Self-Leveling Concrete Toppings on Floors

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Prepared by: ShwanSherzadSadiq

Study Applied to Kurdistan Engineering Unionin order toobtain Engineering ConsultancyDegree

Mob: +9647701576265

Contents

Abstract

Concrete floors can develop faults over time which can cause damage thus hindering smooth transportation, industrial aspects and some residential drawbacks. In addition, flaws and cracks are known to progress into more serious damage with time and use. Self-leveling mortar has been used on a relatively limited scale worldwide to allow for more even, higher performance and easy-to-apply flooring. However, there has been little information available with respect to their use and best practices.

The primary focus of this work is to prepare mortar that possesses self-leveling flow characteristics. Hence, several mixtures have been designed using various constituents with moderate 28-day strength of 35 MPa. Chemical and mineral admixtures have been incorporated together with limestone to enhance the flow and cohesiveness as well as improve performance. The results reveal that self-leveling mortar can be successfully produced with comparable properties to ready-to-use market product. These mixtures were evaluated to have both performance and economic merits.

Keywords: Self Leveling, Mortar, Flooring, Cores

1. Introduction

Whenever you need to repair, smooth, or raise a floor, self-leveling concrete can be a fast, cost-effective solution to the problem.Self-leveling concrete is a cementations mixture much like concrete. But unlike concrete, it flows easier and sets up much faster. The product is mixed with water, pumped or poured into place and spread evenly with a gauge rake. Once it's spread out, it continues to flow evenly and levels itself out. Depending on the product, it may set up smooth and flat within 1-2 hours. In about 6 hours, it may be completely hardened and ready for use, depending on the flooring material being installed on top. Self-leveling concrete can be used as an underlayment for tile, carpet, or other floor coverings.Now, let's clarify some things concerning product names. Instead of "concrete," you might see products called "self-leveling underlayment." This name means exactly the same thing as "self-leveling concrete." They're generally mixtures of Portland cement, polymer plasticizers, and other ingredients. They have the strength of concrete but they flow more easily and set up quickly.Self-leveling concrete can be poured as thin as a quarter of an inch; just enough to smooth out small imperfections if that's all you need. But if the floor has low spots and needs to be smoothed, even more, it can be poured as thick as an inch and a half without the addition of aggregate and 5 inches with the addition of aggregate (though make sure you follow all manufacturers' guidelines).Self-leveling concrete works especially well with radiant heating installations because it easily flows around the tubing. The thicker floor-leveling compounds, that must be troweled to achieve a proper finish, can't do this.

Figure 1: Examples of the use of self-leveling Concrete

There are three main uses for the self-leveling concrete. The first use is known as underlayment which is used to smoothen out any surface and correct the irregularities that the concrete could have (Anderberg&Wadso, 2007). This is done prior to the installation of all types of floors. The second usage is to add the self-leveling mortar from the beginning of the project to act as the actual finished floor without the need for a floor covering and this is known as topping. The third use of the self-leveling mortar is as a repair material for damaged concrete in applications such as bridges or roads. Added to that, the self-leveling compounds can be used to provide a smooth and durable new surface for decorative treatments (Klemenc, 2010).

Self-leveling mortar is a ready use mortar, which should be mixed with water before using it directly. Moreover, it is used to create a flat and smooth surface with a compressive strength similar to or higher than the conventional cement mortar, and it is mainly used as an underlayment or as a topping (Klemenc, 2010). For underlayment, it is installed over a subfloor to smooth it or to correct and fix any irregularities on the surface prior to the installations of all floor coverings (Anderberg&Wadso, 2007). As for toppings, it acts as the actual finished flooring without the need for floor coverings. Nowadays, self-leveling mortar has increased due to the increase in the degree of the flatness and smoothness of floor covering. Self-leveling cement has high flow characteristics in contrast to the conventional cement mortar as shown in Figure 1. It is also characterized by its flow-ability (Lacombe, Beaupré, Pouliot, 1999). However, as the self-leveling mortar get thicker the flow-ability decreases. Also it can't be applied on vertical surfaces because of its high flow-ability. Self-leveling mortar does not need any vibration or compaction. This material also gets hardened quickly in 20 minutes (Soh& Do, 2002). Consequently, a fast crew is required in order to spread the mortar all over the required area before getting hardened. The only equipment that can be used while spreading the mortar over a huge slab to fasten the process of spreading is an aluminum mob. Another characteristic of self-leveling mortar is the fluidity; it has a high fluidity and good segregation resistance as stated before. Self-leveling mortar has a density range between 2000 and 2200 kg/m3, (L Panama, 2015) which is lower than the normal mortar, which is ranged between 2400, and 2600 kg/m3, thus it decreases the dead load. It could come with different colors to be considered as a finish layer without adding any kind of material above it.

Figure 2 - (a) Conventional mortar Figure 3 -(b) Self-leveling mortar

Admixtures are added to self-leveling mortar to increase its workability and to decrease the viscosity of the mortar. Its flow-ability is very noticeable therefore; it can spread all over the surface very straightforwardly. In addition, polymers in such mortar mix unifies the product`s viscosity which means that the composition from the top to the bottom will be the same without facing any segregation. Engineers now use self-leveling mortar as floor covering for industrial areas and sometimes they coat it with epoxy layer to give the color and the glow needed as shown in Figure 2. Moreover, nowadays people started using it in their houses for decoration. Also it can be used as a topping over bricks. On the other hand it can be used as a repairing material such as road pavements, and bridge cracks (Klemenc, 2010).

Figure 4 - (a) Self-leveling mortar as floor coverinFigure 5 - (b) Self-leveling mortar cover with epoxy

2. Properties of Self-Leveling Concrete

Self-leveling concrete (SLC) is a polymer modified high -performance concrete that have the ability to flow, compact and provide a leveled surface when poured over an area. An SLC does not require separate vibration or compaction as required by normal concrete construction.The basic properties, construction features and benefits of self-leveling concrete are explained in the below section.The self-leveling concrete is designed such a way that the following properties are attained:

1. Low Plastic Viscosity
2. High Flow ability
3. Low segregation
4. Low Bleeding
5. Stability

The low plastic property of SLC increases the flow ability properties which imparts the self-leveling property. The balance and proportion of the above-mentioned properties in mix design helps to design the desired SLC concrete.

Providing low viscosity of the concrete mix can result in stability issues. This can result in high segregation and bleeding problems. This low viscosity or high flow ability is introduced by the addition of superplasticizers or polymer agents that maintains the stability without affecting the flow abilitycharacteristics. The viscosity agents added prevents the settling down of aggregates that causes segregation and keep the cohesiveness of the mix within the bond which in turn helps in avoiding bleeding.

High-homogeneity is received by self-leveling concrete with its self-leveling and consolidating property. The flow ability properties of self -leveling concrete is greater when compared with self-compacting concrete. This increase in flow ability is one reason to obtain good finish in final hardened SLC.

3. Construction of Self-leveling Concrete Surface

The main two applications of SLC are in the construction of toppings and underlayment. Whatever be the surface under consideration, the SLC mix is initially poured over the surface. The highly viscous SLC mix is spread throughout the surface with the help of a gauge rake. Care must be taken not to spread in thin layers. A smoother is used later to finish the surface tension over the surface to facilitate finishing process. The polymer addition in the SLC mix helps to maintain the

Figure 6 - Pouring SLC MixFigure 7 - Spreading SLC with a Gauge Rake

4. Advantages of Self-Leveling Concrete

1. Ease of Application
2. Less labor required
3. Leveled and smooth surface is obtained
4. Water Resistant surface is obtained
5. Resist growth of microorganisms
6. Best choice of heavily reinforced concrete construction
7. Hardening of concrete is taking place in a homogeneous way
8. Best option where formwork is arranged in unusual geometry
9. Compressive strength higher than traditional concrete is obtained
10. SLC concrete gives flat and smooth concrete surface
11. Self-leveling concrete give cohesive concrete that resist bleeding and segregation issues

5. Where Self-Leveling Concrete Is Used

Let's say you're upgrading an old, damaged concrete floor that's settled or cracked. Or maybe you're installing a radiant heating system in a floor. Maybe you're building an addition and you need to match the floor to the floor in an adjoining room. Maybe you're finishing a basement where the floor is rough and uneven concrete. Some other applications for concrete toppings include warehouse floors, light industrial applications, retail stores, and institutional facilities. Concrete toppings can also receive pigmented color dyes, stains; saw cuts or mechanical polishing to produce a decorative concrete finished wear surface.

6. Preparing to Use Self-Leveling Concrete

Before you install your new floor, there's an essential consideration you need to address, and that's moisture in the existing concrete floor. All concrete contains moisture, and if the moisture level is too high, it may cause the leveling compound to degrade over time. So you need to test the slab to be sure the moisture level is not too high.

This isn't something you can do just by looking at the slab. No matter how the slab looks, moisture deep in the slab can migrate to the surface over time and cause serious problems. If the moisture level deep in the slab is too high, you need to take steps to remediate it before you can pour your new floor.

This is a well-known problem with a well-known and scientifically proven solution. The way moisture moves in a concrete slab has been studied since the 1960s and researchers have developed a scientifically proven test for measuring moisture levels deep inside a slab. That test is called "the relative humidity test using in situ probes." This is the basis for the ASTM F2170 standard. This standard governs the processes involved with obtaining results using in situ probes in concrete slabs. Despite the complex terminology, this test method is actually very easy and much faster than you would think. Wagner Meters provides an in-situ concrete testing system that conforms precisely to ASTM F2170 in probably the most simple and time-saving way possible.

7. Installing Self-Leveling Concrete

1. Read and follow the manufacturer's instructions to the letter. Don't skip or skimp on any step. And if any of these tips conflict with the instructions, go with the manufacturer's process instead.
2. Buy more product than you need. A difference of a fraction of an inch thickness can mean several bags of product. You have to finish the job in one pour so you can't go back to the store for more.
3. Have all your tools and supplies ready. Once you start to pour, you may only have about 10-20 minutes to work.
4. Keep your leveler product dry – store the bags indoors and up off the ground.
5. Do not mix product in extremes of heat or cold.
6. Do not add water to the product as you're spreading it. The mix ratio is critical.
7. Clean all tools and buckets immediately when you're done. If you allow the product to set it will never come off.
8. Be careful not to pour more product than you need. If you do, quickly and carefully scoop it up into a bucket and remove it.

8. Takeaways for a Successful Self-Leveling Pour

Whenever you need to repair level or raise a floor, self-leveling concrete can be a fast, cost-effective solution.Self-leveling concrete can be used as an underlayment for tile, carpet, or other floor coverings.For a successful self-leveling concrete installation, follow the seven tips in this article.To ensure that your floor does not suffer from a flooring failure, it's essential to test the concrete subfloor for high moisture levels according to the ASTM F2170 standard. It's not that hard to do and you've got a great product from Wagner Meters that can help.

The Rapid RH L6 system is the fastest, easiest, most cost-effective system for RH testing concrete slabs in compliance with ASTM F2170. It will get you accurate results in a fraction of the time versus other methods, and it's digital, with convenient wireless communication to your smart device. This helps you cut down on the paperwork and give you greater confidence in the documentation of your test data.

9. Conclusion

Base on the materials, procedures and other aspects incorporated in this study, the following can be concluded;

a. Lab prepared self-leveling mixtures have high flow-ability and can be placed without the need for vibration. This in turn allows to save energy and to ensure a suitable cast-in-place. Moreover these self-leveling mixtures are high performances mixtures which spread out on the area with less segregation and minimal bleeding.

b. The performed cost estimate indicates that the lab prepared self-leveling mortar has higher initial cost compared to conventional mortar mixtures. However, they are indeed less costly when taking longer life span and performance with minimal maintenance into consideration.

c. Self-leveling mixtures prepared in the lab are less expensive compared to the considered ready-to-use mix available in the market. These mixtures need less labor as it does not need any vibration or any use of equipment while placement. Only a mob could be used for placement in large foot print areas to ensure the mortar is spread all over the area.

d. Based on the characteristics and performance of self-leveling mortar, it can be predicted that self-leveling mortar will be more commonly used due to its higher degree of flatness and smoothness as required by floor coverings products which are expected to increase in the years to come.

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