



EVOLUTION[®] Self Compacting Concrete Guidelines

Introduction

CEMEX EVOLUTION[®] self compacting concrete is an innovative concrete that does not require vibration for placing and compaction. It is able to flow under its own weight, completely filling formwork and achieving full compaction, even in heavily reinforced sections. The hardened concrete is dense, and has the same engineering properties and durability as normal concretes.

Engineering Properties

CEMEX EVOLUTION[®] and traditional concrete of the same strength will exhibit similar properties in the hardened state. Structures made with CEMEX EVOLUTION[®] can generally be designed using the same design codes as traditionally vibrated concrete.

Mix designs

CEMEX EVOLUTION[®] is available in a range of mix designs suitable for ICF structural applications which can be adjusted to your specific requirements, please contact your local CEMEX office for further details.

Testing of CEMEX EVOLUTION[®]

It is recommended that the on site test for checking the uniformity of supply is the Slumpflow test as per BS EN 12350: Part 8.

Site preparation and requirements

Prior to the delivery of concrete, the contractor/user must ensure that appropriate site preparations have been made. These should include

- Confirming that CEMEX EVOLUTION[®] is appropriate for the job
- That site can place the concrete at the agreed delivery rate
- That acceptance procedures for EVOLUTION[®] are agreed and documented
- That site personnel are trained in the specific requirements of CEMEX EVOLUTION[®],
- That formwork is properly prepared

Supervision and skills

It is essential that site personnel used to place CEMEX EVOLUTION[®] have been trained/instructed in the specific requirements for placing this type of concrete. Particular emphasis should be placed on the following.

- Effect of vibration on mix stability
- Rate of placing
- Effect of taking a break/stoppage during placing
- Actions to be taken if a break/stoppage occurs
- Observations for blockages, segregation and air release
- Requirements for placing by pump, skip or chute, including positioning to induce flow
- Finishing top surfaces and curing

Formwork

Formwork Pressure

Formwork pressure depends on the flowability and cohesion of the CEMEX EVOLUTION[®], rate of vertical rise and the method of placing. Formwork design, including support and fixing systems, should normally assume that the full hydrostatic concrete pressure will be applied to the concrete

Formwork design

The high flowability of CEMEX EVOLUTION[®] can result in flotation of any buoyant formwork units, stop ends or detailing that is not securely fixed. Particular attention should be given to fixing and sealing the formwork to the base wherever uplift could be a problem. Leakage at joints can occur and reduce an otherwise high quality of finish.

Because full hydrostatic pressure should be assumed when using EVOLUTION[®], particular attention should be paid to both the outer supports and the tie rod system and spacing to ensure the formwork cannot deform during placing.

Formwork preparation

CEMEX EVOLUTION[®], normally produces a very high quality finish giving a mirror copy of the formwork. This gives opportunity for enhanced

design but if care is not taken, CEMEX EVOLUTION[®] shows up any deficiencies in the formwork material, finish or the release agent and this will detract from the final appearance. Movement at joints or bending of the formwork under pressure from the concrete may also be more noticeable with CEMEX EVOLUTION[®]. It is therefore essential to ensure that sufficient propping of the ICF is provided to avoid movement or deformation of the walls. ICF Units should be inspected prior to assembly and damaged units discarded. Cutting of ICF units prior to pouring of concrete should be avoided unless necessary, and suitable reinforcement of the ICF forms where they have been cut should be installed.

Windows and door openings should have suitable forms placed to close openings in the ICF structure. The forms must be capable of resisting the full pressure of the plastic concrete. Corners and wall ends should be suitably propped to minimise the risk of bursting failure at these points.

Placing and Finishing on Site

General

CEMEX EVOLUTION[®] is designed to have a very high flow combined with characteristics that ensure the mix does not segregate. The use of vibrators will affect this balance and will usually lead to significant segregation. For this reason vibrating equipment should not be used except in special circumstances. Particular attention should be given to possible external sources of vibration from, for instance, nearby equipment.

During placing, the concrete should be regularly checked to ensure that the coarse aggregate is remaining at or very near the surface and that there is no indication of segregation. The concrete should form a regular advancing front at a shallow angle and be observed to flow round and fully enclose reinforcing bars without forming void pockets. There should not be excessive release of large air bubbles that would suggest air is being entrapped by the placing process. Check formwork for signs of leakage.

After completion of the first section of a job the quality of the hardened concrete should be checked and evaluated. Look for top surface laitance, a non uniform surface colour, specific areas where air is being trapped and any other unwanted effects that are visible.

High quality surface finishes are a feature of CEMEX EVOLUTION[®], but to obtain a surface without blowhole, blemishes or discolouring, requires more than just a concrete of good mix design and quality. The formwork face must be faultless and the execution of the casting work and finishing treatment must be of the highest quality. Concrete placers as well as site managers/foremen must understand and take into account the importance of each separate element of the execution and carry it out effectively.

It is essential that the personnel used to place self compacting concrete have been trained/instructed in the specific requirements for placing this type of concrete

Discharging

Discharge should not take place before control checks have taken place.

CEMEX EVOLUTION[®] can be placed by direct discharge from truck mixers via a chute.

Alternatively it can be first discharged into a skip (with tremie pipe) or to a pump.

Placing procedure and rate

Prior to placing CEMEX EVOLUTION[®], it should be confirmed that the reinforcement and formwork are arranged as planned and that the formwork is free of water and debris.

The release of the concrete into the formwork must be in relation to the density or reinforcement, the concrete's flow characteristics and to the potential for entrapment of air.

A reasonable length of flow helps excess air to escape. However a flow length of more than about 10 metres may create a greater risk of dynamic segregation or void formation.

A fast vertical casting may not allow air the time to rise to the surface and escape, causing an increased number of air voids to be trapped in the concrete and blowholes on the surface.

The casting process should be continuous and without interruption as this helps to maintain flow and reduces surface marks and colour variation.

CEMEX EVOLUTION[®] is more cohesive and usually less prone to segregation than normal concrete but free fall of concrete during placement may still cause some segregation and increase the content of entrapped air so it should be avoided if possible. If unavoidable, free fall height should be limited and checked should be carried out to determine the effect.

Where casting ICF walls concrete should not be placed directly at corners or wall ends in order to limit pressure development at these points

When casting extensive horizontal areas where part of the total area must be completed before casting successive areas, permanent stop ends are required and metal lathing has been successfully used with EVOLUTION[®] for this application.

Placing by Pump

Pumping is the most common method of placing CEMEX EVOLUTION[®] and consequently the method from which most experience has been gathered.

If the pump has not been primed with cement grout, the first part of the load (100 – 150 litres) should be run through the pump and recycled

back into the truck. This lubricates the pump lines, while the residual coarse aggregate is remixed back into the bulk of the concrete.

When finish needs to be optimised, CEMEX EVOLUTION[®] should be placed with a submerged hose in order to minimise the possibility of entrapped air. Casting should start at the lowest part of the form, and at a place where the pumping hose can be located as close as possible to the bottom of the form. As soon as sufficient depth has built up, the hose should then be submerged into the concrete. The end of the pump hose should, if possible be maintained below the concrete surface at all times, including when changing its location so that air is never allowed into the hose.

The pumping should be controlled to produce a continuous and even rate of rise of the concrete in the formwork, with as few breaks in delivery as possible.

Placing by concrete chute or skip

Although casting of CEMEX EVOLUTION[®] by a pump is recommended both concrete chute and skip have been successfully used. When discharging with a chute, the outlet from the chute should be directed towards the farthest end of the casting and withdrawn as casting proceeds.

When casting CEMEX EVOLUTION[®] from a crane and skip the following points should be considered.

- The skip method is normally only useful for relatively small units or short walls due to the casting capacity (typically 12-20m³ per hour) but depends on the size of the concrete skip and the manoeuvrability of the crane.
- The skip has to be 'tight' to prevent loss of mortar or paste during transport
- The skip should not be subject to vibration or excessive shaking to avoid segregation of the concrete.
- Concrete that is left in the skip too long will stiffen and it will not run from the skip spontaneously and smoothly when opened for discharge.
- Slow placing rate can cause a prolonged period of stagnation in the form leading to visible horizontal marks between lifts.
- When casting high or thin walls the casting should take place through a tremie pipe or stocking (collapsing hose) from the skip. The use of a collapsing hose rather than a rigid hose helps to

keep the hose full and prevents air being drawn into the concrete, this is especially important if the surface finish needs to be optimised. If a rigid tremie is used, the end should be kept below the concrete surface at all times and extra care is needed to ensure that air is not drawn into the concrete.

Vibration

Vibration of CEMEX EVOLUTION[®] should generally be avoided as it is likely to result in significant settlement of the coarse aggregate. If the desired compaction is not being achieved, consider changing the specification

There are some occasions when carefully controlled and light vibration may be needed:

- In some structures the formwork shape may cause air to be trapped at certain locations. This can normally be removed by localised tapping or simple rodding in the affected area.
- Slabs may require light tamping or a very gently vibrating screed bar to give a level finish, free of protruding coarse aggregate.
- Following a break in placing if the live surface has crusted or stiffened to the extent that a cold joint or surface finish blemish could form

Finishing Slabs

Slabs will generally require a lower flow class than CEMEX EVOLUTION[®] for walls and columns. This consistence, combined with the lack of bleed can make the concrete feel sitcky and difficult to finish. Initial finishing needs to be carried out as soon as possible after the correct level has been reached and before any surface drying has occurred

Vibrating floats and light vibrating screeds have proved to be effective in the screeding of this type of concrete provided the slab is not inclined, but manual equipment should be used if there is any risk of aggregate segregation. Steel floats function better than those made of wood or polyurethane cell foam.

If the surface of the slab slopes more than 2-3% care is required in the use of even light vibrating equipment as this can cause a sideways slipping or other unwanted movement of the fresh EVOLUTION[®]

Levelling of slabs is best carried out with the aid of light finishing with a skip float. This moves the surface concrete and gives sufficient compacting work, without causing unwanted aggregate segregation.

After treatment such as the use of steel trowel finishing or float finishing may be carried out as per conventional concrete, however due to the properties of the concrete, judging the correct time to start this may be difficult.

Curing

Curing is important for all concrete but especially so for the top surface of elements made with CEMEX EVOLUTION[®]. These can dry quickly because of the low water content of the mix and the lack of bleed water at the surface. Initial curing should therefore commence as soon as practicable after placing and finishing in order to minimise the risk of surface crusting and shrinkage cracks caused by early age moisture evaporation.