CONSTRUCTION OF CONCRETE JOINTS – THE LIMITATIONS

A self-supporting concrete-to-concrete jointing solution can enable a sequence of concrete pours, while attaining an established bond throughout the concrete joint – eliminating complicated and time-consuming formwork methods. Kate Pacey of Max Frank reports.

Continuously striving to make processes as simple as possible, without unnecessary complication or hassle, is an important objective. Many construction methods have evolved over the years, enabling contractors to complete on-site procedures with speed, accuracy and ease of installation.

Where concrete structures are concerned, construction or day joints are usually designed to prevent stress and subsequent cracking. Generally referring to an intentional or tolerance-related gap between components or materials, concrete joints can significantly affect the function and performance of the structure. Careful design must therefore take place at the planning stage in accordance with the design requirements of the specific project.

However, when it comes to the construction joints on-site, traditional timber formwork remains a common method, which is time-consuming for contractors who are striving to meet tight deadlines. Timber is labour-intensive to install and to remove, as is scabbling of the concrete surface and where it is necessary for additional systems (for example waterstops) to be installed in a separate process.

Ready-to-install, permanent and self-supporting systems are becoming increasingly popular on large-scale projects where the time-saving opportunities, enabling the project to stay on track, are recognised.

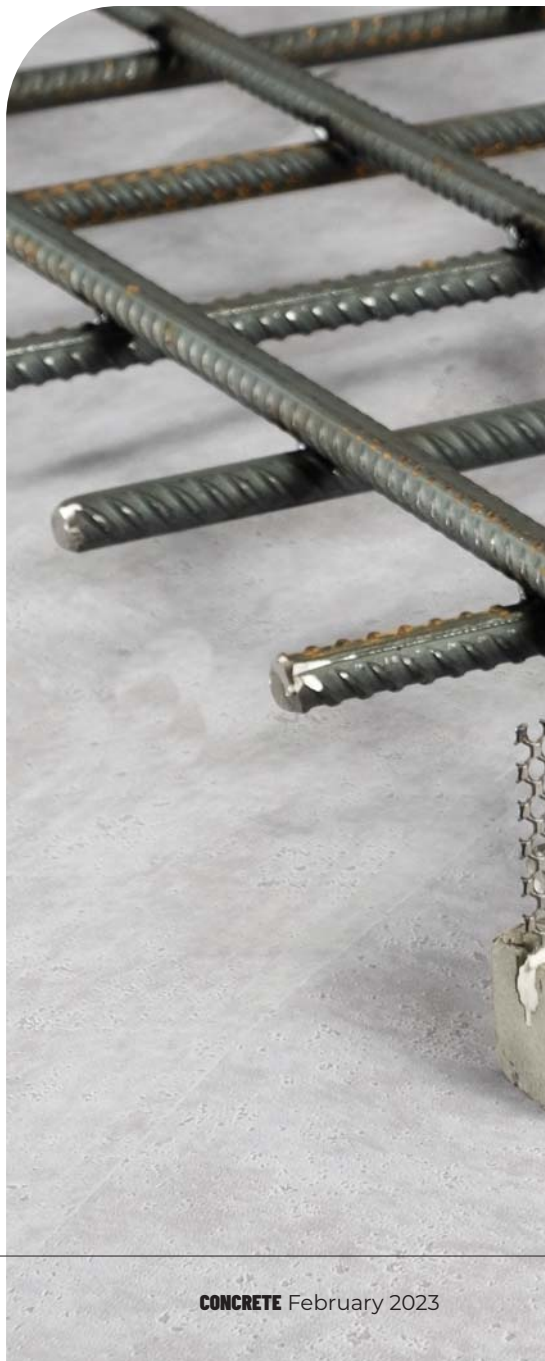
Prefabricated formwork sections are used as lost formwork in construction or day joints – in floor slabs, ceilings and walls. The prefabricated jointing system forms a proven bond with the concrete and provides an easy solution for allowing continuity steel to pass through, without the need for curtailing continuity reinforcement. With defined and structurally proven stiffening solutions, the formwork is suitable for slabs and bases of varying concrete depths, ranging from slim slabs in high-rise construction to deep bases in infrastructure projects. The system can incorporate built-in features, such as waterstop cages and crack-inducing components.

CONSTRUCTION JOINT COMPLEXITY

Considering the complexities involved when forming joints using traditional methods, an innovative self-supporting expanded metal lath (EML) formwork system, Stremaform, was developed to deliver a fast and economical solution for contractors.

The prefabricated jointing formwork was designed with simplicity in mind. It is quick to install and no formwork removal or scabbling of the surface is required. When used alongside a specially designed concrete spacer, with metal mesh comb to the base, grout loss is significantly reduced and subsequent clean-up after the pour is eliminated (see Figures 1 and 2). The stay-in-place solution not only reduces manual handing where on-site operatives are concerned but also helps contractors to achieve time and cost savings during installation when compared with working with timber formwork.

Formed joints can now be concreted immediately. The EML, welded between stiff wires, allows concrete grout to pass through, creating a rough concrete surface



MAIN IMAGE:
Figure 1 – Stremaform system spacer significantly reduces grout loss.

INSET:
Figure 2 – rough concrete surface improves bond to subsequent pour.

finish for a good bond to connect the subsequent pour. According to Eurocode 2 (DIN EN 1992-1-1, Edition 2011-01, Chapter 6.2.5[1]), this allows higher shear force transmission than traditional, smooth surfaces (see Figure 2).

As a proven concrete-to-concrete jointing system, a major benefit that is provided to the contractor is the opportunity to complete a sequence of concrete pours, while attaining a good bond throughout the joint. Where tailored prefabricated solutions are repeatedly used, there is a great saving potential to the overall on-site programme. The challenge of achieving programme target is significantly strengthened (see Figure 3, page 20).

DEEP SLABS AND BASE SOLUTIONS

Deep concrete construction can be a costly and gruelling exercise. The sheer volume of concrete required, as well as the time and amount of reinforcement bar to be placed, require working joints. The EML system can be further reinforced and supported by additional integrated girders to withstand concrete pressures of up to 32.7kN/m^2 and anchors where deep slabs require further support.

This application was carried out when constructing plot G3 of Canary Wharf's new district, Wood Wharf in London. The Stremaform system was designed according to a 2m-deep stop-end and pour sequence for the basement slab, with added working environmental difficulty from heavy, congested reinforcement, with numerous layers in a confined working space. Stremaform, with integrated stiffening and anchors, enabled a proven concrete bond to the subsequent concrete pour, in a technically complex working environment, while withstanding pour pressures of 38kN/m^2 (example in Figure 4, page 20).

EXPANSION JOINTS

Concrete slabs and buildings expand and contract due to changes in temperature from the surrounding environment. Without creating expansion joints, these structures would crack under the induced stress. The stay-in-place formwork allows controlled movement at the joint location, also

LEFT:
Figure 3 – Stremaform enables a sequence of pours and can be supplied including a waterbar cage.

BELOW:
Figure 4 – a deep slab solution was used at Wood Wharf.

reducing sound transmission between concrete members. Shear force dowels may be incorporated where force transmission and dynamic loads are present and the panels can also be designed to incorporate waterstops.

INCORPORATING WATERSTOP

Formwork units can be prefabricated to comprise a cage for subsequent installation of a rubber waterbar on-site. The cage ensures the position of the waterbar is maintained centrally within the joint before and after the concrete pour, and the formwork units can incorporate a single cage or in two-parts, in upper and lower locations. The concrete jointing formwork with integral waterstop is installed at the wall base to enable a continuous system of sealing to be achieved and ensures watertight concrete joints.

INCLUSION OF SHEAR DOWELS

Prefabricated panels incorporating shear dowels permit lateral movement in either direction – within the plane of the slab, to allow controlled movement at the joint location. The system can be designed and manufactured to suit lower transmittable loads in ancillary applications (for example, industrial floors or structural connections) or to withstand transmission of very high loads in larger applications (for example, major concrete structures, basements, tunnelling and railway tracks). In addition to transverse forces, shear dowels can be integrated to combat dynamic forces.

CONTROLLED CRACK-INDUCED JOINTS

A jointing solution to prevent spontaneous cracking in concrete slabs, tailored panels are designed to prevent positive connections between concrete sections, creating an induced crack at the desired location. For crack-induced joints in walls and slabs, the units act as stop-end formwork for sequential pours or for continuous pours in monolithic concrete structures. The units can also include integrated waterbar cages, a metal waterstop or shear dowels.

CONCLUDING REMARKS

The versatile and adaptable EML concrete jointing formwork is a safe, permanent, self-supporting system that is supported by temporary works calculations. Paired with experience and technical knowledge, initial project design and installation challenges can successfully overcome. The construction of any concrete joint is simplified by using the innovative Stremaform self-supporting lost formwork system and the time-saving advantages to the contractor outweigh the initial product cost over the time and resources spent installing traditional timber formwork. C

Reference:

1. DEUTSCHES INSTITUT FÜR NORMUNG, DIN EN 1992-1-1. *Eurocode 2: Design of concrete structures. Part 1-1 – General rules and rules for buildings*. Beuth Verlag, Berlin, 2004+AC:2010.

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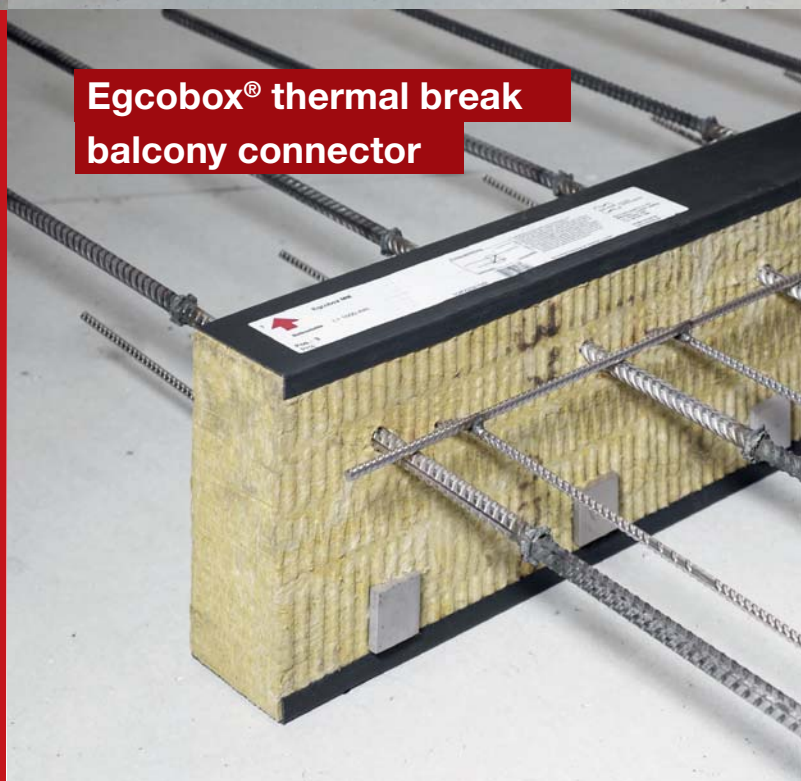

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