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TECHNICAL GUIDES

200 TPH Aggregate Plant Design: Equipment Selection and Layout Optimization

Design a 200 TPH aggregate plant: crusher selection, screen sizing, conveyor layout. Optimize material flow and minimize bottlenecks.

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Designing a 200 TPH aggregate plant requires balancing capital investment against operational efficiency, product quality against production flexibility, and equipment capability against site constraints. A well-designed plant achieves 85%+ mechanical availability, produces specification-compliant materials consistently, and generates returns that justify the ₹3-5 crore investment within 3-4 years. A poorly designed plant becomes a perpetual source of operational headaches, product quality issues, and maintenance expenses that erode profitability from day one.

The 200 TPH capacity represents a strategic sweet spot in Indian aggregate markets—large enough for commercial viability yet manageable in terms of capital, operational complexity, and environmental compliance. Plants at this capacity serve ready-mix concrete plants, infrastructure projects, and construction material traders while remaining within the technical capabilities of most regional equipment suppliers and maintenance teams.

This guide walks through every aspect of 200 TPH plant design, from feed material analysis through equipment selection, layout optimization, and operational considerations. Whether you're designing a greenfield installation or upgrading an existing plant, these principles ensure optimal performance from the first tonne processed.

Feed Material Analysis: The Foundation of Design

Every successful plant design begins with thorough understanding of the feed material. Equipment selection, circuit configuration, and even layout decisions flow from feed characteristics.

Critical Feed Parameters

PARAMETER	IMPACT ON DESIGN	TESTING METHOD	TYPICAL RANGE FOR GRANITE	TYPICAL RANGE FOR BASALT
Maximum Feed Size	Primary crusher selection	Direct measurement at quarry	600-800mm	500-700mm
Bulk Density	Conveyor and hopper sizing	IS 2386 Part 3	1.5-1.7 t/m³ (loose)	1.6-1.8 t/m³ (loose)
Moisture Content	Screening efficiency, dust suppression	IS 2386 Part 3	1-5%	1-4%
Compressive Strength	Crusher type and power	IS 9143	150-250 MPa	200-350 MPa
Work Index (Bond)	Energy consumption prediction	Bond Work Index Test	14-18 kWh/t	16-22 kWh/t
Abrasion Index	Wear part life estimation	IS 2386 Part 4	0.2-0.5 (AI)	0.3-0.6 (AI)
Fines Content	Scalping requirements	Sieve analysis	5-15% passing 10mm	3-10% passing 10mm
Clay/Silt Content	Washing requirements	IS 2386 Part 2	1-8%	0.5-3%

Product Requirements Analysis

Define target products before selecting equipment:

PRODUCT	SIZE RANGE	TYPICAL MARKET PRICE (₹/TONNE)	IS CODE COMPLIANCE	PRODUCTION PRIORITY
40mm Aggregate	20-40mm	700-900	IS 383:2016	Low (limited market)
20mm Aggregate	10-20mm	900-1200	IS 383:2016	High (RMC demand)
12.5mm Aggregate	6-12.5mm	1000-1300	IS 383:2016	Medium
6mm Aggregate	3-6mm	1100-1400	IS 383:2016	Medium
Crusher Dust	0-5mm	400-600	—	Byproduct
Manufactured Sand	0-4.75mm (Zone II)	1200-1800	IS 383:2016	High value-add opportunity

Capacity Calculation Fundamentals

A "200 TPH plant" requires careful definition. Consider:

- **Nominal vs. Effective Capacity:** Equipment is rated at continuous operation with optimal feed. Actual throughput is 80-90% of nominal.
- **Operating Hours:** 10-hour shifts, 300 days/year = 600,000 tonnes annual capacity (at 200 TPH effective)
- **Bottleneck Identification:** The plant's capacity equals its bottleneck capacity—typically secondary crushing or screening
- **Product Split Impact:** Different product mixes require different recirculation ratios, affecting net output

SCENARIO	GROSS THROUGHPUT	RECIRCULATION LOAD	NET SALEABLE PRODUCT	SCREEN LOAD
Open Circuit (no reshaping)	200 TPH	0%	200 TPH	200 TPH
Closed Circuit (30% recirc)	260 TPH	60 TPH	200 TPH	260 TPH

SCENARIO	GROSS THROUGHPUT	RECIRCULATION LOAD	NET SALEABLE PRODUCT	SCREEN LOAD
High M-Sand (50% to VSI)	300 TPH	100 TPH	200 TPH	300 TPH

Design Principle: Size equipment for peak recirculation scenarios, not minimum case.

Equipment Selection: Primary Crushing Stage

Primary crushing reduces quarry-run material to sizes suitable for secondary processing. For 200 TPH plants, jaw crushers dominate due to cost-effectiveness and operational simplicity.

Jaw Crusher Sizing for 200 TPH

MODEL CLASS	FEED OPENING (MM)	CAPACITY RANGE (TPH)	MOTOR POWER (KW)	WEIGHT (TONNES)	SUITABILITY
36x24 / 900x600	900x600	80-150	55-75	15-18	Undersized for consistent 200 TPH
42x30 / 1050x750	1050x750	150-250	90-110	25-30	Optimal for 200 TPH with typical feed
48x36 / 1200x900	1200x900	250-350	132-160	40-50	For larger feed or expansion potential

Recommended Configuration

For reliable 200 TPH production with 600-700mm maximum feed:

- **Primary Crusher:** 42x30 inch (1050x750mm) single-toggle jaw crusher
- **CSS Range:** 100-150mm (adjustable for product size and capacity)
- **Drive:** 110 kW motor with flywheel energy storage
- **Feed System:** Vibrating grizzly feeder (1200x4500mm minimum)

Jaw Crusher Selection Criteria

CRITERION	SPECIFICATION	WHY IT MATTERS
Feed Opening Width	>1.2x maximum feed size	Prevents bridging and feed rejection
Nip Angle	19-23°	Affects grip on feed material, throughput
Stroke	25-35mm for this size class	Longer stroke = higher throughput but more wear
Toggle Type	Single toggle preferred	Higher throughput, simpler maintenance vs double toggle
Bearing Type	Spherical roller bearings	Self-aligning, handles shock loads
CSS Adjustment	Hydraulic preferred	Faster adjustment, safer than wedge systems
Frame Construction	Cast steel or fabricated plate	Cast more rigid; fabricated easier to repair

Grizzly Feeder Requirements

The grizzly feeder controls feed rate and removes undersized material before primary crushing:

PARAMETER	SPECIFICATION FOR 200 TPH	NOTES
Pan Width	1200-1400mm	Match to truck body width
Total Length	4500-5500mm	Including grizzly section
Grizzly Bar Spacing	75-125mm typical	Scalp undersized material before crusher
Drive Type	Eccentric shaft or electromagnetic	Eccentric more robust for heavy duty
Motor Power	15-22 kW	Variable frequency drive for rate control
Hopper Capacity	10-15 m^3 minimum	Buffer between truck tips

Equipment Selection: Secondary Crushing Stage

Secondary crushing determines product gradation, shape quality, and overall plant capacity. Equipment choice here has the greatest impact on final product value.

Secondary Crusher Options Comparison

CRUSHER TYPE	CONE CRUSHER	HSI (HORIZONTAL SHAFT IMPACT)	VSI (VERTICAL SHAFT IMPACT)
Reduction Ratio	4:1 to 6:1	10:1 to 25:1	3:1 to 8:1
Product Shape	Good (cubical)	Excellent (cubical)	Best (highly cubical)
Fines Generation	Moderate	High	Very High
Wear Cost (₹/ tonne)	₹8-15	₹12-25	₹15-35
Capital Cost	₹60-90 lakhs	₹50-70 lakhs	₹55-85 lakhs
Power Consumption	0.8-1.2 kWh/t	1.0-1.8 kWh/t	1.5-2.5 kWh/t
Feed Size (max)	150-200mm	200-400mm	40-60mm
Best Application	Hard, abrasive rock	Medium-hard rock, high reduction needed	Sand making, final shaping

Recommended Secondary Configuration for 200 TPH

For most granite/basalt operations producing aggregate and M-sand:

Option A: Cone-Based Circuit (Best for hard, abrasive material)

- **Secondary Crusher:** 48" (1200mm) cone crusher, 200-250 TPH capacity
- **CSS Range:** 20-40mm
- **Motor:** 200-250 kW
- **Tertiary Crusher (if needed):** VSI for M-sand production

Option B: HSI-Based Circuit (Best for medium-hard rock, cost sensitivity)

- **Secondary Crusher:** 1315 or 1320 HSI, 200-300 TPH capacity

- **CSS/Gap:** 25-50mm
- **Motor:** 160-200 kW
- **Note:** Higher wear costs but lower capital, excellent product shape

Cone Crusher Specifications for 200 TPH

SPECIFICATION	STANDARD HEAD	SHORT HEAD	SELECTION NOTES
Feed Size (max)	150-200mm	75-125mm	Short head for tertiary applications
CSS Range	19-50mm	10-25mm	Hydraulic adjustment recommended
Capacity at CSS 25mm	180-220 TPH	120-160 TPH	Standard head for secondary
Liner Type	Manganese steel	Manganese steel	20-22% Mn for hard rock
Crushing Chamber	Fine, Medium, Coarse options	Extra Fine, Fine, Medium	Match to feed and product
Tramp Release	Hydraulic accumulator system	Hydraulic accumulator system	Essential for uncrushable protection

Screening Equipment Selection

Screens are often the bottleneck in aggregate plants. Proper sizing is critical for achieving rated capacity.

Screen Capacity Calculation

Screen capacity depends on:

- **Deck Area:** More area = more capacity
- **Aperture Size:** Larger openings = higher capacity
- **Material Characteristics:** Wet, sticky, or elongated particles reduce capacity
- **Deck Position:** Top deck sees full load; lower decks handle reduced volumes
- **Oversize/Undersize Ratio:** High percentage of near-size material reduces efficiency

Basic capacity calculation:

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Capacity (TPH) = Base Capacity × Area × K1 × K2 × K3 × K4 × K5

Where:
- Base Capacity: TPH/m² at given aperture (from manufacturer charts)
- K1: Correction for % oversize (material larger than aperture)
- K2: Correction for % half-size (material smaller than half aperture)
- K3: Correction for deck position (1.0 top, 0.9 second, 0.8 third)
- K4: Correction for wet screening (1.0 dry, 0.75 wet)
- K5: Correction for shape (1.0 cubical, 0.85 flaky)
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Recommended Screens for 200 TPH

SCREEN POSITION	TYPE	SIZE (MM)	DECKS	MOTOR (KW)	TYPICAL APERTURES
Primary (Scalping)	Inclined Vibrating	1500x4800	Single	15-22	75-125mm
Secondary Classification	Inclined Vibrating	1800x6000	3-deck	30-45	40mm, 20mm, 10mm
Tertiary/Final	Inclined Vibrating	1500x4800	2-deck	22-30	6mm, 3mm (or washing)

Screen Specification Details

PARAMETER	SPECIFICATION	DESIGN RATIONALE
Inclination	15-20° (inclined type)	Steeper = faster travel, lower efficiency; Flatter = higher efficiency, lower capacity
Stroke	8-12mm	Longer stroke for coarser material
Speed	800-1000 RPM	Higher for fine material, lower for coarse
G-Force	3.5-5.0 G	Higher G improves stratification but increases wear
Screen Media	Wire mesh, polyurethane, or rubber	Wire mesh cheapest; poly/rubber longer life, quieter
Deck Clearance	Minimum 250mm between decks	Allows material flow and prevents bridging

Conveyor System Design

Conveyors connect processing units and account for 15-20% of plant capital cost. Proper design ensures reliable material flow without spillage or damage.

Conveyor Specification Summary

CONVEYOR POSITION	BELT WIDTH (MM)	SPEED (M/S)	MOTOR (KW)	TYPICAL LENGTH (M)	INCLINATION
Jaw Discharge	800-1000	1.5-2.0	15-22	20-30	0-12°
Cone Feed	800-1000	1.5-2.0	15-22	15-25	Variable
Screen Feed	1000-1200	1.5-2.0	22-30	20-40	15-18°
Product Stockpile	650-800	2.0-2.5	11-15	25-40	18-20°
Recirculation	650-800	2.0-2.5	11-15	30-50	18-20°

Conveyor Design Principles

- **Belt Capacity:** Design for 70-80% of theoretical capacity to prevent spillage
- **Belt Speed:** Higher speeds reduce belt width requirement but increase wear and dust
- **Transfer Points:** Use stone boxes or rock ladders to control impact and velocity
- **Skirting:** Minimum 1.5m length at loading points, adjustable for belt wear
- **Troughing Angle:** 35° standard; 45° for increased capacity at same width
- **Belt Grade:** PN/NN 250-315 for standard service; EP grade for higher tension

Critical Transfer Point Design

PARAMETER	DESIGN RULE	CONSEQUENCE OF POOR DESIGN
Drop Height	Minimize; <1.5m preferred	Belt damage, dust generation, material degradation
Chute Angle	>60° from horizontal	Material buildup, blockage

PARAMETER	DESIGN RULE	CONSEQUENCE OF POOR DESIGN
Loading Direction	Material velocity aligned with belt travel	Belt wear, spillage, tracking problems
Impact Bed	Install at all high-impact loading points	Belt damage, idler failure
Belt Cleaners	Primary + secondary at head pulley	Carryback, idler buildup, tracking issues

Plant Layout Optimization

Layout design balances material flow efficiency against site constraints, maintenance access, and future expansion capability.

Layout Design Principles

1. **Gravity Flow:** Use natural elevation changes to minimize conveyor lifts and power consumption
2. **Shortest Path:** Minimize conveyor lengths to reduce capital and operating costs
3. **Maintenance Access:** Provide crane/forklift access to all major components
4. **Stockpile Capacity:** Size stockpiles for 1-2 days production minimum
5. **Traffic Flow:** Separate loading and dumping traffic patterns
6. **Expansion Space:** Reserve area for additional crushers, screens, or products
7. **Environmental:** Position dust sources downwind; plan drainage for runoff

Typical 200 TPH Layout Dimensions

AREA	DIMENSION	NOTES
Overall Plant Footprint	80m x 100m minimum	Includes circulation roads
Primary Crushing Area	15m x 20m	Hopper, feeder, jaw, discharge
Secondary/Screening Area	25m x 30m	Cone, screens, surge bins
Stockpile Area	50m x 60m	5 products + crusher dust

AREA	DIMENSION	NOTES
Each Product Stockpile	15-20m base diameter	500-1000 tonne capacity each
Truck Loading Area	6m wide lanes, 25m turn radius	For 20-tonne trucks
Maintenance Area	15m x 20m covered	Workshop, stores, laydown

Elevation Design

For optimal gravity flow with minimal conveyor angles:

- **Primary Hopper:** Ground level (truck tip) + 3-4m elevation for feeder
- **Jaw Crusher Discharge:** ~1.5m below jaw centerline
- **Surge Bin before Secondary:** Position for gravity feed to cone at correct level
- **Main Screen:** Elevated 6-8m for product separation
- **Stockpile Height:** 8-12m maximum for radial stackers

Electrical System Design

Power Requirements Summary

EQUIPMENT	QUANTITY	MOTOR POWER (KW)	TOTAL CONNECTED (KW)
Jaw Crusher	1	110	110
Grizzly Feeder	1	18.5	18.5
Cone Crusher	1	200	200
Vibrating Screens	2	37	74
Conveyors (8 units)	8	15 (avg)	120
VSI (if installed)	1	250	250
Ancillary (pumps, lighting)	Various	—	50
Total Connected Load			**822.5 kW**
Maximum Demand (0.7 factor)			**~575 kW**

Transformer and Distribution

- **Transformer Sizing:** 750 kVA minimum for 200 TPH without VSI; 1000 kVA with VSI
- **Voltage:** 11 kV incoming, 415V distribution typical
- **Power Factor:** Install capacitor bank to maintain >0.95 PF and avoid penalties
- **Starting Method:** DOL acceptable for <75 kW; soft starters for crushers and large conveyors
- **Emergency Stop:** Plant-wide E-stop system with pull-cord along conveyors

Motor Control Center (MCC)

FEATURE	REQUIREMENT	BENEFIT
Enclosure	IP55 minimum outdoor; IP42 if enclosed room	Dust and water protection
Starters	VFD for feeders; DOL/Star-Delta for conveyors	Rate control, reduced inrush
Interlocks	Sequential start, reverse sequence stop	Prevents material buildup on stopped conveyors
Monitoring	Current, voltage, power factor display	Operational awareness
Protection	Overload, earth fault, phase failure	Equipment and personnel safety

Control System Design

Automation Levels

LEVEL	FEATURES	COST IMPACT	SUITABILITY
Basic	Local start/stop, manual rate control	Baseline	Simple operations, low volume
Semi-Automatic	Interlocked sequencing, basic PLC	+₹10-15 lakhs	Standard commercial plants

LEVEL	FEATURES	COST IMPACT	SUITABILITY
Fully Automatic	Automatic level control, production optimization	+₹25-35 lakhs	High-volume, unmanned operation goals
Smart Plant	Remote monitoring, predictive maintenance, AI optimization	+₹50-80 lakhs	Premium operations, multiple sites

Recommended Interlocks

- **Startup Sequence:** Stockpile conveyors → product conveyors → screens → crusher feed conveyor → crusher → feeder
- **Shutdown Sequence:** Reverse of startup with time delays for clearing
- **Level Control:** Stop feeder when surge bin reaches high level, restart at low level
- **Crusher Protection:** Stop feed on high crusher current, CSS limit, or low lube pressure
- **Belt Protection:** Stop preceding equipment on belt slip, rip detection, or misalignment

Cost Estimation

Capital Cost Breakdown

CATEGORY	COST RANGE (₹ LAKHS)	% OF TOTAL	NOTES
Primary Crushing (Jaw + Feeder)	45-65	12-15%	Including hopper structure
Secondary Crushing (Cone)	60-90	18-22%	Add ₹50-80 lakhs for VSI
Screens (2-3 units)	35-55	10-13%	Including structures
Conveyors (8-10 units)	50-80	15-18%	Including drives and supports
Electrical System	45-65	12-15%	Transformer, MCC, cabling
Steel Structures	30-50	8-12%	Platforms, supports, chutes

CATEGORY	COST RANGE (₹ LAKHS)	% OF TOTAL	NOTES
Civil Works	40-60	10-15%	Foundations, roads, buildings
Installation & Commissioning	25-40	6-10%	Labor, testing, training
Total (without VSI)	**330-505**	100%	₹3.3-5.0 crore
Total (with VSI)	**380-585**	—	₹3.8-5.85 crore

Operating Cost Estimation

COST COMPONENT	₹/TONNE PROCESSED	MONTHLY AT 200 TPH × 300 HRS	NOTES
Electrical Energy	₹25-40	₹15-24 lakhs	At ₹7-8/kWh, 3-5 kWh/t
Wear Parts	₹15-30	₹9-18 lakhs	Jaw dies, cone liners, screen media
Diesel (if applicable)	₹5-15	₹3-9 lakhs	Generators or mobile equipment
Labor (6-8 persons)	₹8-12	₹5-7 lakhs	Operators, loader, maintenance
Maintenance (parts, consumables)	₹10-15	₹6-9 lakhs	Belts, idlers, bearings, oils
Overhead (admin, insurance, etc.)	₹5-10	₹3-6 lakhs	Site costs, compliance
Total Operating Cost	**₹68-122**	**₹41-73 lakhs**	Varies significantly with utilization

Installation Sequence

Recommended Installation Order

1. **Site Preparation (Week 1-2):** Survey, clearing, drainage, access roads
2. **Civil Works (Week 2-6):** Foundations for all equipment, starting with crushers

3. **Primary Section (Week 5-8):** Hopper, feeder, jaw crusher, discharge conveyor
4. **Secondary Section (Week 7-10):** Surge bin, cone crusher, conveyors
5. **Screening Section (Week 9-12):** Screen installation, product conveyors
6. **Electrical (Week 8-14):** Parallel with mechanical, transformer early
7. **Commissioning (Week 13-16):** Individual testing, system integration, load testing

Commissioning Checklist

Pre-Commissioning Verification

- All mechanical installation complete, bolts torqued to specification
- Electrical connections complete, insulation tested
- Lubrication systems filled, bearings greased
- Guards installed, emergency stops functional
- Conveyor belts tracked, scrapers adjusted
- Screen media installed correctly
- Crushing chamber CSS set to specification

No-Load Testing

EQUIPMENT	DURATION	CHECK POINTS
Conveyors	4 hours each	Tracking, speed, motor current, bearing temps
Screens	4 hours each	Stroke, speed, uniformity, structural resonance
Jaw Crusher	8 hours	Bearing temps, toggle action, flywheel balance
Cone Crusher	8 hours	Oil pressure, bearing temps, gyration uniformity

Load Testing Protocol

1. **25% Capacity (8 hours):** Verify all systems functioning, note baseline readings
2. **50% Capacity (16 hours):** Check temperatures stabilizing, product quality

3. **75% Capacity (24 hours):** Sustained operation, fine-tune settings
4. **100% Capacity (48 hours):** Performance verification against design

Conclusion

A 200 TPH aggregate plant represents a significant investment demanding careful engineering at every stage. Success depends on thorough understanding of feed material characteristics, systematic equipment selection based on processing requirements rather than equipment availability, and layout optimization that balances operational efficiency against practical constraints.

The equipment combinations recommended here—42x30 jaw crusher feeding a 48" cone with 3-deck screening—represent proven configurations delivering reliable 200 TPH production with granite and basalt materials. Adding VSI crushing transforms the plant from a basic aggregate producer into a premium manufactured sand facility, commanding significantly higher product prices that justify the additional capital investment.

Invest time in the design phase. Every hour spent optimizing layout, specifying correct equipment, and planning installation sequences saves days of troubleshooting during commissioning and years of operational inefficiency. The most profitable plants aren't those with the most expensive equipment—they're those where every component works in harmony because the design team understood material flow, capacity balancing, and operational reality from the beginning.

Topics: #Aggregate #Crushing #Plant Design

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