

13 Maintenance

Floors provide an operational platform for storage and materials handling equipment and these operations will create wear and tear that must be addressed on an ongoing basis.

13.1 Introduction

Failure to maintain concrete floors and joints will ultimately lead to higher long-term costs and lower efficiency. A philosophy of planned inspection, maintenance and repair should be adopted as soon as the floor is constructed.

Even if the building is left empty, some maintenance will still be necessary; for example, joint movement due to natural concrete drying shrinkage can lead to joint sealant failure.

Issues such as joint deterioration, debonded or split joint sealant and impact damage should be treated under an adopted inspection and maintenance plan.

A defect is defined as a feature or matter causing an obvious serviceability or structural issue that directly prevents safe and efficient use of the floor. Normal wear and tear should not be confused with construction defects.

Examples of typical defects may be identified as loose sections of steel joint protection, shrinkage cracks, loose surface aggregate or aggregate pop-out, concrete contamination, surface delamination, cement/sand balling etc.

Most building contracts have a period of defects liability, typically 12 months, which commences at the point in time where a client effectively takes possession of the building from the main contractor. At the end of that period an inspection determines the defects to be made good and on satisfactory making good of those defects a certificate is issued to that effect.

The function of this period is to identify those defects that become apparent during initial use of the floor in order that they can be repaired, either during the period if the issue is one of concern, or at the end of the 12-month period. The period of defects liability is not a maintenance-free period for the building user.

13.2 Cleaning

Regular cleaning is essential to stop dirt and dust building up, as increased surface wear or susceptibility to slips can result if a floor is not clean and dry. Power-trowelled surfaces can normally be easily cleaned with a wet scrubber/dryer using neutral cleaning agents. Dry cleaning can scratch the surface sealer coat. A wet scrubber drier is preferred to lift fine dust. Larger debris (e.g. nails, wood shards from pallets, steel banding etc.) should be removed from the floor as soon as possible as significant damage can occur when jammed under wheels, especially at joints.

Where road vehicles enter the warehouse, additional cleaning measures may be necessary to remove dirt, water, salts, oil/fuel or other spillage.



Figure 13.1: Mechanical cleaning.

13.2.1 Cleaning frequency

Frequency will largely depend on the type of contamination and level of cleanliness required. For maximum effectiveness, cleaning should be carried out on a daily or weekly basis as part of standard housekeeping procedures.

13.2.2 Cleaning materials

There is a wide range of materials for the cleaning of floors: many are a complex blend of chemicals and some have specific application requirements. Most are formulated to be effective against a range of materials and some are very specific to the contamination they are designed to remove, e.g. bio products which are targeted against fats and oils. Similarly, some cleaning products may have an adverse reaction on the floor surface if used in the wrong concentration, giving rise to etching or wear. This may be a one-off effect or as a cumulative result of repeated activity. Trials should be undertaken on small areas away from sensitive areas prior to widespread use.

13.2.3 Spillages

Spillages of any liquid should be wiped up or absorbed and removed as quickly as possible. Not only is this important for health and safety (slip hazard) but it will also help minimise staining or chemical attack of the floor surface. Once the spillage is removed, the floor should be cleaned thoroughly.

13.2.4 Tyre marks

Non-marking tyres should be used on all materials handling equipment where possible to reduce excessive marking, especially at turning locations. Marking can also result from the wheel skidding and acceleration interaction with the surface floor sealer, often showing as clean patches of floor leading up to a darker marking. To remove these marks, the floor surface sealer has to be removed (usually by a specialist floor cleaning contractor) but only after it is deemed the floor has cured sufficiently and no detrimental effect will result from the removal.

13.3 Surface wear and damage

How the floor surface will wear is dependent on the type of materials handling equipment, cleanliness of the floor and traffic intensity. Most power-trowelled floors are finished with an acrylic curing and sealing agent that will provide some resistance to normal floor use. These agents are designed to gradually wear to reveal the concrete surface but in the case of heavily trafficked areas, they can be reapplied using a roller or spray (after the floor has been thoroughly cleaned).

Areas of impact damage (e.g. dropped goods) or scouring (e.g. dragged fork tines) should be treated to prevent further degradation under trafficking. Scraping of pallets or tines will damage the surface and, especially, the arris of any joints. Pushing of pallets and steel stillages should be avoided and pallets should be well maintained as protruding nails or timber shards can lead to significant surface damage. Under-chassis stabilisers on trucks should be adjusted to prevent dragging when manoeuvring.

If heavy goods (e.g. paper rolls or steel sections) are dropped on the floor, serious cracking may result, requiring a section of slab to be removed and reinstated.

13.4 Joints

Joints typically require most attention in any maintenance plan. The exposed edges of any joint in a concrete floor are prone to damage or wear and protective measures are needed to prevent serviceability issues. For day or formed joints, typically 10mm thick steel plate armouring is cast into the concrete during construction. For sawn-induced joints, sealant of varying hardness can be installed at any time. All joints are susceptible to wear from trafficking, especially by small, hard wheels and an unprotected joint arris will suffer significant damage if left unprotected and unmaintained.

13.4.1 Joint inspection

Joints should be regularly inspected for signs of wear, damage or split/debonded sealant. The ability of the sealant to protect the joint arris should be assessed. Deterioration in the sealant should be treated quickly before significant damage to the joint arris occurs. Any arris damage that has occurred should be quickly repaired as deterioration will accelerate once it has started. It may be necessary to replace joint sealant in more heavily trafficked areas, more frequently, e.g. defined-movement aisles or collation areas.

13.4.2 Joint sealant

Soon after the slab is constructed, a 'soft' elastomeric sealant is normally installed to the sawn-induced joints; this material permits a degree of movement or stretching as the joint opens but offers little protection to the joint itself. Once the sealant reaches the limit of its elasticity, it will split or debond and should be replaced under general maintenance.

Normally, the specification will require replacement of this initial 'soft' sealant with a 'hard' material that can provide significantly more protection but is susceptible to minor joint opening. Generally there is a

balance between ability to accommodate joint opening and hardness of the sealant, i.e. a tough 'hard' sealant will not accommodate significant joint opening but a 'soft' sealant can at the expense of arris protection. See Section 11.12. There are, however, sealants that can offer higher protection whilst having the same movement accommodation as softer materials (e.g. one-part high-modulus polymer sealants). Sealants for use in chemical exposure or cold store environments should be specific for their use and manufacturers should be consulted.

13.4.3 Joint deterioration

Slight ravelling or wear of the joint arris will occur under repeated trafficking and/or insufficient support from the mastic sealant (either because the sealant is too 'soft' or not in proper contact with the joint itself). Minor wear will not affect serviceability of the floor and joint but will need regular inspections and assessment of deterioration.

Sealant installation (or replacement) can fill in smaller areas of ravelling (e.g. max 10mm) but larger or more significant wear/damage should be repaired using an epoxy or resin material with a proven cut-back and fill method. The ability of a given joint to resist wear is also related to how wide the joint has opened and the relative size of the wheeled traffic it receives. The wider a joint opens and the smaller the wheels used on the floor, the greater propensity there is for joint damage. Small hard wheels, often found on collation trolleys or small pallet movers, can inflict significant damage despite being relatively lightly loaded.

13.5 Cracks

As with joints, any cracks that develop should be monitored and, where appropriate, repaired. Durability of a trafficked crack arris is subject to the same wear characteristic of a trafficked joint with the same relationship to opening and movement. With regard to serviceability, if a crack withstands trafficking without wear, it may be better to leave it untreated. Cracks should be monitored as part of the normal floor inspection and maintenance procedures.

It is important to remember that in the case of shrinkage (restraint) cracks, the crack opening can result in smaller openings at joints, simply transferring the maintenance attention accordingly. If the arris of a crack begins to spall or ravel, it should be treated to prevent further deterioration (in the same manner as discussed regarding joints).

However, the requirement to treat or repair a crack should be balanced against the dormant status of the crack, i.e. ideally the crack should not be subject to further opening after treatment as a hard, durable sealant/resin material will perform well under trafficking but will not accommodate future opening. Providing wear at the crack arris does not hamper floor use nor the opening of a crack lead to structural issues, it is advisable to leave treatment as late as possible (e.g. end of the period of defects liability for a new floor) as the treatment will remedy the arris damage and restore serviceability. Repeated treatment of the same crack whilst the floor continues to shrink can lead to a less effective repair in the long run. Where cracks are not dormant but some arris support is considered essential, semi-flexible sealants can be used.

Cracks may be separated into two classes (see Concrete Society Technical Report 22, *Non-structural cracks in concrete*^[72]) for the purpose of deciding on potential repair:

- Dormant cracks which are unlikely to open, close or extend further. The crack widths (minimum value throughout the crack depth) can be subdivided as follows:
 - fine cracks: <0.5mm wide (full aggregate interlock and load transfer)
 - medium cracks: 0.5–1.5mm wide (partial load transfer; approximately 15% at 1.5mm)
 - wide cracks: >1.5mm wide (limited or no load transfer).
- Live cracks which may be subject to further movement, due to changes in the temperature and/or moisture state of the concrete, loading etc.

13.6 Inspection and action schedule

The following are guidelines for when inspections and treatment should be carried out based on a typical warehouse with average usage (e.g. a wide aisle rack based warehouse with a marshalling area in front of loading docks, working a 12-hour shift, 6 days per week). The more intense the working of the warehouse floor, the shorter the intervals between actions.

Daily:

- Cleaning regime to remove dust, dirt and debris.
- Use floor scrubber or vacuum scrubber drier.

Every 3 months:

- General and visual inspection of trafficked areas.
- Repair any spalling or ravelling of joint edges and replace joint sealant (as required).

Every 12 months:

- Inspection and report including typical photographic evidence of the floor's condition.
- Replace sealant in floor joints or cracks if debonded or split due to movement (as required).

Every 5 years:

- Thoroughly clean the floor, remove tyre marking and surface sealer issues and reseal the surface.

13.7 Applied coatings

The application of resin or painted coatings will be subject to their own cleaning and maintenance recommendations; these should be provided by the manufacturer or installer of the coating. It may be necessary to reapply paint coatings periodically as they will wear under trafficking. Line markings will also wear under trafficking and should be regularly inspected and maintained. Some line marking involves shot blasting the surface in preparation and it is important to seal any exposed shot blasted areas to prevent accelerated wear of the concrete.

13.8 Textured surface

Acid etching or shot blasting at the surface of the floor can be used to increase slip resistance (e.g. near vehicle external doors or in wet environments); however, under vehicle trafficking, these textured surfaces will wear smooth and will require further attention to restore and maintain the desired level of roughness. With minor shot blasting designed to expose the fine aggregate and sand, there will be a limited number of times this process can be carried out before larger aggregate is exposed and the desired finish can no longer be provided. This will vary according to aggressiveness of the process, vehicle use and material performance of the base concrete.

It should be noted that cleaning of a floor with a textured surface will be more difficult than a smooth power-trowelled finish.

13.9 Repair

The repair of concrete structures is covered by EN 1504^[73]. The various parts of the Standard cover both the requirements for the repair materials and for the methods of application. Further guidance is given in Concrete Society Technical Report 69, *Repair of concrete structures with reference to BS EN 1504*^[74].

13.10 General tips and advice

To maintain the appearance and service life of the floor, the following basic tips are recommended.

Good practice:

- Clean regularly.
- Remove debris before it causes damage.
- Give higher frequency of maintenance and care to heavily trafficked areas.
- Clean up spillages immediately.
- Remove oil and grease immediately.
- Install spill and clean-up kits at regular locations.
- Ensure cleaning agents are suitable for concrete surfaces – trial areas before use.
- Follow instructions from manufacturers.
- Remember all floors need maintenance as soon as you start using them.

Bad practice:

- Using excess concentrations of cleaning agents.
- Mixing cleaning chemicals and agents.
- Ignoring initial and minor joint damage – get it treated to prevent bigger issues.
- Using aggressive brushes on cleaning equipment.
- Leaving brush heads in lowered position while machine is stationary.
- Feathering out or using thin layers of repair materials – cut vertical and reinstated with recommended layer thickness.
- Using acid or alkali cleaning agents – over time, damage will occur.