Industrial concrete floors: not an easy accomplishment

Out of all the civil engineering works, industrial concrete floors are most certainly considered the easiest to create. Such an approach has always led to underestimating the importance of certain fundamental aspects, which are essential in concrete floors despite not being crucial for other structures. Using high quality, and therefore durable, concrete is a necessary condition. Still, it is not sufficient to guarantee suitable flooring unless, in addition to the design aspects, the technological and executive elements are considered, which are sometimes linked to problems that are difficult to assess.

Key-words related to concrete floor slabs

The quality of an industrial concrete floor is highly dependent on obtaining a firm, durable, flat and crack-free surface.

The surface properties of the floor are affected not only by the concrete quality but also by the pouring and placing operations.

The “time” variable in casting and finishing operations is a highly crucial variable on which the success or failure of the work, in terms of meeting the end user’s expectations, largely depends. Setting and hardening times, plastic and drying shrinkage deformations, the tendency to segregation, water/cement ratio and workability are all significant to control when creating flooring as they affect the finishing process and, ultimately, the performance of the floor slab itself.

Even the work, especially the finishing of the concrete surface, can also affect suitable flooring. A premature finishing operation or the presence of bleeding water on the surface of the concrete leads to a localised increase in the water/cement ratio by forming a layer of mortar with low mechanical strength values, low wear resistance and a solid tendency to cracking and delamination. Furthermore, a finish that is not performed at the right time concerning the setting and hardening of the concrete can result in defects in terms of surface planarity (curling).

The problems of concrete floors

In general, the concrete surface's characteristics determine the flooring's serviceability. Therefore, all the phenomena that can lead to cracks in the concrete surface must be controlled.

Cracks, curling, and delamination are the main problems on concrete floors, damaging the work and compromising service life.

Plastic shrinkage, drying shrinkage, alkali-aggregate reaction, freeze and thaw cycles, and dimensional variations due to temperature changes are all phenomena that can induce stresses within the concrete, leading to the formation of cracks that could compromise the excellent performance of the flooring.

Plastic shrinkage

Plastic shrinkage is a phenomenon that occurs in the first few hours of a concrete's service life as a result of surface capillary stresses that develop when the evaporation rate of the water is faster than the bleeding rate. Concrete structures with vast surface areas exposed to air, such as industrial floors, are particularly prone to plastic shrinkage.

Drying shrinkage

Concrete deforms when the relative ambient humidity changes. More specifically, if the humidity is low, it contracts.

Since the tensile strength of concrete is much lower than its compressive strength (approx. 1/10), shrinkage in a confined structure induces tensile stress that causes cracking; the extent of concrete shrinkage depends on the water/cement ratio and the aggregate/cement ratio, as well as on the shape and size of the structure:

- the increase in the water/cement ratio causes more significant shrinkage because the degree of water evaporation from the concrete increases and the level of concrete porosity increases;
- a reduction in the aggregate/cement ratio, on the other hand, induces an increase in shrinkage due to the greater volume of cement paste in the concrete mixture;
- as the surface/volume ratio increases, shrinkage increases because more surface area is exposed to water evaporation.

Along with relative ambient humidity, temperature is the major driving factor when it deals with shrinkage and cracking phenomena of the floor. Significant temperature differences

within the thickness of a concrete structure lead to thermal cracking due to different contractions among the portions.

Curling

The curling of floor slabs is a direct consequence of shrinkage. This phenomenon occurs due to increasing contractions along the thickness of the slabs due to differential shrinkage, leading to defects of planarity and cracks along the edges of the joints.

The action of freeze-thaw cycles

If the temperature drops below 0°C, the water freezes, and its volume increases, causing a pressure capable of damaging the concrete. This phenomenon occurs cyclically in areas with a harsh climate, and its effects can gradually worsen the top surface layer until it crumbles and delaminates. A typical example of structures subject to this phenomenon is industrial floors located outdoors in areas where the climate is frigid.

Many factors can cause a concrete floor to deteriorate prematurely. It should also be considered that the problems described above can add up, producing cracks, curling and delamination very quickly.

For these reasons, it is always recommended to adopt a Flooring System, the most appropriate combination of different products, each specialised in solving a single problem. As a complete Solution, this System can tackle all the issues that can arise when creating an industrial floor.

The Flooring System is an effective tool for the contractor and ready-mix concrete supplier, enabling them to deal with and provide the best flooring solution.

In the next blog article, we will explain in detail all the components of the Flooring System from Master Builders Solutions.

About Master Builders Solutions

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