Quality Assurance Programme for Carbonated Fly Ash Brick (C-Brick) Plant (2,00,000 Bricks/Day Capacity)

1. Introduction and Scope

This Quality Assurance (QA) Programme details the procedures, checks, and criteria to ensure the consistent production of high-quality Carbonated Fly Ash Bricks (C-Bricks) at the proposed 2,00,000 bricks per day manufacturing facility. The programme covers all stages, from raw material inspection to the testing of finished products, ensuring strict adherence to relevant national standards.

2. SCOPE

This QAP covers:

- Raw material quality control
- In-process quality checks
- Finished product testing
- Equipment calibration and maintenance
- Documentation and traceability
- Safety and environmental compliance

3. ORGANISATIONAL RESPONSIBILITY

Role	Responsibility
Plant Manager	Overall implementation of QAP, production monitoring, approval of reports.
Quality Control Engineer	Supervision of testing, sampling, and lab records.
Laboratory Technician	Daily testing of raw materials and finished bricks.
Production Supervisor	Ensuring process parameters and operational discipline.
Maintenance Engineer	Calibration and upkeep of equipment.

4. RAW MATERIAL QUALITY CONTROL

Material	Parameter	Frequency	Method/Standard	Acceptance Criteria
Fly Ash	Fineness, LOI, Moisture, SiO_2, Al_2O_3, Fe_2O_3, CaO	Weekly	IS 3812 (Part 1)	LOI < 5%, Fineness < 320 m^2/kg
Lime (Quick/Lump)	CaO %, MgO %, Reactivity	Weekly	IS 1514	CaO ≥ 85%, Reactivity ≥ 200 ml (standard test)
Water	pH, Chloride, Sulphate content	Monthly	IS 456	pH 6–8, Chloride < 500 mg/l
CO_2 Gas	Purity, Pressure	Daily	ASTM D1945	CO_2 ≥ 99.5%

5. PROCESS QUALITY CONTROL

5.1 Initial Mixing (Primary Mixer – 91% Fly Ash + 3% Lime)

- **Mixing time**: 4 minutes
- **Moisture**: 8–10%
- **Observation**: Uniform texture, no lime lumps.
- **Check Frequency**: Once per shift.

5.2 Carbonation (Secondary Mixer – CO_2 Injection)

- **Material Hold Time**: 30 minutes
- **CO_2 Pressure**: 6-10 bar (during mixing)
- **Temperature**: ….
- **CO_2 Flow Rate**: …. kg/m^3 of mix
- **Frequency**: Every batch.

5.3 Attrition Mixing (Third Stage – 6% Lime Addition)

- **Mixing time**: 7 minutes
- **Consistency check**: Visual & moisture (8–10%)
- **Check Frequency**: Once per hour.

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5.4 Hydraulic Pressing

- **Pressing Pressure**: ..... kg/cm²
- **Weight of Brick**: .... kg
- **Dimension Tolerance**: ±2 mm in length/width, ±3 mm in height
- **Frequency**: ... bricks/hour/press.

5.5 Precuring

- **Duration**: 2 hours
- **Temperature**: Ambient (≤ 40°C)
- **Observation**: Bricks firm enough for autoclaving.

5.6 Autoclaving

- **Pressure**: 10 bar
- **Duration**: 12 hours
- **Temperature**: 175–185°C
- **Frequency**: Record for each autoclave cycle.

5.7 Final Carbonation

- **CO_2 Pressure**: 6-10 bar
- **Duration**: 1 hours
- **CO_2 Utilization**: Record kg CO_2/ton of bricks
- **Expected Uptake**: ...% by weight of CaO equivalent.

6. FINISHED PRODUCT QUALITY TESTS

Test	Frequency	Method	Acceptance Criteria
Compressive Strength	1 sample per 5,000 bricks	IS 3495 (Part 1)	≥ 10 MPa (Avg), ≥ 8.5 MPa (Min)
Water Absorption	1 per 5,000 bricks	IS 3495 (Part 2)	≤ 12%
Efflorescence	1 per 10,000 bricks	IS 3495 (Part 3)	Nil to Slight
Dimension & Shape	10 bricks/shift	IS 1077	Within tolerance
Density	Weekly	IS 2185	1800–1900 kg/m³

7. EQUIPMENT CALIBRATION

Equipment	Frequency	Calibration Method
Weighing Scales	Monthly	Standard Weights
Pressure Gauges (Press, Autoclave)	Quarterly	Certified Calibration Lab
Thermometers/Thermocouples	Quarterly	Reference Calibration
Flow Meters (CO_2 & Steam)	Quarterly	Factory Calibration
Compression Testing Machine	Half-Yearly	NABL Calibration

8. DOCUMENTATION & RECORDS

- Batch production register (mix ratio, batch size, operator, time)
- Autoclave & carbonation logbooks
- Raw material test reports
- Finished product quality reports
- Calibration certificates
- Non-conformance & corrective action records

9. NON-CONFORMANCE & CORRECTIVE ACTION

- **Identification and Isolation:** Any raw material or finished brick failing the specified quality criteria shall be immediately marked and moved to a designated **quarantine area**.
- **Disposition:** Non-conforming bricks will be segregated for **crushing and re-use** as aggregate/filler material in the production process to maintain resource efficiency. **Under no circumstances** will rejected bricks be dispatched or sold.
- **Corrective and Preventive Action (CAPA):** The QA/QC Manager initiates an investigation into the cause of non-conformity (e.g., equipment failure, batching error, raw material variation) and implements changes to the process or mix design to prevent recurrence. All actions are logged.

10. Calibration and Documentation

1. **Calibration:** All testing equipment (UTM, balances, pressure gauges) and critical process sensors (CO2, temperature) shall be calibrated by a **NABL-accredited external agency** at least **bi-annually**. Calibration status will be clearly displayed on all equipment.

2. **Documentation:** Comprehensive quality records for all stages (Raw Material Test Reports, Batching Logs, Carbonation Cycle Logs, Finished Product Test Certificates, and Non-Conformity Reports) will be maintained digitally and in hard copy for a minimum period of **five years** for full product traceability and audit readiness.

11. SAFETY & ENVIRONMENTAL COMPLIANCE

- CO_2 leak detection & ventilation system checks – daily
- Operator PPE compliance (CO_2, steam zones) – continuous
- Fly ash dust suppression measures – continuous
- Effluent and emissions monitoring – monthly

12. QUALITY AUDIT & REVIEW

- **Internal Audit**: Monthly (process + documentation)
- **Management Review**: Quarterly
- **External Audit (if ISO certified)**: As per audit schedule

13. REFERENCES

- IS 12894:2002 – Pulverized Fuel Ash–Lime Bricks
- IS 2185 (Part 1):2005 – Concrete Masonry Units
- IS 3495 (Part 1–4):1992 – Methods of Tests for Burnt Clay Building Bricks
- ASTM C1559 – CO_2 Sequestration in Cementitious Materials
- ISO 9001:2015 – Quality Management Systems

We hereby provide the necessary information on Quality Assurance Program containing the overall Quality Management and procedures, which we propose to follow during various phases of execution of the Contract.

- A quality assurance program (QAP) is a systematic approach implemented by organizations to ensure that their products or services meet certain predefined quality standards. It involves a set of processes, procedures, and methodologies designed to monitor, assess, and improve the quality of products or services throughout their lifecycle.

- Here are some key components of a quality assurance program: Quality Planning, Quality Control, Quality Improvement, Training and Education, Documentation and Recordkeeping, Audits and Reviews, Customer Feedback and Satisfaction, Supplier Management, Risk

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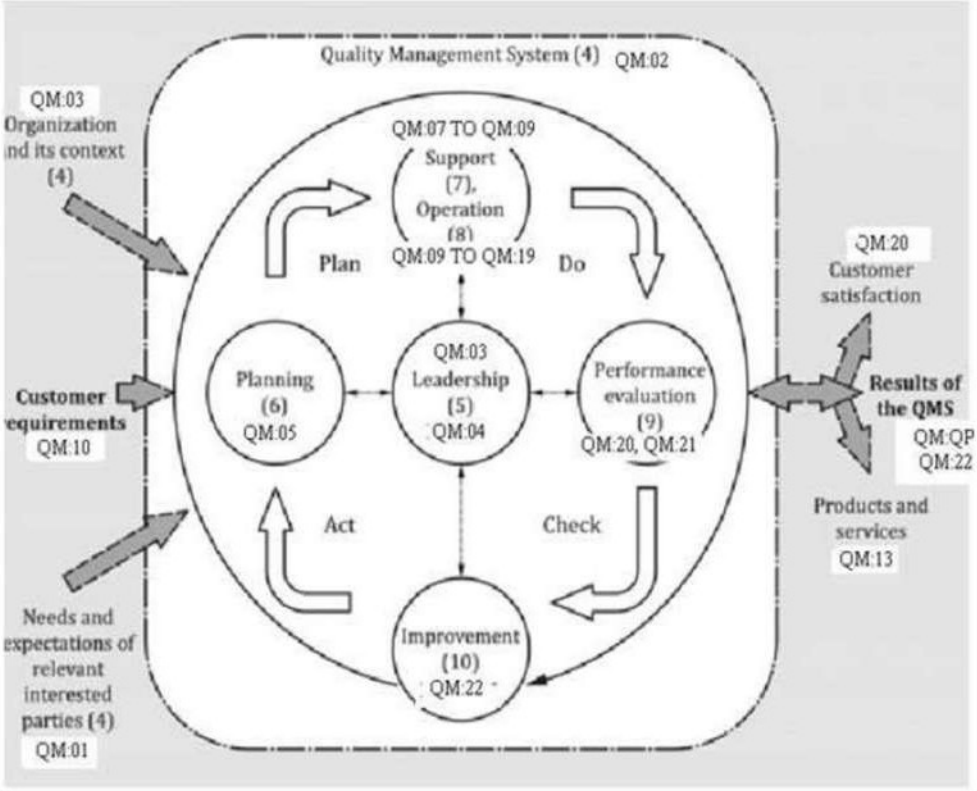
Management. By implementing a comprehensive quality assurance program, organizations can enhance customer satisfaction, improve operational efficiency, reduce costs, and maintain compliance with quality standards and regulations.

Plan-Do-Check-Act Cycle (PDCA)

The PDCA Cycle had applied to all processes and to the Quality Management system as a whole. Figure below illustrates how clauses 4 to 10 can be grouped in relation to the PDCA Cycle.



*Number in Bracket refers to the clauses in ISO 9001:2015 and sections of Quality manual

The company has also established the processes in relevant section of quality manual and methods to monitor and measure where applicable and analyze the same these processes.

MR along with all department heads/ QMS process coordinators determined the key business process needed by QMS and in the company as indicated below

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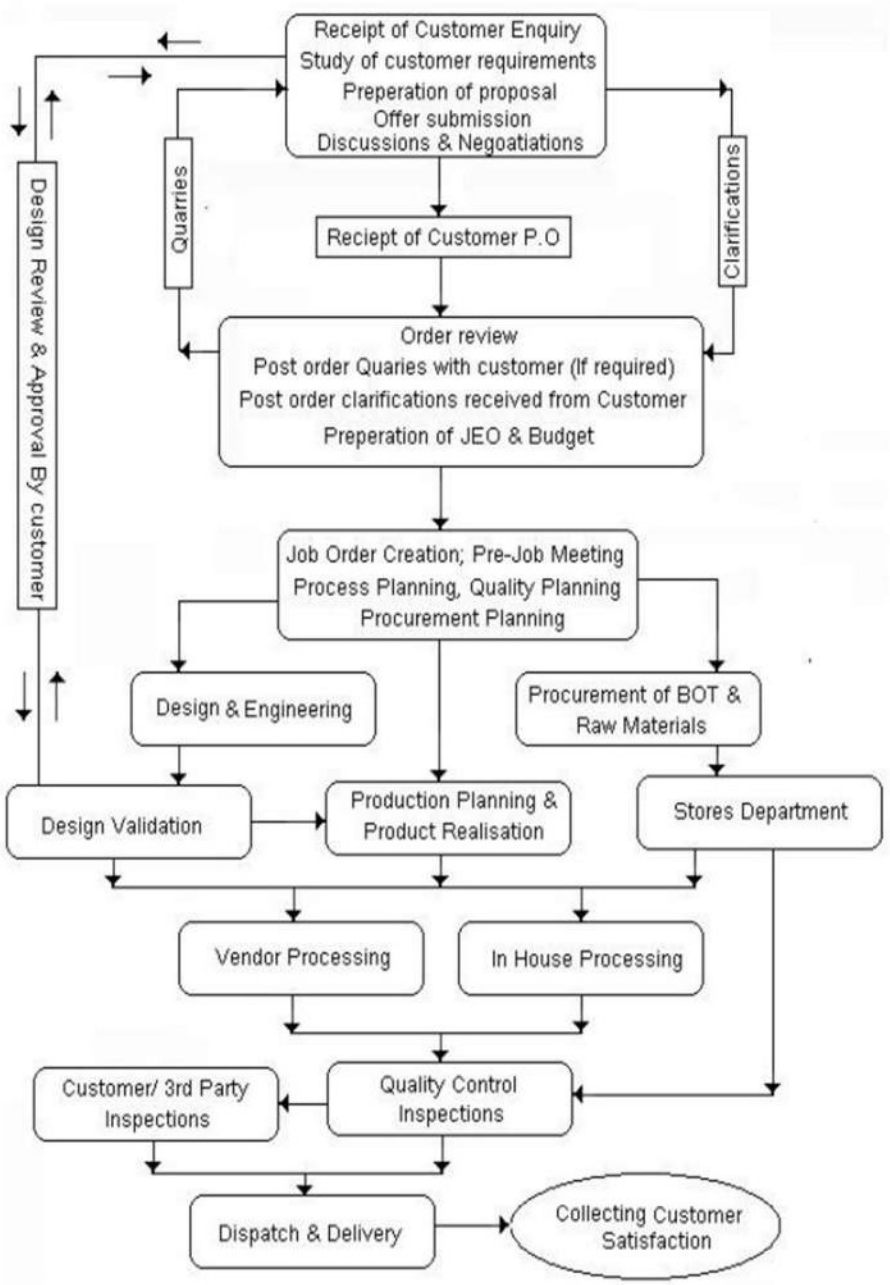
Process and Interaction chart:



We hereby enclosed the reference QAP document which shall be followed for the different equipment/machinery based on their application.

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