USER'S GUIDE AND PROPERTIES OF INDUSTRIAL CONCRETE FLOORS (V. 2.03) Industrial concrete floors (with and without sawed joints) hardened with dry-shake toppings or wet-on-wet surface hardeners

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THIS DOCUMENTS INCLUDES RULES AND GUIDELINES FOR USE AND MAINTENANCE OF INDUSTRIAL FLOORS, DO'S AND DONT'S IN CASE OF UNEXPECTED SITUATIONS AND WARRANTY CLAIM PROCEDURE

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PREAMBLE

This document is based on the current engineering knowledge, reports, publications, own experience and other documents relevant to the operational and functional issues, as well as construction technology of concrete floors. Concrete floor requires particular consideration as a most heavily used part of any civil structure, exposed to various adverse factors during operation. Being tough and resistant to various factors by their very nature, concrete floors are not eternal. Conversely: by accident or by negligence the floor may become damaged, even irrecoverably to a degree impairing or even preventing its use. Quite the opposite, appropriate use and regular maintenance can significantly extend the service life of the concrete floor. This document gives do's and dont's, as well as preventive maintenance and, as such, it becomes the Warranty Document to be included as part of proposals, contracts, specialty/ detailed drawings and specifications used to construct the industrial/concrete floors

GENERAL INFORMATION AND PERFORMANCE

Concrete floor loading schedule

a) Assuming min. ambient temperature of $+15^{\circ}$ C the following distributed loads can be applied on the floor (per 1m² of the floor surface) before achieving the 28 day compressive strength (the following values apply to Portland cement mortars and concrete):



For lower temperatures these times must be increased accordingly. If Portland slag cement is used (CEM III) concrete may achieve full strength after 56 days of curing. Point loads (from racks and trucks) must not be applied in the first 7-14 days of curing and after that time the maximum point loads must not exceed half of the values given above for distributed loads.

- For imposing erection loads on the floor earlier than 28 days from placement b) consult the floor designer. Any erection work to be performed within the floor area in the period of 28 days from placement must be done according to the flooring contractor instructions
- For optimum service and performance: C)

- do not exceed the service loads specified for the floor in the design;
- distribute the loads evenly, as far as practicable (both for loads placed directly on the floor and on the racks) and in particular avoid placing loads close to maximum allowable loading value on a part of the slab with the remaining portion remaining free of any load - this has particularly adverse effect on the floor performance and can lead to cracking;
- when mounting various items on the floor (e.g., machines, equipment, racks, bump rails, protectors, etc.) do not position their supports at or across joints (sawed joints and leave-in-place joint systems) linking two isolated slabs by anchor bolts, thus preventing freedom of vertical movement with adverse effect on the floor performance and development of cracks as a consequence.



Fig. 1. Adjacent slabs joined by bump rails - incorrect





Figs. 2 and 3 Movement of slabs not impaired - correct installation options

- do not use cleaning agents not designed for cleaning of floors and avoid spilling any solutions or liquids.

2 Concrete floor performance characteristics, including natural characteristics of the concrete and floor base

- Any vibratory (dynamic) compaction or pile driving operations must be discontinued during placement, curing and setting/maturing of concrete, both inside and outside the building to avoid damaging the fragile and sensitive to a)
- vibration concrete matrix (showing up as cracking of the concrete slabs). When low temperatures occur during placement of the floor and curing of concrete the Employer/ Client is required to ensure min. temperature of +5°C b) in the jobsite area and prevent freezing of the base, structural components and the floor. Space heating provided by the Employer/ client should not cause overheating and excessive loss of moisture (in particular do not direct the stream of hot air directly to the floor surface and avoid placing on the floor hot air blower hoses) or cause carbonation of concrete (exhaust gas must be removed to the outside of the building). Freezing, excessive loss of moisture and carbonation seriously affect the strength of concrete resulting in damage to the surface layer of the floor not covered by the contractor's warranty.
- C) Variation in colour and efflorescence - concrete floors are by their nature not uniform in colour particularly during curing stage when complex physical and

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chemical processes take place in concrete and due to some level of variation between concrete deliveries (including differences in aggregate, cement, uniformity of mixing) and such differences tend to disappear over time. Similarly, patches of efflorescence may occur as a natural consequence of using penetrating sealers which react with the surface layer of concrete showing up as paler fragments which also tend to disappear as a result of normal use and cleaning of the floor surface. The same applies to marks left by the sheeting which, in places, bonded to the surface during curing. Local



Fig. 4 Efflorescence on the concrete floor which emerged during curing before putting the floor in operation



Fig. 5 Marks left by sheeting used in moisture curing

d) Crazing - on the surfaces of industrial floors a network of fine surface cracks (resembling a spider's web) can appear on the surface of concrete or cement topping. It is a quite common phenomenon, variable in character and while there are no effective technical counter-measures it does not affect the performance or the mechanical properties of the floor, as confirmed by BEB (German) and TR34 (British) reports and as such it is not to be considered a flaw or defect. Crazing does not affect the slab construction. One should bear in mind that cleaning agents (even if inert to the floor surface) may increase the severity of the problem by penetrating into the cracks and widening them over time. Use of appropriate maintenance agents, accepted by the flooring contractor can minimise the risk of such deterioration. The severity of crazing depends on the in-service exposure factors, including rapid variations of indoor temperature and humidity of air and rapid heating up the space soon after floor installation up to the indoor air temperature specified in the design may aggravate this phenomenon, producing tight or even open cracks and curling at the slab edge. Hence it is strongly recommended to consult the flooring contractor before the first heating up the space after floor installation. Crazing can be more severe in spaces with higher specified temperature (especially in excess of 18 Deg. C) and with under floor heating system. Also heavily trafficked areas can make crazing more evident.





Fig. 5-6 Crazing ("spider's web" cracking) visible on the floor surface

- e) The gap opening of floor joints changes due to natural curing shrinkage of concrete. For this reason, the material used to seal shrinkage (sawed) joints, construction joints, expansion joints (made with leave-in-place forms, filled one year form placement and when the gap opening is the widest) can become detached from the joint sides or irregular on the surface due to loss of material which is considered normal and not covered by the warranty. This process is intensified by heavy operation and variation in external factors, for example moisture as a result of floor cleaning. Perimeter isolation joints (at walls, around columns, etc.) for which PE foam is specified as final treatment can also be sealed with an elastic sealant (priced separately). However, due to natural curing shrinkage of concrete, any loss of material or detaching of sealant from the perimeter joint sides is not covered by warranty. This is because such problems are not due to any design or construction faults.
 f) Development of tight and open cracks as well as some curing at various
- f) Development of tight and open cracks as well as some curling at various places throughout the surface is typical of large area structures such as concrete floor slabs, whether with or without joints. The areas most prone to such problems are located at: columns and joints, thresholds of pedestrian and large doors, floor pits and foundations as well as floors on mezzanines/ precast and cast-in-place separating at inductive circuits due to intrinsic shrinkage of concrete and various and unidentified stresses in the floor structure which cannot be controlled (according to BEB, Sec. 7, Cracking). Note that this type of cracking and curling does not affect the structural performance of the floor and does not indicate any design or construction defects (according to ACI report No. 302.1R-96 Guide for Concrete Floor and Slab Construction). Open cracks should be monitored and action should be taken only when deterioration of the floor surface has been noted at the crack (edge spalling). For aesthetic reasons inactive cracks (which do not change over time) may be repaired with an elastic joint sealant. Cracks which widen up or propagate which may be accompanied with spalling at edges should be repaired by routing the crack as expected associated with movement of the adjacent slabs the crack can be "stitched" with steel bars placed across the joint (inserted into pre-drilled holes and adhered with resinous adhesive) as an additional repair measure.
- g) Severe crazing and shrinkage cracks or even deformations are more likely to develop in floors exposed to dynamic thermal effects caused for example by rapid changes of ambient temperature, exposure to high and low temperatures (for example near boilers and air heaters), working with open flame and cooling of coldroom and deep freeze spaces and in such cases these defects are not covered by the warranty.
 h) Note that around piers, at docks, floor trenches and foundations the floor is
- h) Note that around piers, at docks, floor trenches and foundations the floor is particularly prone to cracking and other damage due to vibrations and movements of the structure, even with additional reinforcement in place, and such problems should be reasonably expected by the floor user. These problems are not due to any design or construction faults.



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Fig. 7 Crack running out from the corner of column

- i) Faulting of slabs in floors with joints faulting may develop at joints during service life (especially on routes highly trafficked by forklift trucks and other vehicles). This is caused by development of air pockets between the floor slab and the sub-base primarily due to dynamic action of forklift trucks and other vehicles and subsidence of the base and soil under the floor. Hence, it is important that the base has uniform parameters throughout the floor area and is not subject to excessive strain or subsidence or post-compaction of the floor base will cause damage to the floor including joint edge spalling and development of cracks. Defects of this type can be repaired by injecting cement grout in the pockets under the floor slab (priced separately as the flooring contractor is not responsible for the quality of base and soil-subbase under the floor).
- j) The hardened surface of the floor is subject to normal wear as a wearing surface with durability appropriate to the duty. The surface of traffic routes, warehouse aisles, near pedestrian and large doors and loading docks and other such areas can be wearing faster. As a result, more steel fibres can appear on the surface in these areas (see Sec. 3c) accompanied with increased crazing (see Sec. 2d). Operation of the floor can also make the joint sealant look unsightly.
- k) Concrete floors and cement toppings are not resistant to most chemicals. Chemicals that can be considered aggressive include, without limitation: organic solvents, alkaline and acidic compounds, acids and bases, salts and their solutions, chlorides, sulphides and their derivatives, alcohols and glycols, gases: elementary chlorine, sulphur dioxide, carbon dioxide and oxide, hydrogen sulphide, hydrogen fluoride, as well as oils, fats, sugar, vinegar and other food products. Spilled chemicals and other aggressive substances even if immediately neutralised and removed from the floor surface can cause discolouration, stains and in the worst case even pitting and widening of fine cracks.
- In the case of floors with special parameters such as antielectrostatic, frostresistant and other properties, the floor contractor is responsible for these parameters only within the limits and under the responsibility of the manufacturer of the material used / builded into the floor.

3 Blemishes which may appear after trowelling of concrete floors

- a) The areas at columns, walls, leave-in-place forms, docks, trenches or foundations are difficult to access by power trowels and have to be finished by hand, resulting in lesser smoothness and flatness and different hue of the surface as compared to mechanically trowelled areas of the floor
- surface as compared to mechanically trowelled areas of the floor.
 b) Fine grains of topping can be plucked out from the surface during trowelling, which in the finished floor can show up as pitting. Repairing such small cavities is not recommended as they will not impair normal use of the floor. Moreover, plucked out aggregate can get under the trowel blades and produce circular scratches during final trowelling, remaining on the finished surface. Blade marks can also appear on the surface. Trowel pattern does not affect the floor performance and are not considered a cirtical quality or functional defect.
- c) Another specific surface variation caused by trowelling are so-called blotches. The cause of blotches is variation in the setting time between adjacent portions of the slab. The effect of blotches is limited to colour variation and they do not affect the performance and functional parameters of the floor and, as such, they to not require any remedial action.

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Fig. 8.1 Discolouration - blotch on the floor surface

Fig. 8.2 marks on the floor from the trowel blades.

In places steel fibre can appear on the concrete surface which is normal for fibre reinforced floor slabs. The number of fibres visible on the surface can increase to a different degree due to normal wear and this should not be considered a design or construction fault. Moreover, moisture can cause corrosion of such fibres producing rusty stains on the surface.

Fig. 9 Blemish caused by steel fibres appearing on the floor surface

- e) Locally fibres can be plucked out from the surface during cutting of joints producing small holes which should remain without repair due to superficial nature of this blemish.
- f) Surface delamination can occur sporadically in which thin (ca. 2 mm thick) flakes of topping become detached from the floor surface. The mechanism of surface delamination has not been fully understood and probably there are a few factors behind it, such as non-uniform setting of the concrete. Low viscosity epoxy resin is injected at the interface to re-attach the piece to base as a primary repair method. Should this treatment turn to be ineffective a fragment of floor is cut out around the spall and filled with cement or resinous mortar.

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Fig. 10 Repair of surface delamination with resin injection grout

Fig. 11 Repair of surface delamination by local replacement of the surface

4 **Final Remarks**

- The blemishes discussed in this section are intrinsic to concrete and slab a) structures having a relatively small cross-section in relation to the surface area and are acceptable in current engineering and construction practice and, as such, they are not covered by the warranty and removing them, if recommended and practicable, will be priced separately;
- Definitions: b)
 - Jointless slab is a floor slab divided into panels corresponding to pour areas with leave-in-place forms (such as EPD) in which the panels are free of sawcut joints

- Jointed floor - floor slab in which panels corresponding to pour areas, separated with expansion joint profiles (such as EPD) are additionally subdivided with saw-cut joints

OPERATION AND MAINTENANCE GUIDELINES

General operation guidelines 5

- a) All machinery and equipment must be operated in accordance with the relevant user guidelines. Floor mats should be provided at pedestrian and larege access doors,
- b) appropriate for the application to limit the amount of sand and dirt brought to the floor area.
- Skidding of tires must be eliminated by prohibiting rapid acceleration, braking C)
- and turning with loss of grip of vehicle or truck tyres. Speed limits should be imposed for trucks: 3 km/h in areas of limited visibility and used by pedestrians and 6 km/h elsewhere. d)
- Loads should be moved above the floor surface, lifted and deposited exactly e) at pre-defined locations. Do not drag any loads on the floors! Truck batteries must be charged at designated charging points. Spilled
- f) electrolyte must be immediately neutralized and removed from the floor surface
- Localised damage may occur during normal use of the floor, caused, for g) example by falling objects or insufficient protection of the surface during various production processes or as a result of laying circuits and wires of inductive wire guidance system (typically wires are laid in chases cut in the floor surface). Filling of the floor cuts mostly and especially for the purpose of making induction wires, should be supplemented with hard masses, the recommendation does not refer to expansion joints and those which, according to the individual assessment of the floor contractor, these one should be filled with flexible masses. The most common types of mechanical damage include spalling and chipping of joint edges (caused by shrinkage of concrete), damage caused by welding, cutting with angle grinders and other equipment, impact of tools and materials, scratching and damaging the surface at joint edges by movement of trucks with hard tyres, hitting by or surface at joint edges by intovenient of tracks with hard tytes, finding by or pallets, foreign matter, etc. It is particularly important to protect dummy joints (sawed shrinkage control joints) and construction ("daily") from edge spalling and loss of joint sealant due to dragging or pushing pallets or other materials on the surface, lack of leave-in-place forms at construction joints. result in spalling of joint edges and loss of joint filler. Besides, nails often protrude under pallets causing imminent scratching and damage to the floor surface. Any remedial works depend on the size of damage and practicability of repair.

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Mechanical damage due to improper operation and/or lack of construction joint forms is not covered by the warranty and their repairs will be priced separately

Fig. 12 Example of mechanical damage - scratches caused, for example by dragging pallets on the surface.

- During service any oil and grease spillage should be immediately removed from the surface since smooth finished surface can easily become slippery h) with resulting in slip falls or accidents (the surface has no longer any anti-slip properties). Moreover, oil and grease can penetrate inside the floor leaving stubborn stains.
- Dripping or trickling water or other liquid can erode concrete matrix. Painted signs and lines may be applied on the surface of industrial floor. However, before painting make sure that the compound will not cause any j) damage to the floor. Manufacturers of floor sealers and hardeners recommend use of synthetic resin based paints applied in the specified number of coats on prepared floor surface. Preparation should include cleaning (degreasing), dulling by light grinding and priming. Before painting consult the manufacturer of lining materials.
- Surfacing layers of epoxy, acrylic or polyurethane resins can be applied on k) hardened floor surface subject to appropriate preparation of substrate. Before each application consult the surfacing system supplier. As a recommendation, adhesion test should be carried out on a small surface before application of a new surfacing layer. Space cooling of deep freeze stores can start no sooner than the concrete
- I) and topping have reached the 28-day strength. Industrial floor must be dried up and free of moisture (4% max. moisture content) and during service must not be flooded with water or other liquids. Cyclic freezing and thawing is not allowed. It is recommended to lower the temperature by 3°C-5°C daily to the required working temperature of the freeze store. Sudden temperature changes can cause damage to the floor as described in 2g above.

PERIODIC INSPECTIONS

Periodic inspections in the warranty period

In the warranty period the user shall allow the flooring contractor to carry out inspections at any time and without any restrictions. The inspection findings are recorded, including maintenance or repair recommendations if appropriate.

DAY-TO-DAY CLEANING

Day-to-day cleaning and maintenance of concrete floors

The main recommendations are given in the Quick Guide to Floor Maintenance – Day-to-day Cleaning which is Appendix 1 to this document. a)

- Industrial floors in production, storage and retail areas are the most exposed b) to wearing component of the building and, for this reason, it is critical to observe the basic principles of operation. The durability of the floor can be affected by (the list is not exhaustive):
 - irregular cleaning and untrained cleaning personnel,
 - sand at entrances accompanied with lack of doormats to trap sand and moisture from shoes and litter remaining for longer time on the floor surface including broken glass, wood, metal elements, nails (for example detached from pallets), etc
 - oil, grease, liquid foods, chemicals spilled on the floor surface,
 - ineffective sweeping before wet cleaning (grains of sand may come under the machine and scratch the surface),
 - use of inappropriate chemicals, causing dissolving and weakening of the
 - floor protective coating and lowering pH, use of harsh degreasing and highly acidic products,
 - use of brushes instead of pads, use of too hard pads
 - winter maintenance agents brought on the floor on wheels and soles from roads and other paved areas outside the building.
 - harsh driving of vehicles, including trucks, resulting in scuff marks which can be removed only with special chemicals damaging the surface sealing layer which has to be replaced after such cleaning.

Surface hardening and sealing makes industrial concrete floor highly resistant to abrasion. Regular cleaning and maintenance schedule should be implemented as a condition to use the warranty and enjoy problem-free use of the floor. Maintenance activities should be frequent to increase floor durability.

The following guidelines should be followed to ensure the desired performance a) of the floor during service:

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- Chemicals, both liquid and powdery, including both organic and mineral acids, even at low concentrations, salts and their solutions, fats, solvents, alcohols, greases, oils, sugar, vinegar, etc. must be immediately removed from the surface and neutralized if appropriate,
- Keep off any substances causing damage and corrosion to concrete and corrosion of steel fibres,
- After each use or spillage of the above-mentioned chemicals the surface must be washed with clean warm water,
- Note that stains, discolouration and other damage that may appear on the surface anyway are not covered by the warranty,
- Floor mats should be provided at each pedestrian or vehicle access and the floor should be regularly cleaned and swept to remove foreign matter including oil, aggressive chemicals, grains of sand and other aggregates which may abrade the surface,
- hard brushes or pads must not be used in cleaning machines which could scratch the surface (soft or medium-hard pads should be used, depending on the degree of soiling),
- Day-to-day cleaning is best carried out with sweepers and washing equipment. After wet cleaning the floor should be left to dry up completely. Solutions of mild detergents specifically designed for maintenance of
- concrete industrial floors should be used for cleaning.
- dry-shake topping considerably increases the parameters of the surface and decreases moisture absorption extending the service life of the floor. However, note that dry-shake toppings similarly to concrete are cementbound materials which are not resistant to various chemicals.
- Thus concrete floors, sealed and hardened with dry-shake toppings cannot be called chemical resistant. The rule of thumb is to avoid cleaning agents that may contain substances causing deterioration and/or corrosion of the cement matrix and reinforcing steel.
- This excludes organic solvents (such as acetone, toluene, xylol, trichloroethylene, etc.). Cleaning agents shall not contain strong alkalis and organic solvents, even in low concentrations. Acidic cleaning agents, including any acids must not be used for cleaning the floor, even when diluted. Moreover, the floor may be affected with salts and salt solutions, chlorides, sulphates and their derivatives. Alcohols and glycols must not be used as they may also cause damage to the floor surface by weakening cement structure. The floor structure may be affected also by gaseous substances, such as elementary chlorine, sulphur dioxide, carbon dioxide and oxide, hydrogen sulphide, hydrogen fluoride, as well as oils and fats. Spilled chemicals and other aggressive substances even if immediately neutralised and removed from the floor surface can cause discolouration, stains and in the worst case even pitting in hardened floor surface and widening of fine cracks. Impregnating sealer must be applied in the area which came in contact with aggressive agents. Even though surface hardening and sealing will make industrial concrete floors resistant to chalking, domestic and atmospheric dust and dirt will still accumulate on the surface
- For maintenance of hardened floors, similarly to all other cement-based products appropriate washing and cleaning agents must be used, i.e. the . concentrate (base) of the chemical must be neutral or slightly alkaline with 7 \leq pH \leq 10. Floor cleaning agents should also protect the floor (lowering absorption, prevent lowering of pH, etc.). The technical brochure must be read before application as not all floor cleaning agents are suitable for concrete floors
- Maintenance of hardened concrete floor should, as a recommendation, include: b)
- wet cleaning and maintenance of the surface with a day-to-day cleaning agent, which helps to maintain good condition of the floor surface by forming a protective film, which will be removed together with dirt in the next cleaning;
- thorough cleaning of the floor when heavily stained. After thorough cleaning the surface should be protected by application of special penetrating sealer (the application rate must be sufficient for saturation of the surface) to re-seal the superficial layer of the floor. This will restore the desirable properties that have been affected by thorough cleaning: reduce absorption of water and oil and facilitate cleaning.

Note that the main purpose of the sealant applied right after trowelling is to maintain moisture at a level required for hydration of cement and the film formed by this agent will gradually wear out during operation. Hence, it is necessary to follow the guidelines of the "Caring for Concrete Floors" section below in order to ensure durability and sealing and to minimise weakening of the superficial layer.

CARING FOR CONCRETE FLOORS

Caring for concrete floors includes application of penetrating and/ or finishing compounds designed for use on such floors. The treatments should be carried out by trained specialists and in the warranty period by the flooring contractor (priced separately) or by a company recommended by the flooring contractor. In exceptional cases, subject to Contractor's agreement the floor user can, in order to select appropriate cleaning and care agents, as well as cleaning method consult a specialist floor cleaning company or surface hardening manufacturer. However, the outcome of such consultation must be approved by the Contractor before proceeding. Unskilled contractors or inappropriate agents can not only compromise the desired effect

but can even cause permanent disturbance of the surface layer. In order to avoid that any such treatment in the warranty period must be consulted with the flooring contractor. Silicate based agents are recommended and other agents, such as synthetic resins or hard wax can be used only if accepted by the Contractor. Selection of floor care agent(s) must be based on consultation with the manufacturer (taking into account the type of initially used sealer) and in consultation with the Contractor. The floor user is obliged to keep records of used agents and cleaning machines. The frequency of application of floor care agents should depend on the intensity of use and should be higher in more heavily used areas. The main purposes of floor care carried out by the User is to keep the premises and floor clean and protect the floor from early wear or even damage during normal operation. Regular maintenance will improve durability of flooring by increasing the resistance of the cement matrix to erosion and protecting it from the action of cleaning agents and any substances that may appear on the floor. Warranty

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does not cover defects or blemishes due to lack of day-to-day and regular care resulting in excessive wear, susceptibility to staining, chalking and any other defects.

WARRANTY CLAIM AND REPAIR PROCEDURES

Warranty terms and conditions

In the warranty period given in the Contract/ task order the Contractor shall rectify any defects or flaws under the Contractor's liability (including construction defects, material flaws, etc.). This section defines the warranty procedure to be followed upon discovering any flaws and/or defects.

- For defects which cannot be rectified the Contractor will reduce the price in a) proportion to the defect or additional services, if appropriate.
- A Defect/ Flaw is considered a Material Flaw/ Defect if it prevents or impairs normal operation of the floor in accordance with the design and intended b) function/operation. Any defects caused by misuse, failure to follow these instructions, exceeding the design parameters and any other defects not attributed to the Contractor's fault are not considered material defects.
- In order to keep the warranty rights the User shall on the basis of this C) document and without any further request submit to the flooring contractor daily, weekly, monthly and yearly floor maintenance program specifying: cleaning technique, cleaning agents and their concentrations, duration of action on the floor, type of cleaning equipment, temperature of water. Thorough treatment should be carried out at least once year, twice a year
- d) being the recommended frequency. Irregular cleaning, unskilled personnel, ineffective sweeping before washing (grains of sand may come under the pad or brushes and scratch the surface), as well as use of inadequate cleaners may significantly increase wearing and deterioration of the floor.
- Without the floor maintenance program the flooring contactor will not be able to verify whether it has been used in a correct manner and as such the e) contractor will not honour any warranty claims concerning the floor condition and properties. Damage due to causes described in this section are not covered by the warranty and any repairs will be priced separately.
- f) Moreover the warranty does not include damage caused by accidental loads and situations including: exceeding the maximum service loads given in the design, rapid changes of the slab temperature (heating or cooling, over-drying or freezing), impact loads (dragging heavy loads on the floor surface or dropping of weights), defects due to inadequate preparation of floor base and soil subgrade (excessive deflections and subsidence of base), mine-induced subsidence of soil, action of aggressive chemicals, accidental situations including fire, interfering with the floor structure by: cutting fragments of the floor slab, for example to install foundations, joining the slab with other structural elements, etc.

Warranty and repair procedures

- a) In order for the warranty claim to be honoured the User shall notify the flooring contractor of the discovered defect/flaw within 14 days from the date of its occurrence.
- b) The warranty claim notice, including description of the defect and its location should be forwarded to the following address via registered mail (with the receipt sent to sender): PAL-GAZ Palacz Sp. z o.o., Sp. k. Przyłęk 25A, 64-300 Nowy Tomyśl. Notices sent by electronic mail serwis@palgaz.com.pl will also be accepted subject to the following conditions:
 - the message must be sent in business days (Mon-Fri) between 8:00-15:00 hrs.
 - the Contractor confirmed the receipt of the message.
 - notices sent on Saturday, Sunday, public holidays or closed days (for example working days between public holiday and weekend in which the Contractor's office can be closed) will be accepted with the date of .
- receipt on the first working day after the closed days. The flooring Contractor shall, as soon as, possible confirm validity of the claim specifying the method or repair or agree with the User inspection of the C) floor and verification of the notified defect.
- The repairs will be carried out according to the repair technique proposed by the Contractor at the times and within the extent agreed with the User. The cost of visits unsuccessful due to the User's fault (for example lack of access d) to the area of defect, undue notice, defect beyond the Contractor's liability, etc.) will be covered by User.
- At repair locations we cleaning should be stopped at least 3 days in advance because dry substrate is critical to the effect and durability of the repair to be e) performed. The job site should be made available to the Contractor at times agreed with the user and the area should be isolated and excluded from operation. The user shall provide free access to water and electricity at the job site location. After repair the slab should be left to rest as required for the treatment used (to allow curing of repair materials). Note that the areas of repair will remain distinguishable on the surface.
- The Contractor's warranty for repair becomes invalid if: the User failed to f) comply with the above-described requirements, the method of repair was modified according to the User's requests and material requirements, the materials supplied for repair by User were defective.

10 Standard method of repair:

a) Tight and open cracks should be monitored and action should be taken only when deterioration of the floor surface has been noted at the crack (edge spalling along the crack). Otherwise no action is required (in particular for cracks of less than 0.5 mm opening). For aesthetic reasons inactive cracks (which do not change over time) may be repaired with an elastic joint sealant. Cracks which widen up or propagate which may be accompanied with spalling at edges should be repaired by routing the crack and then filling the widened cut and holes with a resinous patch. If movement of the crack is expected associated with movement of the adjacent slabs the crack can be "stitched" with steel bars placed across the joint (inserted into pre-drilled holes and adhered with resinous adhesive) as an additional repair measure.

PALGAZ

USER'S GUIDE AND PROPERTIES OF INDUSTRIAL CONCRETE FLOORS (V. 2.03) Industrial concrete floors (with and without sawed joints) hardened with dry-shake toppings or wet-on-wet surface hardeners

Fig. 13 Example of crack repair without bevelling of edges with joint sealant

Fig. 14 Example of crack repair with bevelling of edges and filling with resinous patch

Holes (for example caused by plucked out fibres) and spalls (for example at joint edges) are repaired generally with cement or resin based patching b) compounds

Fig. 15 Example of filling a hole created by a plucked out fibre using resinous patch

Faulting of slabs due subsidence or post-compaction of the floor base or natural curling of the slabs will cause damage to the floor including joint edge spalling and development of cracks. Defects of this type can be repaired, if C) practicable, by injecting cement grout in the pockets under the floor slab. The

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cracks and holes are sealed when the slabs have stabilised using the above-specified methods followed by re-sealing the joint. Surface delamination should be repaired by injecting viscosity epoxy resin is injected at the interface to re-attach the piece to base as a primary repair method (the operation may be repeated as many times as required to fill the d) pocket eliminating hollow sounds). Should this treatment turn to be ineffective a fragment of floor is cut out at the hollow sound location and reinstated with cement or resinous mortar.

Any departures from the requirements of this document must be set out in the Contract. Revisions and up-dates to this document can be done in writing.

<u>Attachment No. 1</u> <u>Quick Guide to Floor Maintenance (v 1.01)</u> Day-to-day cleaning

This document is an integral part of the Floor User's Manual which should be referred to for more information on floor operation requirements

Floor cleaning guidelines:				
1		Each time before wet cleaning remove the dust and sweep the area to remove any loose material which could scratch the surface during cleaning such as sand, glass, particles detached from pallets, nails, etc. The vehicle and pedestrian access areas are most prone to accumulation of dirt and from there dirt and sand quickly spreads further and further into the floor area.		
2	pH 8-6 7-9 10-14	Make sure that the composition of detergents is appropriate to this type of surface (substances which must not or should not be used are listed in the Floor User's Manual). The product description should clearly state that it is designated for day-to-day cleaning of concrete surfaces. Harsh substances can cause damage, even irrecoverable to the floor surface. The cleaner harshness is generally defined by the description on the container, classifying it as regular or heavy duty cleaner or stripper. Standard concrete floor care products are diluted in water to 0.5-2% concentration of pH of 7-9.		
3		Check the scrub cleaning material. For day-to-day cleaning soft pads are recommended (generally in red colour) as harder pads can cause excessive abrasion. Brushes, even soft, are not recommended for scrub cleaning as they can scratch the surface.		
4		Cleaning should be done with cleaning machines which collect water thus removing dirt from the surface. This is different from standard mops which rather than picking dirt together with detergent solution smear it on the surface and the surface can be slippery until drying up.		
5		If the surface during and after wet cleaning exhibits (even locally) the following characteristics: - becomes prone to soiling/ absorption of dirt, - quickly absorbs any water spilled on the surface, it must not be cleaned with standard and accepted methods. The problem must be reported to supervisor/ warehouse manager. Such behaviour indicates that abrasion has started on the surface and it has lost its finish which must be renewed.		

The following situations must be avoided:

	Spillage of liquids and preparations:
	• most liquids when spilled on the floor surface are both harmful the floor and create a personal safety hazard. Therefore, any spillages must be immediately removed.
	• the following liquids can permanently soil or damage the surface: battery electrolyte (from truck batteries for example), edible liquids (popular energy drinks and carbonated drinks which are generally acidic), coffee, oil and grease, alcohols and salts - for example winter maintenance agents Litter and other solid particles:
()	 small particles lying on the floor can abrade the surface under the effect of pedestrian and vehicle traffic. The moist heavily soiled areas at large and pedestrian doors should be regularly swept and kept clean at all times to minimise spreading the dirt on the floor. Accidental as well as intentional damaging of the floor surface:
	• concrete floors are not indestructible and can be quite easily damaged: The most common types of damage include:
	 scratching by forks and dragging or carrying loads without lifting to sufficient height above the floor surface,
	 damage and spalls created by falling goods and materials.