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A REPORT ADVOCATING FOR SOCIALLY
RESPONSIBLE SUSTAINABLE DEVELOPMENT

SUSTAINABLE FLOORING: THE BENEFITS OF **POLISHED CONCRETE**

ENEREF INSTITUTE EXAMINES THE PRACTICES OF MAJOR FLOORING MANUFACTURERS, AND FOCUSES IN ON POLISHED CONCRETE.

Enerref Institute encourages facility managers to specify flooring systems that promote occupant health and wellness, using efficient, sustainable or renewable systems, products or processes.

Floor covering and coating manufacturers face a difficult challenge of manufacturing attractive, affordable and high-quality systems that do not conflict with sustainability's best practices.

This report examines how polished concrete flooring meets several of Eneref Institute's environmental benchmarks while benefitting facility owners in their endeavor to satisfy these demands.

BENEFITS OF POLISHED

A natural and inherently sustainable material, polished concrete outshines other flooring system alternatives by offering their best qualities with few of their environmental drawbacks. Polished concrete is an attractive, resilient floor that can be both affordably and ecologically maintained. Polished concrete's outstanding sustainability is the result of a unique refinement process, in which the floor is mechanically polished to a smooth and shiny surface. These flooring

systems, such as QuestMark DiamondQuest and Husqvarna's Hiperfloor, use bonded abrasive diamond tooling to grind, hone and polish a concrete floor, creating a durable, non-slip end-product. Mechanically refined concrete promises a long-lasting, environmentally sustainable floor, outstanding life cycle performance, and a clean, attractive environment.

Despite polished concrete's superior performance, Eneref believes this flooring system is underutilized in the market, often ignored in favor of less sustainable alternatives.

Comparing polished concrete to other flooring solutions demonstrates its exceptional performance.

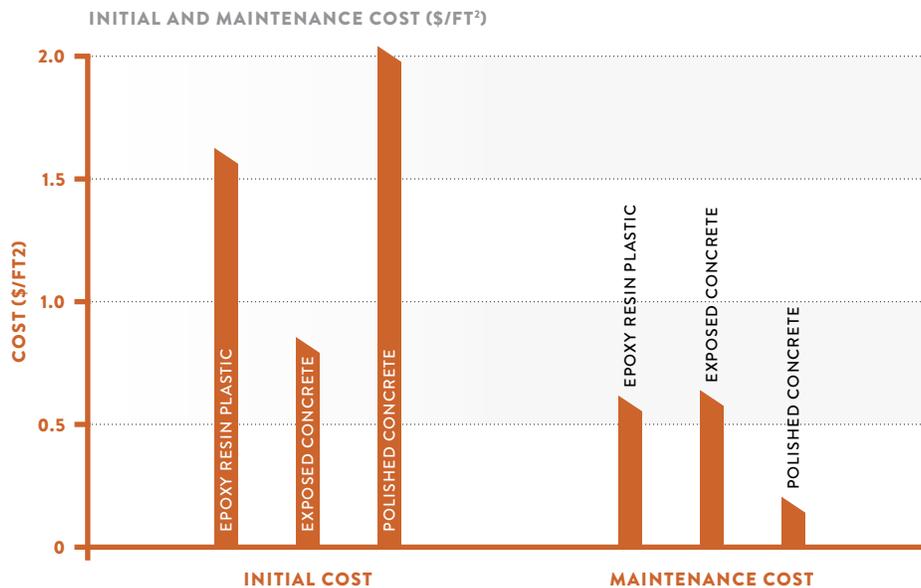
LOW MAINTENANCE, HIGH ROI

Concrete is a sturdy, highly durable material. Due to its high resistance to wear, polished concrete flooring withstands heavy loads and repeated foot traffic. It is ideal in heavily trafficked areas, such as industrial, warehouse and public spaces. (see Initial and Maintain Cost chart).

In an industrial environment, forklift impact damage often occurs as a result of hitting curled joints or heaved cracks. Bumping over construction joints and cracks may put excess and repetitive point load, causing spalls. This contributes to the early degradation of the concrete floor. Curled joints also cause a low-load vehicle to bottom out and scrape or gouge the flooring system.

Polished concrete's flat, smooth, highly abrasion-resistant surface offers a solution. During the installation of polished concrete, the slab can be ground flat or repaired, eliminating these vulnerabilities. Polished concrete's resilient surface is maintained with very little equipment: an auto-scrubber equipped with brushes and a non-toxic cleaner, or sometimes even a damp mop or dust mop, will suffice.

"If you polish it right, and maintain it correctly, it is much more sustainable than other flooring,"



"FLOORING MATERIALS – LIFE-CYCLE COSTING FOR EDUCATIONAL FACILITIES",
BY RESEARCH DEPARTMENT OF UNIVERSITY OF FLORIDA

POLISHED CONCRETE FLOORING BY COMPARISON

says Rick Swanson, owner of Hi-Tech Systems, a flooring product manufacturing company.

Polished concrete's resilience can reap impressive benefits for facility owners, as the floor requires less expenditure in maintenance over the life cycle of the building. The frequency and supplies for maintaining a polished concrete floor may vary depending on how the floor is used and its level of traffic. However, Eneref has determined that, in general, polished concrete systems cost significantly less to maintain than other topical concrete surfaces, such as plastic resin coatings, floor coverings and wax or guard treatments used in similar environments.

CASE STUDY: "If you polish the floor mechanically, and maintain it correctly, it is a much more sustainable floor than any other floor," says Vinny Tagliaferro, plant manager of Melitta coffee company's Cherry Hill facility. Tagliaferro says he was "never really happy" with an epoxy floor in his facility. It would start "cracking and breaking and flaking" after a certain amount of wear and tear. Once the polished concrete floor had been installed, however, Tagliaferro found that "maintaining the floor is much easier... it's a good resilient floor."

Interviews with major retail chain stores determined that maintenance for VCT costs anywhere between \$0.70 and \$0.90/ft² per year, due to repeated cleaning buffing, stripping and waxing. Polished concrete maintenance costs, on the other hand, were reported as low as \$0.17 to \$0.25/ft² per year. While VCT has a lower installation cost, the life cycle cost—including maintenance—is far higher than that of polished concrete.

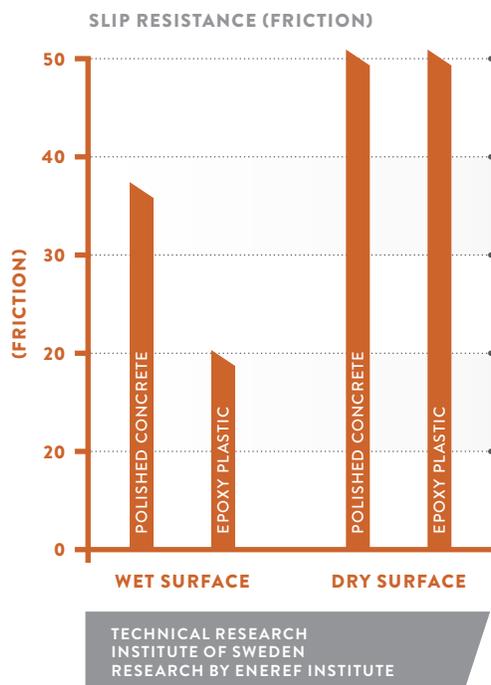
ATTRACTIVE, HIGH GLOSS FINISH

Polished concrete flooring mimics the best properties of natural stone and terrazzo: it is abrasion and slip resistant and can be polished to a smooth and shiny surface, like marble. However, natural stone is a non-sustainable material and demands

more intensive servicing and additional transportation. Polished concrete's durability is greater than natural stone and requires less maintenance, similar to engineered stone, such as terrazzo and Celador.

Gloss, an added benefit of polished concrete, is determined by the level of polishing refinement and gives the floor its distinctive shine. It is measured by the amount of gloss units (GU) of light reflected off the floor, where 100 is the perfect reflectivity of black glass. Most facility owners seek gloss readings of approximately 45 GU in their concrete floor, as this is a highly maintainable, attractive shine. However, a highly refined floor can potentially yield readings as high as 90 GU.

Chemically, concrete is a mixture of 67% aggregates and sand, 16% water, 11% cement (a powdered form of calcium hydroxide) and 6% air. Through hydration—the chemical bonding of cement and water—the cement hardens and gains strength, forming concrete. To accelerate this hardening process, a densifier is added, tightening the concrete particle crystals by hardening any calcium hydroxide that has not yet become hydrated.



When concrete is mechanically refined and polished, reflectivity increases, and it can reduce the lighting load in a facility by adding to the ambient light. During normal use, polished concrete can maintain its gloss reading with minimal maintenance, unlike stone alternatives.

Polished concrete is aesthetically versatile, accommodating the facility owner’s design criteria. During the refinement process, color dye can be added to create an attractive, decorative effect with numerous color palettes and designs. When concrete is new, it can be integrally colored or seeded with aggregate.

CASE STUDY: Principal Brenda Parker, whose school was destroyed by

a tornado and rebuilt using a polished concrete flooring system, greatly appreciated the visually striking effect dyes can have on a polished floor: “We think it’s beautiful... we are complimented almost daily on the beauty of our floors.”

AN ECOLOGICALLY SUSTAINABLE FLOOR SOLUTION

Flooring systems may pose certain environmental drawbacks, or even risks: polyvinyl chloride (vinyl flooring) emits volatile organic compounds (VOC), particularly when first installed. Some glues used to install carpet may produce potentially toxic emissions as well.

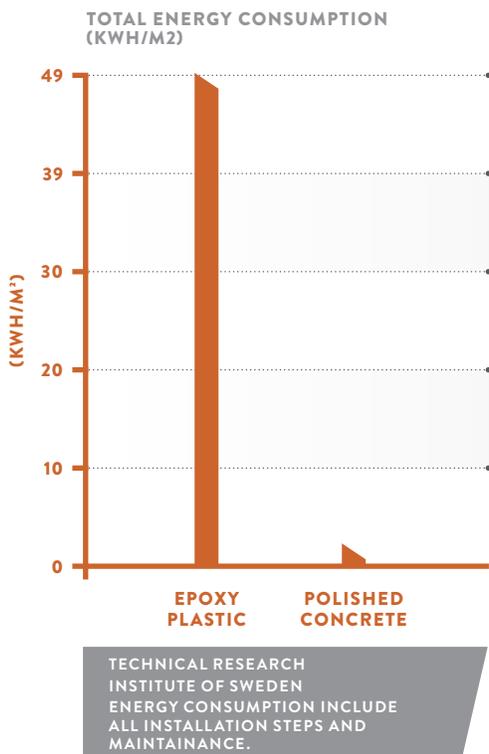
Comparatively, polished concrete is a more environmentally friendly flooring system, as it is “manufactured” directly in the facility. Odorless, non-flammable and non-toxic, installing and refining concrete flooring in situ requires little energy, no solvents and no volatile organic compounds. Further, maintaining properly polished concrete can be as simple as passing over the floor with a damp mop or a dust mop.

Film-forming guards such as epoxy plastic topical coating, in particular, are sometimes applied in lieu of properly refining the floor. However, epoxy coating is far less resilient and has significantly more environmental consequences.

Unlike polished concrete, epoxy is manufactured in an off-premises factory and then shipped to the facility. The energy needed to manufacture epoxy resin is 185 MJ/m², with an added 0.4 MJ/FU required for subsequent maintenance, including regrinding the floor (see Total Energy Consumption chart).

No extended transportation is needed to install polished concrete, and its installation and maintenance require significantly less energy than either wax or epoxy. Installing and maintaining polished concrete uses a total of 6.50 MJ/m² of electrical energy, including all manufacturing steps, the initial floor grinding and any maintenance-related regrinding—30 times less than the energy needed to produce epoxy.

Maintenance regrinding of polished concrete, if the floor is damaged, uses only 0.356 kJ/m², according to the Research Institute of Sweden, or 1,000 times less energy than that required to maintain epoxy (see Total Energy Consumption chart). These figures do not include the energy and resources needed to transport epoxy to the facility where it will be applied. Due to its energy consumption, among other reasons, epoxy plastic topical coating has a global warming potential (GWP) 189 times greater than that of polished concrete flooring (see





FACT

BECAUSE POLISHED CONCRETE FLOORING IS MECHANICALLY POLISHED IT IS ESPECIALLY SUSTAINABLE.

Concrete flooring using topical products are far less sustainable because they require frequent maintenance.

Twenty Years Environmental Impact chart).

Polished concrete flooring—without film-forming guard—is therefore the preferred solution in the pursuit of an ecologically sustainable floor.

MARKET

Sustainable flooring and its importance had varied by market segment even before the introduction of polished concrete flooring in the late 1990s. Today, the education and healthcare markets have made the greatest strides toward flooring sustainability. Polished concrete flooring was initially met with market resistance when first introduced. Maintenance contractors were accustomed to applying wax and/or guard products to hide imperfections

and improve the appearance of floors, which they regularly stripped and waxed. Reducing maintenance threatened jobs. Furthermore, investing in highly specialized polishing equipment was expensive for flooring and maintenance contractors.

QuestMark, a division of CentiMark Corporation, was among the first to recognize polished concrete's potential and invest in the market, using polishing equipment from Sweden-based supplier HTC in 1998. Today both companies are industry leaders. HTC was recently purchased by Husqvarna and is now the largest polishing equipment manufacturer in the world. QuestMark is the largest polished concrete contractor in the world.

"Twenty years ago, we realized that concrete is everywhere and we've been covering it up. We asked, 'Why are we doing that?'" explains Cliff Rawlings, Vice President of Ameripolish.

Once awareness of polished concrete's benefits reached a broader market, sales began to spike. Early adopters, such as Walmart, Home Depot, Kroger and Lowe's, were highly influential in developing the burgeoning success of polished concrete flooring. Today, national retailers are swiftly turning away from topically coated or waxed floors, selecting mechanically polished concrete instead to avoid frequent and costly maintenance.

Major retailers, such as Safeway, Foot Locker, JCPenney, Michaels Stores and Dollar Stores, as well as many industrial facilities, distribution centers and manufacturing plants have switched to mechanically polished concrete.

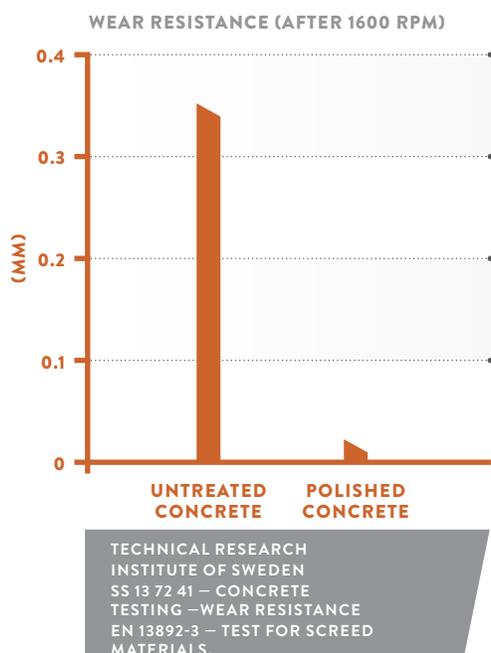
CASE STUDY: "We like polished concrete and it's a bit less expensive. To be honest, it's both an aesthetic and financial choice," says Michael Smith, Director of Store Design for American Eagle Outfitters.

As evidenced by Marriott International launching its new "Moxy" hotel chain using polished concrete floors, commercial facilities are now recognizing polished concrete's superior performance and attractive shine. Commercial buildings such as schools, offices, hospitals—even the New York City World Trade Center—employ polished concrete.

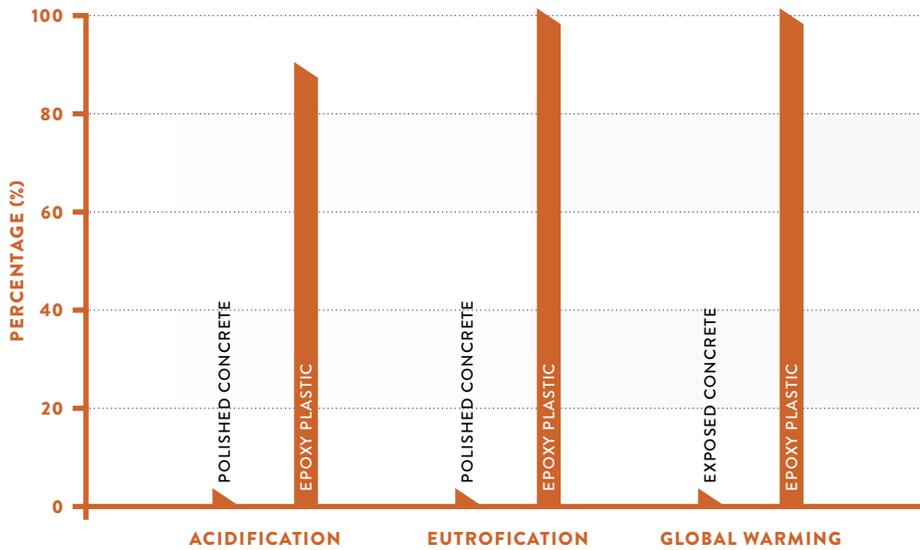
"In the last few years we've seen explosive growth with building owners and large companies who now understand the positive benefits of polished concrete," says Rick Swanson.

OMITTING BEST PRACTICES LIMITS ROI

Polished concrete offers significantly lower maintenance costs compared to other flooring systems. However, facility owners who hire inexperienced polished



20 YRS. ENVIRONMENTAL IMPACT (LCA/M²)



TECHNICAL RESEARCH INSTITUTE OF SWEDEN
RESEARCH BY ENEREF INSTITUTE

concrete contractors or cleaning companies may not enjoy these benefits as a lack of knowledge of proper polishing techniques can result in a subpar product.

In fact, many contractors omit polishing steps where the facility owner “isn’t going to know the difference because it’ll still look good,” explains Rick Swanson. “The floor shines at first but then it’s not going to last... maybe a few months.”

When contractors avoid important installation processes to save time, or the floor is not maintained properly, polished concrete—like any other flooring system—can be permanently damaged. Scratches may form due to day-to-day wear.

“We don’t believe in using guard to hide mistakes. We believe in doing something correctly the

first time around,” says Jennifer Faller, Technical Director of QuestMark Flooring.

When contractors perform all proper and necessary steps, polished concrete will maintain its gloss level and like-new condition with little upkeep.

“It’s the ‘abuse versus use’ principle.” says Faller. “If you use it more than you abuse it, you’ve got a lifetime floor.”

CASE STUDY: Let us compare the cost of maintaining polished concrete to that of maintaining wax or guard. We’ll use the example of a 10,000 sq ft building with a lifetime maintenance expectancy of 50 years, where we will specify either polished concrete or an epoxy plastic coating as the flooring solution. Polished concrete has an initial cost of approx. \$5/ft² and a total LCC (life cycle cost) of approx. \$20/ft². Epoxy plastic coating has an

initial cost of \$1.60/ft² and a LCC of \$83.85/ft². In this case, selecting the lower initial cost alternative (epoxy) at \$1.60/ft² results in a higher LCC. This is due to the significantly higher maintenance cost associated with epoxy plastic. The maintenance cost outweighs the greater initial cost of using polished concrete. Increasing the initial expenditure by \$3.4/ft² results in saving \$63.85/ft² over the service life of the building. By spending an additional \$34,000 to purchase the low LCC alternative (polished concrete) versus installing the low initial cost alternative (epoxy), the facility would save \$638,500 in flooring costs over the service life of the facility. Operation and maintenance costs for shutdowns, as well as the loss of production of man hours, are not included.

BEST PRACTICES PRODUCE RESILIENT FLOORING

Every concrete floor is unique. Concrete density can vary depending on anything from the climatic region where the building is located, to the humidity in the air on the day the concrete was poured. In order to achieve the highest performance, the concrete must be poured, finished and scrutinized, creating what the American Society of Concrete Contractors calls a “canvas.”

Best practices begin with an experienced contractor evaluating the building owner’s needs. For example, does the building use forklifts that drive along the floor or only pallet jacks periodically?



HIGH GLOSS FINISH

Polished concrete is highly reflective, adding to the ambient light.

Does the floor have nonstop foot traffic all day? Does the owner need nationwide service?

“Innovations in diamond tooling technology have greatly helped to advance the polished concrete industry,” explains Michael Turek, Director of Business Development for SASE, a manufacturer of polishing equipment.

Polishing a floor with diamond pads is similar to applying sandpaper to a piece of wood; the flooring system is “sanded” using diamond-bonded abrasive polishing pads, ranging from coarse to fine. Experienced contractors evaluate the concrete floor and determine which procedures, diamond grits, configurations and systems are best to properly refine the

surface in order to achieve the best results.

To maintain consistent air quality, concrete polishers use HEPA vacuum systems to eliminate dust during the polishing process. HEPA (high efficiency particulate air) systems trap particles with a mechanical air filter by forcing air through a fine mesh. Once the building owner’s gloss preference is achieved, a penetrating stain-repellant can be applied, providing a stain-resistant and long-lasting flooring system. Most retailers seek gloss specifications of approximately 45 GU. Some facility managers require gloss readings as a quality control tool to confirm the full polishing process was performed prior to the application of a final penetrating sealer. A gloss reading similar to mechanically

polished concrete is achievable by applying guards. However, guards are far less sustainable and have a significantly higher LCC.

CONCLUSION

Polished concrete is a resilient, sustainable flooring solution with a much lower global warming potential than other systems; polished concrete also requires far less maintenance. Because it is mechanically refined—as opposed to coated with a topical epoxy—polished concrete is a long-term flooring solution for environmentally conscious managers of commercial, industrial and institutional facilities.

POLISHED CONCRETE FLOORING BEST PRACTICES

POLISHED CONCRETE IS A RESILIENT, SUSTAINABLE FLOORING SOLUTION WITH A MUCH LOWER GLOBAL WARMING POTENTIAL THAN OTHER SYSTEMS.

NOT FOLLOWING BEST PRACTICES	CONSEQUENCE
Owner hires inexperienced contractor	> Contractor do not properly educate workers
	> Contractor uses guard to hide poor polishing
	> Floor's appearance is unattractive
	>Guard wears off
	> Frequent maintenance required
Owner neglects to measure gloss before stain	> Guard can hide poor job
Contractor polishing adds scratches	> Scratches can't be removed
Contractor does not fills in gaps	> Holes, cracks and indentations
Contractor uses inferior acrylic guard	> Wastes time, money and effort
	> Floor wears within 3-6 month in high traffic
	> Frequent maintenance and reapply needed
	> Scratches easily
Contractor does not follow specifications	> Higher maintenance costs
Contractor skips polishing steps	> Scratches in the floor
	> The end result is not a shiny gloss
	> Shines lasts only a few months
Maintenance uses wrong bristle for cleaning	> Scratches the floor
Maintenance uses harsh of cleaning chemical	> Etches polished floor
	> Dulls the polish
Maintenance uses big scrubber machine	> Scratches on the floor
Maintenance uses wrong cleaning products	> Ruins the polish and the shine



LEAD BY EXAMPLE.

ENEREF CAMPAIGNS ARE DESIGNED TO CREATE A COMMON UNDERSTANDING OF SOLUTIONS TO GLOBAL WARMING AND ENCOURAGE PEOPLE TO TAKE ACTION.

AS A SOCIETY, we're more likely to act on environmental solutions when knowledge is shared. That is, when every member knows the same information—and knows that every other member shares that knowledge, too. A viral argument becomes common knowledge, and common knowledge becomes

action. Eneref Campaigns bring about that positive tipping point by creating the dynamic of common knowledge and the perceived social pressure to act responsibly. We'll ignite a movement so that you can lead others.

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must harness their capacity to
improve our planet and society.*

Right now, we need to make unprecedented changes to ensure a sustainable and equitable society. Limiting global warming requires rapid and far-reaching transitions in land, energy, industry, buildings, transport and cities. Every extra bit of warming matters to reduce irreversible harm to our ecosystems.

We encourage organizations to grow sustainably and act responsibly by raising awareness for clear, specific solutions that offer an efficient use of natural resources, demonstrate social responsibility and foster a peaceful, earth-friendly economy.

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