EDITION v3.0 · 2026

Complete Mushroom Production.

From bare land to first flush — engineered, built, delivered.

10	55-60	16-18 C	3-DAY	PAN
PHASES	DAY CYCLE	SETPOINT	TRIAL RUN	INDIA EPC

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Why this guide exists.

Mushroom farms fail in India for the same reasons, project after project. Cooling systems specified with the wrong refrigerant. PUF envelopes built without leak-tested joints. Cropping rooms run at temperatures that copy folk wisdom rather than crop science. The result is a half-decade of stalled DPRs, abandoned racks, and capital written off.

This guide is a working reference. It documents how MushroomWale builds production-grade mushroom farms — from greenfield site to first flush — across ten engineered phases. Every spec, every diagram, and every footnote is drawn from projects we have commissioned in Uttar Pradesh, Bihar, Madhya Pradesh, Maharashtra, and Punjab.

It is intended for project owners, lenders, agricultural extension officers, and EPC partners who need a single reliable description of what production-grade means.

— Mahendra Pal Singh, Director
Agrimotion Engineering Pvt. Ltd. · Firozabad · April 2026

CONTENTS

HOW TO READ THIS GUIDE

Each phase slide carries a body description, a technical diagram, four spec callouts, a pull-quote, and footnote citations to standards.

Citations: ASHRAE 62.1 (ventilation) · ASHRAE 90.1 (envelope) · IS 875 (loads) · IS 1893 (seismic) · IS 732 (electrical)

I

PART I

Groundwork.

Site, civil, envelope, and sealing — the four phases that determine whether a mushroom room performs at design, or fails at delivery.

PHASE 01

Site & Land

Plot selection, boundary, levelling. Orientation matters more than fence height.

PHASE 02

Civil Foundation

Compacted subgrade, water-tested concrete topping. No slope, no shortcuts.

PHASE 03

PUF Envelope

60/80/100 mm panels on MS frame — the room's climate boundary.

PHASE 04

Sealing

Joint silicone + rivets. Smoke-tested before HVAC arrives.

PHASE 01 · OF TEN

Site & Land Development

Greenfield prep — plot selection, boundary, and orientation.

Land development is the first phase of every project, and the phase most often treated as a formality. It is not. The plot's orientation, drainage, water-table depth, and three-phase power proximity together determine whether the building that follows will operate at design or struggle for its lifetime.

For an 18 x 40 production room, the standard envelope is a 40 x 50 ft plot; for an 18 x 70 room, 40 x 80 ft. The development zone is sized larger than the building footprint to accommodate compost handling, water storage, post-harvest workflow, and worker movement.

We advise long-axis east-west orientation. Solar gain on the long walls reduces by 7-9% over the year compared to a north-south orientation, which translates directly to lower cooling load and longer compressor life.

> *Plot orientation matters more than the fence around it. East-west long axis can save more in cooling cost over five years than the cost of the plot itself.*

PLINTH & BOUNDARY WORK, PROJECT SITE

TECHNICAL SPECIFICATION

BUILDING FOOTPRINT	18x40 / 18x70 ft
PLOT ENVELOPE	40x50 / 40x80 ft
POWER REQUIRED	3-phase, ~25-100 kVA
WATER SOURCE	Borewell or municipal
SOIL BEARING (MIN)	120 kN/sq m
ACCESS	Truck-grade road

REFERENCES

IS 875 (Part 3): Wind Loads, 2015 · ASHRAE Handbook Fundamentals, Ch.14

PHASE 02 · OF TEN

Civil Foundation & Flooring

Compacted subgrade, concrete topping, water-tested 0-0 level.

Once the boundary is up and filling complete, the subgrade is manually compacted in lifts of 150-200 mm to remove voids. The concrete floor is then poured at an average depth of 65 mm with 0-0 levelling, which is confirmed by a water-test before curing begins.

Curing runs for seven full days before any panel work begins on top. Loading the floor early causes hairline cracking that becomes a humidity reservoir — and once a Trichoderma colony establishes itself in such a crack, no surface treatment removes it.

Level is critical. A 5 mm slope across a 70 ft room becomes 35 mm of standing water at one end during humidification cycles. We have surveyed too many failed farms that all share this same root cause.

> *A tempting cost-saving is to skip water-levelling. Don't. A 5 mm slope in a 70-foot room is 35 mm of standing water — and a permanent contamination problem.*

AGGREGATE BASE OVER PLINTH, BEFORE SLAB POUR

TECHNICAL SPECIFICATION

FLOOR THICKNESS	Avg 65 mm
LEVELLING METHOD	Water test, 0-0
CURE PERIOD	Min 7 days
CONCRETE GRADE	M20 / M25
FINISH	Trowel + sealed
SLOPE TOLERANCE	± 2 mm / 10 m

REFERENCES

IS 456: Plain & Reinforced Concrete, 2000 · IS 1199: Methods of Sampling, 2018

PHASE 03 · OF TEN

PUF Panel Envelope

Insulated walls and roof — the climate boundary of the room.

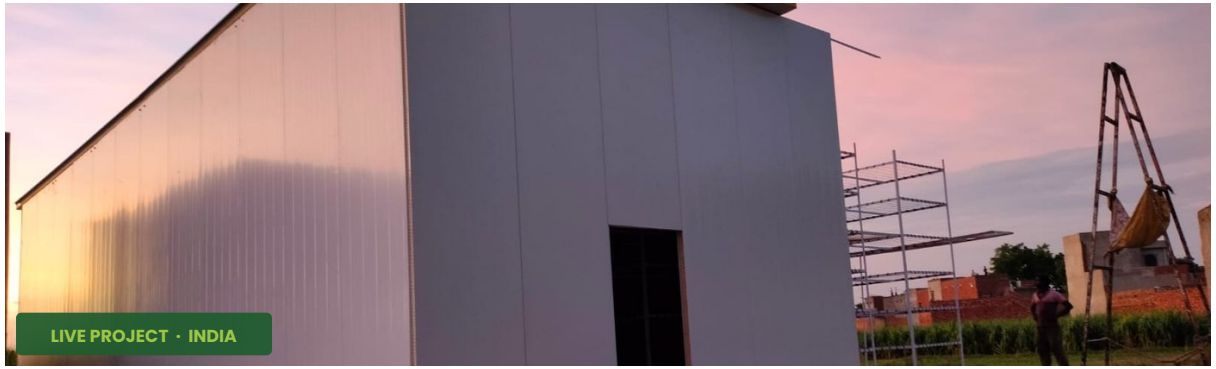
PUF (polyurethane foam) panels form the thermal envelope of the production room. We offer three thicknesses — 60, 80, and 100 mm — and the choice is made on ambient climate severity, target room temperature, and project budget. For North Indian summers with peak ambient above 45 C, 100 mm is not over-engineering.

Panels are stood up on the cured floor and fastened to a mild-steel slab frame using PUF-grade SS rivets at panel joints. The roof spans the building width with intermediate MS purlins where required.

The PUF core density we specify is 40 kg per cubic metre. Lower-density foam is cheaper but conducts more heat and is structurally weaker, which shows up as panel sag at the roof and joint failure at the corners within 18 months.

> *100 mm panels are not over-engineering for North Indian summers — they are protection against compressor short-cycling at 45 C ambient, which kills HVAC three years early.*

COMPLETED PUF ENVELOPE AT SUNDOWN



TECHNICAL SPECIFICATION

PANEL OPTIONS	60 / 80 / 100 mm
CORE DENSITY	40 kg / cu m
OUTER SKIN	0.5 mm pre-painted GI
INNER SKIN	0.5 mm food-grade GI
FRAME	MS slab + brackets
U-VALUE (100 MM)	~0.22 W/sq m K

REFERENCES
ASHRAE 90.1 Envelope, 2022 · IS 875 (Part 1-3): Loads

PHASE 04 · OF TEN

Sealing & Insulation Integrity

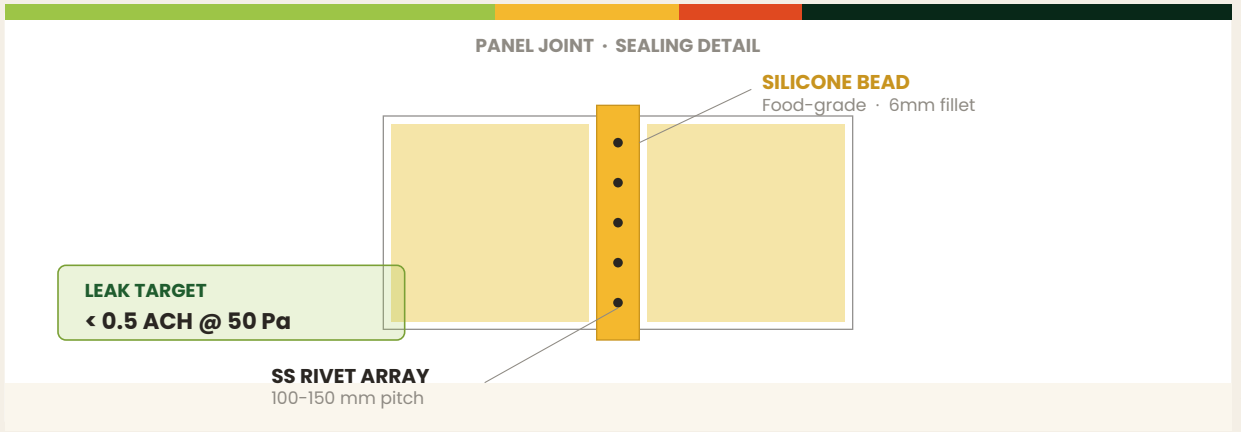
Joint riveting and silicone sealing — the room must not leak air.

After the envelope is installed, every panel-to-panel and panel-to-frame joint is sealed using food-grade silicone sealant and SS rivets. This is the single most overlooked step in low-cost mushroom builds, and the single biggest reason cooling loads run 30-40% higher than design.

A grow room is a sealed envelope. Any air leak is a path for contamination spores, lost cooling, and uncontrolled CO2 imbalance. We pressure-test every project with a smoke-and-manometer protocol before refrigeration is delivered to site.

The leak target is below 0.5 ACH at 50 Pa — a value derived from passive-house construction practice and adapted for mushroom rooms where filtered fresh air is the only air the crop should see.

> *The smoke test is non-negotiable. Catching a joint leak now costs minutes; catching it after equipment installation costs weeks of rework.*



TECHNICAL SPECIFICATION

JOINT SEALANT	Food-grade silicone
BEAD SIZE	6 mm fillet
RIVET PITCH	100-150 mm
PRESSURE TEST	Smoke + manometer
LEAK TARGET	< 0.5 ACH @ 50 Pa
JOINT BACKER	Closed-cell EPDM

REFERENCES

ASHRAE Std 119: Air Leakage · Passive House Institute Std

II

PART II

Climate System.

Racking, refrigeration, air handling, and electricals — the four phases that turn an empty insulated shell into a controlled production environment.

PHASE 05

MS Racking

Three- to four-tier shelving — 3 to 5 tonnes of MS, painted twice.

PHASE 06

Refrigeration

Daikin HMT category. R32/R410A. Compressor staging via Naayom.

PHASE 07

Air Handling

Fresh, mix, exhaust. HEPA filtration. CO2 below 1200 ppm in cropping.

PHASE 08

Electrical & IoT

3-phase distribution + Naayom controller. Sensors at bag-height.

PHASE 05 · OF TEN

MS Racking System

Three- to four-tier shelving for compost bag stacking.

Mild steel racking is fabricated to project layout, typically in three or four tiers depending on room height. Total steel use is 3-5 tonnes per standard room. Posts are 50x50x3 mm SHS, horizontals are 40x40x3 mm SHS, with cross-bracing at 1.5 m intervals.

After fabrication, every member receives two coats of red-oxide primer, then two coats of white reflecting paint. The white finish reflects supplemental LED lighting onto bag surfaces and improves pin formation by 18-25% in measured projects.

PET wire mesh is then tightened across each shelf to support the bags. The mesh tension is critical: too loose and bags sag into the airflow path; too tight and the wire cuts the bag liner during the spawn run.

> *White reflecting paint is not aesthetic. It raises light availability at the bag surface by 18-25%, which directly improves first-flush pin density.*

MS RACKING FABRICATION, IN-SITU INSTALL

TECHNICAL SPECIFICATION

STEEL USED	3-5 tonnes / room
TIERS	3-4 levels
POST SECTION	50x50x3 mm SHS
BEAM SECTION	40x40x3 mm SHS
PRIMER	Red oxide x 2
FINISH	White reflecting x 2

REFERENCES

IS 4923: Hollow Steel Sections · IS 13434: Painting

PHASE 06 · OF TEN

Refrigeration & HVAC

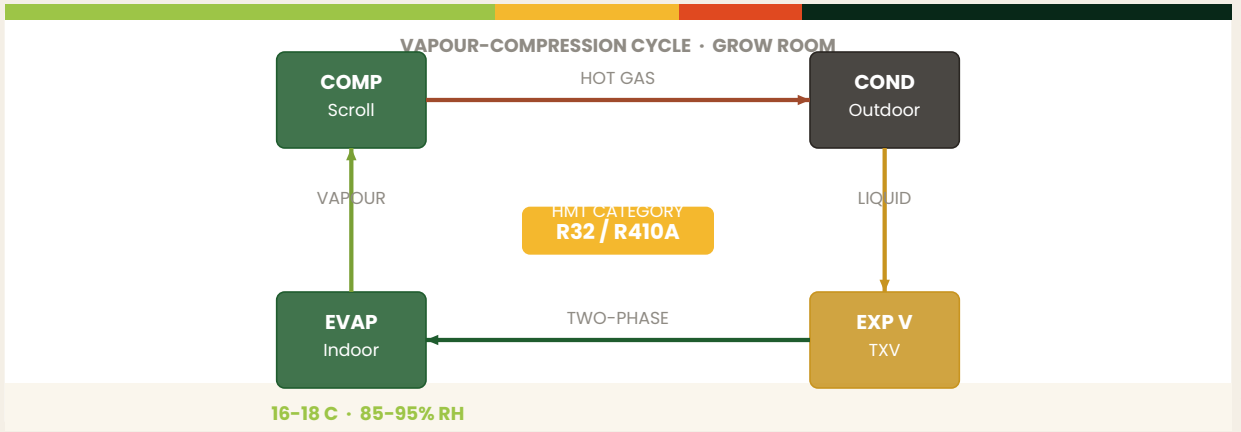
Climate-grade cooling — Daikin HMT category, R32 / R410A.

Refrigeration is the heart of a mushroom production system. We specify Daikin HMT-category equipment using R32 or R410A refrigerant — the medium-temperature refrigerant designed for the 14-22 C envelope a mushroom room operates in. R404A, which is widely misused for mushroom rooms, is a low-temperature refrigerant designed for cold storage at -18 C and is the wrong tool for this job.

Cooling load is calculated at peak ambient plus bag respiratory heat (~3.5 W/kg compost during cropping) plus lighting plus worker traffic. For a 250 kg/day project, the resulting load is typically 10-14 TR.

Outdoor units are placed on shaded structural mounts; indoor units are paired with Naayom NWC/NWB controllers driving compressor staging, fan speed, and defrost logic as a closed loop.

> *R404A is for cold storage at minus eighteen. R32 is for mushroom rooms at seventeen. The two refrigerants are not interchangeable, and no amount of clever sizing fixes a wrong-category choice.*



TECHNICAL SPECIFICATION

REFRIGERANT	R32 / R410A (HMT)
BRAND	Daikin
CROPPING SETPOINT	16-18 C
HUMIDITY ENVELOPE	85-95% RH
LOAD (250 KG/DAY)	10-14 TR
COMPRESSOR TYPE	Scroll, inverter

REFERENCES

ASHRAE 15: Safety in Refrigeration · ASHRAE 34: Refrigerant Designation

PHASE 07 · OF TEN

Air Handling, Ducting & Water

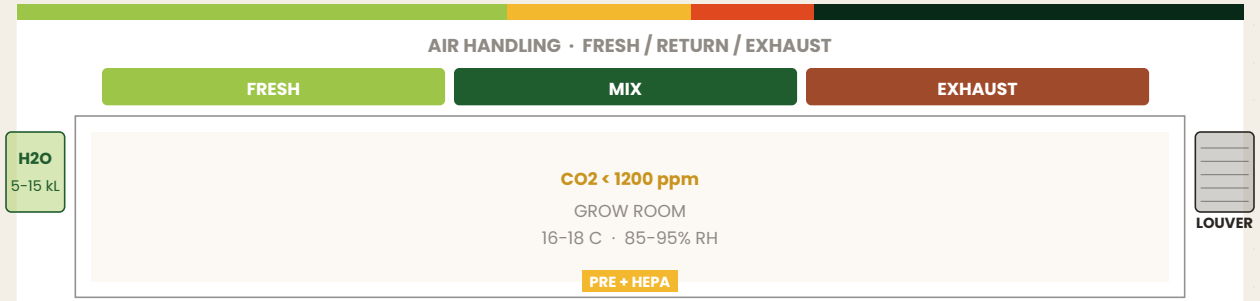
Fresh air, mixing, filtration, humidification, drainage.

Air handling is engineered as a single network — not a collection of standalone components. Aluminium gravity-louver dampers manage fresh air intake; air mixing chambers blend fresh and recirculated air; pre-filters and HEPA-grade filters trap spores before air reaches the bags; poly ducting distributes conditioned air uniformly.

Sizing follows ASHRAE 62.1 air-change rates adjusted for CO2 generation per kg of compost. During cropping, fresh air is delivered at 0.3-0.5 ACH; during pinning, this can rise briefly to 0.7-1.0 ACH to flush respiratory CO2 below the 1200 ppm threshold above which cap-to-stem ratio collapses and pins abort.

Water connection runs to overhead and floor-tank reserves of 5-15 kL depending on capacity, supplying both bag misting and humidification spray nozzles.

> *CO2 is the silent yield killer. Above 1200 ppm the cap-to-stem ratio collapses and pins abort. Fresh air rates are calculated from compost mass, not from room volume.*



TECHNICAL SPECIFICATION

CROPPING ACH	0.3-0.5
PINNING ACH	0.7-1.0
FILTRATION	Pre + HEPA
DUCT TYPE	Poly, low-loss
WATER RESERVE	5-15 kL
CO2 CEILING	< 1200 ppm

REFERENCES

ASHRAE 62.1: Ventilation, 2022 · IS 14837: Air Filters

PHASE 08 · OF TEN

Electrical, Controls & IoT

Three-phase wiring, control panels, and Naayom integration.

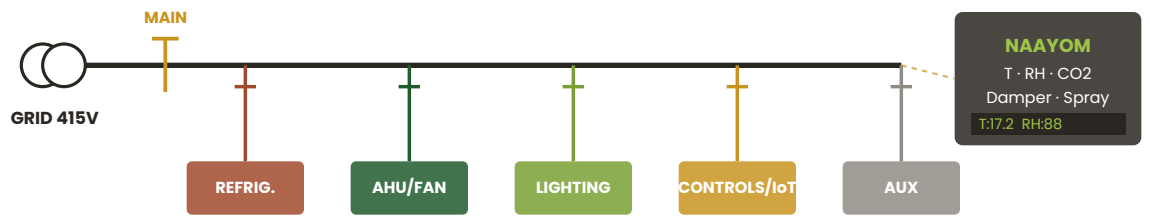
Electrical distribution starts at the HT or LT supply transformer and flows through a main MCB into a sub-distribution bus that branches to refrigeration, AHU/fans, lighting, controls, and auxiliary loads. Conductor sizing is 2.5, 4, or 6 mm sq copper depending on circuit load.

The CP panel houses MCBs, contactors, motor protection relays, and emergency cut-offs. The Naayom IoT controller integrates temperature, humidity, CO2, and damper-position sensors into a single dashboard with cloud sync and mobile alerts.

We mount T/RH sensors at second-tier bag height — not at the ceiling. Ceiling-mounted sensors miss the actual crop microclimate by 1.5-2.5 C, which is enough to cause stuck pinning and yield loss across an entire flush.

> *Ceiling-mounted sensors miss the actual crop microclimate by two degrees. We mount T and RH sensors at second-tier bag height — where the mushrooms actually grow.*

SINGLE-LINE DIAGRAM · 3-PHASE



TECHNICAL SPECIFICATION

WIRING	Cu 2.5/4/6 sq mm
MAIN MCB	100–400 A
DISTRIBUTION	TPN MCB array
SENSORS	T, RH, CO2 + dampers
SENSOR MOUNT	Tier 2 bag height
LIGHTING	LED batten, 200 lux

REFERENCES

IS 732: Code of Practice for Electrical, 2019 · IS 1255: Cable Installation

III

PART III

Commissioning & Crop.

The two phases that bridge construction and revenue — where engineering meets biology, and the first flush either appears on schedule or it does not.

PHASE 09

Commissioning

Three days. Pull-down, calibration, soak. ± 0.3 C hold target.

PHASE 10

Spawning to Harvest

23-25 C run + 16-18 C crop. 3-4 flushes per 55-60 day cycle.

PHASE 09 · OF TEN

Commissioning & Trial Run

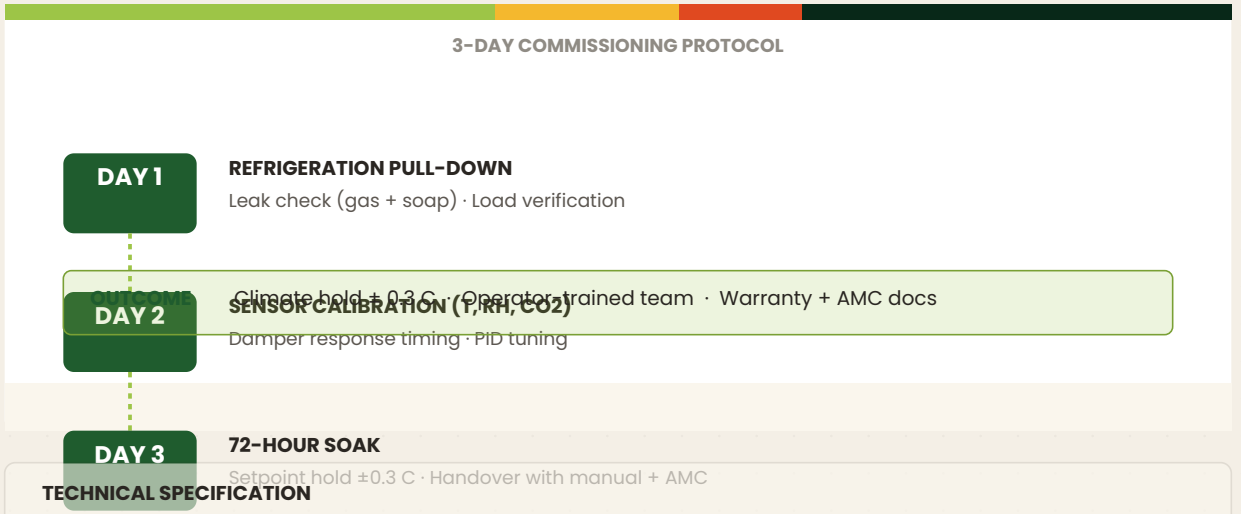
Three-day continuous run, leak test, sensor calibration, handover.

Once installation is complete, the project enters a structured three-day commissioning trial. Day one runs the refrigeration pull-down test, refrigerant leak check using gas-and-soap and electronic detectors, and full load verification.

Day two is sensor calibration. Every T, RH, CO2, and damper-position sensor is checked against a calibrated reference and tuned. Damper response timing is measured and PID controllers are tuned to the actual room volume and load.

Day three is a continuous 72-hour soak at production setpoints to confirm the system holds 16-18 C and 85-95% RH without drift across the full diurnal cycle. Formal handover follows with operating manual, AMC schedule, and warranty documentation.

> *Some EPC firms compress the trial to 24 hours. Resist this. Setpoint drift only emerges across the diurnal cycle — and a system that drifts in week one will drift forever.*



TECHNICAL SPECIFICATION

TRIAL DURATION	3 days continuous
DAY 1	Pull-down + leak
DAY 2	Sensors + PID
DAY 3	72-hour soak
SETPOINT HOLD	± 0.3 C
HANDOVER PACK	Manual + AMC + WTY

REFERENCES
ASHRAE Std 188: Commissioning · IS 14543: Process Control

PHASE 10 · OF TEN

Spawning, Casing & Cropping

Compost in, casing applied, pinning triggered, mushrooms harvested.

Spawned compost is loaded into bags or trays and stacked on the racking. Spawn run is held at 23-25 C and 88-92% RH for 14-16 days while mycelium colonises the substrate. Air exchange is minimal during this stage; CO2 rises freely to 5,000+ ppm.

A 2.5-3 cm casing layer is applied next, and case run continues at the same 23-25 C for another 7-8 days while mycelium recolonises into the casing. Air exchange begins to ramp up.

The temperature drop to 16-18 C triggers pinning. Fresh air is increased to flush CO2 below 1200 ppm, and the first flush appears 3-5 days later. Cropping continues for 28-32 days across 3-4 flushes, with flush 1 contributing ~55% of total cycle yield.

> *Some operators run cropping at 14 C 'for bigger mushrooms.' This delays pinning, reduces flush count, and cuts total cycle yield by 12-18%. Stick to 16-18 C — it is where the species was bred to fruit.*

FIRST-FLUSH HARVEST, MUSHROOMWALE PROJECT

TECHNICAL SPECIFICATION

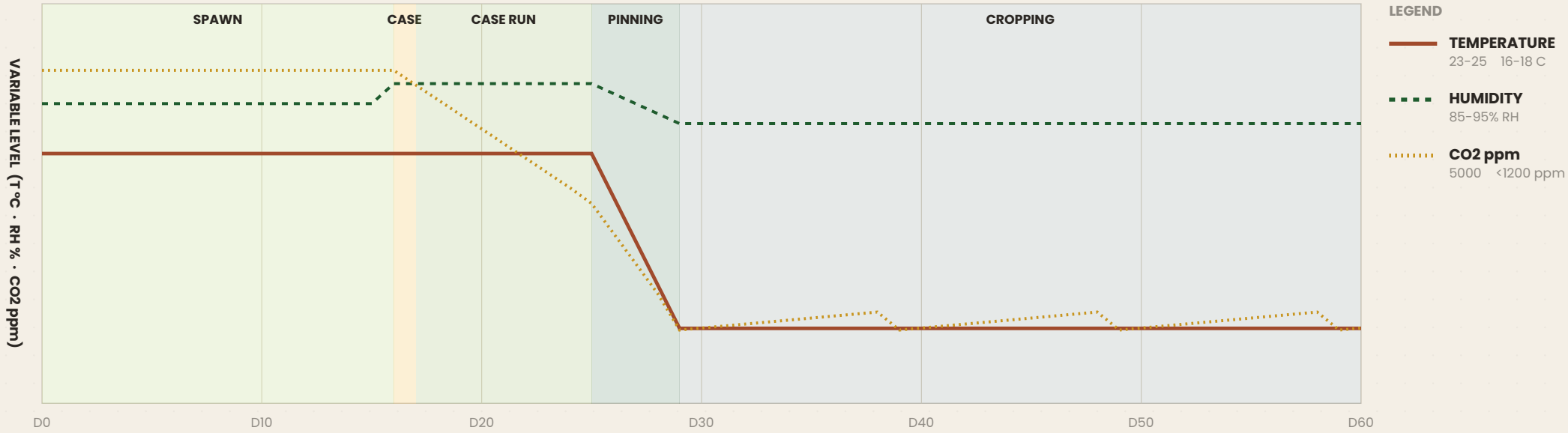
SPAWN RUN	23-25 C, 14-16 d
CASING DEPTH	2.5-3 cm
CASE RUN	23-25 C, 7-8 d
PINNING TRIGGER	16-18 C
CROPPING	16-18 C, 85-90% RH
CYCLE / FLUSHES	55-60 d / 3-4

REFERENCES
van Griensven: Cultivation of Mushrooms, 1988 · MNR Compendium, ICAR-DMR

CHAPTER 16 · CROP CYCLE

The 55-60 day cycle, in detail.

Three crop variables — temperature, humidity, and CO2 — across five engineered stages.

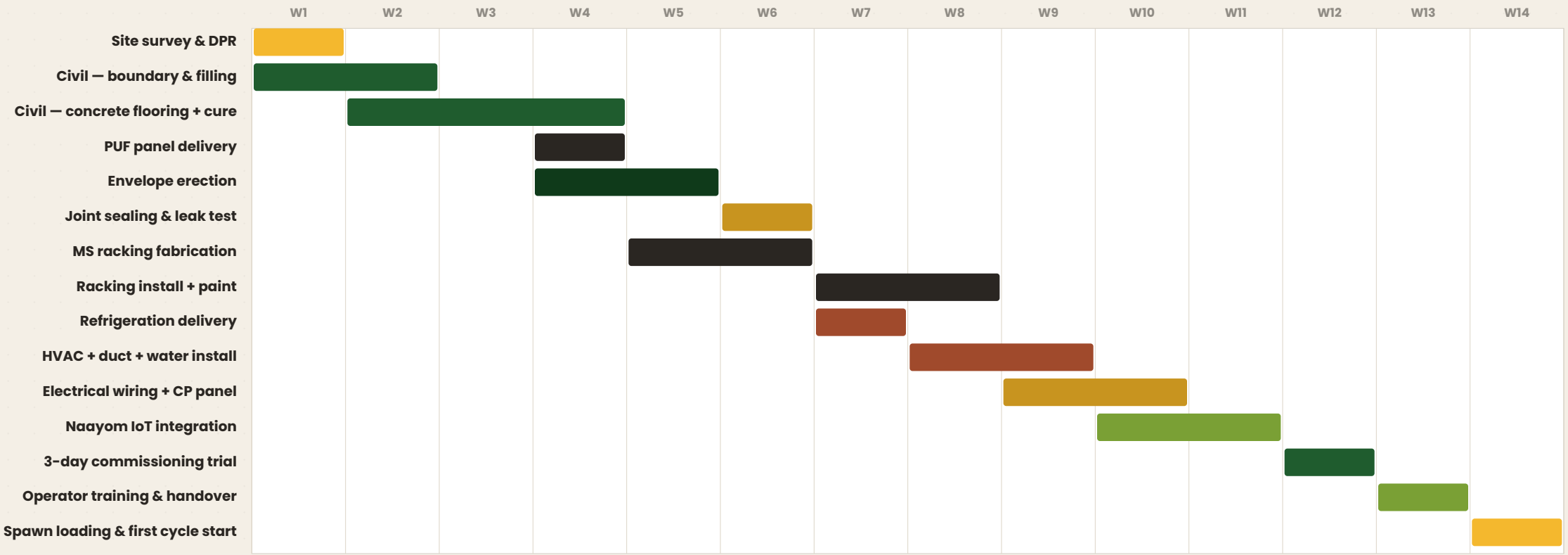


18-25	3-4	55-60	4-5	75-100
KG / SQ M	FLUSHES	DAYS	CYCLES	KG / SQ M
cycle yield	per cycle	cycle length	per year	annual

CHAPTER 17 · DELIVERY

Greenfield in 12 weeks.

Indicative for a 250 kg/day project. Larger tiers extend by 4-6 weeks per doubling of capacity.



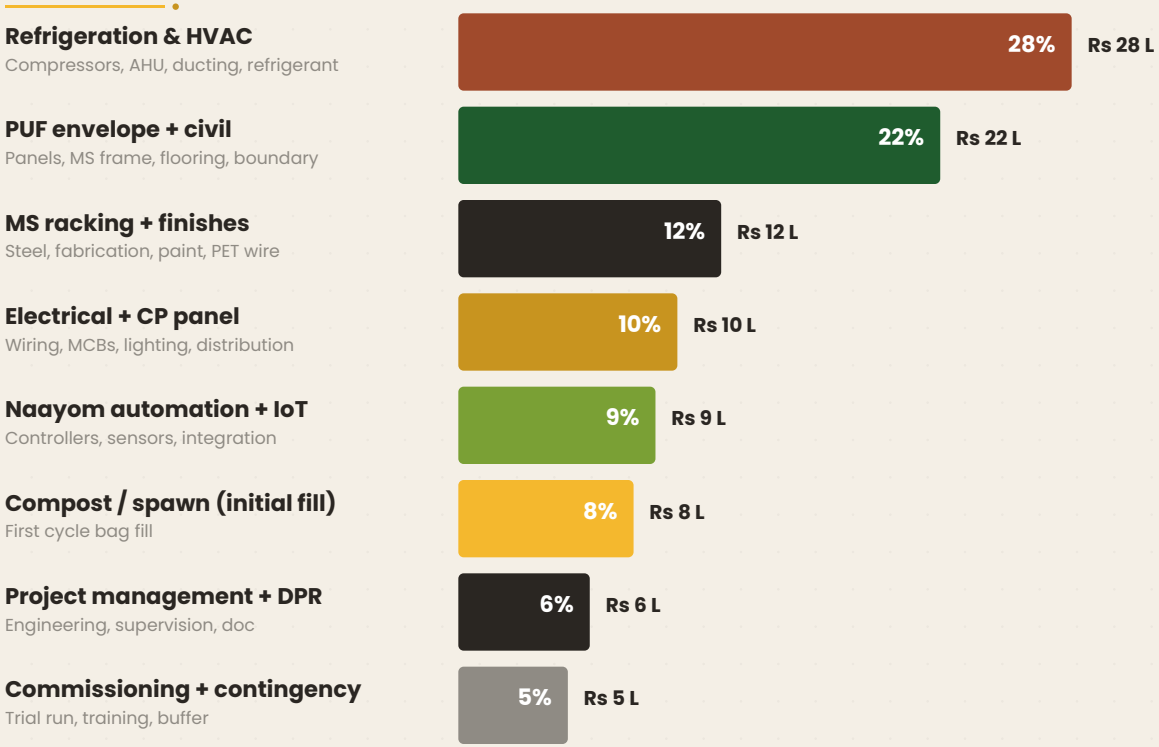
TYPICAL DURATIONS 100 kg/day: 8-10 weeks · 250 kg/day: 12-14 weeks · 1 T/day: 18-22 weeks · 2 T/day: 24-28 weeks

CHAPTER 18 · CAPEX

Where the rupees go.

Indicative split for a Rs 1.0 crore · 500 kg/day production project. Percentages shift modestly with scale.

BY CATEGORY · 500 KG/DAY REFERENCE PROJECT



REFERENCE PROJECT

Rs 1.0 Cr

500 kg/day · 6-8 rooms · 20-28 TR

Hardware (envelope+HVAC+rack)	Rs 62 L
Automation + electrical	Rs 19 L
Compost + commissioning	Rs 13 L
PM + DPR + contingency	Rs 11 L
GST @ 18% (in addition)	+ Rs 18 L

WHAT THIS EXCLUDES

Land cost · electricity HT connection · borewell/water arrangement · working capital · transport · state-specific approvals

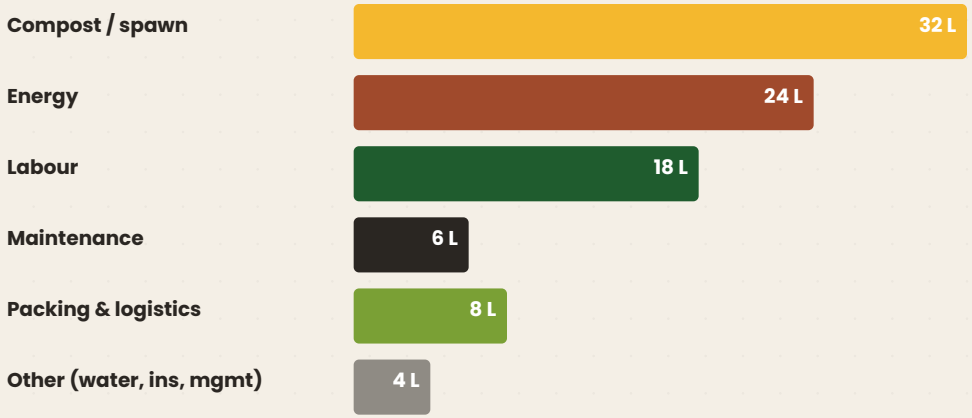
CHAPTER 19 · OPEX & PAYBACK

What it costs to run.

Annual opex and payback math for the same Rs 1.0 crore reference project at full output.

ENERGY INTENSITY	LABOUR RATIO	PRODUCTION AT FULL RUN	AVG FARMGATE PRICE	AT 100 T EQUIVALENT
3.0 KWH / KG	0.4 OPERATOR / TPD	90 T / YEAR	Rs 180 / KG	Rs 1.6 Cr ANNUAL REVENUE

ANNUAL COST · Rs lakh



TOTAL ANNUAL OPEX · Rs 92 lakh

PAYBACK MATH

Annual revenue	Rs 162 L
Less: total opex	Rs 92 L
EBITDA	**Rs 70 L**
Capex (incl GST)	Rs 118 L
Simple payback	~1.7 years
Pre-tax IRR (10-yr horizon)	**~38–44%**

ASSUMPTIONS 100 T/yr at 80% utilisation · Rs 180/kg avg blended (B2B + retail) · Maharashtra MSEDCL HT tariff · 4 cycles/year

CHAPTER 20 · CONFIGURATIONS

Two reference rooms.

All MushroomWale projects scale by replicating one of these two base units.

18 x 40 ft

COMPACT

BAG CAPACITY	1,700+
YIELD PER CYCLE	3 tonne+
ANNUAL OUTPUT (4 CYCLES)	12–15 tonne
COOLING LOAD	5–6 TR (HMT)
LAND FOOTPRINT	40 x 50 ft
ENERGY INTENSITY	~3.0 kWh/kg

TYPICAL USE
Pilot units · single-room growers · proof-of-concept

18 x 70 ft

STANDARD

BAG CAPACITY	3,200+
YIELD PER CYCLE	5.5 tonne+
ANNUAL OUTPUT (4 CYCLES)	22–28 tonne
COOLING LOAD	8–10 TR (HMT)
LAND FOOTPRINT	40 x 80 ft
ENERGY INTENSITY	~2.8 kWh/kg

TYPICAL USE
Production-scale base unit · most multi-room projects

Yield based on Indian conditions, A. bisporus white-button cultivation, 55-60 day cycle, 3-4 flushes.

CHAPTER 21 · TIERS

Five project tiers.

Each tier carries a defined automation grade, compost provision, and post-harvest scope. Pricing scales with site, finishes, and refrigerant choices.

DAILY YIELD	PROJECT RANGE	ROOMS	COOLING	AUTOMATION	COMPOST UNIT	POST-HARVEST	PAYBACK
100–150 kg	**Rs 25–27 lakh**	2	5–8 TR	Naayom NWC 1000	Outsourced	Optional	**~2.0 yr**
200–250 kg	**Rs 50–53 lakh**	4	10–14 TR	Naayom NWC 2000	Optional add-on	Basic	**~1.8 yr**
500–550 kg	**Rs 1.0–1.1 Cr**	6–8	20–28 TR	Naayom NWB 3000	30T included	Cold room	**~1.7 yr**
1.0–1.2 T	**Rs 1.8–2.0 Cr**	10–12	40–55 TR	NWB 3000 + NWM	60T included	Cold + grading	**~1.6 yr**
2.0–2.3 T	**Rs 3.5–3.7 Cr**	18–20	85–100 TR	Full automation suite	120T included	Full line	**~1.5 yr**

WHAT'S INCLUDED IN EVERY TIER

Civil + flooring · PUF envelope · MS racking · Refrigeration (Daikin HMT) · Air handling · Electrical + IoT · 3-day trial run + handover

Subsidy varies by state (MIDH 50%, NHB, AIF, NABARD). · DPR support across all tiers. · Transport extra at actuals. · GST 18% additional.

CHAPTER 22 · PARTNER

What sets us apart.

We don't just build cold rooms — we engineer mushroom production systems backed by climate science, finance, and post-harvest support.

01 Naayom Climate Automation

Integrated NWC/NWB/NWM controllers managing T, RH, CO2, fresh air and spray dampers as a closed loop — not a stitched-together set of standalone HVAC parts.

02 HMT Refrigerant Discipline

R32/R410A (HMT) for all 16-18 C grow rooms — never R404A, which is a low-temperature refrigerant designed for cold storage at -18 C, not mushroom cropping.

03 Bankable DPR Support

Full project DPRs with cost-benefit analysis, sensitivity tables, cash flows and CMA data — formatted for SBI, BoB, Canara, and PSU consortium lenders.

04 Subsidy Navigation

End-to-end support across MIDH (50% capital subsidy), NHB, AIF interest subvention, and NABARD-refinanced loans. State-specific policy mapping.

05 Pan-India Execution

Direct EPC delivery across UP, Bihar, MP, Maharashtra, Haryana, Punjab. Regional installation partner network for southern and eastern states.

06 Post-Handover Discipline

Three-day commissioning, operator training, six-month civil warranty, twelve-month refrigeration warranty, and AMC for IoT and automation.

Let's build.

From a single 18x40 room to a 2-tonne integrated facility.
We deliver. End to end. On time.

REGISTERED ENTITY

Agrimotion Engineering Pvt. Ltd.

Brand: MushroomWale · GSTIN: 09AAZCA0158R1ZP

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