Course: Concrete Technology

Lecture 12: Quality control in concrete

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Session Objectives

- Define the fundamental principles of quality and understand the elements that constitute an integrated management system.
- Analyze the relationship between quality management and concrete technology, identifying its application within construction processes.

Content

- Introduction to Quality Management
- Quality Management Tools
- Concrete Quality Control on Site

Course Knowledge Integration

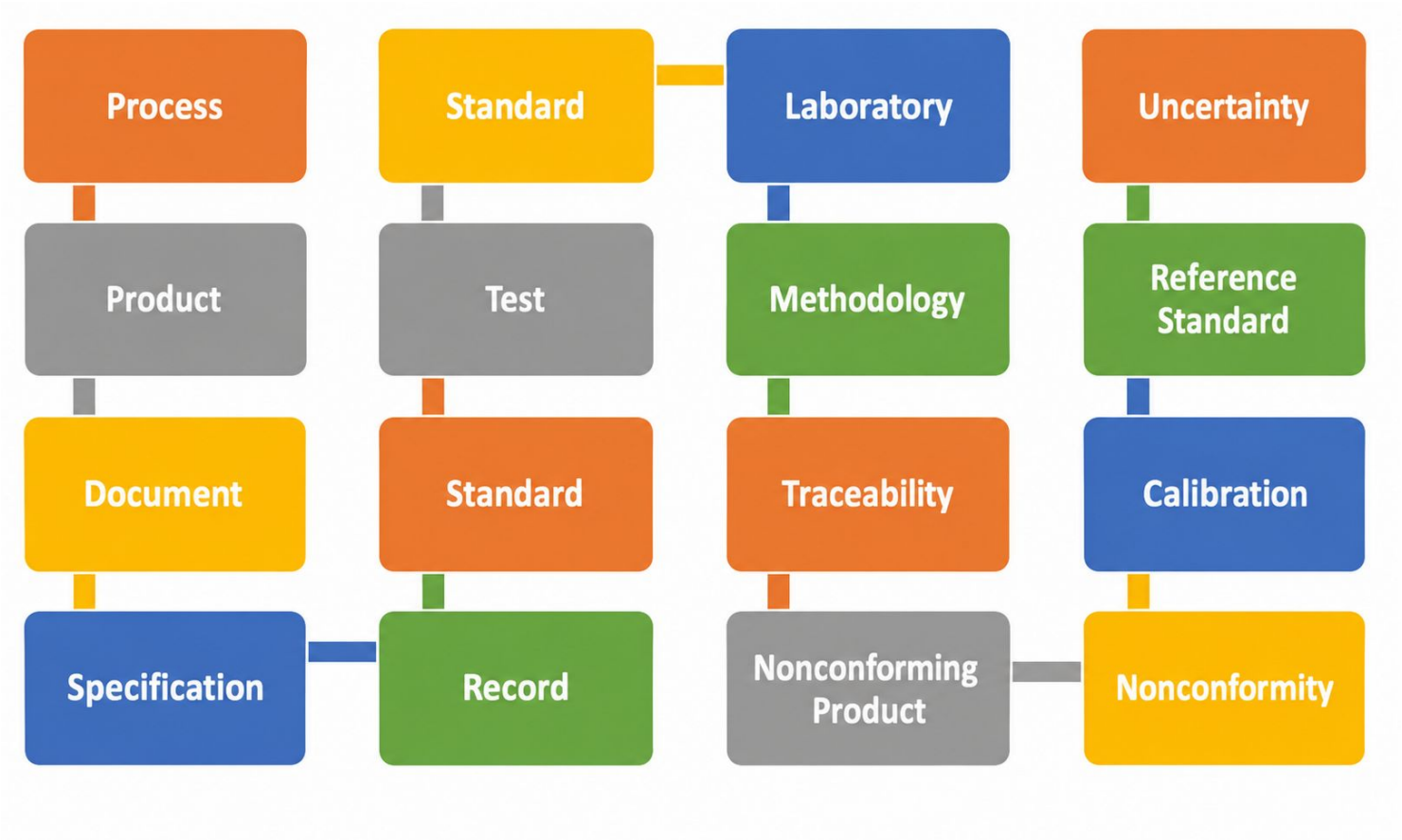
- Reviews previously studied concrete materials and their influence on final performance characteristics.
- Recalls concrete properties in both fresh and hardened conditions during service life.
- Reinforces understanding of concrete mix design and proportioning for required performance.
- Introduces quality control as integration of all previous concrete technology knowledge gained.

Introduction to Quality Management

Concept of Quality

- Quality measures how effectively products, processes, or services meet established requirements.
- Engineering quality ensures compliance with technical, functional, regulatory, safety, and reliability standards.
- Concrete quality guarantees design compliance, expected performance, structural safety, and durability.
- Construction quality requires integrated management from materials selection through inspections and testing.

Key Quality Management Terms



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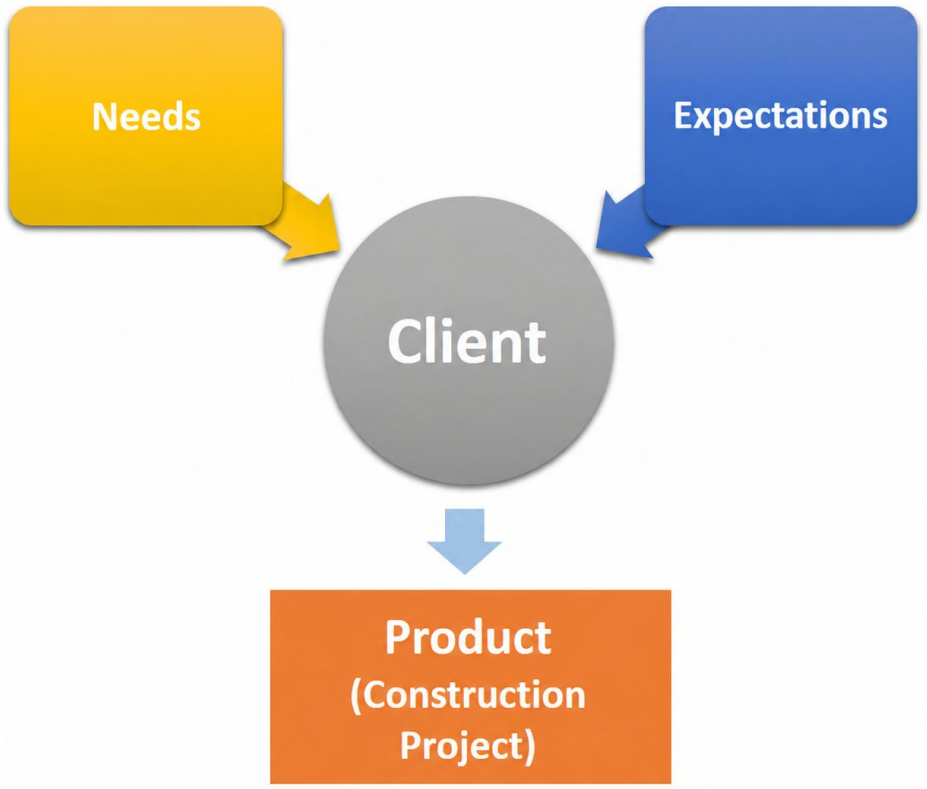
Subjective Nature of Quality



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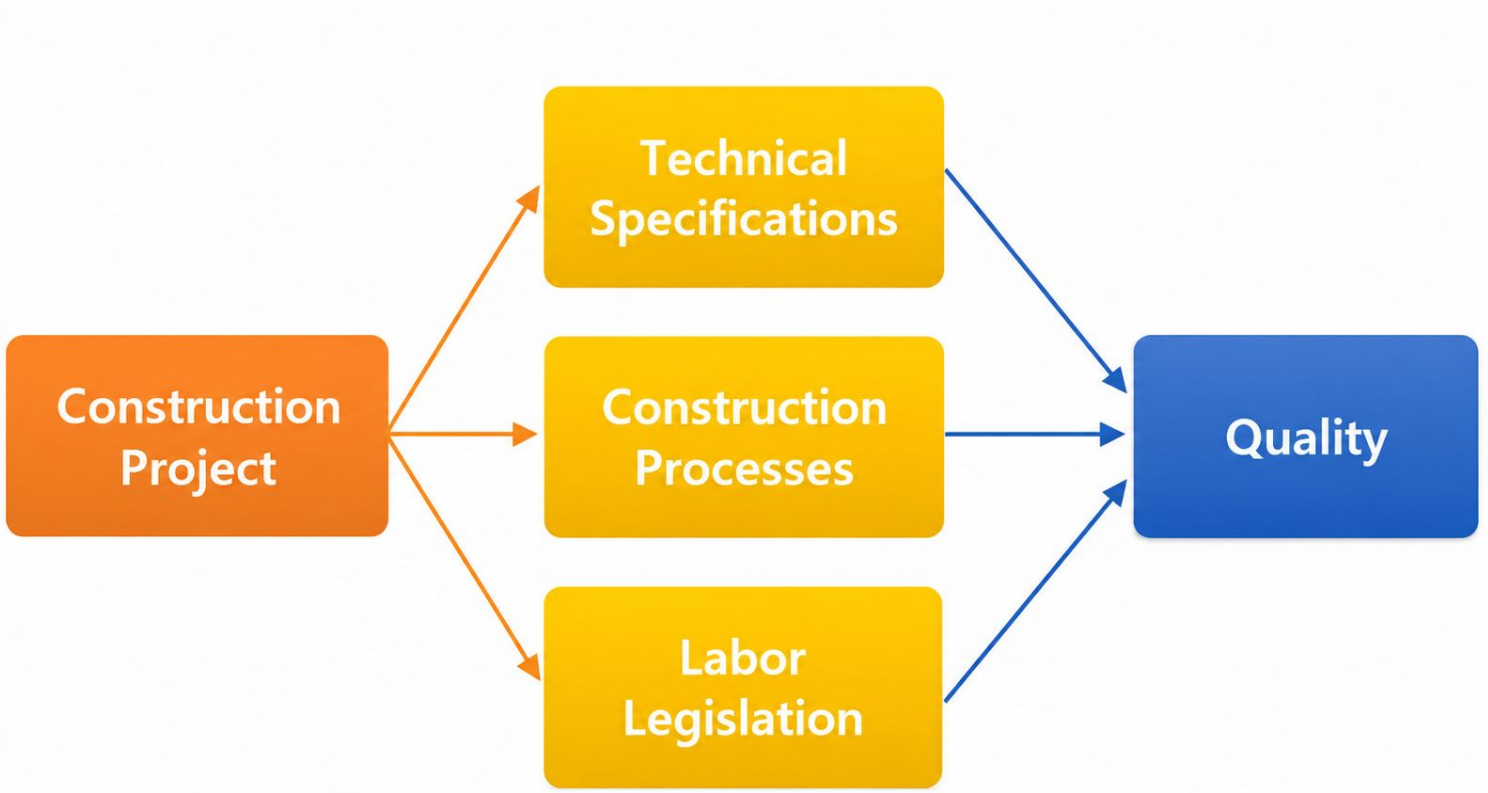
Objective Definition of Quality



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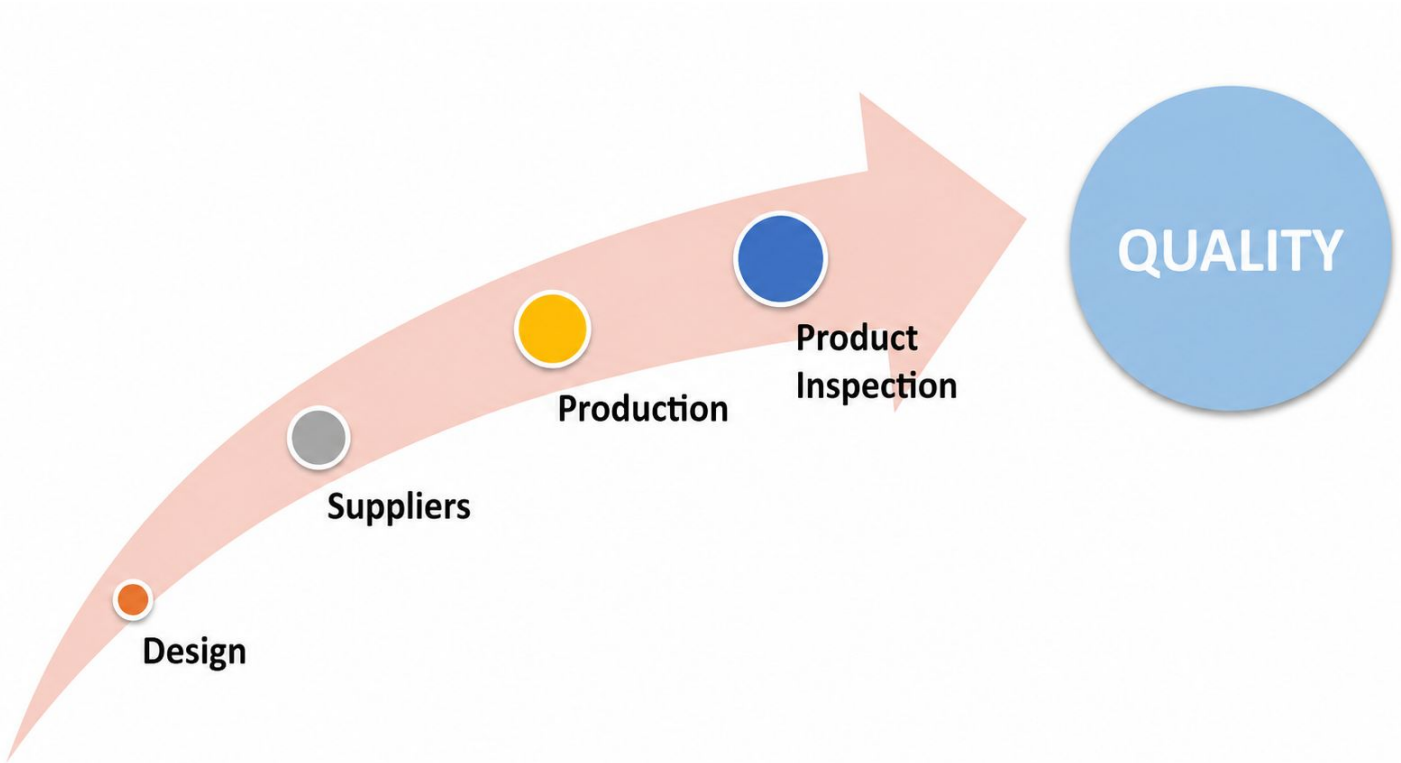
Quality Throughout Project Lifecycle



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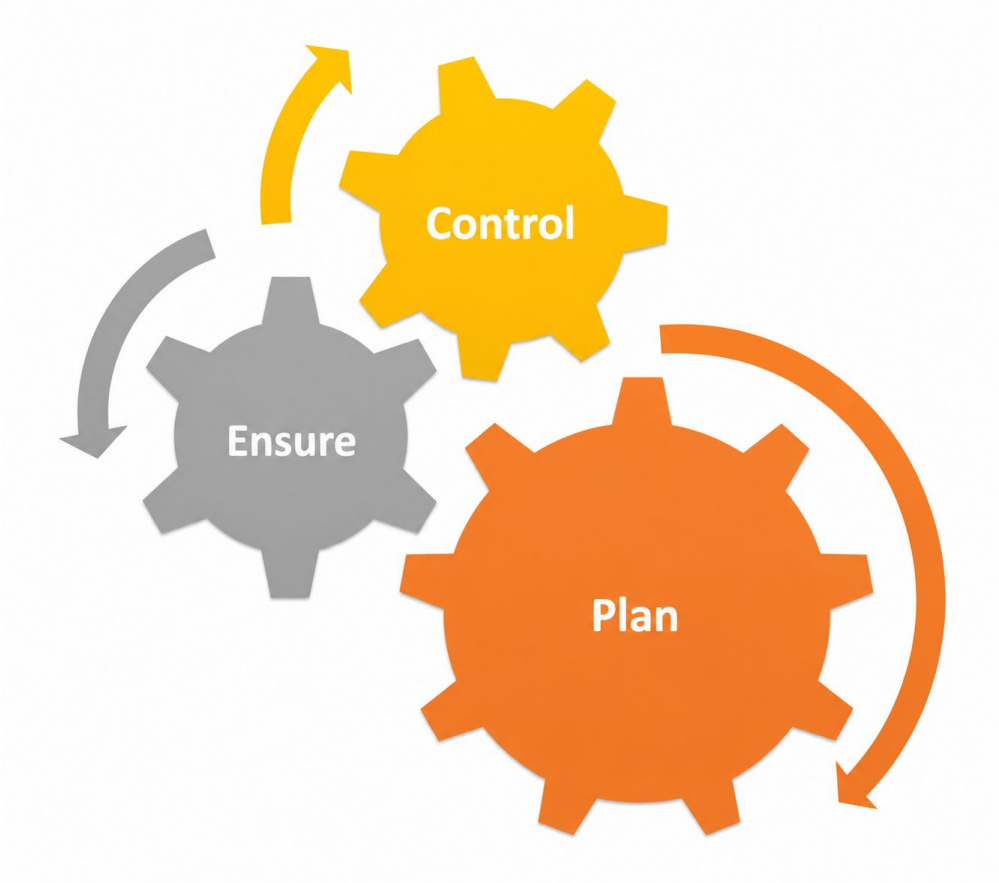
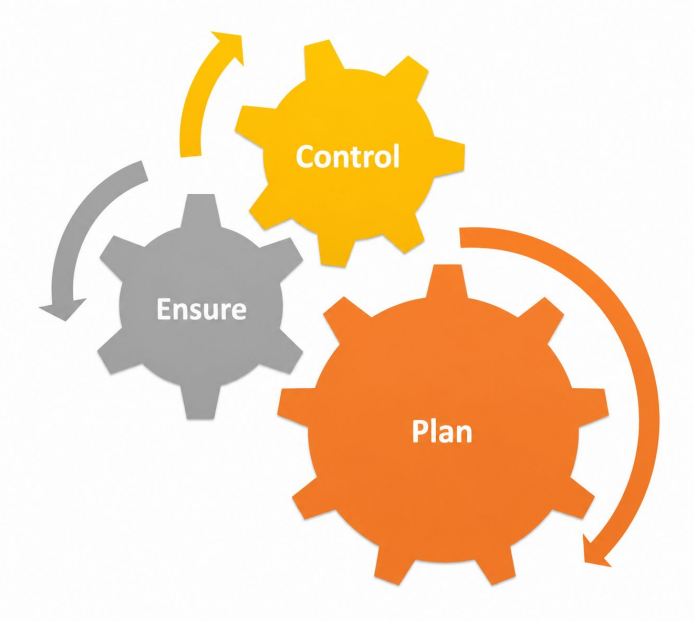
Quality Management Framework



Source: Author’s own ellaboration

Quality Planning

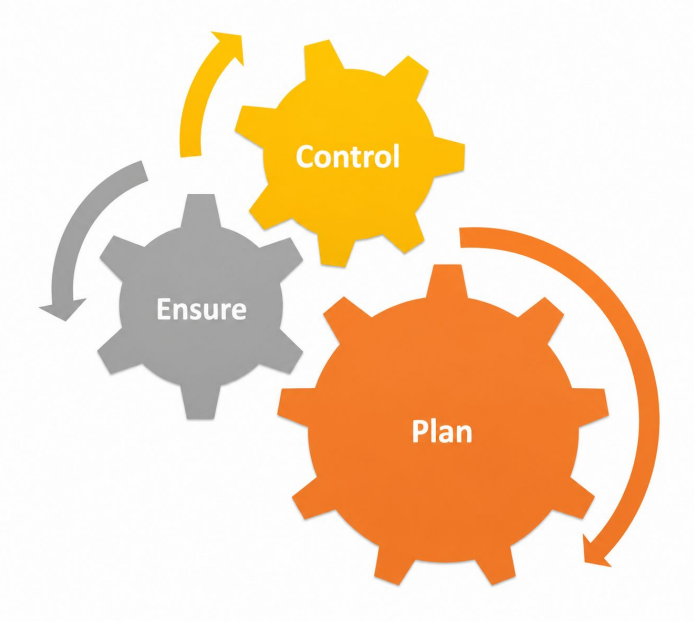
- Defines project quality requirements, standards, objectives, responsibilities, resources, and verification methods early.
- Establishes operational processes necessary to achieve specified quality objectives throughout project execution.
- Identifies applicable standards, procedures, inspections, controls, and required documentary evidence for compliance.
- Provides systematic framework ensuring deliverables meet contractual, technical, and regulatory quality expectations.



Source: Author's own ellaboration

Quality Assurance

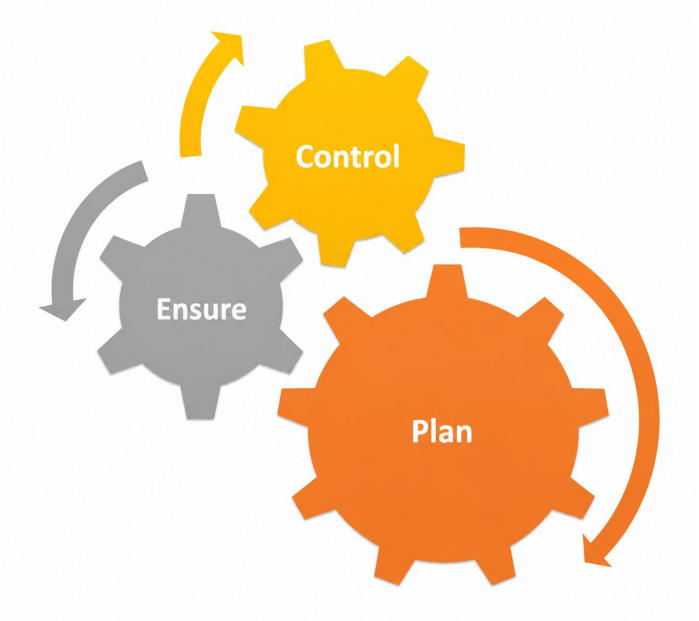
- Verifies project activities comply with established procedures, standards, and quality management requirements.
- Focuses on prevention by ensuring processes are correctly executed before deviations occur.
- Includes audits, technical reviews, and evaluations of implemented quality control results regularly.
- Promotes continuous process improvement to ensure confidence in final product quality outcomes.



Source: Author's own ellaboration

Quality Control

- Monitors, measures, and documents executed work to verify compliance with specifications requirements.
- Focuses on final product performance rather than solely on process execution quality.
- Uses inspections, testing, measurements, and records to validate constructed work conformity objectively.
- Identifies deviations and supports timely implementation of corrective actions when required immediately.



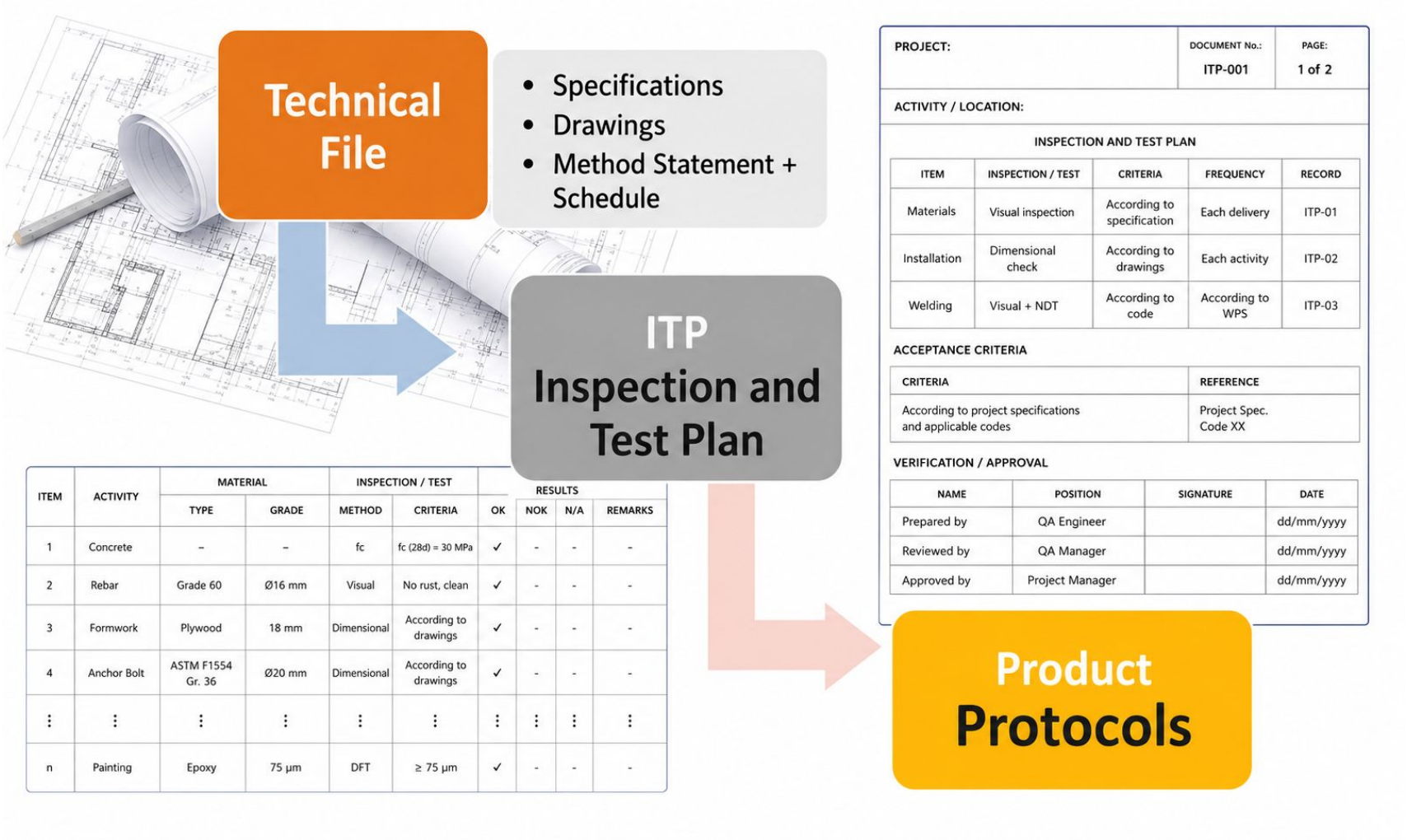
Source: Author's own ellaboration

Prevention versus Detection

- Quality assurance prevents problems through proactive process design and effective risk mitigation.
- Quality control detects deviations after execution, enabling timely corrective action implementation effectively.
- Risk management supports assurance by identifying, evaluating, controlling, monitoring, and reporting risks.
- Repeated risk-control cycles reduce uncertainty and increase probability of achieving required quality.

Source: Open AI (2026)

Quality Management Documentation Flow



ITEM	ACTIVITY	MATERIAL		INSPECTION / TEST		RESULTS			
		TYPE	GRADE	METHOD	CRITERIA	OK	NOK	N/A	REMARKS
1	Concrete	–	–	fc	fc (28d) = 30 MPa	✓	-	-	-
2	Rebar	Grade 60	Ø16 mm	Visual	No rust, clean	✓	-	-	-
3	Formwork	Plywood	18 mm	Dimensional	According to drawings	✓	-	-	-
4	Anchor Bolt	ASTM F1554 Gr. 36	Ø20 mm	Dimensional	According to drawings	✓	-	-	-
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
n	Painting	Epoxy	75 µm	DFT	≥ 75 µm	✓	-	-	-

PROJECT:	DOCUMENT No.: ITP-001	PAGE: 1 of 2

ACTIVITY / LOCATION:

INSPECTION AND TEST PLAN

ITEM	INSPECTION / TEST	CRITERIA	FREQUENCY	RECORD
Materials	Visual inspection	According to specification	Each delivery	ITP-01
Installation	Dimensional check	According to drawings	Each activity	ITP-02
Welding	Visual + NDT	According to code	According to WPS	ITP-03

ACCEPTANCE CRITERIA

CRITERIA	REFERENCE
According to project specifications and applicable codes	Project Spec. Code XX

VERIFICATION / APPROVAL

NAME	POSITION	SIGNATURE	DATE
Prepared by	QA Engineer		dd/mm/yyyy
Reviewed by	QA Manager		dd/mm/yyyy
Approved by	Project Manager		dd/mm/yyyy

Source: Author's own ellaboration

Quality Management Tools

Quality Plan

- Defines how project quality management will be implemented throughout construction execution activities.
- Aligns company quality policy with project objectives and applicable external standards requirements.
- Includes organization, responsibilities, ITPs, procedures, non-conformance management, and monitoring systems comprehensively.
- Serves as roadmap for systematic planning, assurance, and control of project quality.

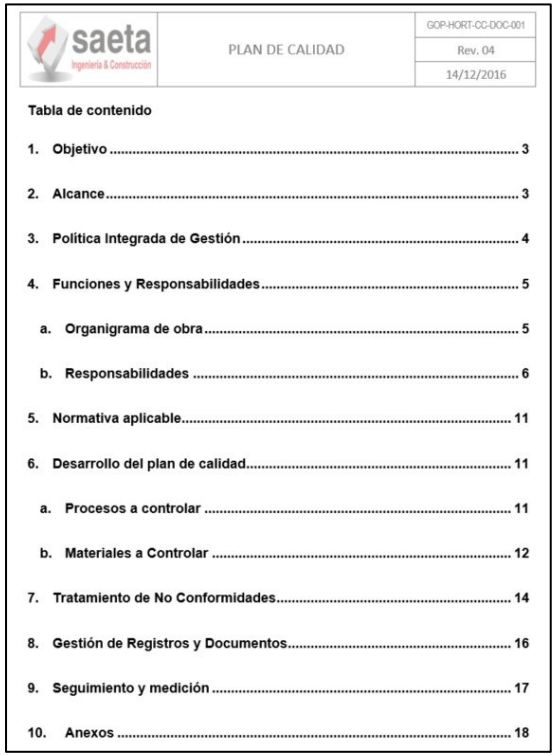


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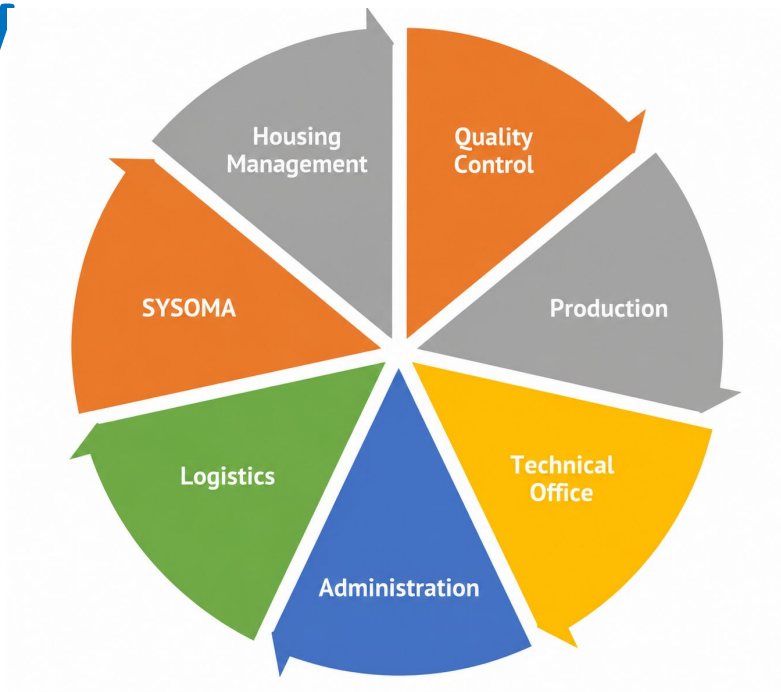
Tabla de contenido

Source: Author's own ellaboration

Cross-Functional Responsibility

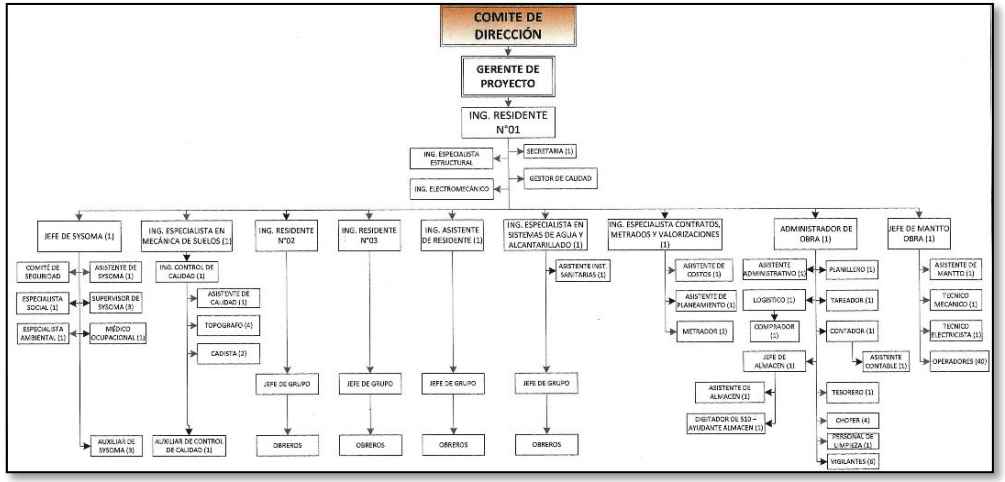
- Quality is responsibility of all project participants, not only quality personnel exclusively.
- Begins in procurement and continues through execution, supervision, and project management activities.
- True project progress requires compliance with standards, specifications, and established procedures consistently.
- Every stakeholder contributes directly to achieving final technical and functional project quality.



Source: Author's own ellaboration

Organizational Structure

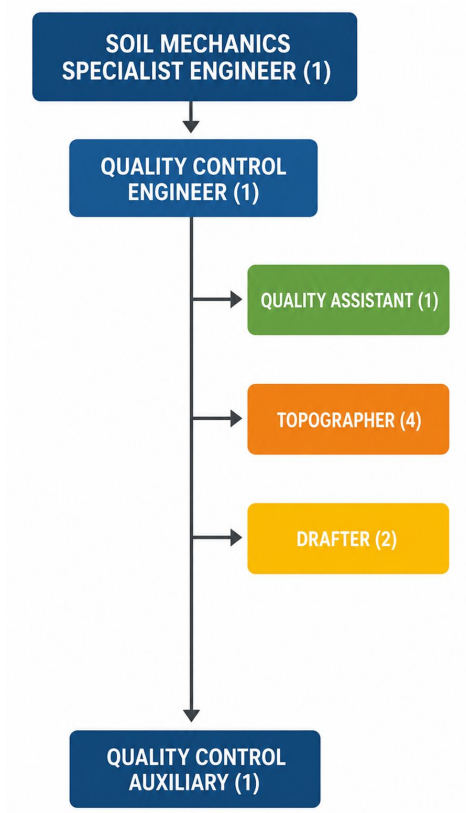
- Organizational charts define responsibilities, authority lines, and communication channels within projects clearly.
- Support project objectives by clarifying decision-making, execution, and supervision roles across departments.
- Typical departments include safety, quality, technical office, production, and project administration teams.
- Clear structure enables accountability, traceability, and effective implementation of quality management systems.



Source: Author's own ellaboration

Roles and Responsibilities

- Quality Plan must define responsibilities for every position and project department clearly.
- Includes inspections, testing oversight, documentation control, training, and non-conformance management responsibilities.
- Supports calibration verification, supplier evaluation, and preparation of periodic quality performance reports.
- Clear responsibilities prevent overlaps, gaps, and misunderstandings within quality management systems effectively.



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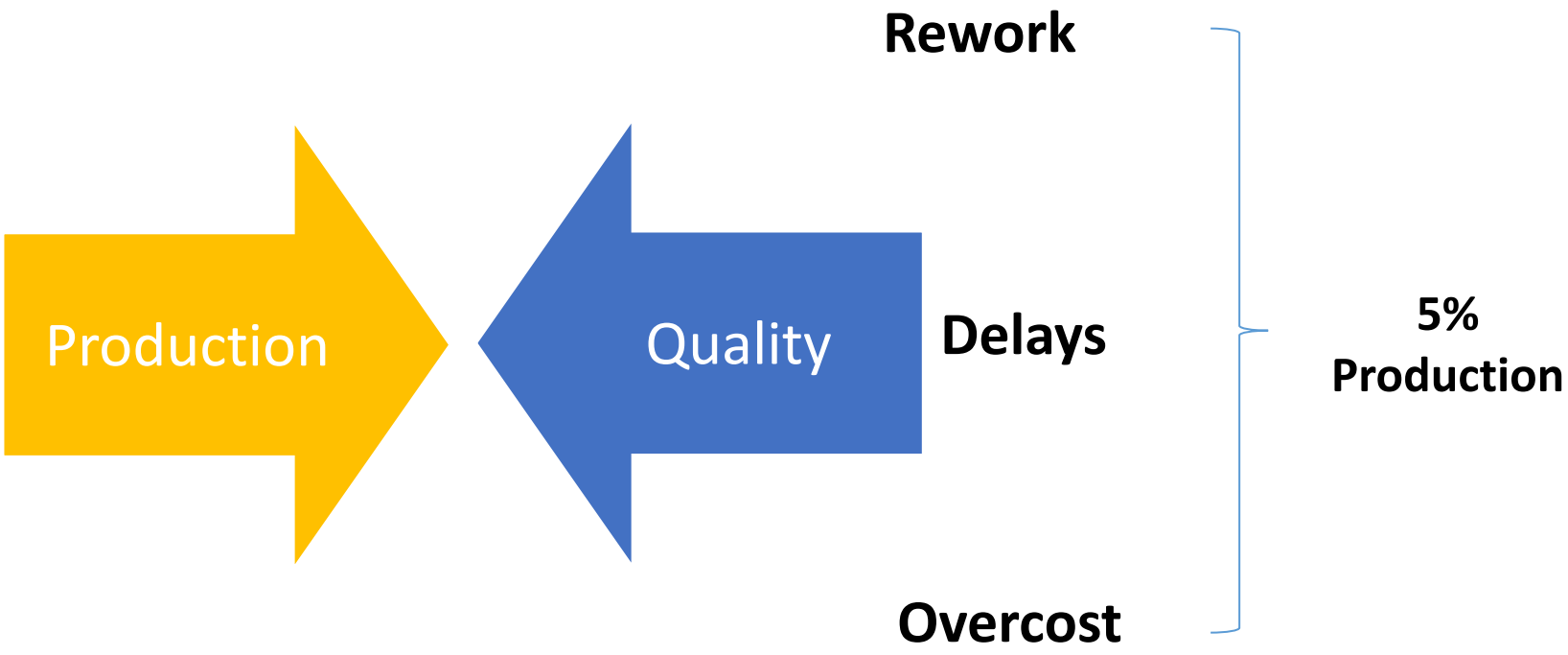
Quality and Production Alignment



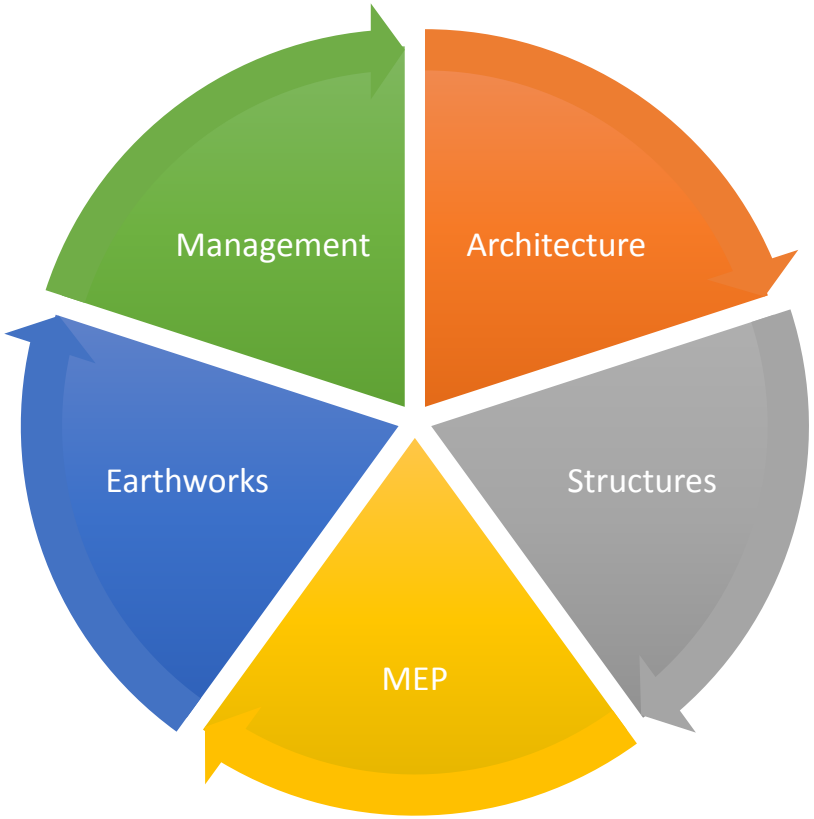
Source: Author's own ellaboration

Procedures and Work Instructions

- Standardize construction activities by defining how each process must be executed properly.
- Include responsibilities, technical references, process steps, acceptance criteria, and control points clearly.
- Must align with project specifications, contractual requirements, and applicable regulatory standards fully.
- Support quality assurance by ensuring consistent execution and personnel understanding of procedures.

Quality Records and Protocols

- Quality records verify and document compliance of executed construction processes.
- Protocols provide objective evidence supporting supervision reviews and client acceptance.
- Applied across disciplines including structures, architecture, installations, earthworks, and administration.
- Support corrective actions, deviation tracking, and validation of construction progress.



Source: Author's own ellaboration

Checklists and Verification Lists

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QUALITY CONTROL RECORD
CONCRETE PLACEMENT

FORM CODE: QC-CC-01
REV.: 0
DATE: 05/2024

PROJECT:	OFFICE BUILDING CONSTRUCTION	LOCATION:	BASEMENT LEVEL – FOUNDATION	DATE:	
CLIENT:	ABC DEVELOPMENT INC.	CONCRETE ELEMENT:	FOUNDATION WALL		
CONTRACTOR:	SAETA ENGINEERING & CONSTRUCTION	ELEMENT ID:	FW-01	TIME:	
SUPERVISOR:	QUALITY CONTROL DEPARTMENT	DESIGN STRENGTH (f'c):	28 MPa (4000 psi)	MIX DESIGN: MD-01	SHEET: 1 OF 1

1. PRE-POUR INSPECTION (BEFORE PLACEMENT)

FORMWORK

	YES	NO
1. Clean and free of debris	☐	☐
2. Proper dimensions and alignment	☐	☐
3. Tight joints to prevent leakage	☐	☐
4. Release agent correctly applied	☐	☐
5. Supports and bracing in place	☐	☐
6. Level and elevation verified	☐	☐
7. Openings and embeds installed	☐	☐
8. Other: _____	☐	☐

REINFORCEMENT STEEL

	YES	NO
1. Correct size and grade	☐	☐
2. Clean and free of rust or contaminants	☐	☐
3. Correct placement and spacing	☐	☐
4. Proper lap lengths and development	☐	☐
5. Adequate supports and chairs	☐	☐
6. Splices according to drawings	☐	☐
7. Clear cover verified	☐	☐
8. Other: _____	☐	☐

CONCRETE

	YES	NO
1. Mix design approved	☐	☐
2. Delivery ticket reviewed	☐	☐
3. Slump test performed (as specified)	☐	☐
4. Air content test performed (as specified)	☐	☐
5. Concrete temperature (as specified)	☐	☐
6. Other: _____	☐	☐

EMBEDMENTS / INSTALLATIONS

	YES	NO
1. Electrical conduits in place	☐	☐
2. Plumbing inserts in place	☐	☐
3. Anchor bolts in place	☐	☐
4. Sleeves in place: _____	☐	☐
5. Inserts in place: _____	☐	☐
6. Other: _____	☐	☐

SLUMP (mm)	AIR CONTENT (%)	TEMPERATURE (°C)

DELIVERY TIME: _____
PLACE TIME: _____

SLUMP (mm)	AIR CONTENT (%)	TEMPERATURE (°C)

DELIVERY TIME: _____
PLACE TIME: _____

2. CONCRETE PLACEMENT

DATE: _____ START TIME: : FINISH TIME: : WEATHER: SUNNY ☐ CLOUDY ☐ RAINY ☐

TEMPERATURE (°C): AMBIENT: _____ CONCRETE: _____ PLACEMENT METHOD: PUMP ☐ BUCKET ☐ CHUTE ☐ OTHER _____

Truck No.	Ticket No.	Load (m³)	Slump (mm)	Air (%)	Temp. (°C)	Placement Location	Layer	Compaction Method	Start Time	End Time	Placed by

SLUMP (mm)	AIR CONTENT (%)	TEMPERATURE (°C)
MIN:	MIN:	MIN:
MAX:	MAX:	MAX:

PLACEMENT VOLUME (m³): PLACEMENT AREA (m²): PLACEMENT THICKNESS (cm):

3. POST-POUR INSPECTION

	YES	NO
1. Surface finish in accordance with requirements	☐	☐
2. Edges and joints in accordance with requirements	☐	☐

3. Curing method in place: _____
4. Initial curing started: YES ☐ NO ☐ TIME: _____ OTHER: _____

PRE-POUR INSPECTION

PREPARED BY:	POSITION:	SIGNATURE:	DATE: / / TIME:
INSPECTION AND MEASUREMENT	QUALITY CONTROL	CONSTRUCTION SUPERVISOR	

POST-POUR INSPECTION

PREPARED BY:	POSITION:	SIGNATURE:	DATE: / / TIME:
QUALITY CONTROL	RESIDENT ENGINEER	SITE SUPERVISOR	

Source: Author's own ellaboration

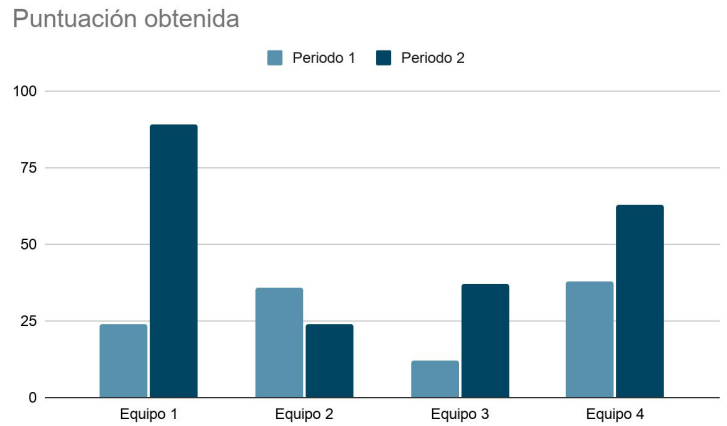
RFIs and Nonconformities

- RFIs formally address ambiguities, technical clarifications, and execution-related project changes.
- Engineering changes document approved modifications to design, scope, or methodology.
- Nonconformities identify deviations, root causes, corrective actions, and preventive measures.
- Together, these tools strengthen traceability and continuous quality improvement efforts.

Source: Author's own ellaboration

Quality Indicators Examples

- Nonconformities per period measure deviations and track process quality improvement.
- First Pass Yield evaluates approvals without corrections, indicating construction efficiency.
- Testing plan compliance verifies scheduled quality control activities are completed.
- Closure time measures responsiveness in resolving identified project nonconformities efficiently.



Source: Author's own ellaboration

Concrete Quality Control on Site

Concrete Quality Control Stages

QUALITY MANAGEMENT OF CONCRETE IN THE FIELD

To understand how quality management is applied to concrete in the field, we will focus our analysis on four typical activities within an infrastructure project that are directly related to this material.

These activities represent key stages of the concrete construction process and help illustrate how quality planning, quality assurance, and quality control are integrated on site.

FOCUS:
CONSTRUCTION SITE ENVIRONMENT
This analysis covers the controls and inspections performed directly during project execution on site.

1 CONCRETE PLACEMENT RELEASE OR AUTHORIZATION

This corresponds to the pre-pour verification stage, ensuring that all technical conditions have been satisfied before concrete placement begins.

2 FRESH CONCRETE QUALITY CONTROL

This includes inspections and tests performed on newly produced or delivered concrete to verify that it meets specified properties before placement.

3 HARDENED CONCRETE QUALITY CONTROL

This includes evaluations conducted after setting and hardening, primarily aimed at verifying compressive strength and other mechanical properties.

4 POST-PLACEMENT VERIFICATION

This involves inspection of the completed structural element, evaluating aspects such as geometry, surface finish, presence of defects, and overall compliance with specifications.

IMPORTANT NOTE:
It is important to clarify that this entire analysis focuses on the construction site environment, meaning the controls and inspections performed directly during project execution.

NEXT SESSION:
This topic will be complemented by addressing concrete quality control in the laboratory environment, where we will study in greater depth the testing methods and technical procedures used for evaluating materials and concrete.

Source: Open AI (2026)

Pre-Pour Authorization

Source: Author’s own ellaboration

Reinforcement Inspection

Source: Author’s own ellaboration

Interdisciplinary Coordination

Source: Author’s own ellaboration

Formwork Inspection

Source: Author’s own ellaboration

Receiving Surface Inspection

Source: Author’s own ellaboration

Fresh Concrete Receiving Control

Source: Author's own ellaboration

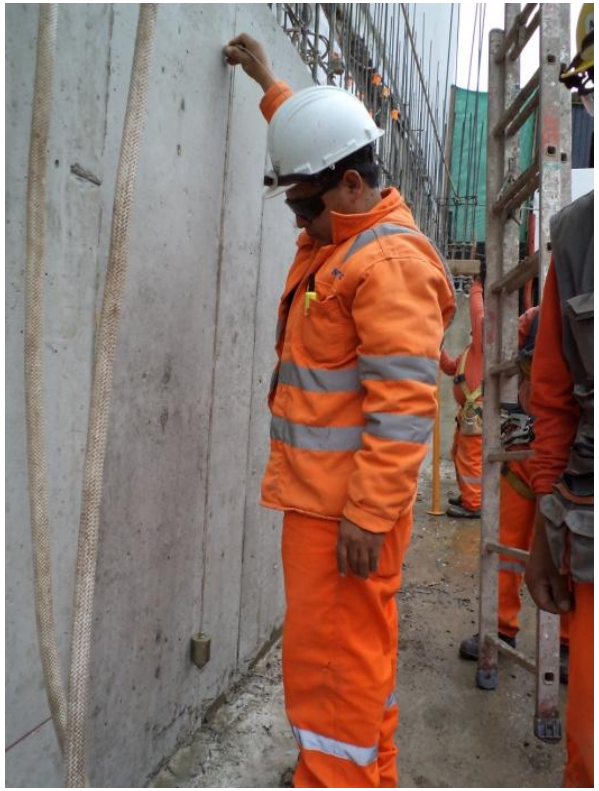
Placement Level Control

Source: Author’s own ellaboration

Specimen Molding and Initial Setting

Source: Author's own ellaboration

Post-Placement Verification

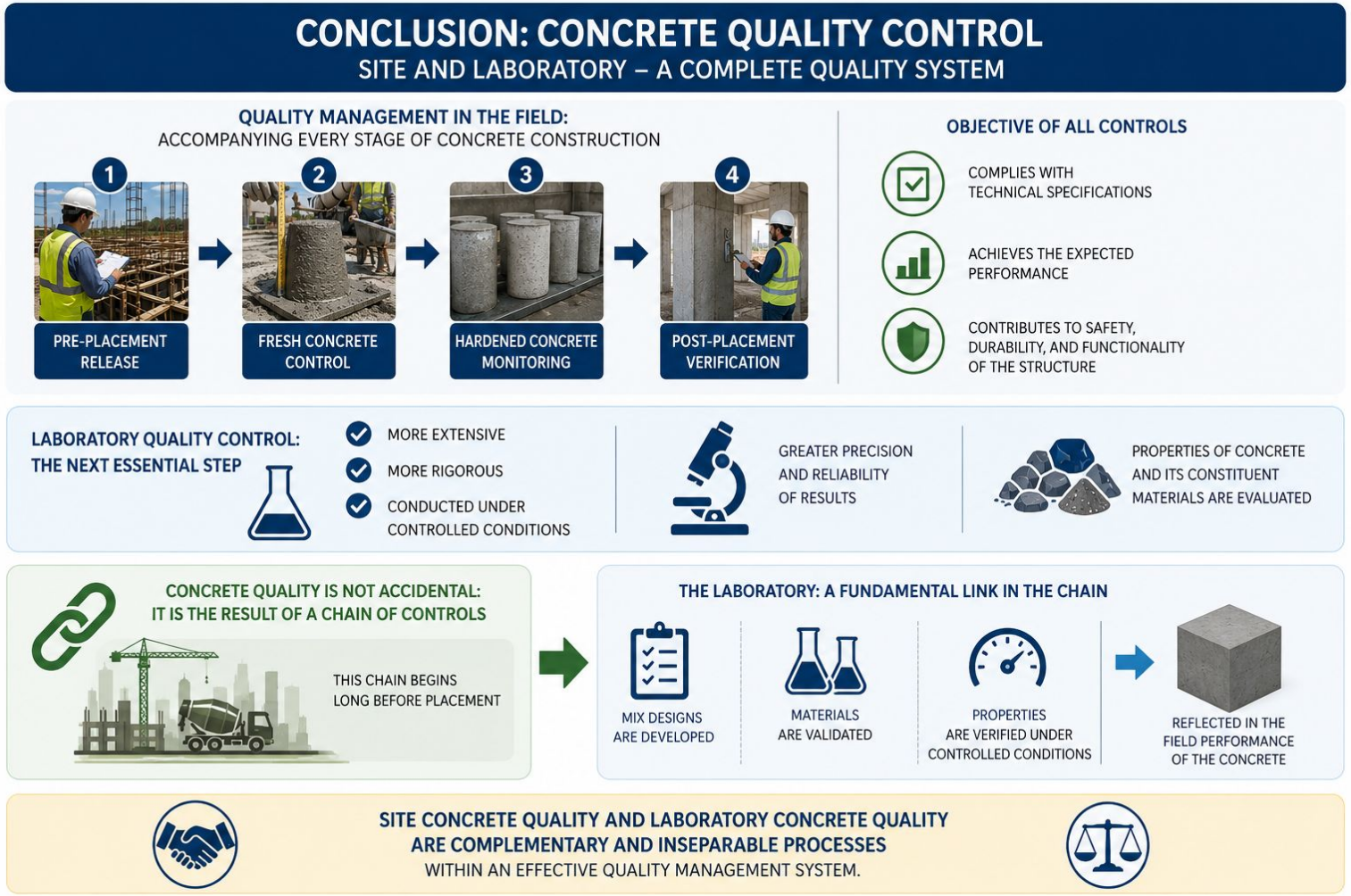


Source: Author's own ellaboration

Nonconformity Identification and Corrections

Source: Author’s own ellaboration

Concrete Quality Control: A Continuous Process from Site to Laboratory



Source: Open AI (2026)

Conclusions

- Quality management in construction involves all project phases and stakeholders through planning, assurance, and quality control processes.
- Concrete quality must be monitored continuously before placement, during fresh concrete operations, throughout hardening, and after formwork removal.
- Effective field controls help ensure compliance with technical specifications, structural performance, durability, and reliability of the concrete.
- Laboratory testing supports quality management by validating materials, mix designs, and concrete properties
  under controlled conditions.

References

- American Society for Testing and Materials. (2006). SIGNIFICANCE OF TESTS AND PROPERTIES OF Concrete & Concrete-Making Materials. West Conshohocken: ASTM International.Pasquel, E. (1998). Topics in Concrete Technology in Peru. Lima: College of Engineers of Peru – National Council.
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- Gómezjurado, J., Osorio, J., & Niño, J. (2014). Concrete Technology: Materials, Properties, and Mix Design. Bogotá: Colombian Association of Concrete Producers.

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