Superflat floor construction – how easy is it?

Superflat floors are required where very narrow aisle trucks are employed to place and pick goods stacked to heights over 12–13m, where the path of the truck is fixed and the truck is floor supported, i.e. it runs on the floor. Superflat floors are not required where the materials handling system runs on a crane rail – in fact floor tolerances to support such systems are quite often not very onerous at all.

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Where the trucks lift to over 8m, but less than 13m, a very flat floor is still required, but these are not usually defined as ‘Superflat’ in the UK. For instance, Concrete Society Technical Report 34 (TR 34) describes floors where the lift height is in the range of 8–13m as Category 1. There are a number of other worldwide specifications pertaining to very flat, defined movement floors, including DIN 15-1853, which is widely specified by materials handling equipment manufacturers throughout mainland Europe. The concept will therefore be used generically for the purposes of this article.

Methods of construction

There are a number of methods used in the construction of these floors. There are three fundamentally different approaches to achieve the desired tolerances, particular operations of ‘cutting’ and ‘filling’ need to be undertaken. As a result, bleed rates, finishability, setting characteristics and workability may all need to be modified. But most importantly is the consistency of concrete within and between loads of concrete. Variations in setting between loads make the achievement of Superflat tolerances very difficult, if not effectively impossible in extreme cases.

Concrete consistency

Much of the success of a Superflat floor installation is determined in advance of the installation. The concrete mix and its consistent delivery are critical. The mix requirements for a Superflat installation may be different to normal. In general, the use of alternative admixtures, particular operations of ‘cutting’ and ‘filling’ need to be undertaken. As a result, bleed rates, finishability, setting characteristics and workability may all need to be modified.

Joints located under centre of masts result in wheel tracks being symmetrically located

Figure 2: Effect of joint location.

Figure 1: Completed Superflat floor.

Procedures

Once installation is under way, concrete quality control is critical. After conventional placement of the concrete, a sequence of strike-off, re-checking of formwork, transverse sawing, longitudinal straight-edging, application of topping (where specified), repeated sawing, straight-edging and, if necessary, re-checking of formwork, follows. All steps and intervals are regulated by the workability and setting rate of the concrete. Finishing, initially by ‘pumming’ using a small, non-overlapping, ride-on trowel, takes place 24 hours later than usual, to minimise disturbance to the surface. In some cases, it may be necessary to regrout the floor after the first pass of the power float, but if the mix design and working of the surface has been done correctly, it is possible to have just one very late pass of the power float prior to commencing power trowelling. Curing is done in the normal way, but care needs to be taken with the application of sawn applied membranes to ensure an even coverage so as not to have an effect on the surface tolerances achieved. Prompt surveying of the floor, particularly during the early stages of a project, with informed feedback to the operators from the supervisors is critical.

Dry-shake toppings

Sometimes, there may be a requirement to install coloured Superflat floors. This can be achieved using dry-shake toppings incorporated into the surface during the sawing or straight-edging process. However, although the better products are helpful in providing ‘Fat’ to aid the cutting and filling operation, which is an integral part of the straight-edging, there is an increased risk of delamination with most of the products available in the UK due to the fineness of their gradation. If inadequate topping is applied, grading may expose the ‘natural’ concrete below. In addition, the application of topping needs to be done very evenly, and most contractors consider it more difficult to achieve Superflat tolerances when a dry-shake is specified.

It is not necessarily the case that dry-shake toppings make the achievement of Superflat tolerances more difficult, but a common method of achieving Superflat floors in Europe and the eastern Mediterranean countries is by the application of a ‘fresh-on-fresh’ topping. This method comprises laying of the base concrete, rebounding the of course, be amended, including those across the ends of the aisle strips. Transverse construction joints within the concrete mix and its consistent delivery are critical. The mix requirements for a Superflat installation may be different to normal. In general, the use of alternative admixtures, particular operations of ‘cutting’ and ‘filling’ need to be undertaken. As a result, bleed rates, finishability, setting characteristics and workability may all need to be modified.
formwork, carrying out an early initial power-floating operation and then applying a 'slurry' of topping material up to 10mm thick. The aggregates used in the topping have a larger maximum size and different grading to dry-shake toppings, but the blend with cement is similar. The water/cement ratio of the topping tends to be in the order of 0.35. This results in a very narrow window in which to carry out the sawing and straight-edging operations. However, the best trained teams can achieve Superflat tolerances without the need for grinding. Not only is this system advantageous in the case of coloured floors, but it also results in a fibre-free surface where steel fibres are used for structural purposes in the base concrete.

Superflat jointless floors
At least one eastern European contractor can install floors to the tightest DIN 15-185 tolerances using a combination of the standard methods and 'wet-screeding' controlled by precise level. This is helpful in order to provide 'jointless' steel-fibre floors, when compared with the normal 'longstrip' method, which normally results in unacceptable aspect ratios for such floor designs. Another method of achieving 'Superflat jointless' floors is by placing an accurately large pour slab and bonding, typically, 70mm-thick 'Superflat strips' to this using a special bonding agent and employing particularly highly skilled labour. Being structurally bonded, the overall depth of the slab is unaltered using this method.

Concluding remarks
In the USA post-tensioning of Superflat floors is common, and the techniques vary slightly compared with European practice. Common in all parts of the world is the need to select the right mix, employ tight concrete quality control and to carry out every operation diligently. Levelling of the formwork is critical, but so is the skill and attention to detail of every operative involved. Hand edging is important for example, even though the joint is located under the racks. This is to ensure that the level of the edge, which becomes the support for the strike-off and sawing beams for the adjacent pour, is tightly controlled. If any one operation is not correctly done, or the job is under-resourced, achieving Superflat tolerances becomes almost impossible.

References: