.)

(6) The amount of water required is not given in the table. This concrete is designed to be compacted by vibration and/or heavy tamping and the amount of mixing water used should be only enough to achieve the required consistence. Too much mixing water will reduce the strength of the concrete.

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