



'VNA-Ready'
Concrete Flooring Delivers Innovative Flexibility

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The expectation for shorter and shorter delivery times - driven in no small part by the relentless growth of e-commerce - is forcing supply chains to evolve faster than ever. While bespoke, purpose-built facilities can be created to match clearly identified warehousing needs, the challenge for developers, owners and occupiers alike is knowing if, how and when warehouse use may change. This is one of the drivers for innovative solutions that deliver 'future-proofed' and 'smarter'

logistics facilities - facilities that can meet existing requirements and provide flexibility in terms of accommodating changes further down the line. And concrete flooring is, quite literally, the base on which this flexibility is built.

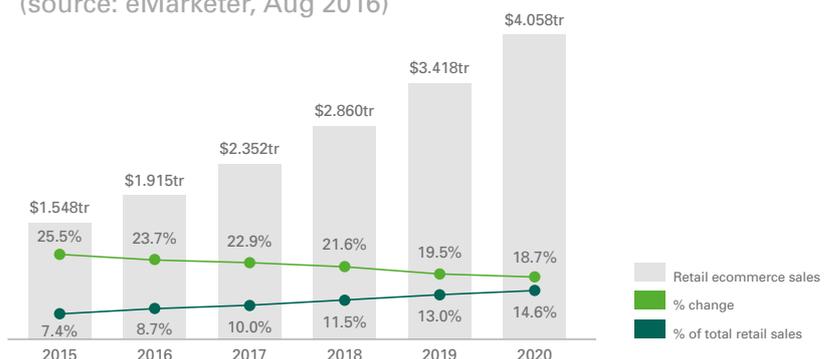
Which is why Prologis, in conjunction with construction contractor Winvic and flooring specialist Stanford, has decided to re-write the rule book when it comes to concrete flooring technology. Together, these companies have developed an innovative new approach that allows real estate developers and owners to offer occupiers a route to rapid evolution of warehouse capabilities while keeping operational expenditure and exit costs at the end of a lease to an absolute minimum.

Prologis is re-writing the rule book

Warehousing Evolution

According to recent research, worldwide retail e-commerce sales in 2016 will reach almost \$2 trillion US dollars for the first time – representing around 9% of total retail spending[1]. By 2019, it is predicted that online purchases will have reached \$3.551 trillion, or 12.4% of total retail sales. And in an age of 'instant gratification', consumers expect that the time from clicking on 'purchase' to receipt of their order be measured in hours rather than days.

Retail Ecommerce Sales Worldwide 2015-2020
(source: eMarketer, Aug 2016)



Furthermore, it's not just 'direct-to-consumer' businesses that are fundamentally changing their approach to customer fulfilment. Global business-to-business (B2B) supply chains in industries ranging from automotive manufacturing to the production of electronics goods are also under growing pressure to reduce costs and shorten delivery times.

These issues have a fundamental impact on warehousing and logistics facilities. One significant trend, for instance, is that a growing number of end users are looking to squeeze more and more pallet positions into their existing facilities by turning to taller, narrow aisle and very narrow aisle (VNA) storage systems.



VNA storage systems

VNA systems typically operate with wire- or rail-guided forklift trucks and demand very tight tolerances of floor flatness when it comes to the exact path of the forklift wheel tracks within the aisles. Building warehouses to accommodate a VNA infrastructure requires special measures during the construction phase and a detailed understanding of the precise racking system and fork lift truck models that will be used.

Over-specifying at construction stage will lead to significantly higher costs

The Flooring Challenge

But what if nobody knows whether a VNA system is likely to be needed?

This is certainly the situation for the real-estate developer involved in a speculative warehouse build, but it is equally applicable to both the warehouse owner and a business moving into a new facility but not yet handling volumes that dictate a VNA implementation.

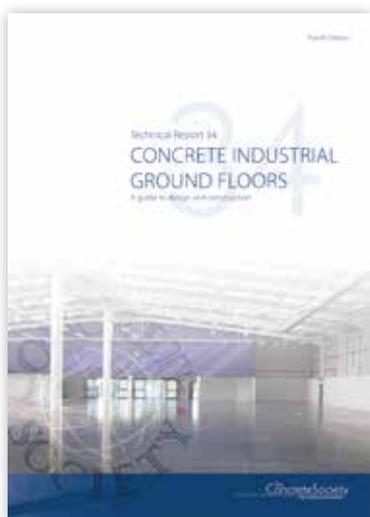
The problem is that, in very many cases, there is no way of knowing if and when a VNA solution will be needed. However, what is known is that over-specifying the flooring at the construction stage in anticipation of a possible VNA infrastructure will lead to significantly

higher costs, an extended construction time and a floor that ultimately costs the occupier more to maintain. Even then, as no detailed VNA specification exists, there are still likely to be significant future costs when it comes to implementing a more volumetric-efficient solution at a future date.

Because of this, the conventional approach to warehouse construction has been for the developer to deliver flooring that is constructed to a tight, general flatness classification. The understanding being that the owner or the lessee will then need to modify this floor as and when their storage requirements change.

Traditional Approach

In the first instance, most floors are constructed to the 'FM2' free movement flatness classification as defined in The Concrete Society Technical Report 34 fourth edition (known as TR34).



Owners demand that occupiers maintain the flooring to a given standard during the term of the lease

Concrete Society TR34

As the name suggests, the floors are designed for warehouses where forklift trucks are allowed to move in any direction. In line with this specification, floors are typically constructed using laser screed processes in standard square panels. Dimensions of the panels can be anywhere between 30m x 30m and 50m x 50m. Best practice dictates that the joints at the boundary of these panels are re-reinforced against wear and tear using 10mm thick steel plates that are cast into the concrete during construction.

However, because they follow a set path, the 'long-reach' articulated forklift trucks used to pick products from very high racks in narrow aisles demand floors that are compliant with much more stringent 'defined movement' or DM specifications. Because of this measures need to be taken to convert an FM floor to a DM floor. Converting an FM2 floor to a VNA-compatible specification requires a survey to see how much remedial work will actually be needed. This is then followed either by an expensive concrete grinding process that will ensure the path of the forklift wheels is always DM-compliant or the implementation of 'build-up' systems whereby an overlay is bonded to the aisle after first shot blasting the slab surface.

What's more, the costs don't end with the initial grinding or overlay. Under the terms of most leases, owners demand that occupiers maintain the flooring to a given standard during the term of the lease, and that they re-instate the flooring to its original specification when the lease ends. This can be very expensive – especially in situations where the occupier has chosen to use trench grinding to channel grooves in the concrete panels along which the forklifts run or where the overlay approach was initially chosen.

Then there is the not insignificant issue of maintenance. The joints between the concrete panels of an FM2 floor are designed to open and this means that there can be gaps of up to 20mm between the steel plates. With the lengths of most aisles easily exceeding 40m (the typical slab length) there is little choice but for the forklifts to pass over these gaps. The hard tyres used on VNA forklifts to ensure stability when reaching to heights of up to 15m are prone to damage and shredding as a result of running over the plates and openings. This not only results in repair bills, but can also lead to long periods of downtime while repairs are effected.

Re-Writing the Rules – VNA-Ready Flooring

Recognising the potential benefits for developers, owners and occupiers, Prologis decided it was time to challenge conventional wisdom and investigate new approaches and techniques for flooring construction. In line with the company's long-term approach to sustainable building development and management, a key aim of the new approach would be to deliver a solution that continued to support the speculative building of warehouses but that could provide higher levels of built-in 'future-proofing'.

More specifically, the new approach would allow facilities to deliver much more flexibility in terms of implementing higher volume storage as and when it became necessary, while reducing the upfront, ongoing and exit re-instatement costs for the occupier.

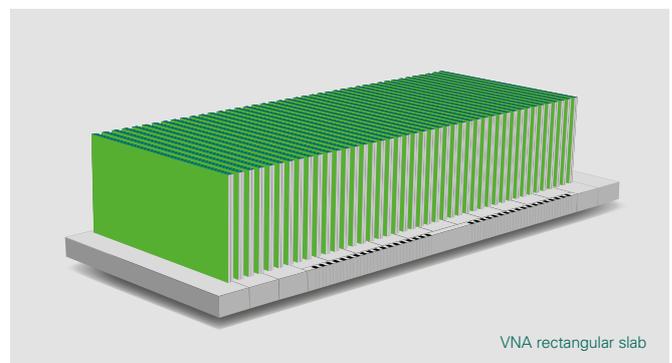
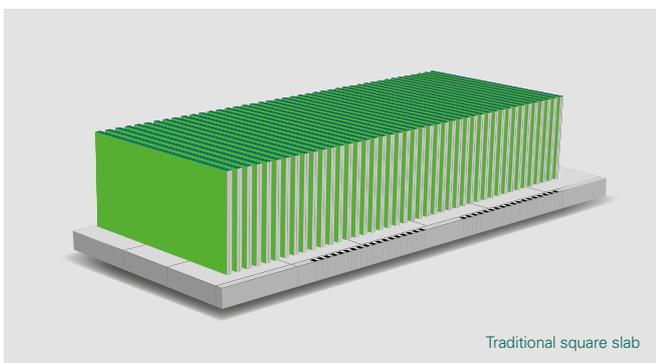
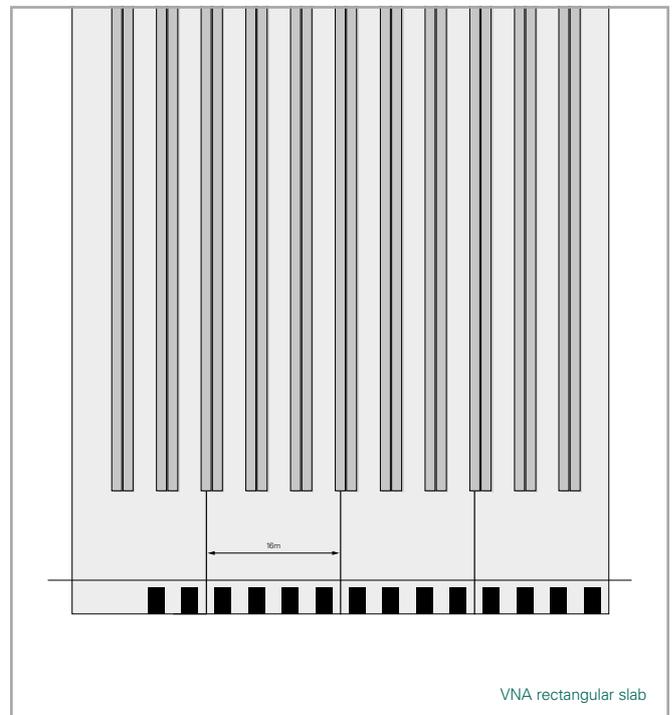
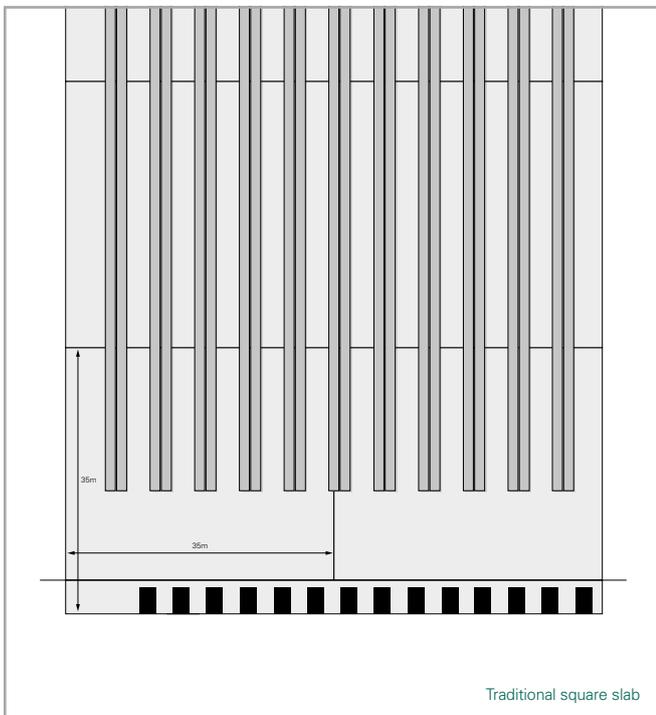
Working in conjunction with prime contractor Winvic and flooring specialist Stanford, they came up with the concept of 'VNA-ready' flooring.

A fundamental difference between 'VNA-ready' flooring and conventional FM2 flooring lies in the aspect ratio of the concrete slabs, with a move away from the traditional square slab to a longer and thinner construction with dimensions of around 120m x 16m. Such a construction can offer significant advantages when it comes to working the concrete once it has been poured.

Traditional vs VNA-ready concrete slabs

It is worth pointing out that whilst the aspect ratio of these longer slabs does not strictly comply with the TR34 specification as written, VNA-ready flooring is designed to be in accordance with the principles and goals of TR34. The concrete bays when laid, for example, still have traditional sawn joints introduced to control cracking with a nominal 6m x 6m grid respecting the square concrete panels as intended by TR34.

The distinct advantage here is that, when laying and levelling the concrete it is much easier to reach the slab centre from the slab edge. This means that the laser-controlled screeding machines can be used for controlling the transverse (across aisle) construction tolerances by placement and boom operation within the concrete pour. Once the laser screeding has done its job then the highly skilled 'bump cutters' can reach the centre of the slab to control the longitudinal (down aisle) construction tolerances. This combination of 'man & machine' ensures a very refined overall flatness tolerance, more suited to VNA truck operations.



A VNA-ready floor

As well as enabling a much higher, defined movement-type tolerance to be achieved across the whole floor (and not just where forklift wheels may be expected to operate), the extended slab length also offers the opportunity to completely eliminate the problem of steel joints crossing the aisles. This is achieved by running the day joints parallel to aisles and along the run of a building's main frame columns. These columns are typically built on 16m centres, conveniently placed so that no VNA path would be compromised by the building frame.

As a result, the forklifts employed in a future VNA installation would never encounter a joint in any of the main aisles

While the approach makes it possible to eliminate joints in the main aisles, the warehouse floor naturally still requires 'shield' joints in between the long strips and where the main floor meets the floor in the warehouse docking area. The latter is a particularly hard-working environment and an area where damage to forklift wheels can often be sustained. In the past, application of costly sealant has been used to mitigate this problem but this is an imperfect solution, with sealant becoming displaced and needing regular maintenance.



Asymmetric joints

The VNA-ready floor system mitigates the problem associated with such joints by swapping traditional straight joints for joints that use asymmetric plates as shown below.

By choosing the 'wavelength' profile of the movement joint interface it is possible to ensure that a forklift's wheels are always in contact with both sides of the joint, which reduces the possibility of damage to the tyres.



VNA-ready floor showing shield joint to docking area

Summarising the Benefits

only around
5% to 8%
of an aisle length
would need any re-work
with **VNA-ready flooring**

typically around
1mm or 2mm
reduced depth grinding
therefore **minimising
time and expense**

Converting a conventional, laser screeded FM2 floor to the DM2 flooring needed for a VNA system typically requires between 40% and 60% of the aisle length to be re-worked – either through grinding or shot-blasting followed by the installation of an overlay. In the case of extensive grinding for forklift wheels, the requirement to cut to depths up to 10mm represents a significant and expensive task, while both approaches present potential future problems in terms of ongoing maintenance and re-instatement.

In the case of VNA-ready flooring, however, it is likely that only around 5% to 8% of an aisle length would need any re-work. Furthermore, this grinding is generally of a much-reduced depth, typically around 1mm or 2mm – a much less time-consuming and expensive proposition.

And, while implementing VNA-ready flooring does carry some increased cost for the developer and, at 1600 to 1800 square metres a day, takes a little longer to lay than conventional flooring, for a company such as Prologis the benefit comes from taking a longer-term view. As both a developer and an owner, this view takes into account how **VNA-ready flooring is an attractive feature that is likely to attract occupiers and that will, ultimately, minimize the headaches associated with flooring re-instatement when a lease comes to an end.**

Going Live

The world's first VNA-ready floors have already been installed at two new Prologis facilities at Prologis Park Ryton in Warwickshire, England that, between them, offer a total floor area of over 43,000 square metres.

The use of the new techniques means that the occupiers of these facilities can benefit from a floor that is suitable for general block stacking and wide aisle racking use now and are ready to accept narrow aisle or very narrow aisle implementations with the bare minimum – if any – additional work.



Prologis facilities at Ryton-on-Dunsmore offer VNA-ready flooring