High tolerance floors using large pour techniques

Figure 1 right : Rectification process.

(Photo: Twintec Ltd.)

Fewer issues within the concrete industrial flooring industry seem to be as emotive as that of flatness tolerances. While the classification of tolerances (surface regularity, free movement, defined movement) seems to be accepted by all parties concerned, the limits imposed on the various properties have led to controversy.

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"With continually improving methods and equipment, it became apparent that the more skilled contractors were generally achieving better standards of flatness than those prescribed in the 1997 supplement."

Over the years, and with each revision of the guidance document TR34[1], changes have been made to the compliance limits. Ten years ago it was this very issue that prompted the formation of the Association of Concrete Flooring Contractors (ACIFC) in a bid to resist the imposition of what flooring contractors at the time deemed to be the unrealistically high standards of flatness contained in the second edition of TR34[2]. Their lobbying was successful and led to the release in 1997 of a supplement to TR34 which actually led to a relaxation in most tolerances by a factor of 1.5.

However, with continually improving methods and equipment, it became apparent that the more skilled contractors were generally achieving better standards of flatness than those prescribed in the 1997 supplement. Twintec were actually regularly working to and achieving the 1994 standard, suggesting that the relaxation of Free Movement standards should be re-examined. This was recognised by specifiers responsible for a significant number of large warehouse developments during this time and many of them began to specify the more onerous FM2 flatness tolerance contained in the 1994 edition.

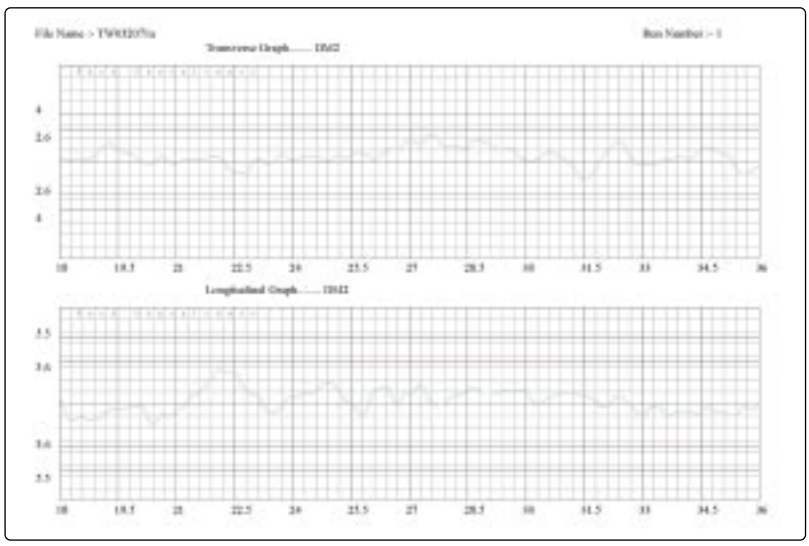
New TR34 tolerances

Thus, with the requirement for a revision to these, and many other standards, the Concrete Society decided to completely update TR34 and set up a project to review all sections, including the flatness section. The flatness working party consisted of flooring contractors, specifiers, clients and representatives of the mechanical handling equipment (MHE) industry and a thorough review was carried out which led to several changes, two of the most noteworthy being:

- the introduction of FM2 Special, a tolerance much tighter than the previous FM2 (1997 supplement) and designed to provide a more suitable option for high-bay warehouses where a very narrow aisle (VNA) racking system is to be provided in the future
- the inclusion of Appendix C 'Floor Regularity' which was included as it would "be useful to provide a platform for future development". The Appendix contains a provisional alternative method for surveying defined movement areas; Table C1 is therefore an alternative to Table 4.3.

These additional tolerances will not be applicable to all floor slabs but they do add greater choice and should ensure that specifiers and contractors provide floors that their clients really need; not just the only flatness that the selected flooring contractor can achieve. It is also the author's firm conviction that these tolerances are achievable as the following case studies demonstrate.

Figure 2 (a) and (b): Graphic read outs.



Case Study 1

Project Blue (DM2)

In 2003, Wates Construction built a new 9500m^2 distribution centre for Game Group plc in the south of England. The flatness tolerance was initially specified as FM2, but

Summary of Results

Run No	Limit	Transverse A	Transverse B	Longitudinal C	Longitudinal D	Run Length Meters
1	95%	0.3%	0.3%	0.5%	0.6%	83.70
	100%	0.0%	0.0%	0.5%	0.0%	
	Max Diff	2.9mm	2.4mm	3.6mm	2.6mm	

as the project developed the client decided to incorporate VNA racking and so a revision to the tolerance was necessary. Category 1 could have been selected, but with encouragement from Wates and agreement from Twintec Ltd the DM2 tolerance from Appendix C was specified by Upton McGougan Consulting Engineers. The ground-bearing floor slab was designed by Twintec as a 170mm-thick steel-fibre-reinforced concrete (40kg/m^3 AFT +1/60 fibres) slab. The floor was cast in just five days during August 2003.

With the finalised racking layout, the centre lines of the aisles were set out and constantly monitored and measured and the surface of the slab was rectified along the full width of the aisle during its plastic state. This unique method (which has always been used by Twintec Ltd for Category 1 floor slabs) has proved to be ideally suited to the new defined movement tolerances contained in Appendix C, providing well-controlled flatness across the full width of the aisle (see Figure 1).

The digital read-out from the profileograph (see Figure 2) clearly shows compliance with the DM2 tolerance.

Case Study 2

Uniserve (FM2 Special)

Dew Construction constructed a new high-bay warehouse for Uniserve on their Tilbury site. Quite rightly, due to the height of the racking and the VNA nature of its layout, the consultants chose a Category 1 tolerance.

However, achieving Category 1 tolerance is only possible with a finalised racking layout. Without a racking layout the recommendation of TR34 (Third Edition)[3] is to cast the floor to FM2 Special in order to reduce the amount of grinding required once the defined movement area has been clarified.

As the first contractors in the UK to repeatedly cast floors to the TR34 FM2 1994 Second Edition standard, Twintec also became the first contractor to cast a floor to the new FM2 Special Flatness Tolerance. Improvements to equipment were necessary and Twintec has adapted the hydraulic system on their laser screed, using multi-directional skip floating techniques. The dry-shake topping is also used as a 'rectification' material, allowing first stage finishers to check the flatness as they progress, ensuring that the specified tolerance is achieved.

Concluding remarks

While Twintec has developed a few special tools and techniques, it is essentially a question of attitude and commitment. The company ensures that the project is planned well, managed effectively, resourced correctly and that workers are properly trained and supervised. This results in the production of an exceptionally flat slab in areas exceeding the limits for FM1 and 100% within the FM2 Special limits.

Whereas Twintec Ltd is content with the new additions to TR34 flatness tolerances, it feels that further developments should be considered, such as the use of standard deviations to provide a fuller picture of the overall flatness achieved on free-movement floors. It also believes that the industry should be more concerned with casting floors to a higher standard of flatness in the first place rather than worrying about the complexity and cost of remedial grinding. This is because floors that require remedial grinding in order to fall inside the compliance limits may contractually be acceptable, but the reality is that they do not provide clients with the sort of flatness they need. ■

References:

1. THE CONCRETE SOCIETY. Technical Report 34, First Edition: *Concrete industrial ground floors – a guide to their design and construction.* Camberley. 1988.
2. THE CONCRETE SOCIETY. Technical Report 34, Second Edition: *Concrete industrial ground floors – a guide to their design and construction.* Camberley. 1994.
3. THE CONCRETE SOCIETY. Technical Report 34, First Edition: *Concrete industrial ground floors – a guide to their design and construction.* Camberley. 2003.