

Quality Control Checklist

Concreting for General Contractors



QC Checklist for General Contractors – Concreting

Building concrete structures often comes with a myriad of challenges and hectic activity at the job site. The construction phases can be very overwhelming and preparing for the upcoming pours is a crucial task. In order to ensure a smooth process, project managers and general contractors must take the appropriate measures to plan every aspect of the pour.

At Giatec, we understand the importance of assuring the quality of the project and preventing any delays or rework. Thus, we have created a comprehensive checklist for general contractors and project managers to make sure everything is in place at the three different stages of the pour:

1. Pre-Pour Inspection
2. Concrete Pour
3. Post-Pour (Stage 1 and Stage 2)

We hope that this checklist helps you to systematically address key aspects of the process, such as ensuring quality and compliance, minimizing risks, and facilitating a successful and efficient concrete placement.

Happy Pouring!

1. Pre-Pour Inspection

a. Check drawings

- The structure/element drawings contain fundamental information, ranging from rebar spacing, formwork details, waterproofing, concrete mix design, concrete sensors, among other details.
- Different types of drawings exist, from structural to electric, hydraulic, etc.
- For each given concrete pour, different drawings might need to be reviewed to guarantee a successful pre-pour inspection.

b. Check rebars

Spacing

- The spacing of the rebars refers to the typical distance between the steel bars.
- Without proper spacing, the element will not behave as intended.
- Spacing is also directly tied to the concrete maximum aggregate dimension. Improper spacing will directly affect the overall concrete durability because it can increase the probability of major honeycombs.

Hairpins

- Hairpins are also rebars with different shapes. They are typically used to interlock different layers of rebars in place.
- They help different layers to act as one while bearing the loads between different mats of rebars.
- They also serve the purpose of spacers, acting like chairs but in the inner portion of concrete elements.
- They can also be used as hooks to sustain and improve the overall stability of the rebar cage before concrete placement.

Diameter

- The rebar diameter is directly tied to the type and size of the element.
- Smaller-sized rebars can be fit for different purposes such as retaining the cage in place.
- Bigger-sized rebars can be used for other purposes such as holding the maximum tension the element is subjected to.
- Other elements such as post-tensioned concrete will have tendons instead of regular passive rebars.

Specifics

- Each design/drawing calls for different specs and arrangements.
- In a shotcrete tunnel, the rebars are often used as mats, whereas in typical concrete elements, the rebars are assembled in place.
- Checking the verticality of the rebars could be representative of a wall.
- Checking if the rebars follow a slope on a tunnel ceiling or a sloping slab can be important from a horizontal perspective. Therefore, different factors should be considered for different element types.

c. Check cover depth

 Distance between rebar and concrete surface

- The cover depth's main purpose is to provide minimum durability requirements for the concrete structure.
- Depending on the standard being used, there is minimal cover thickness based on exposure classes. For example, a C1 concrete would require a minimum cover depth of 75mm or 3 inches.
- Check cover depth both outside and blind side portions.
- The blind side can have an excessive cover that also needs to be addressed.

 Any excessive cover also needs to be addressed (clear cover)

- The excessive cover thickness will also affect durability. Without proper reinforcement, concrete alone can crack excessively, compromising durability.
- If the excessive cover is imposed per design, proper steel mesh can be used to control cracking, i.e., walls with blind side on SOE (Support of Excavation) or rock surface.

 Concrete chairs/spacers are properly placed

- Concrete chairs are fundamental to any reinforced concrete structure.
- Concrete chairs can be made of steel, plastic or concrete/grout.
- Typically, they are placed to support horizontal rebars on concrete slabs or horizontal elements.
- Also used on vertical elements to provide the correct cover thickness from the blind side portion and forms.

d. Check the waterproofing system (if applicable)

 If the structure has waterproofing

- Structures that are exposed to aggressive elements or water typically need waterproofing systems.
- Checking the waterproofing system for proper installation per manufacturer's recommendations.
- Check for fish mouths or any openings.

Waterstops

- Waterstops are typically placed across concrete joints to obstruct the water from coming through. It is an important component of the waterproofing system.

 Drainage

- Slabs on grade can be supported on drained or undrained sections.
- If applicable, a proper drainage system must be in place before the concrete pour.

e. Check forms

 Release agent was applied to the forms

- Release agents are important for several reasons including:
 - Providing an overall good surface finishing.
 - Maintaining the quality of the form throughout the project.
 - Maintaining the cleanliness of forms for new placements.
 - Enabling easier formwork removal.

 Time of application of the release agent

- Check if the release agent has dried out.
- Check manufacturer guidelines in terms of expiration of product after application (How much time before pouring can it be applied?).

 Forms are levelled

- Check the level of forms according to drawings.

 Type of forms and stability

- Check drawings for specs regarding forms support and type of concrete used.
- If SCC is to be used, special formwork is needed to restrain the loads.
- Are the forms significantly ridged and braced?

f. Check Concrete schedule

Delivery of concrete is scheduled

- Typically, the concrete needs to be scheduled no less than 1 day in advance.
- Depending on the size of the project and the agreement with the producer, concrete needs to be booked several days in advance.
- Inspection and checklist should be completed prior to scheduling concrete.

Time of delivery

- Field personnel need to inform the producer of the pouring start time so they can plan the number of drivers and trucks to be available.

Method of placement

- Pump: If the pump is not provided by the producer, coordinate with the operator and the third-party company that is providing the pump.
- Bucket: If bucket pouring, ensure that both crane and operator are ready.
- Chute: If the method is by chute, ensure proper access for the concrete truck.

Define the rate of delivery (i.e., a truck every 20 minutes)

- The rate of delivery is very important.
- If not followed, it could create pouring lines on the element (not architecturally acceptable).
- Could compromise the monolithic approach of a concrete element.

g. Book testing agency

Send the concrete requirements to the testing agency beforehand

Limits on the slump, entrained air, and temperature must be provided

Number of samples to be cast

- Lab cured samples
- Field cured samples

h. Check the mix design to be used

Confirm the type of concrete to be used

- The density of reinforcement might require concrete with a higher slump and limit on maximum aggregate size.
- Special on-site additions such as fibers or superplasticizers.

i. Season of placement and expected weather conditions

Check the weather forecast

- If bigger elements are to be placed and thunderstorm warnings are in place, proceed with caution.
- For the cold season:
 - Forms surface and/or ground temperature have a minimum temperature.
 - Are blankets and heating systems available onsite?
 - If the element is to be in contact with the soil, check the frost line and minimum air requirements in the mix design
- For hot season
 - Cooling pipes to be utilized for mass elements.
 - Does the pour need to be at night?

j. Review all available specs for checks

- Maximum temperature**
- Target strength**
- Maximum differential (Are cooling pipes needed? Check installation)**
- Maximum discharge time (Typically 90 minutes)**
- Maximum pouring temperature**
- Minimum pouring temperature**

k. Placement equipment

- Vibrators are available**
- Post-tensioning: Crew available to prepare the jacks for stressing**

l. Temperature and Maturity sensors

- Sensors installed**
- Check positioning of the sensors**
- Check if the element requires mass concrete thermal control**
- Check maturity calibration before the pour**

2. Concrete Pour

a. Check the concrete tickets

- Make sure it is the correct mix design
- Check the time and expiration time
 - ASTM C94: Allows a maximum discharge time of 90 minutes.
 - CSA A23.1: allows a maximum discharge time of 120 minutes.

b. Check the fresh properties of the first loads

- Slump / Slump flow
- Entrained air
- Temperature

c. Properties other than strength that are required for hardened concrete

- AVS (Air void system)
- RCP (Rapid Chloride Penetrability)
- ASR (Alkali Silica Reaction)

d. Cast concrete samples

- Concrete samples cast on the initial or initial loads
- Cast concrete cylinders for concrete acceptance (lab samples)
- Cast additional field cylinders if maturity is not being used

e. Follow the pour direction (when applicable)

- Identify and flag the beginning of the pour based on job site nuances
 - Concrete pavement: Slope – Begin from the highest point to the lowest (Exceptions may apply).
 - Elevated slab: Typically starts in the furthest corner returning to the slab access point.

f. Confirm delivery rate

- Trucks are arriving at the requested pace
- If using trailers, adjust the rate accordingly

g. Temperature and maturity sensors

- Confirm installation practice
- The cable and/or body are installed at the necessary locations (i.e., body closer to the surface and cable at the deep center of the element)
- Perform confirmation reading (download data)
- If using the SmartHub™, ensure that it is on and actively collecting readings from the sensors

h. Curing

- Curing activities have begun after the placement
- The time of pour met expectations
- No cold joints

i. Weather

- If cold weather, blankets have been applied and used correctly
- If hot weather, is pouring at night necessary? Record ambient conditions

3. Post-Pour (Stage 1)

a. Curing

- Confirm curing schedule is taking place (i.e., 3 days curing with tarps or blankets)
- Tarps/blankets must be available before the pour and must be checked daily

b. Protection for winter

- Confirm if the heating system is running continuously
- If power outages occur, confirm if the structure's temperature is within the tolerances, and that heaters are turned on as soon as possible
- SmartRock™ sensors can also be used to track the heater during the cold season, alerting users if issues occur

c. Check on sensors for temperature and maturity

- If mass element: Max temperature and temperature differentials
 - Can take proactive measures using blankets.
- If strength monitoring: confirm initial target has been hit
- If cold weather: confirm if the concrete temperature was/is within the tolerances

d. Thermal control

- Based on sensors information: Utilize blankets to prevent maximum temperature differential
 - Cooling pipes are active to reduce the temperature differential and maximum temperature peak (if applicable)

e. Strength

- Based on sensors data: Strips forms and/or stress cables
- Based on field concrete samples: Strip forms and/or stress cables

4. Post-Pour (Stage 2)

a. Check on sensors for temperature and maturity

- Export reports for QC acceptance and conformity. If needed, SmartRock reports can be used for CRs or NCRs.**
 - The strength readings will confirm if the target has been hit or if there is still a need to develop more strength.
 - The temperature readings will confirm if the steps taken made the concrete stay within the tolerances.

b. Removal of forms

- Perform formwork removal with caution after receiving confirmation from the sensors or samples that stripping is allowed**

c. Concrete finish

- Architectural concrete:**
 - Is the finish according to specs?
 - Do you need to make repairs?
- Measure the location of the cracks**
 - Size of the cracks.
 - Cracks are active or passive.
 - Use a crack meter to ensure the opening is within maximum tolerances.
- Imperfections and/or honeycombs**
 - If major issues are found, outline locations.
 - Define if repairs are needed.
- Open CRs or NCRs if needed**



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