

Technical and Economical Efficiency of the Concrete Floor Surface Treatment by Polishing

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Abstract: In this article, concrete floor overlays and protective coverings have been evaluated, the current situation and future provisions in this field have been analysed, and the technical and economical efficiency of concrete floor polishing have been assessed. Properties of concrete floor surface have been overviewed in this paper, as well as their suitability for the Latvian conditions. The purpose of the research is to find out physical properties of polished concrete floors, as well as weariness, efficiency, building costs, lifetime, visual attractiveness, maintenance costs, surface overlaying methods and usage of protective coverings, depending on the floor usage specifics.

Keywords: floor, concrete, overlaying, polishing.

INTRODUCTION

Nowadays there are many options for choosing floor coverings: marble, granite, stone tiles, concrete floors with epoxy, polyurethane, acrylic coverings, vinyl floor coverings etc. All above mentioned floor materials possess their own advantages and disadvantages.

At present, all kinds of building materials and flooring technologies with different characteristics are available at the Latvian market of building materials. Concrete polishing is a rather new idea which came out of traditional stone polishing technologies. Today a lot of manufacturers offer chemical products, which improve the look of polished concrete and its technical parameters. In order to achieve the set aim, the following tasks have been defined: to explore the physical characteristics, wearlife, effectiveness, installation costs, servicing time, visual attractiveness, maintenance costs, as well as what types of flooring and protective overlays are used, depending on the floor usage specifics; to define and compare the most popular types and materials of concrete floor overlays, as well as flooring technologies of concrete floors. Modern technologies allow improving the floor materials and optimize the work process.

The floor choice is defined by its physical and mechanical characteristics. These must withstand the effect of various external forces. The floors are affected by both mechanical and mixed mechanical loads caused by slipping lift foundation big crowds of people, as well as chemical loads which can be found in food manufacturing, where there are organic acids falling down on the floors or thermic effects caused by hot water and steam. These and other factors create the main load, which the floor type and its installation methods are defined.

Surfacing of concrete floor and types of overlays

Overlays of concrete floors provide a maximum protection and durability by minimum expenses.

Hermetization provides a protection of concrete floor. To protect concrete floors (hermetization) different types of overlays are used [8].

To protect concrete from aggressive environment and to make it look attractive, you can choose covering materials made from strong composite materials, without any solvents, up to the thermally strong epoxy, acrylic and polyurethane combinations of different colours. Such floor overlay is a good solution for all kinds of warehouses, manufacturing buildings, offices, apartments and exhibitions.

It is necessary to prepare the surface very well before putting the polymeric upper layer. The upper layer can be sensitive to different conditions during its installation.

The most popular types of overlays are as follows: epoxy (made from epoxy resin), acrylic and polyurethane (polyurethane basis).

The advantages of concrete floor surfaces are: surface resistance to mechanical weariness is enhanced, resistance to the influence of chemical substances is enhanced, it is easier to clean the floor, the dust does not come into concrete, floors look nicely, they are safe and colourful.

Thickness of the overlaid floor is from 1 to 15 mm.

When choosing and using the types of overlays (acrylic, epoxy and polyurethane) correctly and properly, the floor's durability of 10 to 20, or even more years, can be achieved. It is important to install the concrete foundation technically correctly and to fulfil all technical requirements at each step, when laying the floors.

Accelerated tests have proved that the overlaid floors can serve as:

- “Weak weariness” group – up to 140 years;
- “Average weariness” group – up to 80 years;
- “Strong weariness” group – up to 50 years [4].

When using all types of floor overlays, there is a question of rapid and qualitative automatic cleaning of the rooms. When choosing the floor surface the overlaid floors can be a very good solution because of there is no smoothness and seams (except polymer surface constructions with roughness). Polymer surfaces due to its high chemical resistance in the case of specific soiling can be cleaned by solvents and active washing means. The covering fully conforms to the hygienic requirements.

An important property of overlaid floors is its fire resistance. Epoxy and polyurethane floors are widely used in highly explosive areas. In case of a fire, polymer floor

overlays help to prevent a big fire and spreading of poisonous substances.

Conditions of concrete flooring:

1. Concrete's pressure strength should be at least 25 MPa;
2. A new concrete floor should be kept for 28 days (if there is a ground colour used for a wet floor, the floor should be cured for 2 days);
3. A humidity level of concrete floor should be less than 97% from relative humidity or 4% from mass;
4. The floor temperature and air temperature should be more than +10°C, relative air humidity less than 80%.

Flooring technologies (polymer overlays)

In order to use the organic flooring, it is necessary to consider the following features:

First of all, the concrete should be dry; its humidity should not exceed the 4-5% limit. If there is a special concrete used, the flooring can be made onto a wet concrete.

Secondly, the polished concrete must be milled, cleaned from pumpcrete to create pores, so that the concrete could start hardening. By using special devices with a small shot jet (appr. 0.5 mm in diameter), the concrete's upper layer becomes rough and clean. Concrete grinding machines with rough abrasives can be used to smooth out the surface, if this cannot

be achieved by a small shot. While priming, it is necessary to put some prime coating on the surface. Otherwise, pores can appear and the material will not be hardening. Before starting this work, please make sure that the surface is fully ready for the flooring, and only then you can put on an optimal flooring material.

Various epoxy materials, as well as polyurethane and acrylic are often used as organic overlays. Each of these materials has its advantages and disadvantages.

Choosing an optimal technology of concrete floor surfaces, main differences of overlays

One of the positive characteristics of polished concrete floors is that they are considered to be ecologically safe comparing to some standard floors, for instance, wood materials, carpets, ceramic tiles, etc.

Table 1 provides the comparison of the polished concrete floor to different alternative floors (industrial floors) [7]. The polished concrete has a lot of advantages, which other floor materials do not possess, especially when mentioning its durability, performance and sustainability.

Table 2 provides the comparison of the polished concrete floor to different alternative floors (in offices, apartments) [7].

TABLE 1
Comparison of Polished Concrete Floors to Other Floor Materials (Industrial Floors)

	Epoxy coating	Acrylic coating	Polyurethane coating	Polished concrete floor
Wide design options	Yes	Yes	Yes	Unlimited design options
Lifetime and efficiency	Good	Poor	Good	Excellent
Usage	High weariness	High water resistance and standards of hygiene	A good weariness provides a good connection with the walls, sewerage etc.	High weariness. Resistant to oils, sparks
Disadvantages	High cost (price)	Fast installation (15 min), acid smell when drying, low weariness	High price. Low temperature is necessary for hardening	No
Easy maintenance	Very good	Very good	Very good	Excellent
Shining and saved warmth	Yes	No	No	Yes
Not protected against humidity	No	No	No	No
Mustiness and allergens are characteristic	No	No	No	No
Sustainable floor alternative	Yes	No	Yes	Yes
Costs 1m ² (price, LVL)[14]	12-15	8-12	9-40	8-15 LVL/m ² With 3000 grind abrasive
Lifecycle costs	High	High	Medium	Very low

TABLE 2
Comparison of Polished Concrete Floors to Other Floor Materials (in Offices, Apartments)

	Carpet (soft floor surfaces)	Tiles	Linoleum or vinyl	Wood or laminate	Natural stone (granite, marble)	Polished concrete floor
Wide choice of design	Yes	Yes	Yes	Yes	No	Unlimited design options
Longevity and effectiveness	Poor	Good	Good	Good	Excellent	Excellent
Easy maintenance	Poor (it is necessary to clean the dust too often)	Good	Good (irregular waxation is needed)	Good	Good	Excellent
Reflect warmth and save sun energy	No	No	No	No	Yes, depending on the material	Yes
Not protected from humidity and its damages	Yes	No	Yes	Yes	No	No
Mustiness and allergens can appear	Yes	No	No	Yes (mustiness, if the floor is wet)	No	No
Sustainable floor alternative	No	Yes	Maybe (if linoleum or natural materials is used)	Maybe (if made of polished wood)	Yes	Yes
Average costs per 1m ² , LVL	8-20	15-25	12-25	8-30	30-70+	8-15 (With 3000 grind abrasive)
Costs of one usage cycle	High	Low	Medium	High	Very low	Very low

DESCRIPTION OF POLISHED CONCRETE FLOOR

The polished concrete is a shining concrete floor, mechanically polished by special devices, with the removed upper layer. It is polished and waxed by powerful grinders, discovering an existent denser basic layer below and showing up the concrete beauty. It possesses an excellent feature of light reflecting, making the room lighter. Depending on the concrete component parts and colour components, it is possible to get various colourings and patterned surfaces [1].

Depending on the physical and external characteristics of polished concrete, it is close to natural stone. When polished, the created floor becomes as shining and smooth, as a glass surface. To have a very shining concrete, a very thin abrasive, which corresponds to the 3000 glass-paper or is even thinner, is used at the final stage of polishing. The surface can be covered by special liquids to make it clean and shining.

The polished concrete has a lot of advantages, comparing to other coverings. Even though the surface is polished very well and is shining, anyway it will provide a better sliding resistance than many other concrete coverings. If the surface is well maintained and is regularly kept cleaned by using the appropriate methods and cleaners, its sliding resistance will be kept forever [2].

The main differences and benefits of the polished concrete, comparing to other coverings, [5] are:

We have a tough and wearproof floor:

1. high durability;
2. high resistance to scrapes and scratches;
3. high resistance to chemicals' effect;
4. long service time.

Safe to environment [6]:

1. concrete is a natural product;
2. it does not contain chemicals or solvents that evaporate in the air;
3. it does not make dust which can cause different illnesses;
4. it does not contain substances which can cause some allergies.

Concrete can "breathe":

Concrete does not have any coating that could prevent the water evaporation through its sub layers.

It is unreceptive to various bacterium.

It is achieved by a high PH level in concrete, so that it can be used as floor surface in places with high hygienic requirements: hospitals, schools and food making enterprises.

Aesthetics:

It has a nice visual view when it is polished like a shining glass. Concrete can be toned by adding to it the stones of definite colour or colour pigments. It is also possible to make colour tones by using special staining solutions while polishing the surface. After laying them onto the concrete surface, they are absorbed and, as a result, they do not rub down during their exploitation.

Economical:

1. low maintenance expenses;
2. long service time;
3. easy to maintain;
4. there will not appear footprints from rubber soles or vehicles' tires;
5. electric energy savings (up to 40%), because a glass smoothed floor surface can reflect the light very well;
6. it is possible to renew the floor's upper layer, if it has become worn, the renewal expenses will be much less than the original expenses.

A clean air in the room:

When a concrete surface is hardening, calcareous parts are chemically connected and they do not allow the dust parts to come up from the floor's upper layer.

Safety:

A wet polished concrete surface is not slippy (friction resistance increased up to 400%), which is very important for public rooms and premises with a high humidity.

Capacity of concrete surfacing:

It is possible to make concrete surfacing according to the customer's required time schedule.

Costs:

The cost of the polished concrete surfacing can be compared to the cost of one square meter of floor surface from the average quality stone or the ceramic floor stone.

TABLE 3

Physical Properties of Polished Concrete Floor Comparing to Flooring Alternatives

Characteristic of covering	Overlay types			
	Polyurethane coating	Acrylic coating	Epoxy coating	Polished concrete
Design options	If colour density is up to 0,8mm	Yes	Yes	Unlimited design options
Pressure resistance after 28 days	45-50 MPa	40 MPa	Above 60 MPa	45 MPa
Tensile strength	10-40 MPa	30 MPa	20-25 MPa	7 MPa
Weariness	0.9 g/cm ²	1.3 g/cm ²	0.15 g/cm ²	0.12 g/cm ²
Start of exploitation after installing	5-6 hours can walk, 3 days whole loading	4-5 hours can walk, 3 days whole loading	10 hours can walk, 3 days whole loading	Start of exploitation after installing Whole loading after polishing process if concrete has been hardening for 28 days
Chemical resistance	High	Low	High	High
Repair Options	Yes	Yes	Yes	Yes
Most often occurred problems	Low temperature is necessary during hardening. Installing only on a dry rigid concrete with a smooth surface. High price	Installation time 15min. Acrid smell when drying. Low abrasion resistance	Becomes dark if water comes under overlay protective layer, swelling, colour heterogeneity	Colour heterogeneity

Surfacing possibilities of different concrete surfaces:

It is possible to make surfacing both for the already existent concrete floors and for those which are foreseen in future objects. Concrete polishing can be used for making new concrete floors, as well as for visual and functional renewal of the existent concrete floors' upper layer.

The comparison of physical features of polished concrete floors and floor relaying and surfacing alternatives is provided in Table 3.

The polished concrete floor is not affected by scrapes, it is not worn out, comparing to epoxy, polyurethane or acryl overlays. The polished concrete enhances light reflecting,

there is no dust appeared, floor view becomes beautiful and it is easy and not expensive to maintain such surface. Moreover, a hardener decreases the level of humidity and water absorption. The concrete polishing process is very quick, and the new equipment at most have very effective dust control systems, with a minimal effect on environment.

After the whole cycle of concrete hardening (28 days), it is possible to start concrete polishing. For concrete polishing, it is necessary to use an abrasive with diamond parts having the dimensions of 70-10 microns. The polishing and grinding sequence is described in Table 4 [12].

TABLE 4

Polishing and Grinding Sequence of Polished Concrete Floor by Abrasives

No.	Abrasive grain size	Assignment
50	300 mkm	First stage of rigid grinding, for smoothed floors (granite or marble)
100	150 mkm	Second stage of rigid grinding (for granite or marble floors)
200	70 mkm	First stage of grinding
400	35 mkm	Second stage after grinding by No.200 In this stage before concrete polishing it is advisable to do concrete surface chemical hardening
800	20 mkm	The first polishing step, after grinding with by No.400
1500	14 mkm	Second stage of polishing, after polishing with by No. 800
3000	10 mkm	The third stage of polishing, after polishing with 1500
BUFF	--	Finish polishing by special polishing pads (by special polishing liquids which contain acryl or urethane)

If there is a special requirement for emphasising the colour depth and shining features, special liquids are used at the final stage of polishing, installing and polishing the floor by special polishing devices with fast rotation at 1500-1800 rot./min. If there is no such requirement, it is possible to use the 800-3000 abrasive device.

CONCRETE FLOOR'S POLISHING TECHNOLOGIES

Object: supermarket, located in Talsi, Latvia, a new concrete floor (45 days).

Purpose: to make concrete B30 floor grinding and polishing (Fig. 1. grinding in eight oventions in three places which are separately polished with abrasive lowing 800, 1500 and 3000 grains/cm². Three sample fields were prepared for the customer to compare and choose the best polishing grade and price.

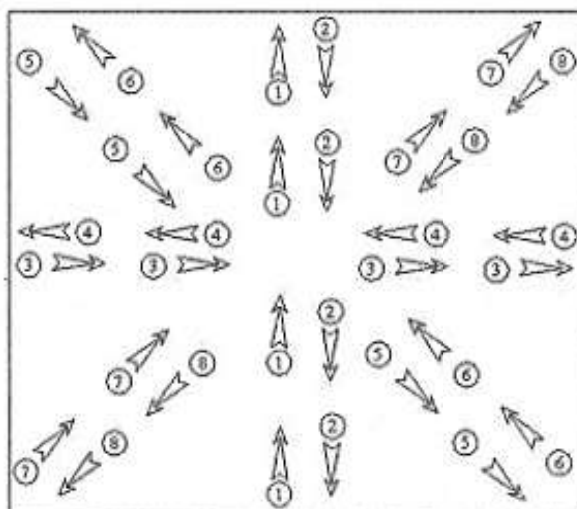


Fig.1. Numbers show the grinding and polishing directions and their sequence

Some samples were also prepared for their further weariness control in the laboratory.

Rigid polishing of the concrete floor surface (Fig. 2);



Fig. 2. Rigid polishing of concrete floor surface

By using hardening and packing agents, the concrete resistance has been increased, the chemical resistance has been improved and elimination of dust appearance has been increased twice. This process ensures chemical stability and weariness of concrete. The hardener is a liquid which consists of amorphous silica that comes into reaction with the concrete's free lime Ca(OH)₂.

Further grinding and polishing of the floor until the required shining is achieved (Fig. 3 - Floor Polishing and Grinding). For qualitative concrete polishing, it is necessary to make a good choice of polishing abrasives, because the polishing stage requires definite abrasives [13].



Fig. 3. Floor polishing and grinding



Fig. 4. Flooring by special maintenance means

Flooring by special maintenance means (Fig. 4) is performed with account of the maintenance conditions.

The floor protective means are used for the chemical improvement and increasing mechanical properties of the concrete floor, easy floor cleaning and surface maintenance, as well as for improving the floor's structural properties.

Concrete floor's polishing results at various grinding depth and different end abrasives roughness (Table 5).

TABLE 5
Grinding Depth and Finish Abrasive Roughness

Grinding depth	Reveals fine aggregates (sand, gravel) To 0.5 mm				Found in small aggregates To 1.5 mm				Revealed large aggregates To 3 mm			
	Mat	Semi-matte	Semi-glossy	Glossy	Mat	Semi-matte	Semi-glossy	Glossy	Mat	Semi-matte	Semi-glossy	Glossy
Finish work												
Sh abrasive grind	100	200	400	1500	100	200	400	1500	100	200	400	1500

WAYS OF IMPROVING OF CONCRETE FLOOR WORKING PROPERTIES – POLISHED CONCRETE FLOORS

During the exploitation concrete floor's its view will be depending on concrete class which was used for floor construction; and the filling materials, and how much it can be discovered when polishing.

When repairing coverings, an old covering, for example, mortar, glue, mastics, membranes, etc., should be dismantled before starting a new polishing process. In this case, the special PCD abrasives are used which are foreseen specially for covering dismantling.

First of all, a preliminary covering of the concrete floor is wiped off (usually it is a rigid polishing with PCD abrasives Polycrystalline Diamond) or very rigid 6, 16 or 20 abrasive grinds, depending on dismantling covering).

The damaged places are repaired (cracks, crumbs) [9].

The two-stage rigid polishing (surface smoothing) is available.

Open pores are filled up in concrete upper layer.

The concrete is overlaid by the hardener.

The concrete is polished until the floor becomes smooth (a smooth polishing, liquidation of rigid abrasives' footsteps and further surface polishing, with account of necessary properties of the end-product).

The concrete is polished for the required shining.

It is possible to make various tones of concrete surface by special colour liquids and this colour is absorbed in concrete upper layers and is not worn out.

Concrete is overlaid by maintenance means taking into account the floor surface working conditions.

Polished concrete floors are successfully used for easy and high loads.

Main advantages of polished concrete – existing concrete floors [11]:

1. Floors are more rigid and wearproof:
 - a) high durability;
 - b) high resistance to scrapes and scratches;
 - c) high resistance to chemicals' effect;
 - d) long service time;
 - e) it is possible to renew surfaces and the cost will be much less than the primary flooring costs (more than 50%), if the floor surface looks worn and is not esthetically nice;
 - f) the floor does not glide (wet too);
 - g) when working with mechanical devices, there are no footprints of tires.
2. Safe to environment:
 - a) concrete is a natural product;
 - b) it does not contain chemicals or solvents that evaporate in the air;
 - c) it does not make dust which can cause different illnesses;
 - d) it does not contain substances which can cause some allergies.
3. Concrete can "breathe" (concrete does not have any coating that could prevent the water evaporation through its sub layers).
4. Unreceptive to various bacteria, it is achieved by a high PH level.

5. Visually attractive:
 - a) It has a nice visual view when it is polished like a shining glass;
 - b) polished concrete is like a polished stone;
 - c) concrete can be toned by adding to it the stones of definite colour, or colour pigments.
6. Economical:
 - a) long service time;
 - b) low costs for such quality floor surface;
 - c) easy to maintain;
 - d) low maintenance expenses;
 - e) no footprints from rubber soles or vehicles' tires will appear;
 - f) it is possible to renew the floor's upper layer, if it has become worn; the renewal expenses will be much less than original ones;
 - g) electric energy savings (up to 40%), because a glass smoothed floor surface can reflect the light very well.
7. Clean air in the room (when a concrete surface is hardening, calcareous parts are chemically connected and they do not allow the dust parts to come up from the floor's upper layer).
8. Because of a big weight of concrete floor, it can accumulate heat very well and work as a heat accumulator for regulating microclimate in the room.

Polished concrete floors – for new concrete floors

The best quality and least costs of building polished concrete floors will be achieved if B25 or B30 concrete class are chosen (depending on the floor usage purposes concrete class can be chosen even B15).

Concrete grinding and polishing technologies are being progressed and developed, choice of colours and patterns is more required, thus there are used special concrete colorings to improve the view of the floor. It is also possible to tone the concrete surface after rigid surface polishing by special liquid colours which are absorbed in the concrete upper layers, making it colourful.

Concrete polishing, grinding – for new concrete floors:

1. Standard concrete floor is installed;
2. Concrete is hardening for 28 days, before the two-stage rigid polishing is started;
3. Pores, which are found after the concrete surface rigid polishing, are filled;
4. The concrete is overlaid by a hardener (28 days after the concrete laying, during polishing);
5. Concrete is polished to achieve a smooth floor (usually 4-8 polishing stages with abrasive grinds 800-3000);
6. Concrete is overlaid by maintenance means, taking into account the floor exploitation conditions.

Costs of one square meter of polished concrete floor depends on the quality of the overlaid concrete, the room type (industrial or apartment), the total area, the advisable polishing level, the design details and other factors.

The costs of one square meter can vary from LVL 8.00 to 20.00 per square meter [5].

COMPARISON OF CONCRETE FLOOR SAMPLES (LABORATORY RESEARCHES)

Concrete weariness defining according to ГOCT 13087-81

Used equipment and materials [14]:

Testing device ЛКН-3, sand, technical scales, a ruler, slide gauge.

Sample requirements:

Sample's form is cube, dimensions of sample 70.7×70.7×70.7 mm.

Samples are tested in series; the number of samples in on series is 3 pcs.

Testing sequence:

Before testing, samples should be kept for at least two day in the room with the temperature of 25±10 °C and the relative air humidity of 50±20 %. Before testing, samples should be weighed and measured (with the accuracy of 0.2%). Before testing, the sample cube side cracks are numbered and tested by these numbers.

Testing process:

Two samples are tested at the same time in the testing device ЛКН-3. One testing cycle is 150 m for each sample (i.e. 28 rotations for each sample's crack). After each cycle the sample is turned 90° (according to its numbering) and the test is repeated (each sample is tested 600 m). When the test is finished, the sample is cleaned from dust and weighed.

Testing results:

Concrete weariness G_1 g/cm² is calculated by mass loss with the error up to 0.1 g/cm², for each sample by the formula

$$G_1 = \frac{m_1 - m_2}{F}$$

where m_1 – sample mass before testing, g;

m_2 – sample mass after four cycles of testing, g;

F – area of sample cracks, cm².

Object: supermarket, located in Talsi, Latvia, a new concrete floor (45 days).

Sample-cubes have been prepared and overlaid for analysis of the polished concrete weariness. The samples were prepared on 12 February 2010, the concrete class B30, testing was done in the RTU laboratory on 16 February 2010.

Quantity of samples:

1. Original-unpolished concrete class B30 - 3 pcs;
2. Polished by 800 abrasive grinds – 3 pcs;
3. Polished by 1500 abrasive grinds – 3 pcs;
4. Polished by 3000 abrasive grinds – 3 pcs.

The samples are cubes with the dimension 70.7×70.7×70.7 mm. The samples were prepared to enable using the laboratory research results, to compare and choose the best floor weariness type.

The purpose of the laboratory researches: to recover the physical properties of the polished concrete floor, weariness efficiency, lifetime, which surface covering methods and protective overlays are used, depending on the floor usage specifics (Table 6) [10].

TABLE 6
Concrete Weariness Check

Sample labelling No.	Height losses after check H, mm	Weight losses, g	Abrasion resistance G_1 , g/cm ³
1. TALSI original-unpolished concrete class B30	3.15	6.45	0.3750
2. TALSI concrete class B30 Polished by 800 abrasive grinds (MAYAN) Lythic	1.55	3.75	0.1145
3. TALSI concrete class B30 Polished by 1500 abrasive grinds (MAYAN) Lythic	1.35	3.65	0.1130
4. TALSI concrete class B30 Polished by 3000 abrasive grinds (MAYAN) Lythic	1.35	3.65	0.1130

The test was made by the device ЛКИ-3, according to OCT-13087-81.

The samples were prepared on 12 February 2010.

Concrete class: B30.

The samples have been weighed and measured within the accuracy of 0.2%.

The test was made in the RTU laboratory on 16 February 2010.

The NTMA (USA National Terrazzo & Mosaic Association Inc) data on different floor surface material installation and maintenance costs during the exploitation period of 20 years [3]. The data are valid for the 1000 square meter big floor. The costs have been calculated for one square meter of floor surface [5].

TABLE 7
Installation and Maintenance Costs of Floor Surface Materials

No.	Material	Installation costs (from-to), LVL	Maintenance Costs, LVL/year	Exploitation period (years)	Total costs for 20 years, LVL	Average cost per year, LVL
1.	Linoleum	12-25	6.6	10	156-182	7.8-9.1
2.	Tiles	15-22	5.8	20	131-138	6.55-6.9
3.	Polished concrete	8-15	0.2	20	12-19	0.6-0.95
4.	Polyurethane coating	9-40	0.2	20	13-44	0.65-2.2
5.	Acrylic coating	12-24	1.0	15	36-52	1.8-2.6
6.	Epoxy Coating	12-20	0.2	20	16-24	0.8-1.2

Table 7 provides a dramatic correlation of the exploitation costs for different floor surface types. If, for example, we compare a tiled floor, which is very popular in Latvia (it is widely used in shopping centres, supermarkets, warehouses, manufacturing houses, etc.), with the polished concrete during 20 years of exploitation, there is a such big difference in costs demonstrating that polished concrete floors are ten times more economical.

Tiled floors are sliding and are not safe. The cheapest tiled floor building is twice more expensive than the one having polished concrete floors. Maintenance costs are 20 times higher. Therefore, tiled floors are not appropriate for usage.

Polished concrete floors are ideal for modern apartments, offices, shops, warehouses and public exhibitions. Concrete polishing is appropriate for supermarkets and warehouses when changing ordinary tiled floors.

Maintenance of polished concrete is very cheap, because there are a lot of means used for the polished floor maintenance. Therefore, such surface will serve for a long time saving its primary properties.

CONCLUSIONS

The main factors for choosing the concrete floor surfaces are the purpose of usage, costs and the required durability.

For analysis of polished concrete, some samples have been made. It was found during the research that concrete surface polishing makes concrete shining, beautiful and easily used.

When analysing the weariness values in the laboratory, it has been found that the concrete floor polished by the 3000 grind abrasive got the biggest weariness value.

Polishing process makes concrete harder, thus diminishing its wear and prolonging the floor surface serving time.

Having analysed the achieved results, we can conclude that: concrete floor polishing is a technically and economically effective process. Polished concrete floors are intended for both small and high loads. They are good to use in the areas where it is necessary to use a heavy cargo transport, for instance, at warehouses, foodstuff manufactures, with easy servicing and maintenance requirements.

Concrete floor grinding and polishing it is future for floor overlaying, it hasn't got any covering which can be flaked away, crumbled or worn out.

Polished concrete floors are worn-proof and look like a natural stone or murmur. Due to the high hardness, weariness and easy cleaning of polished concrete floors, they are becoming very popular. The popularity has started because of the development of new technologies and the latest achievements in chemistry, the knowledge about concrete and concrete overlaying - all that allow making flooring works better and faster. Moreover, polished concrete floors are the most profitable floor solutions if considering installing as

constant maintenance costs, all above mentioned properties make concrete polishing an ideal solution in modern apartments and office buildings, public and industrial areas.

It is obvious that polished concrete today is one of the most modern and profitable way of floor overlaying, and its popularity is leading at floor surface market. It is the most cost-efficient floor solutions from the functional and economical aspects.

Polished concrete has quickly become one of the most rapidly increasing tendencies in concrete floors' sphere.

There were evaluated last technologies which appeared in Latvia in the last time, types of concrete floor overlays and protective coverings, the current situation as well as future tendencies in this field were analysed, a technical and economical efficiency of concrete floor polishing were evaluated in the article. There are considered properties of concrete floor surface in the paper, as well as its suitability to Latvian conditions. The purpose of the research is to find out the physical properties of polished concrete floors, as well as their weariness, efficiency, building costs, lifetime, visual attractiveness, maintenance costs, surface overlaying methods and usage of protective coverings, depending on the floor usage specifics.

REFERENCES

1. Mackenzie A.Permaban. *Light-coloured floor surfaces* // Concrete magazine. –2009. – Nr.4.– 30-32 p.
2. Noble J. *Concrete Polishing: Crack, Joint and Spall Repair Are Critical To Lasting, Quality Jobs*, 2009. – 64 p.

3. NTMA (National Terrazzo & Mosaic Association inc.), *NTM/ Specifications Guide*. Fredericksburg, 2008. – 70 p.
4. Saxby A.Permaban. *Concrete floor finishes* // Concrete magazine. - 2003. – Nr.11/12.– 62-63 p.
5. SIA Grinders. *Polished concrete technology in today's concrete floor surface treatment*. Material and technical information. Riga – 2010.
6. Sobesky J. *Natural style: decorating with an earth-friendly point of view*, 2008. – 207 p.
7. Balogh A. *The Concrete Network. Polished Concrete versus Other Flooring Materials*. Internet. – http://www.rconcreteresolutions.com/pdfs/polished_concrete.pdf resource described on February, 2011
8. Internet. – <http://www.concretenetwork.com/concrete/polishing>, resource described on February, 2011
9. Lythic: Internet. – <http://www.lythic.net/tech.html> resource described on February, 2010
10. Lusis V. *Betona grīdu virsmu apstrādes ar pulēšanu efektivitāte (Efficiency of the concrete floor surface treatment by polishing)*; Rīgas Tehniskā Universitāte. Rīga, 2010. 80 lpp.
11. SIA Grinders: Internet. – <http://grinders.lv/lv/pulets-betons/> resource described on February, 2011
12. Floorus: Internet. – <http://www.floorus.ru/UserFiles/File/wip.pdf> resource described on February, 2011
13. Toolocity: Internet. – <http://www.toolocity.com/diamondpolishingpads.aspx> *Quality Diamond Tools for Polishing Granite, Marble and Concrete*, resource described on February, 2010
14. ГОСТ 13087-81. *Бетоны. Методы определения истираемости. Concretes. Methods of determination of abrasion*. – Moscow– 1982.

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Vitalijs Lusis. Pulētas betona grīdas virsmu apstrādes tehniskās un ekonomiskās efektivitātes pētījumi

Rakstā izanalizēta pašreizējā situācija, kā arī nākotnes redzējums šajā jomā, izvērtēta betona grīdas virsmu apstrāde ar pulēšanu tehniskā un ekonomiskā efektivitāte. Darbā apskatītas pulētas betona grīdas virsmas īpašības, to piemērotība Latvijas apstākļiem. Pētījuma mērķis: noskaidrot ar pulēšanu apstrādētu betona grīdas virsmu fizikālās īpašības, nodilumizturību, efektivitāti, ierīkošanas izmaksas, kalpošanas laiku, vizuālo pievilcību, kopšanas izmaksas, kādas virsmas apstrādes metodes un aizsargpārklājumi ir pielietojami atkarībā no grīdu izmantošanas specifikas. Noskaidrot un salīdzināt populārākos betona grīdu pārklājumu veidus un materiālus, kā arī betona grīdu apstrādes tehnoloģijas.

Pulētā betona grīdas ir ļoti izturīgas un izskatās pēc dabīga akmens vai marmora. Pateicoties pulētā betona grīdu izcilajai cietībai, nodilumizturībai un vieglajai kopšanai, tās kļūst populāras. Popularitāte radusies, pateicoties jaunu tehnoloģiju attīstībai un jaunākajiem sasniegumiem ķīmijā, zināšanām par betonu un betona apstrādi, kuras ļauj labāk un ātrāk veikt darbus objektā. Turklāt pulētā betona grīdas ir visrentablākais grīdas risinājums gan uzstādīšanas, gan nepārtrauktas uzturēšanas izmaksu ziņā, visas iepriekšminētās īpašības padara betona pulēšanu par ideālu risinājumu mūsdienu projektētiem dzīvokļiem un biroju ēkām, sabiedriskajām telpām un industriālajām grīdām. Betona grīdu pulēšanas process samazina to nodilumu un pagarina grīdas virsmas kalpošanas laiku. Tas ir izdevīgākais risinājums grīdai gan no funkcionālā, gan ekonomiskā aspekta. Analizējot iegūtos rezultātus, var izdarīt secinājumus, ka betona grīdas virsmu apstrāde ar pulēšanu ir tehniski un ekonomiski efektīva.

Виталий Лусис. Экономическая и техническая эффективность обработки поверхности бетонных полов полированием

Целью работы является исследование появившихся в последнее время технологий об обработке бетонных полов и их защитных покрытиях.

В статье проанализирована текущая ситуация, реализуемые проекты и видение развития области обработки поверхности бетонных полов полированием, рассмотрена экономическая и техническая эффективность обработки поверхности бетонных полов полированием и пригодность технологии латвийским условиям. В статье проводится исследование обработанной полированием бетонной поверхности пола для выяснения таких важных качеств, как, износостойкость, затраты на установку, срок службы, визуальная привлекательность, стоимость, а также методы обработки бетонной поверхности и закономерность применяющихся защитных покрытий в зависимости от специфики использования пола. В работе исследованы свойства самых популярных технологий и материалов и проведено их экономическое сравнение. Рассмотрены обнаруженные преимущества и недостатки обработки бетонных полов и их покрытий.

Полированные бетонные полы очень долговечны и выглядят как натуральный камень или мрамор. Благодаря новым технологиям производства и обработки бетона, знаниям в области химии, полированный бетонный пол обладает высокой твердостью и износостойкостью.

Процесс полировки уменьшает износ и увеличивает срок эксплуатации поверхности. Кроме того, полированные бетонные полы сегодня являются экономически наиболее выгодным решением для установки и затрат на техническое обслуживание и уход. Благодаря вышеперечисленным достоинствам они становятся все более популярным решением для современной жизни в квартирах и офисах, общественных местах и промышленных зданиях. Анализируя полученные результаты можно утверждать, что обработка поверхности бетонных полов полированием с экономической и технической точки зрения является эффективной.