



Jaykaycem (Central) Limited

**TECHNO ECONOMIC FEASIBILITY REPORT
FOR
GREENFIELD INTEGRATED CEMENT PLANT
IN
MADHYA PRADESH
With
SPLIT LOCATED GRINDING UNIT
IN
UTTAR PRADESH**

Feb 2021



Holtec Consulting Private Limited



CONFIDENTIAL

THIS DOCUMENT SHOULD BE TREATED AS CONFIDENTIAL AND MUST NOT BE REPRODUCED, COPIED, LOANED OR DISPOSED, DIRECTLY OR INDIRECTLY, NOR USED FOR ANY PURPOSE OTHER THAN FOR WHICH IT IS SPECIFICALLY FURNISHED, WITHOUT THE PRIOR WRITTEN CONSENT OF HOLTEC CONSULTING PRIVATE LIMITED, GURGAON.



ACKNOWLEDGEMENT

WE EXPRESS OUR SINCERE GRATITUDE TO THE OFFICIALS OF THE JAYKAYCEM (CENTRAL) LIMITED, FOR THE ASSISTANCE AND CO-OPERATION EXTENDED THROUGHOUT THE PREPARATION OF THE REPORT, BUT FOR WHICH THIS REPORT COULD NOT HAVE BEEN SUCCESSFULLY PREPARED.



TABLE OF CONTENTS

CHAPTER NO.	DESCRIPTION	PAGES
0	PROJECT AT A GLANCE	0.1-0.9
1	PREAMBLE	1.1-1.2
2	THE CEMENT MARKETS	2.1-2.7
3A	RAW MATERIALS & Fuels – IU	3A.1-3A.13
3B	RAW MATERIALS & Fuels – GU	3B.1-3B.2
4A	LOCATION & INFRASTRUCTURE - IU	4A.1-4A.6
4B	LOCATION & INFRASTRUCTURE - GU	4B.1-4B.4
5A	PLANT TECHNICAL CONCEPT - IU	5A.1-5A.39
5B	PLANT TECHNICAL CONCEPT - GU	5B.1-5B.24
6A	HUMAN RESOURCES - IU	6A.1- 6A.3
6B	HUMAN RESOURCES - GU	6B.1-6B.3
7A	IMPLEMENTATION SCHEDULE - IU	7A.1- 7A.3
7B	IMPLEMENTATION SCHEDULE - GU	7B.1-7B.3
8	FINANCIAL APPRAISAL	8.1-8.5



LIST OF ANNEXURES - IU

CHAPTER NO.	ANNEXURE NO.	DESCRIPTION
3A	3A.1	Raw Mix Design
	3A.2	Limestone Raising Cost
	3A.3	Mining Equipment Cost
4A	4A.1	Photo Gallery
5A	5A.1	Mass Flow Diagram
	5A.2	Capacity of Major Equipment and Storages
	5A.3	Quality Plan
6A	6A.1	Implementation Period
	6A.2	Operation Period
7A	7.1	Project Execution: Turnkey
	7.2	Project Execution: Semi Turnkey
	7.3	Project Execution: Package
	7.4	Project Execution: Shopping
	7.5	Comparative: Procurement Options
	7.6 A	Project Schedule – Pre Project Activities – IU
	7.6 B	Project Activities After Main Machinery Order Placement – Implementation Schedule – IU
8	8.1	Summary of Investment Cost Estimates
	8.2	Investment Cost Estimates
	8.3	Cost of Civil Structures & Foundations
	8.4	Cost of Mechanical & Electrical Equipment
	8.5	Cost of Power Distribution Equipment



LIST OF ANNEXURES - GU

CHAPTER NO.	ANNEXURE	DESCRIPTION
5	Annexure 5B.1	Indicative Mass Flow Diagram
6	Annexure 6B.1	Estimated Manpower Requirement During Implementation Period
	Annexure 6B.2	Estimated Manpower Requirement During Operation Period
7	Annexure 7.1	Project Execution: Turnkey
	Annexure 7.2	Project Execution: Semi Turnkey
	Annexure 7.3	Project Execution: Package
	Annexure 7.4	Project Execution: Shopping
	Annexure 7.5	Comparative: Procurement Options
	Annexure 7B.6A	Project Schedule – (Pre-Project Activities)
	Annexure 7B.6B	Project Activities After Main Machinery Order Placement – (Implementation Schedule)
8	Annexure 8.6	Summary of Investment Cost Estimates
	Annexure 8.7	Investment Cost Estimates
	Annexure 8.8	Cost of Civil Structures & Foundations
	Annexure 8.9	Cost of Mechanical & Electrical Equipment
	Annexure 8.10	Cost of Power Distribution Equipment



LIST OF ANNEXURES - CONSOLIDATED

CHAPTER NO.	ANNEXURE OR DRAWING NO.	DESCRIPTION
8	Annexure 8.11	Unit cost of production (IU)
	Annexure 8.12	Unit cost of production (GU)
	Annexure 8.13	Interest calculations and repayment schedule for Term Loan
	Annexure 8.14	Working results & profitability computations
	Annexure 8.15	Working Capital requirements
	Annexure 8.16	Projected Funds Flows
	Annexure 8.17	Projected Balance Sheets
	Annexure 8.18	Internal Rate of Return on Total Investment
	Annexure 8.19	Internal Rate of Return on Equity
	Annexure 8.20	Break Even Point & Indicators of Performance (DSCR)



LIST OF DRAWINGS - IU

CHAPTER NO.	DRAWING NO.	DESCRIPTION
5	20151-05A-IU-1-01	Plant Layout
	20151-05A-IU-1-02	Flow Sheet for Limestone Crushing
	20151-05A-IU-1-03	Flow Sheet for Limestone Stockpile
	20151-05A-IU-1-04	Flow Sheet for Corrective/ Additive Stockpile
	20151-05A-IU-1-05	Flow Sheet for Coal/ Petcoke Stockpile
	20151-05A-IU-1-06	Flow Sheet for Alternate Fuel Stockpile
	20151-05A-IU-1-07	Flow Sheet for Raw Mill Hoppers
	20151-05A-IU-1-08	Flow Sheet for Raw Mill - 1
	20151-05A-IU-1-09	Flow Sheet for Raw Mill - 2
	20151-05A-IU-1-10	Flow Sheet for Raw Meal Blending Silo
	20151-05A-IU-1-11	Flow Sheet for Preheater, Kiln & Cooler
	20151-05A-IU-1-12	Flow Sheet for Clinker Storage & Load Out Silos
	20151-05A-IU-1-13	Flow Sheet for Flyash Storage & Conveying
	20151-05A-IU-1-14	Flow Sheet for Cement Mill Hoppers
	20151-05A-IU-1-15	Flow Sheet for Cement Mill
	20151-05A-IU-1-16	Flow Sheet for Cement Silos
	20151-05A-IU-1-17	Flow Sheet for Cement Packing & Loading
	20151-05A-IU-1-18	Flow Sheet for Coal Mill
	20151-05A-IU-1-19	Power Distribution Scheme
	20151-05A-IU-1-20	Control System Configuration



LIST OF DRAWINGS - GU

CHAPTER NO.	DRAWING NO.	DESCRIPTION
4	20151-04-GU-1-01	Conceptual Plant Layout
	20151-04-GU-1-02	Flow sheet for Additives & Coal handling & storage
	20151-04-GU-1-03	Flow sheet for Hot Air Generator (HAG)
	20151-04-GU-1-04	Flow sheet for Clinker storage & conveying
	20151-04-GU-1-05	Flow sheet for Cement Mill Hoppers
	20151-04-GU-1-06	Flow sheet for Flyash storage and conveying
	20151-04-GU-1-07	Flow sheet for Cement Mill circuit
	20151-04-GU-1-08	Flow sheet for Cement storage
	20151-04-GU-1-09	Flow sheet for Cement Packing & Loading
	20151-04-GU-1-10	Power Distribution Scheme
	20151-04-GU-1-11	Control System Configuration



LIST OF ABBREVIATIONS

ABBREVIATION	DESCRIPTION
%	Percent
a	Annum
Avg.	Average
°C	Degree Centigrade
BE	Bucket Elevator
BH	Bag House
BIS	Bureau of Indian Standards
BRO	Border Road Organization
CC	Calcium Carbonate
CCBM	Closed Circuit Ball Mill
CCR	Central Control Room
CCRP	Closed Circuit Roller Press
CCTV	Closed Circuit Television
cm	Centimeters
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
CPP	Captive Power Plant
CPU	Central Processing Unit
DC	Direct Current
DCS	Distributed Control System
DG	Diesel Generating Set
Dia.	Diameter
Diff	Differential



ABBREVIATION	DESCRIPTION
dpa	Days Per Annum
DPC	Deep Pan Conveyor
E & I	Electrical & Instrumentation
ESP	Electrostatic Precipitator
FY	Financial Year
GA	General Arrangement
ha	Hectares
HAG	Hot Air Generator
HEME	Heavy Earth Moving Equipment
HOLTEC	Holtec Consulting Private Limited, Gurgaon
hpd	Hours per day
HT	High Tension
ILC	Inline Calciner
IRR	Internal Rate of return
ISO	International Organization for Standardization
JCL	Jaykaycem (Central) Limited
kcal	Kilo Calories
kg	Kilograms
kL	Kilo Liters
km	Kilometers
kV	Kilo Volts
kVA	Kilovolt Amperes
kW	Kilo Watts
kWh	Kilo Watt Hours



ABBREVIATION	DESCRIPTION
LMV	Light Motor Vehicle
LSF	Lime Saturation Factor
LT	Low Tension
LV	Low Voltage
m	Meters
Max.	Maximum
MC	Magnesium Carbonate
MCCs	Motor Control Centres
mg	Milligrams
min	Minutes
mio	Millions
mm	Millimeters
mmWG	Millimeter Water Gauge
Min.	Minimum
MIS	Management Information System
ML	Mining Lease
MSL	Mean Sea Level
MVA	Megavolt Amperes
MW	Megawatts
NCV	Net Calorific Value
NPV	Net Present Value
NSDP	Net Standard Domestic Production
Nm ³	Normal Meter Cube
No./ nos.	Numbers



ABBREVIATION	DESCRIPTION
NO ₂	Nitrogen Dioxide
O ₂	Oxygen
OH	Overhead
OPC	Ordinary Portland Cement
PC	Pre Calcliner
PGNAA	Prompt Gamma Neutron Activation Analysis
PH	Preheater
PL	Prospecting Lease
PLC	Programmable Logic Control
p.m.	Per Month
PPC	Portland Pozzolana Cement
PSD	Particle Size Distribution
PVC	Poly Vinyl Chloride
RCC	Reinforced Cement Concrete
RM	Raw Mill
ROM	Run of Mines
RP	Roller Press
RPBM	Roller Press with Ball Mill
s	Second
SBC	Safe Bearing Capacity
Sn	Serial Number
SO _x	Sulphur Oxides
t	Tonnes
TAD	Tertiary Air Duct



ABBREVIATION	DESCRIPTION
TEFR	Techno Economic Feasibility Report
tpa	Tonnes Per Annum
tpd	Tonnes Per Day
tph	Tonnes Per Hour
UNFC	United Nation Framework of Reserve Classification
UPS	Uninterrupted Power Supply
V	Volts
VRM	Vertical Roller Mill
XRD	X-ray Diffractometer
XRF	X-ray Fluorescence



CHAPTER 0: PROJECT AT A GLANCE

Integrated Unit (IU)

Promoters	Jaykaycem (Central) Limited
Project	<p>To set up an Integrated Cement Plant of capacity 8,000 tpd clinker and 2.0 mio tpa cement capacity.</p> <p>Installation of Waste Heat Recovery System (WHRS) of 22 MW capacity is also envisaged as part of the project.</p>
Plant Capacity	<p>Clinker : 8,000 tpd</p> <p>Cement : 2.0 mio tpa</p>
Plant location	<p>Village villages Harduwa Ken, Puraina, Maddiyan and Sotipura, Tehsil Amanganj, District Panna, Madhya Pradesh</p> <p>Locating co-ordinates:</p> <p>Latitude : N 24° 19' 14"</p> <p>Longitude: E 73° 53' 9"</p> <p>Elevation : ~315 m from MSL</p>
Markets	<p>The markets of interest for JCL's proposed cement plant include Madhya Pradesh and Uttar Pradesh.</p> <p>It is estimated that JCL would be able to achieve 100% capacity utilization by the 4th year of operation i.e. FY27.</p> <p>The average net cash realization for OPC is estimated to be Rs. 3,638/ t (Rs. 182/ bag) and for PPC it is 3,482/ t (Rs. 174/ bag).</p>
Product Mix	<p>40% OPC</p> <p>60 % PPC</p>
Applicable Standards	<p>OPC: IS 12269 -1987</p> <p>PPC: IS 1489-1991</p>
Limestone Reserve & Deposit Life	<p>About 237.27 mio t of cement grade limestone, 58.20 mio t of blendable grade limestone, and 27.32 mio t inferior grade probable limestone reserves have been estimated by JCL in Kakra ML area.</p> <p>The estimated limestone reserves shall meet the requirement of clinkerisation plant for about 80 years for the envisaged production capacity of 2.64 mio tpa clinker.</p>



Jaykaycem (Central) Limited

Fuel	Indian Coal & Petcoke.				
Suggested Raw Mix	Component			Proportion, % by weight	
	Limestone			96.6	
	Bauxite			2.20	
	Ore Iron			1.20	
	Raw Meal to Clinker Factor			1.51	
Water Requirement	Item		Unit	Consumption	
	Cement Plant		m ³ /day	2,100	
	Drinking, Sanitation & Plantation		m ³ /day	100	
	Mines		m ³ /day	150	
	Waste Heat Recovery System (WHRS)		m ³ /day	150	
	Total		m ³ /day	2,500	
Power Requirement	34 MW				
Raw material & Fuel	Raw material	Source Locality	Source Category	Approx. distance (km)	Approx. Landed Cost (Rs/ t)
	Limestone	Kakra, Kamtana, Judi, Saptai, etc. villages of Amanganj tehsil, M.P.	Captive	1	181.21
	Bauxite	Various sources from Maihar tehsil, District Satna, M.P.	Purchase	100	1,500
	Iron Ore	Various sources from Sihora tehsil, Jabalpur, M.P.	Purchase	130	1,100



Jaykaycem (Central) Limited

	Gypsum	Imported gypsum from Gulf region through sea port(s) located in Andhra Pradesh	Purchase	~1,350 from seaport	3,700
	Fly Ash/ Pond Ash	Various thermal power plants in the radius of ~200km from plant site	Purchase	200	681
	Indian Coal	Sohagpur Coalfields, SECL, M.P.	Purchase	400	4,388
	Petcoke	Majorly imported from various sources and received via sea port(s) located in Andhra Pradesh	Purchase	~1,350 from seaport	9,326
Basis for Assessment	Kiln operation			330 dpa	
	Envisaged specific power consumption			48 kWh/ t Clinker	
				65 kWh/ t PPC 80 kWh/ t OPC	
	Envisaged specific heat consumption			680 kcal/ kg clinker	
	Product Composition:			OPC	PPC
	Clinker	%		90	60
	Gypsum	%		5	5
	Fly ash	%		-	35
	Limestone	%		5	-
Main Machinery	Item		Capacity		
	Limestone Crusher (tph)		1,600		
	Corrective/ Additive Crusher (tph)		300		
	Coal crusher (tph)		300		



Jaykaycem (Central) Limited

	Raw material grinding (CCRP) (tph)	2 x 375		
	Kiln (tpd)	8,000		
	Cooler (tpd)	8,000		
	Coal mill (VRM) (tph)	90 (Coal)/ 50 (Petcoke)		
	Cement grinding (VRM) (tph)	1 x 300		
	Packing machine (tph)	2 x 240		
Main Storages	Item	Storages (t)		
	Limestone (Linear covered)	2 x 40,000		
	Bauxite (Linear covered)	7,500		
	Iron Ore (Linear covered)	7,500		
	Raw meal silo (RCC)	10,000		
	Coal Stockpile (Linear covered)	2 x 10,000		
	Petcoke Stockpile (Linear covered)	2 x 3,000		
	Clinker silo (RCC)	100,000		
	Fly ash silo (RCC)	5,000		
	Pond Ash storage (Linear covered)	5,000		
	Gypsum (Linear covered)	2,100		
	Additive Limestone (Linear covered)	1,000		
	Cement silos (RCC)	3 x 5,000		
Suggested Manpower	Phase	General	Shift	Total
	Implementation Phase	65	-	65
	Operation Phase	125	325	450
Project Implementation Period	24 months			

Grinding Unit (GU)

Promoters	Jaykaycem (Central) Limited
Project	To set up a greenfield Clinker Grinding Unit (GU) of 2.0 mio tpa cement production capacity in Hamirpur district in the State of Uttar Pradesh.



Jaykaycem (Central) Limited

Plant location	<p>The approximate locating coordinates and altitude of the proposed site are:</p> <ul style="list-style-type: none"> • Latitude : N 25° 46' 16" • Longitude : E 80° 07' 40" • Altitude : Average about 122 m with respect to MSL 			
Land	<p>About 27 acres of land (approx. 11 hectares) is being procured for the purpose of setting up the proposed Grinding Unit.</p> <p>A total of about Rs.900 lakhs is envisioned by the company as the capital expense towards land procurement and its land-use conversion from agricultural to manufacturing purposes.</p>			
Product mix	100% Portland Pozzolana Cement (PPC)			
Markets	<p>Relevant parts of Uttar Pradesh state are envisaged as the target market, as listed below:</p> <ul style="list-style-type: none"> • South East UP • North East UP • Central UP <p>It is estimated that JCL should be able to achieve 100% capacity utilization by the 4th year of operation, i.e., FY26.</p> <p>The average net cash realization for PPC is estimated to be Rs. 3,936/ t (~ Rs. 197/ bag).</p> <p>Furthermore, JCL is envisaged to avail of Uttar Pradesh SGST exemption (70% of SGST for sales in Uttar Pradesh, max up to 300% of Fixed Capital Investment for 15 years) which shall help alleviate the overall net realization to around Rs.4,432/ t (~ Rs. 222/ bag).</p>			
Water Requirement	<p>The total water requirement for the project is envisaged to be about 300 m³/day, which is envisaged to be met from underground sources and secondary sources like rainwater harvesting, etc.</p>			
Raw materials & Fuel	Material	Mode of procurement	Source(s)	Average Landed cost (Rs/ t)
	Clinker	Purchase	JCL's upcoming integrated unit in district Panna (M.P.) planned to be located at an approximate distance of 240 km from the plant	3,300



Jaykaycem (Central) Limited

	Fly ash & Pond ash	Purchase	3x660 MW Ghatampur Thermal Power Station (TPS) of Neyveli Uttar Pradesh Power Limited (NUPPL) located at an approximate distance of 30 km from the plant	350
	Gypsum	Imported; Purchase	Various (Imported from Oman/Iran, and sourced through operators and importers via East coast of India), in pre-crushed and sized form	4,500
	Coal (for HAG)	Purchase	Various sources from the regional coal hubs, through traders, in pre-crushed and sized form	4,500
Main operational parameters for technical concept	Plant operation		330 days per annum	
	Mill operation		21 hours per day	
	Design/Safety factor for major sections		Approx. 1.05 for grinding section & 1.25 for packing section	
	Specific power consumption for plant operations		An average of ~32 kWh/t specific power consumption per ton of PPC produced at plant is envisaged (average blaine of 3,600 kg/sqcm).	
Raw Material proportioning	Material		Theoretical raw material proportioning for manufacturing of PPC:	
	• Clinker		60%	
	• Gypsum		5%	
	• Fly ash / Pond ash		35%	
Power demand	The total maximum power demand for the proposed plant has been estimated as about 12 MW, which is envisaged to be met from the Sumerpur grid substation of U.P. Power Transmission Corporation Limited (UPPTCL) located at about 6km crow-fly distance from the proposed plant. The average tariff for sourcing industrial power is envisaged to be about Rs 7.70 per kWh.			



Jaykaycem (Central) Limited

Main Machinery	Item	Capacity
	Cement grinding mill	300 tph (PPC at 3,600 Blaines) Envisaged to be a VRM, with suitably sized HAG
	Cement Dispatch	
	Packing machines	2 x 240 tph
	Loading machines	6 nos. Truck/ Trailer loaders & 1 no. Bulk loading system
Main storages	Hot Air Generator	Approx. 12 to 15 kcal/h system (Capacity however to be analysed yet with respect to estimated inherent moisture content in input material, and their proportions)
	Item	Capacity
	Clinker	1 x 25,000 t
	Gypsum (pre-crushed)	1 x 2,500 t
	Pond ash	1 x 2,500 t
	Fly ash (Dry)	1 x 5,000 t
	Coal (pre-crushed)	1 x 1,000 t
	Cement	2 x 5,000 t & 1 x 1,000 t (Future)
Estimated manpower	About 30 personnel for implementation phase, and about 204 personnel estimated for operation phase	
Project implementation period	A most-likely implementation period of 18 months from the date of signing/ effectiveness of the contract is envisaged	



Consolidated Financials

Project Estimate	Capex	Item	Figures in Rs. Lakhs			
			IU	GU	Common	Total
		Land and Site Development	47,495	2,270	-	49,765
		Civil Works and Structures	37,863	8,205	-	46,068
		Plant and Machinery	128,524	21,163	-	149,687
		Engineering & Know How	1,100	400	-	1,500
		Expense on Training	750	50	-	800
		Miscellaneous Fixed Assets	3,018	210	-	3,228
		Pre-Operative Expenses including interest during construction period	-	-	24,778	24,778
		Contingency provision	-	-	19,710	19,710
		Margin Money for Working Capital	-	-	1,494	1,494
		TOTAL	218,750	32,298	45,982	297,029
		Sources of Funds				
		Debt		1,67,886		
		Equity		1,29,143		
		TOTAL		2,97,029		
Financial Indicators		Item		Value		
		IRR on Total Investment		16.4%		
		IRR on Equity		24.3%		
		Net Present Value @ 10% (Rs. Crore)		1,603		
		Payback Period		6 Years 6 Months		
		Average Debt Service Coverage Ratio		2.38		
Conclusion		It is concluded that the project is technically feasible and financially viable.				



CHAPTER 1: PREAMBLE

1.1 THE PROJECT

Jaykaycem (Central) Limited (JCL) proposes to set up a Greenfield Integrated Cement Plant (IU) of 8,000 tpd clinker and 2.0 mio tpa cement capacity at village Devra, Hardua, Puraina, Sotipura and Madaiyan, tehsil Amanganj, district Panna, Madhya Pradesh with a split located Grinding Unit (GU) of 2 mio tpa capacity in district Hamirpur, Uttar Pradesh.

The project also envisages setting up of Waste Heat Recovery System (WHRS) based power plant, along with the integrated cement plant.

The project does not envisage Captive Power Plant (CPP) and Railway Siding at both the locations.

A part of Clinker produced shall be consumed at integrated cement plant and balance shall be supplied to **JCL's** Grinding Unit (GU) in Hamirpur, Uttar Pradesh.

1.2 PROMOTER'S BACKGROUND

Jaykaycem (Central) Limited (JCL) is a wholly owned subsidiary of JK Cement Limited, which in turn, is the Cement vertical of the industrial conglomerate JK Organisation. **JCL**, thus, is an affiliate of the flagship JK Organisation.

The primary set of promoters of JCL as on date are:

- Mrs. Sushila Devi Singhania : Chairman
- Mrs. Kavita Y Singhania : Associate Director
- Mr. Raghavpat Singhania : Managing Director
- Mr. Madhavkrishna Singhania : Deputy Managing Director & CEO

JCL has plans to set up a greenfield grey cement manufacturing unit of 8,000 tpd clinker capacity in Panna district of Madhya Pradesh, and a greenfield split grinding unit in Hamirpur district of Uttar Pradesh.

1.3 CONSULTANT BACKGROUND

This study has been carried out by:

Holtec Consulting Private Limited
HOLTEC Centre,
A Block, Sushant Lok - I
Gurgaon – 122 001, Haryana, INDIA

Incorporated in 1967, **Holtec Consulting Private Limited** is an ISO-certified advisory, primarily positioned to service the entire gamut of multi-functional, consulting needs of the global cement industry.



HOLTEC's ensemble of 800+ clients, in over 84 countries, includes cement producers, equipment & service providers, EPC & construction firms, infrastructure developers, investing & funding bodies and all other relevant stakeholders. Since its inception, **HOLTEC** has delivered significant value to its clientele through 4,000+ consulting assignments executed by its 300+, multi-disciplinary staff with an experience inventory of over 8,500 man-years

1.4 THE REPORT

JCL has appointed **HOLTEC** for the preparation of Techno Economic Feasibility Report for the Greenfield Integrated Cement Plant in Madhya Pradesh with split located Grinding Unit in Uttar Pradesh.

HOLTEC constituted a multifunctional team comprising of raw material, markets and project/ plant specialists for the assignment. Data collection and analysis was done based on desk study and site/ market visits were not carried out due to COVID19 travel restrictions.

This consolidated report covers the combined financial appraisal of the Integrated Unit (IU) in Panna, Madhya Pradesh and Grinding Unit (GU) in Hamirpur, Uttar Pradesh.

This study draws extensively from **HOLTEC**'s database.



CHAPTER 2: THE CEMENT MARKETS

2.1 PREAMBLE

This chapter looks at the market scenario for two greenfield units of **Jaykaycem (Central) Limited (JCL)**. Integrated Unit (IU) shall be located at Amanganj tehsil in district Panna of Madhya Pradesh with cement capacity of 2.00 million ton per annum and Grinding Unit (GU) shall be located at Hamirpur, Uttar Pradesh with capacity of 2.00 million ton per annum.

It estimates the future demand and supply in the target market and examines the market position of **JCL**. The sale volumes and the net sales realization that could be achieved have also been assessed.

2.2 MARKETS OF INTEREST

The markets of interest for the **JCL**'s proposed plants are as follows:

Madhya Pradesh (MP):

- **West MP:** which includes Neemuch, Ratlam, Barwani, East Nimar, Indore, Mandsaur, Ujjain, Jhabua, Alirajpur, Burhanpur, Dhar, West Nimar, Rajgarh, Shajapur, Harda, Betul, Bhopal, Dewas, Sehore and Hoshangabad
- **North MP:** which includes Guna, Shivpuri, Datia, Sheopur, Gwalior, Morena and Bhind
- **Central MP:** which includes Sagar, Vidisha, Damoh, Raisen, Narsimhapur, Jabalpur, Mandla, Katni, Chhindwara, Seoni, and Balaghat
- **East MP:** which includes Tikamgarh, Chhatarpur, Panna, Satna, Rewa, Sidhi, Umaria, Shahdol and Dindori

Uttar Pradesh (UP)

- **South East UP** which includes Allahabad, Azamgarh, Jaunpur, Kaushambi, Mirzapur, Pratapgarh, Sant Ravidas Nagar, Sonbhadra, Sultanpur, Varanasi, Chandauli, Ghazipur, Mau and Ballia.
- **North East UP** which includes Shravasti, Ambedkar Nagar, Balrampur, Basti, Deoria, Kushinagar, Faizabad, Gonda, Gorakhpur, Maharajganj, Sant Kabir Nagar and Siddharthanagar.
- **Central UP** which includes Auraiya, Bahraich, Banda, Barabanki, Chitrakoot, Etawah, Farrukhabad, Fatehpur, Hamirpur, Hardoi, Jalaun, Jhansi, Kannauj, Kanpur Rural & Urban, Lakhimpur, Lalitpur, Lucknow, Mahoba, Mainpuri, Rae Bareilly, Shahjahanpur, Sitapur and Unnao.

The markets of interest for **JCL** have been depicted in **Chart 2.1**

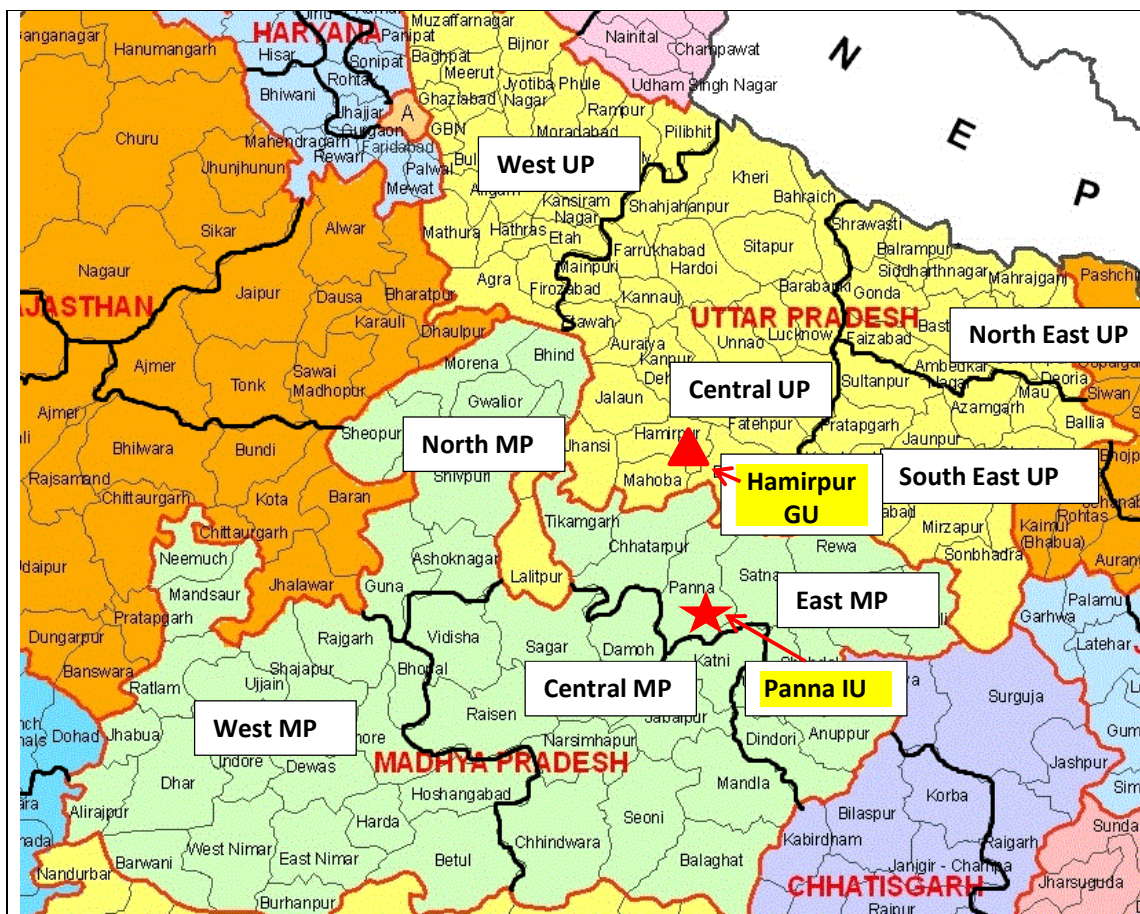


Chart 2.1: Markets of Interest for proposed JCL Plants

2.2.1 Current Demand

The demand for different regions of markets of interest is given in the following table:

Figures for FY 20

Market	Consumption (mio t)	Share of target market %
Central MP	3.8	9%
East MP	3.2	8%
West MP	7.7	19%
North MP	2.6	6%
Central UP	11.1	27%
South East UP	7.5	18%
North East UP	5.2	13%
Total	41.1	100%

Source: Holtec Analysis

Table 2.1: Cement consumption in various regions of market of interest



Jaykaycem (Central) Limited

The estimated cement consumption in the markets of interest for FY20, based on market information, is estimated to be around 41 mio t.

2.2.2 Market Shares

The market shares of players in the target region based on market visit and industry feedback for FY20 are given below.

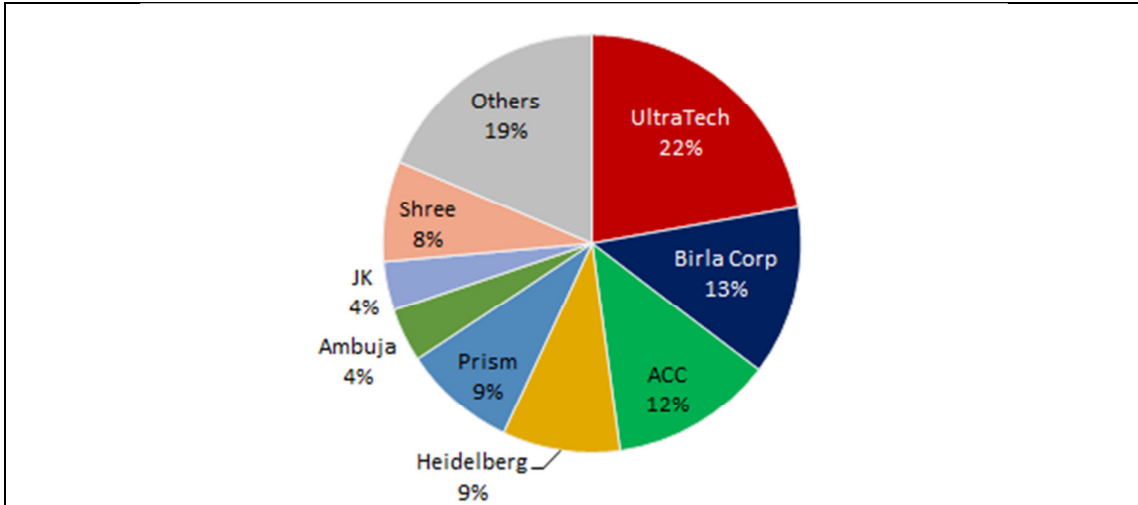


Chart 2.2: Estimated Market Shares in Target Market

UltraTech, Birla Corp and, ACC are the main players in the market; jointly they hold 47% of the market share.

2.2.3 Prices

The average retail price of PPC is depicted in the table that follows

Market	Price Range for PPC (Rs per bag)
Central MP	275 - 355
East MP	280 - 345
West MP	315 - 360
North MP	325 - 365
Central UP	295 - 380
South East UP	315 - 400
North East UP	340 - 385

Table 2.2: Region wise Price Range (PPC)

The price of OPC is Rs 10/ bag higher than PPC.

2.2.4 Packaging

Most of the cement supply in the target region is in 50 Kg HDPE bags.



2.2.5 Logistics

Freight is the key component in cement distribution and pricing. Primary freight (freight from cement plant to cement depot/ warehouse in the desired market) for players has been worked out based on road distances from each cement plant to each district in the target region. The cement outward logistic for **JCL** is considered by road.

2.2.6 Advertising & Promotion (A&P)

The most commonly used modes of advertising in the target region are wall paintings, hoardings and dealers boards. Cement companies generally highlight their product and message using these media. Some of the cement companies also advertise in electronic and print media viz., television, newspapers, magazines, etc. Local companies also advertise their products in local construction directories.

Promotional tools like gifts, calendars, diaries, key chains, etc. are distributed among the channel members.

2.3 FUTURE OUTLOOK

2.3.1 Cement Demand

The future growth rates for different markets in the target region are given in **Table 2.3**.

Market	Future CAGR*
Central MP	6.2%
East MP	4.7%
West MP	6.2%
North MP	4.7%
Central UP	5.9%
South East UP	5.9%
North East UP	5.2%

*CAGR: Compound Annual Growth Rate

Table 2.3: Future growth rates of different markets (FY 20 - FY 27)

The demand forecast results may change depending on the covid-19 pandemic situation in future. Thus, demand forecast would need to be reviewed as the situation changes.

Based on the above given region wise future CAGR, **Table 2.4** shows the trend of future cement demand in different markets of the target region.

Figures in mio t

Markets	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27
Central MP	3.8	3.5	3.9	4.2	4.6	4.9	5.3	5.8



Jaykaycem (Central) Limited

Markets	FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27
East MP	3.2	3.0	3.3	3.5	3.7	3.9	4.2	4.4
West MP	7.7	7.2	8.0	8.6	9.3	10.0	10.8	11.7
North MP	2.6	2.5	2.7	2.9	3.1	3.2	3.4	3.7
Central UP	11.1	10.4	11.6	12.4	13.4	14.4	15.5	16.6
South East UP	7.5	7.0	7.8	8.4	9.0	9.7	10.4	11.2
North East UP	5.2	4.9	5.4	5.8	6.2	6.6	7.0	7.5
Total	41.1	38.5	42.7	45.8	49.2	52.8	56.6	60.8

Table 2.4: Cement Demand Forecast

From a level of around 41 mio t in FY 20, cement demand in the target region is likely to reach around 61 mio t in FY 27 growing at a CAGR of around 6%.

2.4 PROJECTED SALES VOLUMES AND NET CASH REALIZATION

2.4.1 Market Selection

The target markets are to be serviced from **JCL**'s proposed units at Panna, Madhya Pradesh and Hamirpur, Uttar Pradesh. Market selection is done based on the competitiveness of the plants to service a market.

JCL already has presence in the target region through its parent company (JKCL) units at Aligarh in West Uttar Pradesh and Nimbahera in Rajasthan which cater to parts of the target market. Thus, market analysis takes into account supply from the existing plants while estimating cement sales volumes from **JCL**'s proposed units at Panna, Madhya Pradesh and Hamirpur Uttar Pradesh.

2.4.2 Volumes for JCL

We believe that a company's strength in a market, as denoted by its market share, depends primarily on its **Competitive Advantage**.

Competitive Advantage (CA): CA for a player can be measured by comparing its "Net Cash Realization" in a market center with that of the other players. CA indicates how well a player is positioned with respect to its competitors, to sell in a given market.

Steps followed in CA Analysis:

- The potential competitors of **JCL** in various markets were first identified.
- For each of these players, the components of its "**Net Cash Realization**" were estimated, where

$$\text{NCR} = \text{Retail Price} - \text{GST} - \text{Channel Margin} - \text{Primary \& Secondary Freight}$$

(GST Rate considered at 28%)



Jaykaycem (Central) Limited

- Using this information, **NCR** was then computed for each of the players in the markets of interest to **JCL**.
- Competitive Advantage Index (CA Index) for **JCL** and all its probable competitors was computed where,

$$\text{CA Index} = \frac{\text{Net Cash Realization for a player in a market}}{\text{Average Net Cash Realization for all players in a market}}$$

A competitiveness Index = 1 means that the player has average competitiveness in the market. CI > 1 implies good competitiveness.

- Achievable market shares for **JCL** in the target market was estimated based on:
 - Competitive advantage
 - Present market shares of **JCL**
 - Future Capacity additions
 - Estimated future demand

2.4.3 Achievable Volumes and Market Shares

The following table gives the market wise estimated achievable sales volume and market shares for **JCL** in FY 24, Panna IU is envisaged to commission in this year. Hamirpur GU is envisaged to commence operation in Feb 23 but it will work only two month in FY 23 thus achievable volumes are given for FY 24.

Figures in mio t

Market	Market Size (FY24)	Achievable Sales Volumes FY 24		Total Volume	Market Share
		Panna (IU)	Hamirpur (GU)		
Central MP	4.57	0.39	-	0.39	9%
East MP	3.71	0.32	-	0.32	9%
West MP	9.30	0.20	-	0.20	2%
North MP	3.06	0.26	-	0.26	9%
Central UP	13.37	0.04	1.18	1.22	9%
South East UP	9.00	0.44	0.13	0.57	6%
North East UP	6.18	0.03	0.42	0.45	7%
Total	49.19	1.68	1.73	3.41	7%

Source: Holtec Analysis

Table 2.5: Achievable Volumes for JCL

Year wise achievable cement volumes and capacity utilization for **JCL** are given as follows:

Plants Years	Achievable Sales Volumes			Capacity Utilisation		
	IU	GU	Total	IU	GU	Total
Total Capacity	2.00	2.00	4.00	-	-	-
FY 23	-	1.61	1.61	-	81%	40%



Jaykaycem (Central) Limited

Plants Years	Achievable Sales Volumes			Capacity Utilisation		
	IU	GU	Total	IU	GU	Total
FY 24	1.68	1.73	3.41	84%	87%	85%
FY 25	1.80	1.86	3.65	90%	93%	91%
FY 26	1.92	2.00	3.92	96%	100%	98%
FY 27	2.00	2.00	4.00	100%	100%	100%

Source: Holtec Analysis

Chart 2.6: Year wise achievable volume and capacity utilization

2.4.4 Net Cash Realization

The realization calculated for cement is as follows:

Figures in Rs. / t

Particulars	IU		GU
	OPC	PPC	PPC
Retail Price	6,441	6,241	6,475
GST @ 28%	1,409	1,365	1,416
Margins	500	500	500
Freight	894	894	623
Realisation, Rs./ t	3,638	3,482	3,936
Realisation, Rs./ Bag	182	174	197

Table 2.7: Realization of JCL

2.4.5 Product Mix

JCL proposes to produce 80% PPC and 20% OPC on the overall volume. Product mix at IU is 60% PPC and 40% OPC and at GU it is 100% PPC.

2.5 OVERALL CONCLUSION

The markets of interest for **JCL's** proposed units include Madhya Pradesh and Uttar Pradesh.

As per Holtec's Analysis, JCL (both plants considered) is expected to reach 100% capacity utilization by FY 27.

The average net cash realization of PPC is estimated to be **Rs. 3,482/ t or Rs. 174/ bag for IU and Rs. 3,936/ t or Rs. 197/ bag for GU**. Realization of OPC is estimated to be **Rs. 3,638/ t or Rs. 182/ bag for IU**.

JCL is expected to avail of Uttar Pradesh SGST exemption (70% of SGST for sales in Uttar Pradesh, max up to 300% of Fixed Capital Investment for 15 years) which shall help alleviate the overall net realization.

JCL's Panna IU is eligible for Investment Promotion Assistance of 15,000 Lakhs to be reimbursed over 7 years as per the Madhya Pradesh Incentive Policy.



CHAPTER 3A : RAW MATERIALS - IU

3.1 RAW MATERIAL SOURCES

Jaykaycem (Central) Limited (JCL) intends to set up 8,000 tonnes per day clinkerisation plant at Amanganj tehsil of Panna district in the state of Madhya Pradesh.

The envisaged raw materials, fuel and additive sources for the proposed plant are furnished in **Table 3.1**

Raw material	Source Locality	Source Category	Road distance from plant (km)	Remarks
Limestone	Spanning across Kakra, Kamtana, Judi, Saptai, etc. villages of Amanganj tehsil, M.P.	Captive	< 1	The crusher is proposed to be located in the periphery of mines. Crushed limestone from the crusher shall be transported to plant by belt conveyor
Bauxite	Various sources from Maihar tehsil, District Satna, M.P.	Purchase	100	To be used as corrective and shall be transported by trucks to plant site
Iron ore	Various sources from Sihora tehsil, Jabalpur, M.P.	Purchase	130	To be used as corrective and shall be transported by trucks to plant site
Gypsum	Imported gypsum from Gulf region through sea port(s) located in Andhra Pradesh	Purchase	1,200 to 1,350 depending on receiving seaport	To be used as an additive. Shall be transported to plant site by trucks from the sea port
Fly ash	Various thermal power plants in the radius of ~200km from plant site	Purchase	200	To be used as an additive. Shall be transported to plant site by bulkers
Indian Coal	Sohagpur Coalfields, SECL, M.P.	Purchase	400	Major component of the fuel mix. Shall be transported to plant site by road
Pet coke	Majorly imported from various sources and received via sea port(s) located in Andhra Pradesh	Purchase	1,200 to 1,350 depending on receiving seaport	To be used as fuel and shall be transported by road to plant site

Table 3.1 | Details of Raw material, fuel and additive sources for the proposed plant

JCL has been granted mining lease (ML) for mineral limestone in villages Kakra, Kamtana, Judi, Saptai, Devri Purohit and Devra in tehsil Amanganj, District Panna, Madhya Pradesh. The clinkerisation plant is proposed to be located adjacent to the mines. The location of the mining lease is shown in **Fig. 3.1**.

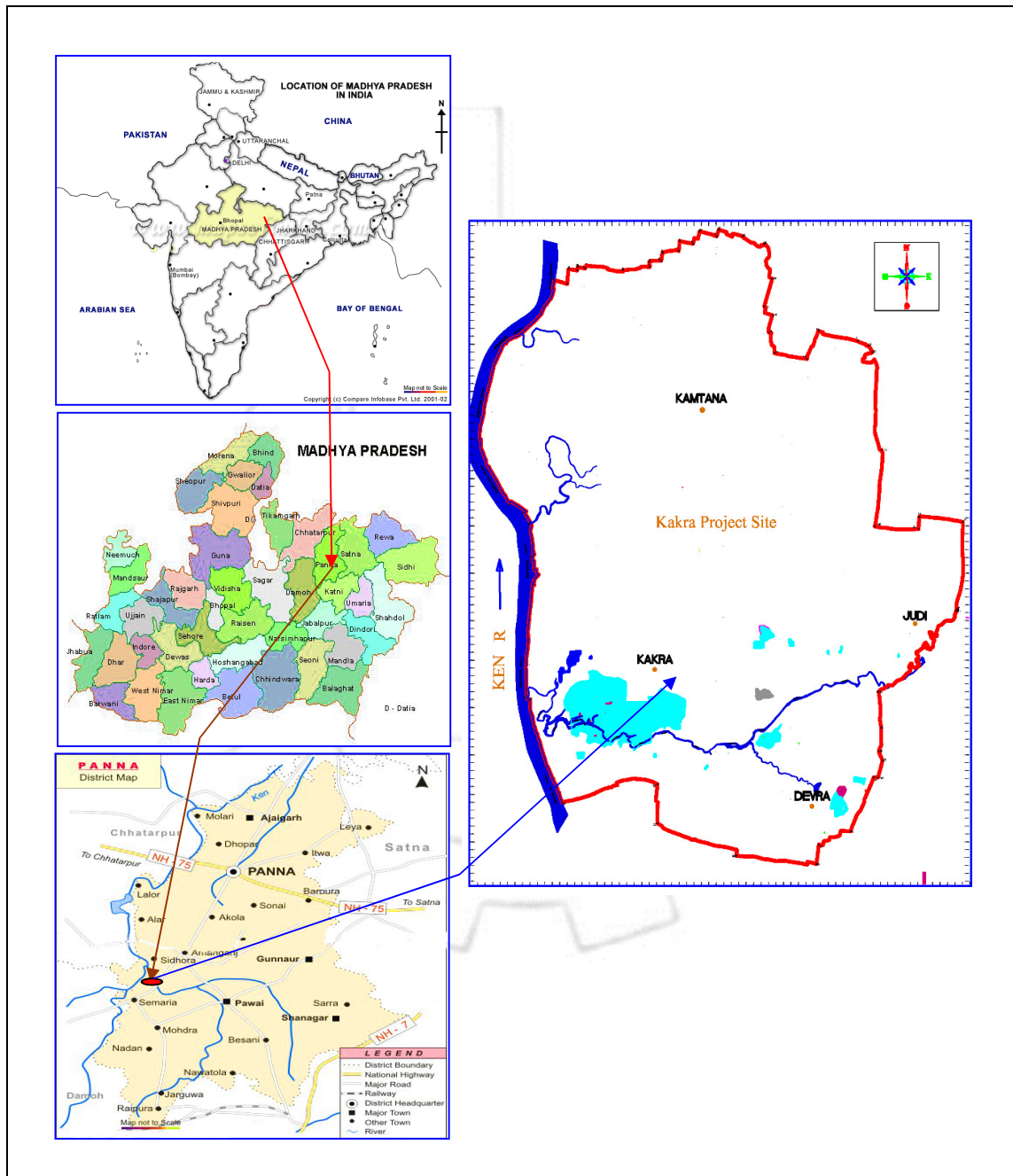


Fig. 3.1 | Location of Kakra ML Area



3.2.1 Mineral Concession Status

The mineral concession status and the status of approved Mining plan and environmental clearance in context to the limestone reserves are furnished under **Table 3.2** & **Table 3.3** respectively below:

Mineral Concession	Extent of the area (ha)	Villages	Remarks
Mining Lease	1,594.34	Kakra, Kamtana, Judi, Saptai, Devri Purohit & Devra, Amanganj tehsil, Panna district	Mining lease agreement executed on 23 rd September 2020

Table 3.2 | Mineral Concession status

ML area (ha)	Present Status of ML	Environmental Status
1,594.34	Mining Plan and Progressive Mine Closure Plan has been approved by IBM vide letter ref. no. MP/Panna/Limestone/ MPLN /G-16/14-15/4140 dated 4/8/2015.	Environment clearance obtained on 31 st August 2020 from MoEFCC for a maximum limestone production capacity of 4.08 mio ton per annum

Table 3.3 | Status of Approval of Mining Plan and Environmental Clearance

3.2.2 Land Status

The land status of granted ML areas are given in **Table 3.4**.

Area in Hectares

Land Type	ML Area
Govt. Waste Land (hectare)	75.754
Private Land (hectare)	1,518.586
Total (hectare)	1,594.340

Table 3.4 | Land Status

- JCL initially plans to purchase **621.075 Ha** mineralized private land in Kakra block.
- A Rehabilitation & Resettlement (R&R) study has been carried out by JCL during the Environment Clearance process. No major rehabilitation is envisaged in the area of interest.

3.2.3 Exploration

The geological investigation over the ML area had been carried out by JCL during the year 2010-11 through assigned third-party investigations. The details of the exploration carried out is summarized in **Table 3.5**.



Sn	Parameters	Activity
1	Topographical Survey	35.13 sq km PL area on a scale of 1:4000 with 1 m contour interval
2	Geological Mapping	35.13 sq km PL area on a scale of 1:4000
3	Core Drilling	2324.35 m in 86 boreholes
4	Sample Analysis	380 samples for TC/ MC analysis 1531 samples for major oxides, viz., SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ , CaO, MgO, and LOI 306 composite samples for major and minor oxides, viz., SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ , CaO, MgO, Na ₂ O, K ₂ O, SO ₃ , TiO ₂ , Mn ₂ O ₃ , P ₂ O ₅ , Cl and LOI

Table 3.5 | Summary of Exploration

The exploration of the area has been carried out during prospecting license (PL) period in both Kakra & Simariya blocks upto G2 level (general exploration) of exploration as per Mineral (Evidence of Mineral Contents) Rules-2015. The detailed exploration upto G1 level shall be carried out within five years after execution of lease deed. The exploration carried out is adequate to estimate probable category of reserves within ML area.

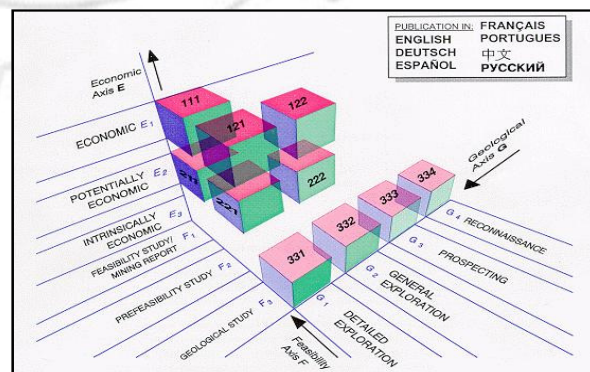
3.3 RESERVES AND QUALITY

3.3.1 Reserves Classification

The UNFC (United Nations Framework of Reserve Classification) has formulated a three-dimensional system for classifying the mineral deposit. This system evaluates and rates a deposit on merits of **Economics, Technical Feasibility and Geology**.

Based on the economics of mining, a deposit may be classified as “economic” (**Code 1**), “potentially economic” (**Code 2**) and “intrinsically economic” (**Code 3**). Based on the location, topographical condition, existing quarries in nearby area and the cost of exploitation as per mining plan and also worked out in the while evaluating the mine for its feasibility, which works out to be comparable with the costs of other operating mines of similar size in the region, thus, deposit is **classified as “1” on the Economics axis**.

On the basis of the level of technical feasibility of mining a deposit, a deposit could be classified as “whether the Feasibility Study/ Mining Report has been concluded” (**Code 1**), “whether a Pre-Feasibility Study has been concluded” (**Code 2**) and “whether only a Geological Study has been concluded” (**Code 3**). Since a Pre-Feasibility study has been concluded for the deposit, thus the ML area is **classified as “2” on the axis of Technical Feasibility**.



The process of geological assessment is generally conducted in stages of increasing details of exploration i.e. “reconnaissance” (**Code 4**), “prospecting” (**Code 3**), “general



exploration” (**Code 2**) and “detailed exploration” (**Code 1**) with clearly defined degrees of geological assurance. Taking into account the fact that general exploration has been carried out in the concession area on 400 m x 400 m grid, the deposit is being **classified as “2” on the Geology axis.**

Thus, in accordance with the UNFC classification, the reserves at Kakra ML area are classified under “**122**” and blocked resources “**222**” category. These reserves of “122” need to be converted to “**111**” category by further detailed exploration.

3.3.2 Reserves

Reserves within Kakra ML area have been estimated by **JCL** by both conventional cross-sectional as well as Solid Model method. Based on the relative level of occurrence of the lower band of limestone (L1) in different parts of Kakra block, the ore : overburden ratio with respect to L1 in different parts of the block and relative contribution of boreholes towards the overall usable limestone vis-à-vis total overburden in different parts of the block, the Kakra block was further divided into two sub-blocks, named as **Sub-Block A** (northern part covering 987 ha) and **Sub-Block B** (southern part covering 249 ha).

The assessment of the limestone resource and reserves has been done by **JCL** on the basis of geological cross sections prepared across the strike in the ML areas. A total of 13 cross sections were prepared. The cross sections were prepared on the basis of structural and lithological concept formulated based on detailed geological mapping and its correlation with the core drilling.

The depth considered for estimation is as per the thickness of limestone intercepted in different boreholes in a particular section line. The reserves have also been estimated by Solid Modeling (SM) Method. The reserves have been estimated for the three bands, viz., Cement Grade, Blendable Grade and Inferior Grade Limestone separately. Mining/ losses have been considered as 30% to arrive at net reserves from the gross reserves.

The summary of limestone reserves estimated from Solid Model method of Kakra deposit is given in **Table 3.6**.

Sub-block	Net Limestone Reserves (mio t)			
	Cement Grade Limestone (CGL)	Blendable Grade Limestone (BGL)	Inferior Grade Limestone (IGL)	Total
A	178.68	45.66	23.14	247.48
B	58.59	12.54	4.18	75.31
Total	237.27	58.20	27.32	322.79

Table 3.6 | Limestone Reserves



Inferences

- ❑ The limestone band is not uniform and contains interbands of cement grade, blendable grade and inferior grade limestone often interlayered with siliceous limestone, clay, dolomitic limestone, etc.
- ❑ A total of **237.27 mio t** cement grade, **58.20 mio t** blendable grade and **27.32 mio t** inferior grade limestone reserves have been estimated in Kakra ML area by **JCL**. All these three lithounits can be used for manufacture of clinker after judicious blending.
- ❑ The estimated Recovery Ratio (Limestone : Reject) is 1:0.50

3.3.3 Quality

The qualitative assessment of the limestone deposit has been done by **JCL** on the basis of the chemical analysis of core samples generated in the course of exploration conducted in the ML area.

The limestone has been classified as per the following criteria:

- ❑ Cement Grade Limestone : CaO 44-52%; MgO \leq 3.5%
- ❑ Blendable Grade Limestone : CaO 40-44%; MgO \leq 5%
- ❑ Inferior Grade Limestone : CaO 34-44%; MgO \leq 4%

The weighted average quality of limestone based on the core sample analysis is given in **Table 3.7**

Lithounit	Weighted Average Quality (%)											
	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	SO ₃	Na ₂ O	K ₂ O	TiO ₂	P ₂ O ₅	Mn ₂ O ₃	Cl
Cement Grade	7.86	1.52	0.93	47.54	1.48	0.15	0.10	0.55	0.09	0.03	0.07	0.03
Blendable Grade	13.30	2.42	1.49	42.14	2.53	0.34	0.13	0.86	0.19	0.03	0.06	0.02
Inferior Grade	18.49	3.51	2.32	37.87	2.49	0.43	0.15	1.22	0.30	0.05	0.05	0.02

Table 3.7 | Average Limestone Quality

The quality of the limestone as given above is based on the sample analysis of the actual core recovered. The average core recovery during the investigation was 85%. In view of clay pockets, cavities, shale/ shaly limestone bands within the limestone which cannot be segregated in mining process shall dilute the Run of Mine quality of limestone. An assimilation of 15% of these intercalations with limestone has been assumed to arrive at the Run of Mine (ROM) quality of limestone.

In view of low lime and high silica content in inferior grade limestone, this limestone band is proposed to be mined by selective mining by delineating high shale containing bands to achieve average f CaO% of about 38% in this limestone horizon

The estimated ROM quality considering dilution and selective mining of inferior grade limestone is given in **Table 3.8**



Lithounit	RoM Quality (%)											
	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	SO ₃	Na ₂ O	K ₂ O	TiO ₂	P ₂ O ₅	Mn ₂ O ₃	Cl
Cement Grade	11.01	1.79	1.12	45.15	1.74	0.13	0.09	0.47	0.08	0.03	0.06	0.03
Blendable Grade	15.63	2.56	1.60	40.56	2.63	0.29	0.11	0.73	0.16	0.03	0.05	0.02
Inferior Grade	16.11	3.00	1.93	37.90	4.38	0.37	0.13	1.04	0.26	0.04	0.04	0.02

Table 3.8 | Run of Mine Quality

The cement grade, blendable grade and inferior grade limestone can be blended judiciously for their use in manufacture of clinker.

3.4 CORRECTIVES

In order to meet the deficiencies in iron and alumina content in limestone, Bauxite and iron ore are proposed to be used as correctives to meet the desired quality of cement raw mix.

3.4.1 Bauxite

Bauxite is proposed to be used as corrective to meet the deficiency of alumina in raw mix. bauxite is available in Maihar tehsil of Satna district at a distance of about 100 km from the proposed plant.

The average quality of bauxite is given in **Table 3.9**.

Material	Chemical Composition (%)					
	LOI	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO
Bauxite	20.88	12.00	37.79	25.10	0.85	0.36

Table 3.9 | Quality of Bauxite

The quality of the bauxite considered is suitable for Al₂O₃ correction in the raw mix. JCL envisages the landed cost of bauxite at the plant site to be around **Rs. 1,500/ t**.

3.4.2 Iron ore

Iron ore is proposed to be used as corrective to meet the deficiency of iron in raw mix. Iron ore can be procured from Katni district over a distance of about 130 km from the proposed plant site. The average quality of iron ore is given in **Table 3.10**

Material	Chemical Composition (%)					
	LOI	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO
Iron ore	4.81	11.48	9.21	73.40	0.00	0.00

Table 3.10 | Quality of iron ore



The quality of the iron ore is suitable for Fe_2O_3 correction in the raw mix. The approximate landed cost of iron ore envisaged by **JCL** at the plant is **Rs. 1,100/ t.**

3.5 ADDITIVES

3.5.1 Gypsum

JCL envisages to utilize imported gypsum sourced from the Gulf Region as the primary source of gypsum for the proposed cement plant. The shiploads shall be received and unloaded at the sea-ports located in the state of Andhra Pradesh. The average landed cost of gypsum at the proposed plant site is estimated to be around **Rs. 3,700/ t.**

3.5.2 Fly Ash

Fly ash is proposed to be procured from various thermal power plants located in the radius of about 200 km from proposed plant site (Bajaj Hindustan CPP, Lalitpur TPP, Sanjay Gandhi TPS, etc.). Fly ash shall be transported to plant site from the respective sources by bulkers. **JCL** envisages the average landed cost of fly ash at the proposed plant site to be around **Rs. 681/ t.**

3.6 FUEL

A blend of Indian coal (80%) and Petcoke (20%) is envisaged to be used as the fuel mix.

Indian coal shall be sourced from Sohagpur Coalfields of SECL located at a distance of about 400 km from proposed plant site.

Petcoke is primarily envisaged to be sourced from various overseas sources. The imported pet coke has been considered to be transshipped from sea-ports in Andhra Pradesh. In addition, indigenous sources (Jamnagar & Bina refineries) may also be explored in future.

The properties of coal and the pet coke blend are given in **Table 3.11**

Properties (average)		Coal (Indigenous)				Petcoke (Imported)		
Inherent Moisture (%)		1.88				0.32		
Sulphur (dry basis) (%)		0.50				6.95		
Volatile Matter (dry basis) (%)		29.27				9.30		
Fixed Carbon (dry basis)		35.94				80.65		
Ash (dry basis) (%)		36.80				1.99		
NCV (kcal/ Kg)		4,350				7,933		
Chemical Composition of Ash (%)								
Source	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	SO ₃	K ₂ O	Na ₂ O
Coal	59.30	23.40	6.20	4.50	0.70	2.50	0.75	0.10
Pet Coke	48.00	15.00	11.00	9.00	1.40	7.00	0.51	0.60

Table 3.11 | Properties of envisaged fuel types



For the 80% indigenous coal usage, **JCL** envisages to utilize a mix of G8 and G9 grades of SECL sourced indigenous coal, the average NCV of has been considered to be around 4,350 kcal/kg, and average landed cost is estimated to be **Rs. 4,388/ t** (average landed cost of G8 grade coal envisaged to be Rs. 4,623/ t while that of G9 grade coal being Rs. 3,952/ t).

For the 20% imported petcoke usage, the average landed cost of the has been considered to be **Rs. 9,326/ t**, as per estimated details furnished by **JCL**. The average NCV of imported petcoke has been considered to be around 7,940 kcal/kg for analyses.

3.7 THEORETICAL RAW MIX

The chemical composition of different raw mix components considered for theoretical raw mix design is given in **Table 3.12**.

Raw Material	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	LOI
Cement Grade Limestone	11.01	1.79	1.12	45.15	1.74	38.01
Blendable Grade Limestone	15.63	2.56	1.60	40.56	2.63	35.33
Inferior Grade Limestone	16.11	3.00	1.93	37.90	4.38	34.95
Bauxite	12.00	37.79	25.10	0.85	0.36	20.88
Iron ore	11.48	9.21	73.40	-	-	4.81

Table 3.12 | Chemical composition of Raw Mix Components

Based on the preliminary design basis and guidelines imparted by **JCL** for the proposed project, the raw mix design has been worked out using the blend of **80% Indian coal & 20% Petcoke** as the fuel mix.

For the purpose of present study, as per discussions with **JCL**, the following clinker moduli limits have been considered:

Clinker Moduli	C ₃ S	AM	SM	LSF	PL
Upper limit	55.00	1.50	2.60	0.97	30.00
Lower limit	50.00	1.20	2.20	0.93	26.00

Based on the above envisaged raw material chemical composition parameters and in conjunction with the envisaged clinker moduli range, good quality clinker can be produced.

The theoretical (indicative) raw mix design, thus, arrived is furnished under **Annexure 3.1** appended with this Section-3 of the Report.

Salient clinker related parameters derived from the theoretical raw mix being:

- Lime in clinker : ~ 63%
- LSF : ~ 0.93
- Free Lime : ~ 1.0
- C₃S : ~ 53%



- C_2S : ~ 21 %

Indicative composition of the major components in the theoretical raw mix options being:

Components	Raw Mix (%)
Cement grade limestone (CGL)	69.16
Blendable grade limestone (BGL)	16.81
Inferior grade limestone (IGL)	10.63
Bauxite	2.20
Iron ore	1.20

Table 3.13 | Indicative Proportions of envisaged Raw Mix Components

The theoretical raw mix study has established the following:

- ❑ The blendable grade limestone (BGL) and inferior grade limestone (IGL) may be utilized in conjunction with the cement grade limestone (CGL) in certain permutations and combinations for manufacturing of quality clinker using desired fuel blend of Indian coal (80%) and petcoke (20%).
- ❑ In rawmix, about 96.6% limestone with a blend of 69.16% cement grade limestone, 16.81% blendable grade limestone and 10.63 Inferior grade limestone shall be used.
- ❑ Within limestone the cement grade limestone shall be 71.60%, blendable grade limestone 17.40% and Inferior grade limestone 11%.
- ❑ Bauxite and Iron ore are the two corrective components required besides the captive limestone, which may be purchased from the region fulfilling their respective parameters viz. availability, quality, and cost.

3.8 MINING CONSIDERATIONS

3.8.1 Mode of Mining

Details pertaining to limestone production, mining machinery and mines manpower have been estimated based on the proposed plant capacity of 2.64 mio tpa clinker production.

The total limestone requirement from the captive ML area(s) approximately works out to about 13,550 tpd for clinkerisation capacity of 8,000 tpd considering the following broad parameters:

Parameters	Unit	Details
Clinker production	tpd	8,000
Plant working days per annum	nos.	330
Clinker annual production	tpa	2,640,000
Raw meal to clinker conversion factor		1.51 (average)
Raw meal requirement	tpa	4,144,800



Parameters	Unit	Details
Limestone total requirement in the raw mix	%	96.60%
Mining Losses and Moisture content	%	1.5%
Limestone requirement	tpa	40,63,934
Mine working days per annum	nos.	300
Limestone to be fed to crusher @ 300 mine working days	tpd	13,546
Working shifts		2 shifts of 8 hours each

Cement grade limestone, blendable grade limestone and inferior grade limestone shall be blended in the proportion as per suggested raw mix in **Annexure 3.1**.

3.8.2 Mining

On the basis topography, deposition, structural set-up of the deposit, environmental aspects and mining consideration, the deposit is best suited open cast mining method.

- Primary drilling : 110 -150 mm diameter blast holes
- Blasting : Conventional method (High explosives and ANFO)
- Excavation : By diesel operated excavators of 6.5 m³ bucket capacity.
- Transportation : By 60 ton off highway rear dump trucks.
- Mode of Mining : Open cast mechanized mining

The average landed cost of limestone at the plant works out **Rs. 181.21/ t**. The cost is inclusive of royalty/ surface rent/ rural and infrastructure development fund and exclusive of depreciation, interest, and manpower. The estimated cost breakup details are furnished under **Annexure 3.2**.

The requirement of mining equipment and their cost breakup is furnished under **Annexure 3.3**. The capital cost of procurement of mining machinery for 8,000 tpd clinkerization plant is indicatively estimated as **Rs. 4,150 Lakhs**.

3.9 MINES DEVELOPMENT

Creation of necessary internal infrastructure at the quarry, development of access road and development of requisite number of working benches in limestone and overburden, would primarily form the quarry developmental activities. An area of about 75m X 50 m dimension shall be involved in initial mine development by developing two benches, one each in overburden and limestone. About 75000 M³ (187,500 ton) of excavation has been considered for initial mine development. The mine development cost shall be about **Rs 124 lakhs** @ Rs 66/ t material excavation cost. (The development excavation cost considered is about 1.5 times of the actual material handling cost of Rs 44 per t).



3.10 DEPOSIT LIFE

The requirement of limestone has been computed based on the proposed limestone production of 4.08 million tonnes per annum. The life of the plant utilizing different grades of limestone is estimated as follows:

Since blendable grade limestone is occurs above the inferior grade limestone, initially blendable grade limestone is foreseen to be used along with cement grade limestone. Once the blendable grade limestone gets exhausted, the cement grade limestone shall be utilized along with inferior grade limestone.

Components	Limestone (%)	Reserves in Mio tonnes	Life in Years
Cement grade limestone (CGL)	71.60	237.27	81.62
Blendable grade limestone (BGL)	17.40	58.20	82.38
Inferior grade limestone (IGL)	11.00	27.32	61.17
Total	100.00	322.79	

With the proposed consumption of cement grade limestone 71.60%, blendable grade limestone 17.40% and Inferior grade limestone 11%, the life of cement grade and blendable grade limestone shall be **82 years** and inferior grade limestone shall be **61 years @ 4.06 million tonnes per annum**.

It is however to be noted that the reserves are presently under 122 category, which needs to be converted to 111 category by further detailed geological investigation(s).

3.11 ENVIRONMENTAL SENSITIVITY

Panna Tiger Reserve/ National Park is understood to be about 16 km away from the mining lease boundary of the proposed plant, which is more than the statutorily mandated 10 km safe zone distance.

JCL shall need to ensure that the statutorily mandated distance is maintained with respect to the boundary of the Tiger Reserve/ National Park vis-à-vis its mining lease area boundaries as well as plant land boundaries.

3.12 INFERENCES

- Limestone reserves are not uniform and contains inter-bands of cement grade, blendable grade and inferior grade limestone types, often interlayered with partings of siliceous limestone, clay, dolomitic limestone, etc.
- About **237.27 mio t** of cement grade limestone, **58.20 mio t** of blendable grade limestone, and **27.32 mio t** inferior grade probable limestone reserves have been estimated by **JCL** in Kakra ML area.
- About 69.16 % cement grade limestone, 16.81 % blendable grade limestone and 10.63 % inferior grade limestone together with about 2.2% bauxite and 1.2% iron ore shall be used in rawmix.
- The estimated limestone reserves shall meet the requirement of clinkerisation plant for about **80 years** for the envisaged production capacity of 2.64 mio tpa clinker.



- ❑ The reserves are presently under 122 category, which needs to be converted to 111 category by further detailed geological investigation(s).
- ❑ Theoretical raw mix exercises were conducted using a blend of 80% Indian coal and 20% Petcoke as the fuel blend. The raw mix suggests production possibility of good quality clinker utilizing blend of available cement grade, blendable grade and inferior grade limestone along with use of bauxite and iron ore as correctives.
- ❑ The capital cost of procurement of mining machinery for 8,000 tpd clinkerization potential capacity is estimated as **Rs. 4,150 Lakhs**.
- ❑ The average landed cost of limestone at the plant works out to **Rs. 181.21/ t**. The cost is inclusive of royalty/ surface rent/ rural and infrastructure development fund and exclusive of depreciation, interest, and manpower.
- ❑ Bauxite is envisaged to be procured from Maihar tehsil in Satna district located about 100 km from the plant. The landed cost of bauxite at the proposed plant site is estimated as **Rs. 1,500/ t**
- ❑ Iron ore is envisaged to be procured from Sihora tehsil of Katni district located about 130 km from the proposed plant site. The landed cost of iron ore at plant site is estimated as **Rs. 1,100/ t**
- ❑ A blend of Indian coal (80%) and Petcoke (20%) is envisaged to be used as the fuel mix. Indian coal is envisaged to be sourced from Sohagpur Coalfields of SECL located at a distance of about 400 km from proposed plant site. Petcoke is primarily envisaged to be sourced from various overseas sources. For the 80% indigenous coal usage, **JCL** envisages to utilize a mix of G8 and G9 grades of SECL sourced coal, the average NCV of which is expected to be around 4,350 kcal/kg, and average landed cost **Rs. 4,388/ t** (average landed cost of G8 grade coal envisaged to be Rs. 4,623/ t while that of G9 grade coal being Rs. 3,952/ t). For the 20% imported petcoke usage, the average landed cost of the same at proposed plant has been considered to be **Rs. 9,326/ t** as per estimated details furnished by **JCL**. The imported petcoke shall be transshipped from sea-ports located in coast of Andhra Pradesh.
- ❑ Imported gypsum sourced from the Gulf Region, shall be received and unloaded at the sea-ports located in the state of Andhra Pradesh. The average landed cost of gypsum is considered to be around **Rs. 3,700/ t**
- ❑ Flyash is envisaged to be procured from various thermal power plants located in the radius of ~200 km from proposed plant site, with average landed cost estimated as **Rs. 681/ t**.



Annexure 3A.1

THEORETICAL RAW MIX DESIGN

Raw Material	Composition													
	LOI	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	K ₂ O	Na ₂ O	SO ₃	TiO ₂	Mn ₂ O ₃	P ₂ O ₅	Cr ₂ O ₃	Cl
Cement grade LS	38.01	11.01	1.79	1.12	45.15	1.74	0.47	0.09	0.13	0.08	0.00	0.03	0.00	0.00
Blendable grade LS	35.33	15.63	2.56	1.6	40.56	2.63	0.40	0.08	0.08	0.00	0.00	0.03	0.00	0.00
Inferior grade LS	34.95	16.11	3.00	1.93	37.9	4.38	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.02
Bauxite	20.88	12.00	37.79	25.10	0.86	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron Ore	4.81	11.48	9.21	73.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Fuel type	Composition															
	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	K ₂ O	Na ₂ O	TiO ₂	Mn ₂ O ₃	P ₂ O ₅	Cr ₂ O ₃	Cl	SO ₃	Ash	Sulphur	NCV
Indian Coal	59.30	23.40	6.20	4.50	0.70	0.75	0.10	2.50	2.50	0.00	2.5	0.00	2.50	36.80	0.50	4,350
Petcoke	48.00	15.00	11.00	9.00	1.40	0.51	0.60	0.00	0.00	0.00	0.00	0.00	7.00	1.99	6.95	7,933

Specific Heat Consumption consideration (kcal/ kg of clinker)	680
---	-----

Clinker Parameter	C ₃ S	C ₂ S	C ₃ A	C ₄ AF	AM	SM	HM	LSF	PL	BI	MgO	Tot Alk	Cl	SO ₃	QF
Upper Limit	55	-	-	-	1.5	2.6	-	0.97	-	-	-	-	-	-	-
Lower Limit	50	-	-	-	1.2	2.2	-	0.93	-	-	-	-	-	-	-

Fuel mix - (80% Indian Coal & 20% Petcoke)	
Cement grade LS	69.16
Blendable grade LS	16.81
Inferior grade LS	10.63
Bauxite	2.20
Iron Ore	1.20
Clinker Quality	
SiO ₂ (%)	20.98
Al ₂ O ₃ (%)	5.35
Fe ₂ O ₃ (%)	4.33
CaO (%)	63.41
MgO (%)	3.22
K ₂ O (%)	0.62
Na ₂ O (%)	0.12
SO ₃ (%)	0.67
TiO ₂ (%)	0.17
Mn ₂ O ₃ (%)	0.09
P ₂ O ₅	0.03
Cr ₂ O ₃	0.00
Cl (%)	0.00
Na ₂ O _{eqv}	0.53
Free Lime	1.00
Bogue Components	
C ₃ S	52.54
C ₂ S	20.51
C ₃ A	6.84
C ₄ AF	13.18
Modulii	
AM	1.23
SM	2.17
HM	2.07
LSF	0.93
Other Indices	
Liquid at 1450°C (%)	30.00
BI	2.62
Heat of Formation	400.84
Grindability Index	0.7048
Q Factor	0.97
Conversion Factor	1.51



Annexure 3A.2

ESTIMATED LIMESTONE RAISING COST

Sn	Cost Head	Cost (Rs./ t)
		(8,000 tpd clinker)
1	Drilling	6.64
2	Blasting	15.24
3	Loading	16.03
4	Transportation	23.60
5	Pumping	0.12
6	Miscellaneous operation	7.58
Sub-Total		69.21
7	Royalty & Cess / surface rent, etc.	112.00
Landed cost of Limestone at Crusher		181.21



Annexure 3A.3

ESTIMATED MINING EQUIPMENT COST

Sn	Particulars	Unit	Qty	Rate (Rs Lakh)	TOTAL (Rs Lakh)
1	Hydraulic excavator Showel type	Nos			-
2	Hydraulic excavator Backhoe	Nos	3	154	462
3	Dumper (40T)	Nos	15	152	2,280
4	Bulldozer	Nos	1	213	213
5	Fire tender	Nos			-
6	Hydraulic Drill machine	Nos	3	65	195
7	Hydraulic Excavator with Rock Breaker Attachment	Nos	1	140	140
8	Wheel Loader	Nos	1	28	28
9	Motor/ Road Grader	Nos	1	125	125
10	Fork lift with tyre Handler	Nos	1	28	28
11	Mobile van	Nos	1	42	42
12	Water Sprinkler	Nos	2	25	50
13	Explosive van - Large	Nos	1	34	34
14	Explosive van - Small (Detonator)	Nos	1	15	15
15	Bulk mixing and delivery truck for ANFO	Nos	1	45	45
16	Maintenance tools for mining	Set	1	20	20
17	Workshop tools for mining	Lot	1	20	20
18	Water pumps	Nos	2	2	4
19	Dewatering Pipelines, cables etc.	Lot	1	2	2
20	Lighting towers	Nos	4	8	32
21	Vibro Compactor	Nos	1	30	30
22	Diesel Bowser	Nos	1	26	26
23	Dumper safety items as per DGMS	Nos			-
24	Compressor	Nos			-
25	EOT Crane	Nos	1	33	33
26	Utility Vehicle	Nos	1	15	15
27	Weighbridge	Nos			-
28	Explosive Magazine, AN Store, AN Mixing shed	Lot	1	80	80
29	Diesel Pump		1	50	50
30	Commissioning	Days	60	15,000	9
	Total				3,978
	Misc. Items Cost				170
	Grand Total				4,148 Say 4,150



CHAPTER-3B : RAW MATERIALS & FUEL (GU)

3.1 MAJOR RAW MATERIALS

3.1.1 Clinker

Clinker is envisaged to be received at the GU by trucks from **JCL**'s proposed integrated unit in Panna district of adjoining Madhya Pradesh state, located at an approximate distance of 240 km from Hamirpur GU. The landed cost of clinker has been estimated as Rs.3,300/ t (sourced at Rs.2,700 ex-gate at upcoming Panna IU) via road transport.

Clinker sourcing is not envisaged to be challenging as it is to be sourced from a sister-plant.

3.1.2 Fly ash and Pond ash

JCL is understood to have entered into a long-term sourcing contract of fly ash and possibly dumped utilizable pond ash from the presently under construction 3x660 MW Ghatampur Thermal Power Station (TPS) of Neyveli Uttar Pradesh Power Limited (NUPPL) located at an approximate distance of 30 km from the GU.

Fly ash shall be received at the GU by bowzers, while pond ash shall be transported via open trucks. The average landed cost of dry fly ash and pond ash has been considered as Rs.350/ t (sourced at Rs.100 ex-gate at NUPPL TPS which includes handling, contracting and miscellaneous charges as well). Due to long-term sourcing contract with the TPS and short distance, **JCL** proposes to have limited quantum of fly/pond ash at the plant.

3.1.3 Gypsum

Gypsum shall be used as an additive for manufacturing of cement. The plant envisages to source imported pre-crushed mineral gypsum through industry traders who source high volumes of good quality gypsum from Iran and/or Oman via east-coast based port cities of India.

Gypsum, sourced from the traders, shall be brought to plant via trucks (the traders usually bring large volumes by rail, and stock at transit depots from where end-users in cement industry source it). The landed cost of gypsum has been envisaged by **JCL** as Rs.4,500/ t. The same has been considered for this report.

3.1.4 Coal

Coal shall be required as fuel for running the hot air generator. The plant envisages to source pre-crushed coal granules suiting HAG's fuel specifications from various sources from the regional coal hubs.

Average net calorific value of coal is envisioned to be ranging between 2,000 kcal/kg to 4,350 kcal/kg depending on the source and quality of the coal which shall be available to the GU at various points of time. For the purpose of formulation of this Report, an average landed cost of Rs.4,500/ t has been considered for project's commercial analyses in this Report, which is on the higher realm of considered price range, but shall fulfil for the contingent scenarios as well.

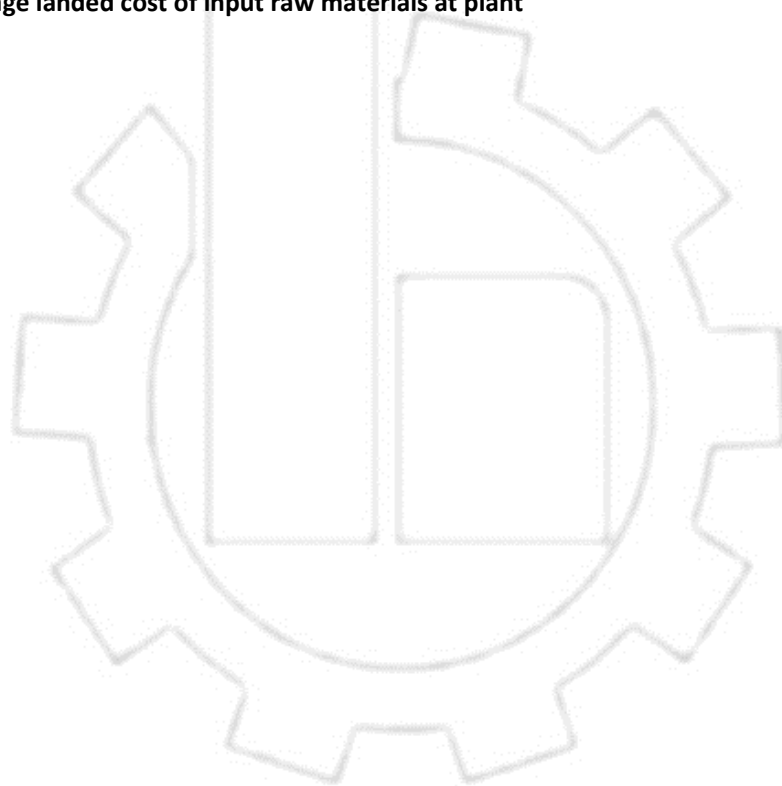


3.1.5 Summary of Raw Material Landed Costs

Summary of average landed cost of major raw materials is furnished below in Table 3.5:

Sn.	Raw material	Mode of Sourcing	Envisaged average landed cost (Rs/t)
1	Clinker	Purchased	3,300
2	Fly ash & Pond ash	Purchased	350
3	Gypsum	Purchased	4,500
4	Coal	Purchased	4,500

Table 3.5 | Average landed cost of input raw materials at plant





CHAPTER 4A: LOCATION & INFRASTRUCTURE - IU

4.1 INTRODUCTION

This chapter covers aspects of plant location, requirements/ availability of infrastructure facilities such as land, power, water, fuels, transport, communication, socio economic environment and site conditions for the proposed integrated cement plant. The chapter also covers the logistics requirement of the proposed plant.

4.2 PLANT LOCATION

4.2.1 Criteria for Selection of Plant Location

Following are the main criteria, considered for locating an integrated cement of desired capacity:

- The site should ideally have about 200-400 acres of flat/ slightly undulating land for accommodating plant, development of greenbelt and employees' colony with all the amenities besides keeping in view the future expansion prospects for the project.
- The land should belong to government rather than any private party.
- Availability of adequate ground water and/or perennial source in a reasonable vicinity of the plant site.
- Availability of reliable power supply.
- Proximity or proper connectivity of the plant with national transport network.
- The land sub-strata should have good load bearing capacity to minimize the construction cost.
- The available land should be as far as possible, free from encumbrances such as:
 - Farmland – Being sensitive
 - Away from habitation, to avoid disturbances during operations.
 - Forest land
- The available land should be as far as possible, free from following hindrances:
 - At least 500 m away from any National Highway and Rail line
 - Away from high tension electricity line
- Proximity to an established township, which would offer reasonable amenities to the plant employees.

The choice of location will depend on that place, which will be able to deliver cement at the most economical rate, commensurate with the capital investment of the entire project.



4.2.2 Location of Cement Plant

The proposed site has been examined in due consideration of the above mentioned selection criteria mentioned at **para 4.2.1**. The site has been prima facie found suitable for setting up the proposed cement plant subject to environmental clearance.

The proposed location provides the following advantages:

- Proximity to limestone deposit.
- Availability of sufficient flat land.
- Proximity to SH-49.

From the above considerations, the proposed land falling under the village Harduwa Ken, Puraina, Maddiyan and Sotipura of tehsil Amanganj, district Panna, Madhya Pradesh has been found suitable for locating the proposed cement plant.

The locating co-ordinates of the proposed IU are:

- Latitude : N 24° 19' 14"
- Longitude : E 79° 58' 40"
- Elevation : 315 m from MSL

The choice of the site is appropriate from the point of view of available infrastructure, market access and raw material availability as indicated in the respective chapters.

A Photo gallery exhibiting the proposed plant site and infrastructure facilities is given at **Annexure 4.1**.

4.2.3 Approach and Accessibility

The proposed plant site is located at a distance of about 14 km from Amanganj in South West direction and can be approached from Amanganj by traveling on State Highway SH-49 (connecting Damoh–Hata–Amanganj–Panna–Ajaygarh–Naraini (Uttar Pradesh)) towards Damoh.

The proposed plant site is located at about 2 km m from state highway (SH-49) in the west direction.

4.2.4 Location for Crushing Plant

Considering the short distance between Mines and the proposed plant site, it is envisaged that the limestone crusher shall be located in the mines, adjacent to the plant.

4.3 INFRASTRUCTURE

4.3.1 Land

JCL plans to acquire about 480 acres of land for setting up the cement plant, and about 1,060 acres of land for limestone mining purpose. The tentatively earmarked plant site for setting up of cement plant is largely private agricultural land.

The land profile is largely flattish without major undulations or slopes.



The envisaged cost of land provided by **JCL** is about Rs 424.2 Crore.

4.3.2 Utilities

4.3.2.1 Power

The maximum power demand for the proposed Plant and Mines has been estimated as about 34 MW. The power requirement is proposed to be met through a combination of Grid and Waste Heat Recovery System (WHRS) based thermal power plant

At potential clinker capacity of 10,000 tpd clinker, the WHRS capacity is estimated to be about 19 MW. However, **JCL** plans to install a WHRS of 22 MW capacity to exploit benefit from operations optimization in future.

At 8,000 tpd, about 5,78,800 kWh/ day energy consumption is estimated considering the envisaged specific power consumption. Out of this about 3,38,400 kWh/ day shall be from WHRS and balance from Grid.

Grid connectivity of about 20 MW is envisaged from the nearest 132 kV grid sub-station located at a distance of about 45 km from the proposed plant site.

Prevailing tariff for grid power and power generation cost WHRS is as given below:

Grid	:	Rs 7.5 per kWh
WHRS	:	Rs 0.4 per kWh

4.3.2.2 Water

The water requirement for plant, colony & WHR has been estimated as about 2,500 m³/ day. The details of water requirement are given below.

Item	Water Consumption (m ³ /day)
Cement Plant	2,100
Drinking, Sanitation and Plantation	100
Mines	150
Waste Heat Recovery System (WHRS)	150
Total	2,500

Table 4.1 Water Requirement

Water requirement is envisaged to be primarily met from mines pits, check dams, rain harvesting, etc. besides Ken River.

For domestic purposes, water requirement may be augmented utilizing underground sources (borewell) for which requisite statutory approval (CGWA approval) has already been obtained in February 2020.



4.3.3 Transport

4.3.3.1 Road

The proposed plant site is well connected by road network. The proposed plant site can be approached from by traveling on National Highway – 75 (NH-75) upto Panna and then traveling on Madhya Pradesh State Highway SH-49 towards Damoh. The approximate distance of the site from NH-75 is about 48 km and about 12 km from Amanganj. The approximate distance of the proposed project site from the major cities is as follows:

Panna	:	55 km
Damoh	:	85 km
Katni	:	90 km
Satna	:	110 km
Jabalpur	:	180 km
Jhansi	:	250 km
Allahabad	:	285 km
Kanpur	:	290 km
Bhopal	:	335 km
Lucknow	:	350 km
Gwalior	:	350 km

4.3.3.2 Rail

Railway network is not available in the near vicinity of the proposed cement plant.

The nearest railway station is at Damoh at a distance of about 85 km in South direction.

Rupaund railway station located at a distance of about 115 km South East direction from the proposed plant site is the PFT of **JCL**'s sister concern JK Cement Ltd.

4.3.3.3 Air

The nearest domestic airport is at Khajuraho at about 100 km distance from proposed plant site. The nearest international airport is at Lucknow at a distance of about 350 km from proposed site.

4.3.4 Communication

Communication facilities such as telephone, telefax and Internet are available in the vicinity of the proposed plant site. The same facilities can be extended till the proposed site.

4.4 LOGISTICS

4.4.1 Inbound

This section provides an insight into logistics of raw material to the proposed plant site. In addition to Limestone, following key raw materials are required for production of cement:

1. Bauxite
2. Iron Ore
3. Gypsum



4. Fly ash/ Pond Ash
5. Indian Coal
6. Petcoke

The estimated quantity of raw material (except Limestone) required per day and number of trucks loads per day, based on carrying load of trucks is mentioned in **Table 4.4**.

Sn	Item	Per day requirement (t)	Truck Capacity (t)	No. of Trucks per day (nos.)
1	Bauxite	266	20	13
2	Iron Ore	145	20	7
3	Indian Coal	859	35	25
4	Petcoke	215	35	6
5	Gypsum	303	20	15
6	Flyash/ Pond Ash	2,121	20	106
Total number of Truck loads required per day				172

Table 4.4: Requirement of Trucks for Inbound Material

4.4.2 Outbound

The outbound materials are clinker and cement. The estimated quantities per day and number of truckloads per day, based on carrying load of trucks are mentioned in **Table 4.5**.

Sn	Item	Per day requirement (t)	Truck/ Rake capacity (t)	No. of Trucks/ Rake per day (nos.)
1.	Cement	6,061	35	173
2.	Clinker	3,636	35	104
Total number of Truck loads required per day				277

Table 4.5: Requirement of Trucks for Outbound Material

4.5 SOCIO ECONOMIC ENVIRONMENT

4.5.1 Habitation

Amanganj is the nearest town located at about 14 km from the plant site. All basic amenities such as school, hospital, market, etc. are available in this town. Panna is the nearest city and district headquarters.



4.5.2 Social Amenities

A residential colony to accommodate about 200-250 management staff and essential services related personnel is proposed initially. The colony shall be located in close proximity to the cement plant. The colony shall have facilities like dispensary, shopping complex, community centre, guesthouse, school, temple, club etc.

4.6 SITE CONDITIONS

4.6.1 Topography

The terrain in the area proposed for plant site is largely flat without major undulations. As such, a nominal lumpsum provision for site grading and leveling has been considered in the cost estimates.

4.6.2 Temperature

The area has generally hot climate. The maximum temperature is around 45 °C while the minimum is 8 °C.

4.6.3 Rainfall

The average annual rainfall of this area is about 800 mm.

4.6.4 Relative Humidity

The annual relative humidity varies between 30 to 90%.

4.6.5 Seismology

The proposed plant site area falls in Seismic Zone III. This aspect shall be duly considered while designing the structures.



PHOTO GALLERY



View of Mining Lease Area



View of Plant Area



View of Damoh Railway Station



State Highway (SH – 49) connecting plant site to Damoh and Panna



132 kV substation at Pawai



View of Ken River



CHAPTER-4B : LOCATION & INFRASTRUCTURE (GU)

4.1 INTRODUCTION

This chapter covers the aspects relating to proposed plant site related details like location, site conditions, land extents, infrastructure, socio-economic environment, etc. for the proposed grinding unit.

4.2 PLANT LOCATION

4.2.1 Salient Criteria for Selection of Plant Location

Following are the salient criteria, considered as near-ideal conditions, for locating a clinker grinding unit of the desired capacity:

- The site should have sufficient flat and/or slightly undulating land for accommodating the Plant; its ancillaries & amenities; development of greenbelt; besides keeping in view the future expansion prospects for the project.
- Availability of adequate ground and/or perennial source of water in a reasonable vicinity of the plant site.
- Availability of reliable power supply, ideally from a grid substation located at a reasonable distance.
- Proximity or proper connectivity of the unit with the transport network connecting the markets of interest.
- Plant land's sub-strata should ideally have reasonably good load bearing capacity, which results in having optimized sub-structure construction cost.
- The available land should be as far as possible, free from encumbrances such as:
 - Farm land – (being sensitive)
 - Forest land – (being sensitive)
 - Away from habitation – to avoid inadvertent disturbances during operations
- The available/envisaged plant land should as far as possible ideally be:
 - At least 10 km away from the Eco-Sensitive Zones, National Parks, Reserve forests, and similar sensitive zones.
 - Approximately 100 m away from any National Highway and major Rail lines.
 - Approximately 50 to 100 m away from high tension electricity lines.
- Proximity to an established township, which would offer reasonable amenities to the plant employees.



The choice of location largely depends on that place, which could help in delivering the manufactured cement at the most economical rate, commensurate with the capital investment of the entire project.

4.2.2 Location of the Proposed Grinding Unit

JCL envisages to set up the proposed greenfield Clinker Grinding Unit (GU) of 2.0 mio tpa cement production capacity in Hamirpur district in the State of Uttar Pradesh. The district falls under Chitrakoot Division.

The approximate locating coordinates and altitude of the proposed site being:

- Latitude : N 25° 46' 16"
- Longitude : E 80° 07' 40"
- Altitude : Average about 122 m with respect to MSL

The location shall provide the following broad advantages to the proposed plant:

- The location is relatively away from the densely populated city limits of Kanpur and its suburbs, while still being within reasonable distance of about 90 km from the city.
- The area provides good connectivity to the regional infrastructural network that shall help catering to the region of interest.
- Good access to the markets of interest that the plant envisages to serve.
- The plant envisages to procure clinker and flyash & pond ash by road, and bring it to the grinding plant by means of trucks. Gypsum shall be sourced via combination of rail and road from east coast locations.

The choice of the site is appropriate from the point of view of available infrastructure and market access as indicated in the respective chapters.

4.2.3 Approach and Accessibility

The area falls around 80 km south-southwest of Kanpur with accessibility from the National Highway NH86, which is also known as Kanpur-Hamirpur-Sagar road.

The site shall be easily accessible via the existing road and rail infrastructural networks.

4.3 LAND & INFRASTRUCTURE

4.3.1 Land

JCL is in final process of procuring a land patch of about 27 acres area (approx. 11 hectares) for the purpose of setting up the proposed Grinding Unit. A total of about Rs.900 lakhs is envisioned by the company as the capital expense towards land procurement and its land-use conversion from agricultural to manufacturing purposes. The same has been considered for working out the cost estimates at this stage of Report formulation.



The area is almost flat, but used for agricultural purposes presently. The top-soil cover shall need to be removed at most of the places at the time project works initiate. The site shall be requiring nominal-to-moderate site preparation, grading and development works, towards which a nominal lumpsum amount has been considered in the capex estimates.

4.3.2 Transport

Road

The considered location of the cement manufacturing unit is well connected with major cities and town, and the markets of interest. The approximate road distances of the proposed site from the major towns and cities are:

• Kanpur	:	85 km
• Lucknow	:	170 km
• Raebareli	:	180 km
• Prayagraj	:	220 km
• Panna (Amanganj)	:	240 km
• Varanasi	:	350 km

Air

The nearest airport is at Kanpur at a distance of about 90 km from the proposed cement manufacturing unit.

Rail

The nearest railway station from the proposed plant site is at Ingotha at a distance of about 2.5 km. The other nearest railway station is at Bharuwa Sumerpur located about 9 km from the site.

Subject to the synergies and/or requirements in future, the plant has the option of tapping the main railway line at an approximate distance of 3 km for establishing the captive railway siding for any planned inward or outward material movement. However, significant rail transport of material is not foreseen for either inward or outward movement of material at this stage of the project.

4.3.3 Communication

All the modern communication facilities such as telephone, telefax, broadband and internet are available in the region of interest and the same can easily be extended to the site.

4.4 SOCIO ECONOMIC ENVIRONMENT

4.4.1 Habitation



Hamirpur is the nearest major township at a distance of about 20 km from the proposed plant site, which offers ample residential facilities to the plant employees. In-between habitation areas under Sumerpur may also serve as possible residential and social hub other than Hamirpur.

All basic amenities such as school, hospital, market, etc. are available nearby within reasonable distance.

4.4.2 Residential and Social Amenities

No dedicated colony for **JCL** staff is envisaged to be constructed at this stage. The staffs are planned to reside in nearby township and existing habitation clusters.

All the basic and required social amenities are easily accessible in the region.

4.5 SITE CONDITIONS

4.5.1 Site preparation and development

The terrain of the proposed location/ area is generally flat. As the elevation difference is not significant, cutting - filling using external earth material is not envisaged in the project. However, since the land presently is being used for agricultural purposes, the top layer of organic soil cover shall need to be removed and disposed-off. A nominal lump sum amount has been considered towards land and site development in the investment cost estimate.

4.5.2 Climatic conditions

The area witnesses a dry-winter humid subtropical climate.

The average annual temperature is about 25 °C. The average minimum and maximum temperatures recorded in the past few decades has been 18 °C and 32 °C respectively, while the record minimum and maximum temperatures have been 0 °C and 47 °C.

The annual average rainfall is around 820 mm for the region.

4.5.3 Seismology

The proposed plant site area falls at the cusp of Seismic Zone II & III. For safer side design, the region should be considered under Seismic Zone III for which the zone factor is 0.16 is recommended as per IS 1893 (Part I). This aspect shall be duly considered while designing the structures.



CHAPTER 5A: PLANT TECHNICAL CONCEPT - IU

5.1 PLANT CAPACITY

Jaykaycem (Central) Limited (JCL) proposes to set up a Greenfield Integrated Cement Plant of 8,000 tpd clinker and 2.0 mio tpa cement capacity, at villages Harduwa Ken, Puraina, Maddiyan and Sotipura of tehsil Amanganj, district Panna, Madhya Pradesh.

The project does not envisage railway connectivity and installation of Captive Power Plant (CPP). However, Waste Heat Recovery System (WHRS) based thermal power plant is considered.

A part of Clinker produced shall be consumed at integrated cement plant and balance shall be supplied to **JCL**'s Grinding Unit (GU) in Hamirpur, Uttar Pradesh.

JCL envisages setting up pyro processing section with 8,000 tpd nominal capacity and 10,000 tpd potential capacity. To exploit the potential capacity of the pyro section in future, upstream equipment are sized accordingly.

JCL proposes to produce OPC and PPC as per relevant BIS standards:

Sn	Product type	Proportion	Cement Volume	Relevant IS
1	OPC	40%	2,424 tpd	IS 12269 -1987
2	PPC	60%	3,636 tpd	IS 1489 -1991

Table 5.1: Proportion of OPC & PPC

The cement production may vary depending on the product mix and actual addition of fly ash.

The proportion of various constituents in the cement is as given below in Table 5.2:

Sn	Component	Proportion, %	
		OPC	PPC
1	Clinker	90	60
2	Gypsum	5*	5*
3	Fly ash	-	35
4	Limestone	5***	-

Table 5.2: Proportion % in various products

* % Addition of Gypsum shall depend upon the quality of clinker and purity of Gypsum. However for sizing of equipment and storages, 5% Gypsum addition has been considered.

** As per the specification specified in IS:1489-1991, the Flyash can be added in the cement upto 35% depending upon clinker quality and quality of Flyash procured. Since the actual quality of



clinker and Flyash is not known, the Flyash addition in PPC has been considered as 35% for the purpose of the report.

*** Limestone shall be used as performance enhancer in the cement manufacturing process as per IS12269 (Amendment 7, Year 2003)

Based on the above concept, a cement manufacturing plant with following operating parameters is proposed:

- Plant working days : 330 days per annum
- Clinker capacity : 8,000 tpd (Nominal), 10,000 tpd (Potential)
- Cement capacity : 6,060 tpd (equivalent to about 2.0 mio tpa)

5.2 TECHNICAL GUIDELINES

- Choice of process and main machinery best fitting the prevailing circumstances
- Layout and design appropriate for the existing site conditions including:
 - Geography and topography
 - Climate
 - Standardization
 - Future expansion
 - Skill levels and training of personnel
- Flexibility for future plant development and expansion, raw mix adjustment, cement additives and product variations.
- Low investment cost.
- Low production cost based on:
 - Selecting efficient, reliable and well proven equipment with:
 - ÷ High thermal efficiency, low heat energy consumption
 - ÷ Low electrical energy consumption
 - ÷ Maximum utilisation of available waste heat
 - ÷ High availability
 - ÷ Low maintenance demand
 - High degree of mechanization and process control automation
 - ÷ Balance mass flow
 - ÷ Adequate equipment capacities



- ÷ Sufficient storage volumes
- Ease of maintenance
 - ÷ Adequate maintenance access and hoisting facilities
 - ÷ Optimised layout
- Environmental protection measures in accordance with applicable Indian/ Lafarge norms and standards i.e.,
 - ÷ Maximum dust emissions in cleaned exhaust gas < 20 mg/Nm³.
 - ÷ Maximum gaseous emission for NO_x < 600 mg NO₂/Nm³ and SO_x < 100 mg SO₂/Nm³.
 - ÷ Noise level below limits set forth by Indian/ Lafarge standards.
 - ÷ Health and safe workplace by selecting equipment with zero risk to the employees thus meeting targets set for lost time due to accidents and injuries
 - ÷ Reliance as far as possible on domestic services, contractors, material and equipment supply.

The above objectives are partly interrelated and conflicting, thus priority will be given to the most cost efficient solution incorporating the trends and developments in the internationally operating cement industry, which are considered to be representative in this field.

□ **Plant Design Capacity and Key Production Parameters**

Nominal kiln capacity	:	8,000 tpd clinker
Potential kiln capacity	:	10,000 tpd clinker
Raw material/ clinker factor	:	1.51
Cement capacity	:	2.0 mio tpa cement

□ **Basic Design Parameters**

Kiln operating days	:	330 dpa
Clinker to cement factor	:	0.9 for OPC & 0.60 for PPC
Average envisaged heat consumption	:	680 Kcal/ kg clinker

Envisaged specific electrical energy consumption

Total Plant	:	~ 65 kWh/ t PPC
		~ 80 kWh/ t OPC
Clinker	:	~ 48 kWh/t Clinker



Fuel

Fuel	Average Net Calorific Value (Kcal/Kg)
Indian Coal	4,350
Petcoke	7,933

During operation, the choice of fuel shall be based on economic considerations. However, for the purpose of technical concept, mix of Indian Coal and Petcoke in 80%:20% proportion is considered.

□ Plant Selection and Concept

In order to meet above key production parameters suitable plant concept comprising of 8,000 tpd clinker dry process kiln system is developed. The concept includes limestone crushing and transport, correctives & additive crushing, transport, pre-blending stockpiles, Closed Circuit Roller Press (CCRP) for raw material grinding, a vertical roller mill for coal grinding, 6-stage double string preheater with in line calciner, Waste Heat Recovery System, coal fired rotary kiln with 3 roller stations, storing & dozing of fuel, clinker cooler, clinker storage silo, clinker extraction system, Vertical Roller Mill (VRM) for clinker grinding, clinker bulk loading via trucks, cement silos, packing and loading equipment.

JCL envisages setting up pyro processing section with 8,000 tpd nominal capacity and 10,000 tpd potential capacity. To exploit the potential capacity of the pyro section in future, upstream equipment are sized accordingly.

5.3 CAPACITIES OF MAIN EQUIPMENT AND STORAGES

The main machinery and storages have been sized in accordance with international norms, local conditions for operation of plant coupled with **HOLTEC's** experience for similar capacity plants. These norms are summarized in **Tables 5.3** and **5.4**.

Sn	Department	Operating			Design Safety Factor
		Hrs/Day	Days/Year	Hrs/Year	
1.	Mines	10	300	3,000	1.10
2.	Limestone Crusher	10	300	3,000	1.15
3.	Corrective & Additive Crusher	10	330	3,300	1.15
4.	Coal crusher	10	330	3,300	1.15
5.	Raw Mill	21	330	6,930	1.15
6.	Coal mill	21	330	6,930	1.15
7.	Cement Mill	21	330	6,930	1.15
8.	Packer	15	360	5,400	1.25

Table 5.3: Norms for operating hours and safety factors for plant & machinery



The provision of storages varies from plant to plant, depending upon the following:

- Lead distance of raw material source from plant.
- Ownership of raw material source i.e. self or “bought out”.
- Transportation route.
- Cost of resource.
- Seasonality
- Operator’s comfort.
- Inventory cost for storages.

Based on above considerations, the following storage days are proposed considering the capacity of plant to produce 8,000 tpd clinker and 2.0 mio tpa cement:

Sn	Department	Storage Days	Remarks
1.	Limestone Stockpile	3	Mill Days
2.	Corrective,	15	Mill Days
3.	Raw meal	2.14 (1.5 active)	Kiln Days
4.	Fuel (Coal/ Petcoke)	7/15	Kiln Days
5.	Clinker	10	Kiln Days
6.	Fly ash/ Pond Ash	4	Mill Days
7.	Gypsum	7	Mill Days
8.	Cement	3	Mill Days

Table 5.4: Storage Days

5.4 RAW MIX AND PLANT DESIGN

Following “raw mix design” (Ref. Chapter 3) utilizing mix of 80 % coal & 20% Petcoke as fuel has been considered for the project is given below in **Table 5.5**.

Material	Theoretical Raw Mix
Fuel	80% Coal + 20% Petcoke
Limestone	96.6%
Bauxite	2.20%
Iron Ore	1.20%
Raw meal to clinker factor	1.51

Table 5.5: Raw mix

The average moisture content considered in the raw materials is indicated in **Table 5.6**:

Sn	Department	Moisture Content, %
1.	Limestone	4
2.	Bauxite	15
3.	Iron Ore	5



Sn	Department	Moisture Content, %
4.	Indian Coal	12
5.	Petcoke	10
6.	Gypsum	15
7.	Flyash	Dry
8.	Pond Ash	25

Table 5.6: Moisture content in raw materials and fuel

For the suitably designed pyro processing system (Double string, 6 stage PH with inline calciner (ILC)), as recommended later in this chapter, the specific heat consumption is expected to be in the range of 680 - 700 kcal/ kg clinker depending on the operational conditions like variations in the quality of kiln feed material and fuel, variations in feed rate, sudden dislodging of coating etc. The specific heat consumption is envisaged to be about 680 Kcal/ kg clinker.

5.5 ASSESSMENT OF SIZING OF MAIN MACHINERY AND STORAGES

The capacities of major equipment and storages have been worked out for various departments as below.

5.5.1 Limestone Crusher

The project envisages crushing of Limestone in plant.

The boulders from the mines shall be transported and unloaded in the crusher dump hopper through dump trucks. Hopper extraction shall be done through heavy duty apron feeders to the wobbler feeder. From the wobbler feeder the screened material shall be transported to the crusher. Screening of about 25% in the wobbler feeder is envisaged.

The Limestone crushing requirement is estimated as about 1,656 tph (refer **Annexure 5.2**). With 25% screen the crusher capacity works out to about 1,242 tph.

However, considering potential capacity of pyro section and also to mitigate any variation in the raw mix, material quality, etc in the future, Limestone crusher of higher capacity is considered.

Crusher capacity = 1,300 tph

Wobbler feeder Capacity = 1,600 tph

The brief technical details of the proposed limestone crushing system are as under:

Type of Crusher : Impactor
Crusher Location : In Mines (Adjacent to Plant)
System Capacity : 1,600 tph
Feed Size : ROM 1200 x 1200x 1000 mm



Output Size	: 95 % (-) 50 mm
Crusher Feed Hoppers	: One dump hopper
Hoppers Extraction	: Heavy duty apron conveyor
Dedusting crusher	: Self contained nuisance bag filter
Compressed air supply	: Independent compressor plant
Cranes and hoists	: Crane above intake hopper and hoists for crusher maintenance
Process Control	: Suitable instrumentation and Programmable Logic Controller with communication bus to central control system and stockpile equipment
Transportation to stockpile	: Crushed material shall be transported through belt conveyor to limestone open stock pile.
Cross Belt Analyser	: Immediately after surge bin it is proposed to install a PGNAABased Cross Belt Analyzer.
Environmental Control	: Dust arrestment and control of the crusher and transfer points of the raw material transport will be by means of fabric nuisance bag filters. Water based cold fog dust suppression shall be provided for crusher dump hopper.

5.5.2 Limestone Handling and Transportation to Stockpile

The capacity of the limestone handling and conveying system is proposed as 1600 tph. A belt conveyor is envisaged for the transportation of crushed limestone from the crusher to the limestone stockpile.

5.5.3 Limestone Pre-blending Stockpile

Material	Storage type	Storage capacity
Limestone	Linear stockpile	2 x 40,000 t

Two nos. Chevron type, longitudinal stockpiles have been proposed for storages and homogenization of the Limestone. The storage capacity has been considered for 3 days. The limestone received from the crusher shall be stacked with the help of a Stacker of rated capacity 1,600 tph. For extraction, one bridge type Reclaimer of rated capacity 900 tph has been considered.

Limestone Stacker	:	1,600 tph
Limestone Reclaimer	:	900 tph

While stacking shall be done in one pile, its reclaiming will be done from the other. Reclaimed material shall be transported to the raw material hoppers in the raw mill department through a series of belt conveyors.



5.5.4 Corrective/ Additive Crushing

As per the theoretical raw mix (**refer Chapter 3**), correctives envisaged for the project are mainly Bauxite and Iron Ore. The additives to be used are Gypsum and Limestone.

Only corrective crushing is envisaged.

The Corrective crushing requirement is estimated as about 55 tph (Refer **Annexure 5.2**).

However, considering potential capacity of pyro section and also to mitigate any variation in the raw mix, material quality, etc in the future, Corrective crusher of higher capacity is considered.

Corrective received via trucks shall be unloaded with the help of truck tippler on to the Box Feeder. Box feeder shall feed the material to sizer.

Crusher capacity for Correctives = 300 tph

Crusher bypass system shall be provided for material not requiring crushing.

The brief technical details of the proposed corrective crushing system are as under:

Type of Crushers	: Sizer
Crusher Location	: In Plant
Capacity	: 1 x 300 tph
Feed Size	: 300 x 300 x 300 mm
Output Size	: 95 % (-) 50 mm
Crusher Discharge System	: Crushed material shall be discharged by belt conveyors and stacked by a stacker.
Dedusting crusher	: Self contained nuisance bag filter
Compressed air supply	: Connected to plant compressed air network.
Cranes and hoists	: Crane above intake hopper and hoists for crusher maintenance
Process Control	: Suitable instrumentation connection to DCS system
Transport to stockpiles	: Crushed correctives will be transported to covered linear stockpile and stacked with stacker.
Environmental Control	: Fugitive dust from crusher and transfer points shall be controlled with the help of bag filters.

Additive shall be manually unloaded in stockpile and stacked with the help of Payloader.



Additive shall be reclaimed with the help of Payloader and ground hopper arrangement.

5.5.5 Corrective/Additive & Blending Material Storage

The required storage capacities for various correctives and additives are estimated at **Annexure 5.2**:

Considering potential capacity of pyro section and also to mitigate any changes in the raw mix, material quality, operational requirements in future, storages of higher capacity are considered.

The envisaged corrective storages are given below.

Bauxite : 7,500 t

Iron Ore : 7,500 t

The envisaged storage capacity for additive is as follows:

Gypsum : 2,100 t

Limestone : 1,000 t

Pond ash : 5,000 t

Separate covered linear storages for all correctives and additives with above capacities have been considered.

Stacker with side scrapper has been considered for correctives. Additives shall be manually handled

Reclaiming of correctives shall be done with the help of a Side Scraper of suitable capacity.

Correctives Stacker : 500 tph

Correctives Side Scraper : 200 tph

Dry Flyash shall be received in bulk carriers and unloaded pneumatically into a storage silo.

Pond Ash shall be received in trucks and shall be unloaded manually in the additive Stockpile.

The envisaged storage capacity for Blending Material is as follows:

Dry Flyash : 5,000 t

Pond Ash : 5,000 t

A RCC silo is envisaged for dry fly ash storage. Pond ash shall be stored in additive storage shed along with Gypsum and additive Limestone.



Environmental control shall be by virtue of having totally covered material storage area, nuisance bag filters at transfer points and bag filters at all discharge points of conveyors.

5.5.6 Fuel Handling, Storage and Transport

Indian Coal and Petcoke are envisaged as fuel for the proposed cement plant.

Fuel shall be received in the plant by road. The trucks shall be unloaded by truck tipplers & Bulk Receiving Units (BRU) arrangement. From the crusher fuel shall be transported to storage by a series of belt conveyors and stacked by a stacker.

Considering the storage requirement of fuel for cement plant, linear stockpiles and handling equipments of following capacities are envisaged.

Fuel Storage : 2 x 10,000 t (Indian Coal)
2 x 3,000 t (Petcoke)

Fuel Stacker : 1 x 300 tph
Fuel Side Scraper : 1 x 200 tph

5.5.7 Fuel Crushing and Transport

The Coal crushing requirement is estimated as about 166 tph (Refer **Annexure 5.2**).

However, considering potential capacity of pyro section and also to mitigate any variation in the fuel mix, material quality, etc in the future, Coal crusher of higher capacity is considered.

Crusher capacity for Coal = 300 tph

Crusher bypass system shall be provided for Petcoke which does not require crushing.

The brief technical details of the proposed Coal crushing system are as under:

Type of Crushers	: Roll crusher
Crusher Location	: In Plant
Capacity	: 1 x 300 tph
Feed Size	: 300 x 300 x 300 mm
Output Size	: 95 % (-) 50 mm
Crusher Discharge System	: Crushed material shall be discharged by belt conveyors and stacked by a stacker.
Dedusting crusher	: nuisance bag filter
Compressed air supply	: Connected to plant compressed air network.



Cranes and hoists	:	Hoist for crusher maintenance
Process Control	:	Suitable instrumentation connection to DCS system
Transport to stockpiles	:	Crushed coal shall be transported to covered linear stockpile by a series of belt conveyors and stacked through a Stacker.
Environmental Control	:	Fugitive dust from crusher and transfer points shall be controlled with the help of bag filters.

5.5.8 Fuel Drying and Grinding

The Coal Mill requirement is estimated as about 78 tph (Refer **Annexure 5.2**) considering Indian coal.

However, considering potential capacity of pyro section and also to mitigate any variation in the fuel mix, material quality, etc in the future, Coal drying and grinding system of higher capacity is considered.

Keeping in view the lower specific energy consumption, ease of operation and compact layout the provision of Vertical Roller Mill (VRM) offers advantages over other grinding systems. Additionally considering equipment similar to **JCL's** existing plants, a **Vertical Roller Mill** of 90 tph capacity (Coal)/ 50 tph capacity (Petcoke) @ 15% R90 micron is proposed for the project.

The brief technical details of the fuel drying and grinding system are summarized below:

Coal Mill feed bins	:	2 numbers feed hoppers have been considered for separate storage of two types of fuels. The feed bins shall be designed as mass-flow steel bins resting on weight load cells. The feed bins shall be of storage capacity 150 t. The feed bins shall be dedusted by nuisance bag filters. Coal mill feed bins transport shall be provided with magnetic separator and metal detector to prevent entry of tramp metal into the mill system.
Feed bins extraction	:	Raw coal from feed bins shall be extracted by weigh feeders as per the desired ratio for combined grinding.
Raw coal transport to mill	:	Raw coal extracted by weigh feeder shall be collected on a belt and transported to mill intake chute. The mill feed transport shall be provided with magnetic separator and metal detector to protect the mill against tramp metal. Coal mill inlet will be provided with rotary feeder.
Drying	:	Kiln hot gas shall be used for drying of coal in the coal mill. It is desired that the finished mill product moisture should not exceed 1.0 %.
Vertical roller mill	:	The proposed VRM shall have a capacity of 90 tph for Coal/ 50 tph Petcoke @ 15% R90 micron, designed for high drying and grinding efficiency. VRM shall be equipped with the new generation high efficiency separator. The mill feed system shall be equipped with bin



for reject tramp metal and shall also be used for calibration of weigh feeders. The VRM shall be designed for low-pressure drop of the mill and low power consumption.

Exit gas from mill shall be transported by mill induced draft fan to the bag house type filter. Cleaned gas from bag house filter will be transported by bag house filter fan to the stack.

- Mill product collection : Coal mill product shall be collected at the bag house filter hoppers by a system of chain conveyors, screw conveyors and transported to the fine coal bins. For transport of fine coal to kiln and pre calciner pneumatic transport has been considered.
- Coal mill dedusting : As mentioned above coal mill main gas stream will be dedusted in bag house filter. All other material transfer points and including fine coal bin will be dedusted by suitably sized fabric nuisance filters. Mill venting bag filter shall be designed for emission level below 20 mg/Nm³.

5.5.9 Fuel Firing System

The fuel firing equipment shall comprise of:

- One complete combined multi fuel firing system for rotary kiln burner
- One complete fuel firing system for PC burner

The firing system shall include required oil pumps, filters, pipes, valves, safety instruments, primary air fans, etc.

5.5.10 Raw Material Drying and Grinding

The required capacity of Raw drying and grinding system is estimated as 688 tph (refer **Annexure 5.2**)

However, considering potential capacity of pyro section and also to mitigate any variation in the raw mix, material quality, etc in the future, Raw Material Drying and Grinding system of higher capacity is considered.

For raw materials drying and grinding, the following main alternatives are usually available:

- Closed Circuit Ball Mill (CCBM)
- Roller Press and Ball Mill (RPBM) combination
- Close Circuit Roller Press (CCRP)
- Vertical Roller Mill (VRM)

Keeping in view the lower specific energy consumption, ease of operation and compact layout Closed Circuit Roller Press (CCRP) is recommended for Raw Material drying and grinding. Thus, **CCRP of 2 x 375 tph** has been considered for drying and grinding of the raw materials.



The brief technical details of the raw mill drying & grinding system are as follows:

- Raw mill
hoppers : For mill feeding, 3 nos. steel hoppers of mass flow design (500 t for Limestone, 100 t for Bauxite and 100 t for Iron Ore) shall be installed for each mill.
- Raw mill feeding : Material from the respective raw materials hoppers shall be fed into the mills through the weigh feeders provided beneath each hopper.
- Drying : Hot gases from the Preheater shall be used for drying raw materials. Mill product shall have maximum moisture of 1.0 %.
- Mill System : The CCRP shall be equipped with a new generation, high efficiency dynamic separator and a static separator suitably designed to meet the drying requirement of materials using PH gases.
- Gas from the CCRP system fan along with the gases from PH fan exit shall be dedusted in the bag filter. From bag filter exit, the gas will be transported to the bag house fan and vented out.
- Separate bag filters shall be provided for dedusting of the feed hoppers and mill auxiliaries.
- Product
Collection : Material collected at the bottom of the cyclones and bag house shall be transported to the raw meal storage silo through a set of air slides, screw conveyors and bucket elevators. Material collected from the bag house bottom shall be transported to the kiln feed bin when kiln operates in direct mode.
- Raw mill
dedusting : The main bag filter common for Pyroprocessing section will do dedusting of CCRP gases after CCRP cyclones. Bag house will be designed to meet the requirements of prevalent environmental norms.

5.5.11 Raw Meal Blending and Kiln Feed

A continuous flow homogenizing silo system shall be provided to reduce the quality variation in the raw meal and the kiln feed. The capacity of the raw meal-blending silo shall be **10,000 t**.

The blending silo requirement is estimated to be about 25,886, sufficient for 2.14 days storage (1.5 active day storage). However, **JCL** plans to have the blending silo capacity of 10,000 t.

The raw meal transport arrangement shall ensure feeding raw meal properly distributed all around the silo.

The silo aeration blower's is to be located in silo bottom house. Emptying of the silos must be ensured by appropriate design of silo bottom and aeration system. A silo level indication system shall be installed.

A small load cell mounted collecting bin of 100 ton will be placed below the Silo and from this bin through air-slide and elevator the kiln feed will be transferred to another bin of 250



ton capacity placed in the Preheater building, from where the kiln feed will be fed to the Preheater through Rotor Scale, airslide and elevator. Provision for stand by flow meter shall be kept for future requirement.

The transport system as well as the homogenizing silo shall be dedusted by using pulse jet filter, which shall be designed for clean gas dust content less than 20 mg/ Nm^3 .

5.5.12 Preheater, Precalciner, Kiln, Cooler

5.5.12.1 Kiln, PH & PC

A dry-process kiln installation has been envisaged. The PH may have 4, 5 or 6 stage cyclones. With higher number of cyclone stages in the PH, the specific heat consumption and the PH exit gas temperature would be lower. On the other hand, the total pressure drop across the PH and hence, the specific power consumption of the PH fan increases with increasing the number of PH stages. In view of economy in the specific heat consumption vis-à-vis utilization of PH exit hot gases for the power generation through Waste Heat Recovery (WHR) systems, it is recommended to install a double string, 6 stage PH systems having new generation, high efficiency cyclones with low-pressure drop. The overall separation efficiency of the PH will be minimum 94 %. An inline calciner (ILC) is envisaged to be installed. About 40 % fuel shall be fired in the kiln and the balance 60 % fuel shall be fired in the PC.

The kiln feed material from blending silo shall be introduced into the PH by means of an energy efficient mechanical transport system having bucket elevator and air slides. The material will be preheated in the PH before entering the PC. Fuel firing in the PC shall be controlled to achieve about 90-95 % calcination of the material at its discharge. A separate tertiary air duct (TAD) will be installed to transport the preheated air from the clinker cooler to PC. A provision to feed Alternate Fuels (AF) like plastic, tire chips, carbon black, rice husk, bio mass is also envisaged.

For the PH strings, single fan of high efficiency, suitably designed with variable speed drive shall be installed for handling the gases.

The preheater fan (ID fan) shall be designed suiting the arrangement required for waste heat recovery system (WHRS).

5.5.12.2 Gas Transport System

A Baghouse and 3 fan system is proposed for transport of kiln and raw mill gases and their cleaning. The 3 ID fans for kiln, raw mill and baghouse are envisaged to be frequency controlled variable speed fans.

5.5.12.3 Dedusting of Kiln

Kiln and Raw Mill exit gases shall be cleaned in common baghouse type filter. Kiln/ raw mill baghouse dedusting filter shall be of modern design equipped with high temperature textile filter bags (preferably glass-fiber laminated membrane bags). The baghouse dedusting system shall be designed for maximum dust content in cleaned exit gas of 20 mg/ Nm^3 .

Cleaned exit gas from kiln and raw mill system shall be vented to the atmosphere through a kiln stack of appropriate height and structure. On-line gaseous emissions and dust monitoring equipment shall be provided at the kiln stack.



A provision shall be kept for quenching air fans, to take care of system when WHR is bypassed or under maintenance. A separate silo built in structural steel with capacity of 100 t has been considered to hold baghouse dust. A silo discharge and weight metering equipment to accurately meter the kiln dust from the dust silo back into the raw meal silo or alternatively to kiln feed bin has been considered.

5.5.12.4 Kiln and Kiln Firing

The technical concept considers a rotary kiln with nominal capacity of 8,000 tpd clinker and potential capacity of 10,000 tpd clinker. The kiln shall be 3 roller stations and shall be driven by suitably sized frequency controlled variable speed drive. Kiln burner platform shall be roofed and shall include a suitable hoist for lifting of equipment and refractory. Individual fans have been considered for kiln shell cooling. For monitoring the kiln shell temperature, shell scanner has been considered.

5.5.12.5 Kiln Burner

A modern multi channel, multi fuel type burner with low primary air consumption shall be installed for fuel firing in the kiln. Kiln burner will be suitable for using multiple fuels.

5.5.12.6 Clinker Cooler

A new generation, high heat recuperation efficiency (minimum 75%), modular type pit-less clinker cooler shall be provided. The cooler shall be capable to cope with fluctuations and disturbances in the kiln, which may occur during kiln operation. The Controlled flow regulator system of the cooler (closed aeration) allows for optimum clinker distribution at the cooler inlet and for controlled and uniform aeration and cooling of individual sections. The clinker cooler shall be equipped with clinker roll crusher at discharge of clinker cooler. The clinker cooler shall be designed for clinker outlet temperature of max 65°C above ambient.

The cooler discharge has been considered above the ground level to avoid any pit or tunnel and considering the environmental hazards. The tertiary air extraction shall be located at kiln hood. The clinker cooler waste gas can be dedusted through ESP. The ESP dedusting system shall be designed for maximum dust content in cleaned exit gas of 20 mg /Nm³. Cleaned gas from clinker cooler shall be vented through stack. On-line dust monitoring equipment shall be provided at the cooler stack. Dust from cooler ESP shall be transported to the clinker pan conveyor to clinker silo.

For a situation when the cooler exit gas temperature exceeds a certain value, around 300 °C, gas cooling water spray system in duct between cooler exit and cooler ESP shall be installed. However, the water spray system shall not operate when the WHR boiler is under operation.

5.5.12.7 Specific Heat Consumption

For the suitably designed pyro processing system (Double string 6 stage PH with inline calciner (ILC)), the specific heat consumption is expected to be in the range of 680 - 700 Kcal/ kg clinker depending on the operational conditions like variations in the quality of kiln feed material and fuel, variations in feed rate, sudden dislodging of coating, etc. Hence, the specific heat consumption is envisaged to be about 680 Kcal/ kg clinker.



5.5.12.8 Clinker Transport & Storage

Clinker transport from cooler to clinker silo has been considered to be with the help of pan conveyor. Pan conveyor shall be sized with a nominal capacity of 625 tph.

Clinker storage is envisaged in an RCC silo of capacity 100,000 t live capacity equivalent to about 10 days storage.

Clinker shall be extracted from the bottom of the clinker silos through a set of Deep Pan Conveyors and unloaded on to two set of belt conveyors. One set of belt conveyor transport clinker upto elevator in the hopper building in the cement grinding section. Another set of belt conveyors shall transport clinker to load out silos. From the load out silos, the clinker shall be filled up in trucks by a bulk loading spouts with inline Weigh Bridges for transport to **JCL**'s grinding unit.

5.5.13 Waste Heat Recovery System (WHRS)

The Cement industry is highly Energy Intensive, wherein in addition to high Electrical energy requirement the heat energy requirements are also high. The waste heat energy (after utilization of the heat for cement process) is available for waste heat recovery.

Considering the potential heat values of the waste flue gases of cement plant process it is proposed to install the "waste heat recovery based power plant". The heat values of pre-heater exhaust gases and clinker cooler exhaust gases shall be utilized in the waste heat recovery boilers to generate the steam.

Total 2 no's WHR boilers are proposed to be installed in this project as per the details summarized below:

- ❖ For Proposed new Cement production line
 - One Boiler for the PH string
 - One AQC Boiler for the clinker cooler

The generated superheated steam shall be introduced to the common steam driven turbine generator set. The generated power shall be utilized for the cement plant operations while operating in parallel with grid.

5.5.13.1 Waste Heat Recovery Boiler (WHRB)

The PH boiler shall be a vertical configuration single drum boiler. AQC boiler shall be vertical single drum boiler. Both the boilers are top supported, outdoor unit suitable for the specified Pre-heater and Clinker Cooler exhaust of cement plant.

JCL proposes to install waste heat recovery based boiler which is expected to generate about 22 MW power from heat available.



5.5.14 Cement Grinding System

For cement grinding, the following main alternatives are usually available:

Closed Circuit Ball Mill (CCBM)

In this system, clinker and gypsum are ground in a ball mill, where steel balls are used as grinding media. The discharge from mill is lifted by a bucket elevator and fed to a high efficiency separator. Fines from the separator are collected in the cyclones and further transported to the cement silo. The coarse material from the separator is fed along with fresh feed to the mill inlet for further grinding. The fly ash may be fed directly to the separator. Partial quantity of separator circulating air is vented in a bag filter. For mill venting a bag filter or an ESP may be installed. Fines collected in bag filter/ ESP is transported to cement storage silo(s) by a system of air slides and bucket elevator.

Roller Press and Ball Mill (RPBM) combination

In this system, a closed circuit RP is installed as a pre grinder in semi finished mode before the ball mill, which is used for finish grinding. Fresh feed along with the RP output is fed to a high efficiency, static separator installed above the RP. Coarse material from this separator is taken as feed to the RP. Fines from this separator are either taken to the mill inlet or fed directly to a high efficiency dynamic separator (mill separator). The product from ball mill is fed through a bucket elevator to the mill separator. Coarse material from mill separator returns to the mill inlet, while fines are transported to the cement silo(s). For mill venting, a bag filter or an ESP may be installed. Fines collected in bag filter/ ESP is transported to cement storage silo(s) by a system of air slides and bucket elevator.

Close Circuit Roller Press (CCRP)

In this system, a closed circuit RP is installed in finished mode. Fresh feed along with the coarse material from the separator is fed to the RP. Fines from this separator i.e. the product is fed through a bucket elevator to the cement silo(s). For venting, a bag filter or an ESP may be installed. Fines collected in bag filter/ ESP is transported to cement storage silo(s) by a system of air slides and bucket elevator.

Vertical Roller Mill (VRM)

VRM has an inbuilt high efficiency separator for material grinding. A mix of clinker, gypsum and/or fly ash and/or slag is fed to the grinding table fitted with hydraulically operated rollers, which apply pressure on the material bed for grinding purpose. The ground material is air swept to the high efficiency separator, where coarse material falls back on grinding table for further grinding. Fines from separator are collected in a bag filter. Fines collected in bag filter are transported to cement storage silo(s) by a system of air slides and bucket elevator. Depending on the suppliers' recommendation, grinding aid may be used.

In order to maintain the required gas flow through mill nozzle ring, hot gas may be required during mill start up after long shutdown. Hence, a suitably sized hot air generator (HAG) may be required for this system.

Technically, all of these cement grinding options, viz., CCBM, RPBM, CCRP and VRM, are acceptable in the cement industry. However, final selection of one of the available options, or their variants thereof, depend upon various factors like Customer's experience,



consultant's recommendations, initial as well as operating cost parameters, etc. to name a few.

Keeping in view the lower specific energy consumption, proven performance and inline with **JCL**'s other cement plants, it is recommended to install VRM (Vertical Roller Mill) of capacity of 300 tph PPC @ 3,600 Blaine.

The brief technical details of the cement drying & grinding system are as follows:

- | | |
|--------------------|--|
| Cement Mill Bins | : For mill feeding, 1 no. hopper of 400 t for clinker and 3 nos. hoppers 75 t for Gypsum, 150 t for Pond Ash and 50 t for Limestone shall be considered. |
| Cement Grinding | Clinker, Gypsum, Pond Ash and Limestone from the respective material hoppers shall be fed into the cement mills through the weigh feeders provided beneath the hopper.

Cooler hot gas shall be used to meet the hot gas requirement of the mill.

For production of PPC controlled/ measured quantities of flyash shall be drawn from fly ash hopper through dozing valves and shall be fed to the mill through dedicated solid flow meters. Load cells shall be provided for on line check weighing/ calibration of solid flow meters. |
| Mill system | : Dust laden air from the cement mill outlet shall be dedusted in bag filter. From bag house exit, the gas shall be transported to cement mill bag house fans and vented out. |
| Product collection | : Material collected at the bottom of bag filter i.e. product shall be transported to the cement storage silos with the help of bucket elevator and air slides. |
| Mill dedusting | : The solution envisaged for dedusting of cement mill gases is with a bag house. Bag house shall be designed to meet the requirements of prevalent environmental norms. |

5.5.15 Cement Storage

The cement storage requirement is estimated as 18,182 t (refer **Annexure 5.2**).

However, **JCL** plans to install 3 x 5,000 t (RCC) cement silos for the project.

Cement storage capacity = 3 x 5,000 t (RCC)

Cement from the grinding system is transported to the silos with the help of airslides and bucket elevators. From the silos, cement shall be transported to the packer with the help of a set of airslides and bucket elevators.



5.5.16 Cement Packing and Dispatch

5.5.16.1 Cement Silos Extraction

The cement silos shall be capable of complete emptying by an appropriate design of the silo bottom and the aeration system. Silo extraction systems with multiple outlets and collecting hoppers shall be provided.

5.5.16.2 Cement Transport to Packing Plant

Transport of cement from cement silo to packing machines by means of airslides and bucket elevators has been considered.

5.5.16.3 Cement Packing Plant

2 X 240 tph, 16 spouts, double discharge packing machines have been considered.

6 nos. semi automatic truck loaders for loading of bags to road trucks have been considered.

The rotary packer outlet up to loading of the packed bags, suitable system with flat transport belts and diverters has been considered.

Provision for installation of bulk loading system in future shall also be kept from two nos cement silos in case of requirement of bulk cement in future.

5.6 QUALITY CONTROL

The quality control department at the plants shall have the following facilities:

5.6.1 For Chemical Analysis

5.6.1.1 Bulk Material Analyzer

Cross belt analyzer system shall be used for on-line real time process control & raw material management.

One Cross Belt Analyzer (CBA) installed at Limestone transport conveyor system after crusher, shall be used for controlling the quality of stockpile & raw material management

5.6.1.2 X-ray Fluorescence (XRF)

X-ray fluorescence can be used for on-line proportioning and control of raw mix preparation. Generally 5 -13 elemental oxides can be analyzed. Provisions for installation of Auto sample collection, Auto sample preparation employing robotic technology & its pneumatic transportation to laboratory are envisaged.

5.6.1.3 X-ray Diffractometer (XRD)

It can be used for estimation of phases (C_3S , C_2S , C_3A , C_4AF) & free lime in clinker in the cement plant.

In addition, conventional chemical analysis system will also be used.



5.6.1.4 Conventional, Chemical Analysis Equipment

In addition, conventional chemical analysis system will also be used.

Chemical Analysis Equipments has been envisaged to meet the requirement of the plant and investment cost for the same has been considered.

5.6.1.5 Robo Lab

The plant will be equipped with state of the art Robotics for automatic management of samples.

5.6.2 For Physical Analysis

For determining the particle size distribution of the raw mix, clinker, cements, etc. a laser diffraction type PSD analyzer may be installed having typical particle size range of 0.3 mm - 400 micron.

5.6.2.1 Particle Size Distribution (PSD)

For determining the particle size distribution of the raw mix, clinker, cements, etc. a laser diffraction type PSD analyzer may be installed having typical particle size range of 0.3 mm - 400 micron.

5.6.3 Quality Control Plan

To produce good quality cement, it is imperative that sampling & testing of various raw materials, fuels, in-process materials and the final product is carried out regularly at the required intervals for taking corrective action timely.

Facilities and equipment envisaged for quality control of the raw materials and final products for the proposed plant are as follows:

Raw mix preparation	- Raw material control in mines
	- Raw material control before pre-blending
	- Raw meal control after raw mill
Pyro-processing	- Kiln feed
	- Fuel
	- Hot meal
	- Clinker
Cement	- Before cement mill
	- After cement mill

To ensure consistent product quality and to permit the trouble free and cost effective operation, the quality control plan for sampling & testing of various raw materials, in-process materials and the final product is suggested as given in the following **Annexure 5.3**.



5.6.4 Laboratory

The laboratory shall be accommodated in Central Control Room building. The quality control concept includes all sampling stations and a fully equipped chemical and physical laboratory.

5.7 UTILITY SYSTEMS

5.7.1 Power System

This has been dealt with in detail in para 5.10, Electrical Engineering

5.7.2 Water Supply

The water requirement for plant, colony & WHR has been estimated as about 2,500 m³/day. The details of water requirement are given below.

Item	Water Consumption (m ³ /day)
Cement Plant	2,100
Drinking, Sanitation and Plantation	100
Mines	150
Waste Heat Recovery System (WHRS)	150
Total	2,500

Table 4.1 Water Requirement

Water requirement is envisaged to be primarily met from mines pits, check dams, rain harvesting, etc besides Ken River.

For domestic purposes, water requirement may be augmented utilizing underground sources (borewell) for which requisite statutory approval (CGWA approval) has already been obtained in February 2020.

5.7.2.1 Process Water Circuit

Cooling water (required for machine cooling). Make-up water shall be provided while re-circulating water shall be in a close loop.

5.7.2.2 Potable Water

Depending upon the quality, water shall be treated to remove impurities and minerals to make it suitable for plant use.

A suitably designed water treatment and chlorination plant shall be installed



5.7.3 Compressed Air Supply

It is proposed to install the compressors/ roots blowers, for compressed air requirements, at one/ two centralized location in the cement plant suitable for complete plant.

5.7.4 Fuel Supply

Imported coal is envisaged to be the fuel for kiln and pre calciner. Apart from coal as the fuel for the main plant, suitable storage for Diesel for the cement plant has been considered as described below:

Storage tank for diesel fuel : 100 kL

A diesel oil tank with a total storage capacity of 100 kl has been considered in order to provide fuel for filling station for vehicles such as trucks and heavy mobile equipment.

Two diesel stations are envisaged one each for limestone quarry and plant.

5.7.5 Fire Fighting System

A complete fire fighting installation is foreseen including housing area and in particular special equipment for the fuel storage. It shall consist of a network of fire hydrants with the necessary fire-fighting equipment and surge tank.

A complete fire fighting system shall be provided comprising of:

- A suitable high-pressure system of fire hydrants consisting of suitable number of fire hydrants.
- Heavy-duty ABC powder type fire extinguishers shall be hung at particularly important electrical equipment areas.
- Portable CO₂ extinguishers shall be provided throughout the plant.

5.7.6 Auxiliary Infrastructure Facilities

5.7.6.1 Workshop

Adequately equipped workshops have been envisaged for all disciplines i.e. mechanical, electrical, electronic computer maintenance etc. at proposed cement plant.

5.7.6.2 Warehouse and Spare Parts Store

A store building shall be constructed as warehouse or spare parts store. The warehouse shall store tools, spare parts, consumables such as refractory, lubricants etc. Fenced open-air yard with sheds shall be built for storing heavy parts.

Sufficient spare parts have been considered as part of supply with the initial plant delivery for the first two years of operation as well as the required strategic spare parts.



5.7.6.3 Elevators, Cranes, Hoists and Maintenance Tools

Elevators, maintenance cranes and hoists and all required specially designed maintenance tools for equipment and plant shall be provided. 2 nos Personnel elevators have been considered. Following areas shall be provided with personnel elevators in cement plant:

- Preheater
- CCR

5.7.6.4 Plant Maintenance

All necessary maintenance tools and special tools required for proper maintenance of the mechanical and electrical equipment of the plant as well as spare parts required for normal operation during 2 years have been considered.

5.7.6.5 Heating, Ventilation and Air-conditioning

Suitable heating, ventilation and air conditioning systems as appropriate have been considered in dedicated rooms i.e. electrical and control rooms, laboratories etc.

5.7.6.6 Central Control Room Building

A central control room building shall be considered at strategic location of the plant common for both the phases. The central control room building shall house a spacious central control room, X-Ray laboratory, and various technical offices. All buildings shall be provided with sufficient toilets.

5.7.6.7 Administrative Office

A suitable admin office shall be considered. All administrative and production buildings shall be provided with sufficient toilets and ventilation.

5.7.6.8 Time and Security office

At the entrance of the unit, a time office and a security office shall be constructed.

5.7.6.9 Dispensary

A dispensary with first aid facilities will be provided in the plant premises.

5.7.6.10 Weighbridge

Two sets of electronic weighbridges are envisaged to take care of the incoming and outgoing materials.

5.7.6.11 Bags Godown

Space shall be provided in the packing plant department for the storage of bags.

5.7.6.12 Parking

Adequate parking space shall be provided in the plant premises for the parking of vehicles.



5.7.6.13 Colony

A residential colony to accommodate about 200-250 management staff and essential services related personnel is proposed initially. The colony shall be located in close proximity to the cement plant. The colony shall have facilities like dispensary, shopping complex, community centre, guesthouse, club etc.

5.8 ENVIRONMENTAL PROTECTION

5.8.1 Dust Emissions and Control

5.8.1.1 Major Emissions

Efficient dedusting and monitoring of dust sources like kiln exhaust gases, clinker cooler vent air; cement mill etc. has been considered.

Bag-house type filters have been considered for the kiln, raw mill, cement mills and ESP for clinker cooler.

5.8.1.2 Smaller Emissions

To minimize the fugitive dust emissions during operation of the plant, sufficient number of standardized dust filters (nuisance filters) of the fabric type shall be considered at:

- Material transport transfer points
- Hoppers, bins and silos
- Dust generating machinery viz. crushers, loading equipment, packing, conveyors etc.

5.8.2 Gaseous Emissions and Control

The proposed kiln system shall be designed with emphasis to minimize emissions to the atmosphere and for compliance with local environmental criteria for gaseous emissions. Modern technology burners, dosing systems (fuel and kiln feed), emissions monitoring and kiln control systems should be considered to minimize gaseous emissions from combustion processes (e.g. NO_x , CO, SO_2)

There are several options available for reducing NO_x and SO_x in the cement pyro process. It is important to choose the one that is cost effective, as well as flexible in terms of raw materials, fuels and operating conditions

While the new SO_x & NO_x norms were proposed to be applicable w.e.f 1st Jan 2017, they are still under discussions due to various industry representations and representations.

Since it is possible to maintain the SO_x & NO_x levels within the prescribed norms through Primary reduction measures, same has been taken into consideration for the system design at this stage.

Integrated pollution measurement and monitoring shall consider gaseous effluents and dust emissions measurement to verify and ascertain the limits of pollution standard and to provide the required inspection point for authorities.



5.8.3 Noise Emissions

All equipment considered in technical concept shall be designed to operate within the prescribed noise levels as defined by relevant standards. Where necessary special sound enclosures shall be considered or the buildings shall be designed with noise protection.

5.8.4 Sewage and Effluent Treatment

Both sewage grade water and effluent (e.g. from water cooling system) shall be collected and treated. A sewage treatment plant shall be considered in order to provide appropriate facilities for the collection and disposal of sewage from the plant (industrial sewage) as well as for the domestic sewage.

The treated water quality will be such to allow for its re-use in the clinker production process (water injection).

5.8.5 Site Drainage

Suitable drainage system has been considered.

5.8.6 Roads

All the major roads and paved places planned for traffic movement within the proposed plant shall have the surface concrete paved or tarred in order to reduce dust generation and protect the roads against damage.

5.9 PLANT LAYOUT

Based on the overall plant technical concept and above description, a proposed plant layout is enclosed as **Drg. No. 20151-05A-IU-1-01** along with the proposed flow sheets enclosed as **Drg. No. 20151-05A-IU-1-02 to 15107-05A-IU-1-17**.

5.10 MATERIAL FLOW DIAGRAM

Based on the technical concept as described above, the Material flow diagram for the proposed project is shown in **Annexure 5.1**.

5.11 CIVIL ENGINEERING CONSIDERATIONS

5.11.1 Introduction

This section briefly outlines the civil engineering considerations relating to the prevailing site conditions and indicative design criteria broadly conceptualized for this project based on the envisaged plant's technical concept.



5.11.2 Site Conditions & Basic Design Criteria

5.11.2.1 Topography

The terrain in the area proposed for plant site is largely flat without much undulation. As such, a nominal lumpsum provision for site grading and levelling has been considered in the cost estimate.

5.11.2.2 Corrosion / Degradation

Corrosion or substrata degradation can become a serious hazard to the overall health of any industrial unit if is present in ambient environment and/or by means of adverse substrata conditions, and if not catered to adequately.

There is not much evidence of a harsh corrosive environment in any of the plant site locations. However, provision of adequate painting and surface protection of concrete as well as steel structures must be provisioned for sites located within close to moderate distance from the sea.

The possibility of chemical attack by soil on foundation concrete has also not been envisaged for the time being in the Civil cost estimates. However, presence of corrosive elements if identified during detailed soil investigations shall be taken care of during the detailed Engineering.

5.11.2.3 Subsurface Condition

Site specific geotechnical and subsurface investigations for the purpose of ascertaining the subsurface conditions and soil's bearing capacity details are understood to be in progress by **JCL** yet at the time of formulation of this Report.

Based on the preliminary inputs gathered from inputs received from **JCL**, the substrata where the proposed cement plant is envisaged to be set up comprises of highly fractured rock and soil strata. It is presumed at this stage, based on preliminary inferences of the assigned geotechnical agency's investigations, that short to medium piles might be required for all major, heavy and dynamically loaded structures.

The exact spectrum of the sub-surface shall however be known only upon conclusion of the detailed sub-surface investigation studies, and the detailed analysis and prognosis of the findings that shall be put to use during the detailed design aspects.

For the purpose of cost estimates, friction piling system of shallow to moderate depth with respect to the natural ground level, have been considered for all major structures and heavily loaded process buildings.

In general, the type, footprint and depth of foundations shall depend upon the loading intensity configuration of the loading points at foundation level. Depending upon the loading intensity and the localized safe bearing capacity of the soil, exact type of foundations shall be designed for respective structures.

However, in case it is ascertained after detailed soil investigations that deeper and major piling is unavoidable; the construction cost of respective area/ structure may further increase to the extent of 10-20% depending upon numbers, dimensions and type of the piles required.



5.11.2.4 Ground Water

Site-specific hydrological investigations are yet to be carried out for the proposed plant location.

Ground water table of the area where the IU is envisaged to be set up is not expected to be encountered until greater depths below the average ground level. As such, no special precautions for waterproofing of underground basement, tunnels, pits, etc. are envisaged in the costing at present.

However, the actual depth and seasonal variation of ground water table should be determined during detailed hydrological studies of the respective plant sites to determine various design parameters.

5.11.2.5 Seismicity

Based on guidelines of Indian Standard IS 1893 (Part I), the proposed plant site area falls in the Seismic Zone III. Corresponding zone factor should be duly factored in during detailed engineering stage and the structures be designed accordingly.

5.11.3 General Design Criteria

5.11.3.1 General Design Principle

In general, the civil design and construction of structures in the plant have to meet the load data conditions and functional requirement as stipulated by the main machinery suppliers.

As a matter of practice, most of the structures and buildings are envisaged to be primarily designed and constructed in reinforced cement concrete (RCC) with suitable masonry and/or metal sheet roofing and cladding. Extensive structural steel usage shall mainly be limited to sheds, conveyor galleries, duct supports and working platforms or where flexibility of stage-wise constructions is constrained. Emphasis has also been laid to keep the civil cost optimised to the extent possible. As such, the plant structures, non-plant & office buildings and colony are envisaged to be built following the 'moderate-finish-low-cost model' of construction practices. The linear storages are envisaged to be light-weighted gantries primarily with corrugated galvanized iron roofing and suitable cladding/ louvers.

Infrastructural elements like the roads, drains, etc. are envisaged to be of all-weather type constructions.

5.11.3.2 Loads & Impacts

All the relevant loading and impact details like wind load, earthquake load & level, static loads, loads from machinery & equipment, dynamic loads, hoist loads, other calculated loads, etc. shall be duly taken into consideration during the detailed engineering process.

5.11.3.3 Codes of Practice and Standards

Indian Standards shall be used for all design and detailing work unless otherwise specified.



5.11.4 General Construction Methodology

5.11.4.1 Earthworks

The site preparation and development works shall predominantly be carried out by mechanized means taking into cognizance the inputs from the topographic survey, design benchmarks and overall plant design principle & layout.

For earthworks relating to buildings and structures, the excavation levels shall be requirement specific as per design and should have additional adequate working space for construction purpose. Mechanized means shall be employed for most of the excavation purposes barring excavation towards final level-dressing of the foundations, or small footings, or any other requirement-specific condition, etc. Any excavation, if inadvertently is carried out below the required design level(s) under any circumstances, shall be filled and made good with plain cement concrete fill.

For backfilling, good quality excavation products of soil can be used after objectionable materials are removed from therein. Back filling material should be free of like bigger sized boulders, organic materials, clay balls, any kind of constructional or non-constructional debris, and other objectionable inorganic matter, etc. Back filling should be done in layers of not more than maximum 300 mm and each layer should be well watered and compacted by mechanized and manual means. The boundary of any compacted back-fill material shall extend at least 1.00 m (0.50 m from each side) beyond the foundation footprint.

Disposal of surplus earth, if any, shall be done taking into account the needful permissions, agreements, etc. from local authorities/ bodies/ etc., as the case may be.

5.11.4.2 Substructure & Superstructure elements

The substructure and superstructure elements shall primarily be guided by the overall plant design principle together with other necessary design elements like individual structure's/ building's design calculations, site conditions, architectural/aesthetic inputs, etc.

Based on the assumptions and considerations adopted for the formulation of this Report, isolated, combined and/ or raft foundations of shallow-to-moderate depth are envisaged for the plant structures and buildings in general.

The depth and size of the foundations of the respective plant and non-plant structures shall however depend upon numerous design parameters like loading data and conditions; type & height of structure; wind, earthquake and other related forces acting upon various structure elements.

In general, the dimensions of isolated footings should at least be 300 mm more than that of RCC column cross-sectional dimensions from all sides. The minimum size of RC Footing shall be 1,000 mm and the thickness should not be less than either 400 mm or the minimum acting column dimension. The structures shall be framed (tied) with rigid tie beams in RCC and/or structural steel to connect isolated footings.

Basement or tunnels walls must be designed with reinforced concrete and flexible joints to be provided in the tunnel footing connections. The reinforced concrete skeleton buildings shall have plain cement concrete floors over well-compacted sub-base for ground floors and shall generally be 150 mm thick. The floor at higher levels shall either be of RCC or structural steel depending upon the design criteria and other work progress related factors.



5.11.4.3 Finishing and Aesthetics

The proposed plant shall have all the basic industry-prevailing facilities and infrastructure. The aesthetics and type of finishes for the superstructure are envisaged to be contemporary but of moderate scale so as to keep the project cost optimized.

5.11.4.4 Health, Safety and Environment (HSE)

All necessary measures towards maintaining high standards of Health, Safety and Environment during entire construction period must be enforced at site, and adhered to by all the contracting agencies.

5.11.5 Civil Cost Estimates

Based on the conceptualized plant technical concept, interactive exchange with JCL personnel, together with HOLTEC database, the civil cost estimates have been estimated for the purpose of carrying out the project financial analysis.

Based on available inputs & data at this stage of the project conceptualization together with logically foreseeable implementation scenario for the project, the unit rates for the civil works have been considered. Average unit rates for major work items that are envisaged to include discounted (special) landed cost of building material, contractors' costs and overheads, allied taxes on the building material, etc. are tabulated below:

Sn	Item of work	Unit	Unit Rate (Rs.)
1	Earthworks (ordinary soils)	m ³	350
2	Earthworks (hard & dense soils)	m ³	750
3	Earthworks (soft rock & hard soils)	m ³	1,400
4	Earthworks (hard rocks)	m ³	2,000
5	PCC M10	m ³	4,450
6	PCC M15	m ³	4,800
7	RCC M20	m ³	5,600
8	RCC M25	m ³	6,350
9	RCC M30	m ³	7,150
10	RCC M35 / M40	m ³	7,650
11	Plain formwork	m ²	750
12	Slip formwork & Special formwork	m ²	1,150
13	Reinforcement steel work	t	55,000
14	Structural steel work	t	84,000
15	Sheeting work (plain+colour coated)	m ²	1,450
16	Brick+Block masonry	m ³	6,650
17	Stone masonry	m ³	6,350

Unit Rates of major complete work items (material + labour rates)



The item rates mentioned above are the average rates considered for the complete item works and are inclusive of the basic material cost. These rates are inclusive of respective construction material costs and the GST component on the purchase of the construction material. However, these unit rates do not include the GST component on the “Contractors’ Services” part, which are capitalized separately in the civil cost estimate at an average rate of 18% (on the 40% component of the overall estimated civil cost).

The average basic cost of the major materials considered for costing purpose, on as landed at plant site gate basis (material cost+taxes+freight), are as tabulated below:

Sn	Material base price	Unit Rate (Rs./ t)
1	Cement (at special discounted price from JCL plants)	5,000
2	Reinforcement steel (various types & diameters)	44,500 to 7,000
3	Structural steel (various types & sections)	45,000 to 9,500

Average basic cost of major three building materials

5.12 ELECTRICAL ENGINEERING

5.12.1 Power Source and Power Demand

The maximum power demand for the proposed Plant and Mines has been estimated as about 34 MW. The power requirement is proposed to be met through a combination of Grid and Waste Heat Recovery System (WHRS) based thermal power plant

At potential clinker capacity of 10,000 tpd clinker, the WHRS capacity is estimated to be about 19 MW. However, **JCL** plans to install a WHRS of 22 MW capacity to exploit benefit from operations optimization in future.

At 8,000 tpd, about 5,78,800 kWh/ day energy consumption is estimated considering the envisaged specific power consumption. Out of this about 3,38,400 kWh/ day shall be from WHRS and balance from Grid.

Grid connectivity of about 20 MW is envisaged from the nearest 132 kV grid sub-station located at a distance of about 45 km from the proposed plant site.

Prevailing tariff for grid power and power generation cost WHRS is as given below:

Grid	:	Rs 7.5 per kWh
WHRS	:	Rs 0.4 per kWh

5.12.2 Power Distribution

5.12.2.1 Primary Medium Voltage (11kV) Power Distribution System

The power to plant loads shall be distributed via Load Centers, located close to the electrical loads in the different process departments as shown in the Drawing no. **20151-05A-IU-1-19**.

For cement plant the power at 11 kV will be stepped down to 415 V at these load centers through 11kV/ 0.433 kV distribution transformers and connected to LT switchboards to



cater to LT loads of the plant. 11 kV motors will be fed directly from 11 kV boards located at the respective Load Centers in the cement plant and at crusher.

A process-conform subdivision of power distribution shall limit the interdependencies between departments. A power failure or maintenance shutdown in one department shall not affect other plant sections.

Power to various decentralized consumers spread over the plant layout shall be provided by means of cables installed on cable trays placed on utility bridges and/ or support structures of conveying equipment inter-connecting the major plant departments.

The plant power factor shall be corrected on two levels. The first level includes two centralized power factor and harmonics filtration units connected to the each section of medium voltage busbar e.g. mill motors, as well as high voltage fed variable speed drive systems shall be corrected by central power factor correction and harmonics filtering equipment. An overall power factor of approx. 0.95 shall be achieved at LV & MV Bus (considering MV and LV-compensation).

5.12.2.2 Low Voltage Power Distribution and MCC (415 V 50 Hz)

The low voltage power distribution scheme has to comply with the process requirements. Independent process departments shall receive independent power supplies and distributions. Process departments are generally determined by material storage facilities. Power will be distributed from the primary power distribution system to distribution transformers arranged in separate rooms located adjacent to the decentralized electrical rooms of the various plant sections. These transformers will supply power to low voltage distribution switchgears, to which all consumers, such as lighting, motor control centers (MCC), large low voltage motors, low voltage power factor correction equipment and non-process equipment (e.g. auxiliary buildings), will be connected. The low voltage distributions systems will be equipped with controlled capacitor banks arranged in the different electrical rooms close to the MCC's.

The entire power distribution system (HV, MV and LV) shall be designed to guarantee selective fault isolation, isolating a faulty circuit from the remainder of the electrical system and thereby eliminating unnecessary power outages.

The low voltage power distribution switchgear and the MCC shall be located in decentralized electrical rooms in the respective plant buildings. All electrical rooms shall be generously sized and provide enough space for future modifications and additions. In order to fulfill the operational requirements and to allow fully automatic control and supervision (digital and analogue) through PLC from the Central Control Room, all LV-Distribution equipment and MCC's shall be equipped with I/O-units as an integral part of the LV-Distribution or MCC-panels.

The I/O-units shall provide a compatible standard bus system and protocol for the signal exchange with the Process Control System applied. The I/O-unit hardware shall be located in a separate section of the LV-or MCC-panel. The status of each individual Input or Output at the I/O-unit shall be visible from outside of the panel.

5.12.2.3 11 kV/ 415 V Distribution Transformers

For the distribution of low voltage power at level 415 V, 50 Hz, the 3 phase, Dyn11, mineral oil filled, ONAN, copper wound distribution transformers complete with off load tap



changers (OLTC) and all specified accessories have been considered to feed the low voltage loads at the respective departmental MCCs'. To attain transformer standardization, the transformers shall have rating of 630 kVA, 1,000 kVA, 1,250 kVA, 1,600 kVA 2,000 kVA and 2,500 kVA. Special transformers for variable speed drives may deviate from above standardization. The transformer capacity shall be selected within above-mentioned sizes and shall not be less than total connected load but include some 20 % spare capacity.

5.12.2.4 Motor Control Centers

Department wise intelligent MCCs (IMCC) controlling a group of interconnected and simultaneously operated loads during the process are envisaged and shall be located in decentralized electrical rooms in the respective departmental sub-stations/ plant buildings.

Each feeder module of the MCCs shall incorporate a mini-processor for serial bus connectivity, and shall be connected to the CPU through daisy-chain serial data link. Further, the MCCs shall comprise of all equipment for a safe remote control of the different plant sections and consist of process power feeders only.

5.12.2.5 Power Factor Correction

The plant power factor shall be corrected on two levels. The first level includes two centralized power factor and harmonics filtration units connected to the each section of medium voltage busbar e.g. mill motors, as well as high voltage fed variable speed drive systems shall be corrected by central power factor correction and harmonics filtering equipment. An overall power factor of approx. 0.95 shall be achieved (considering MV and LV-compensation).

5.12.2.6 Electrical System Components

Drives

The type of drives considered is based on following requirements:

- Speed/ torque characteristics of the driven equipment
- Enclosure protection depending upon the work environment
- Performance characteristics i.e. high power factor and efficiency at operating point
- Accuracy and range of speed control required for specific application

All motors, generally above (300 kw) shall be connected to 11 kV distribution and all motors below (300 kW) shall operate on 415 V. In addition to this all motors above 132 kW rating shall have starting current limiting device and shall be provided with soft starters to ensure smooth start.

Power saving equipment like medium voltage AC variable frequency (MVAC) drives and low voltage AC variable frequency (LVAC) has been taken into consideration to minimize energy costs as to achieve precise speed control.

5.12.2.7 Requirements For Electrical Motors

All constant speed motors will be of the squirrel cage type, totally enclosed and of protection Class IP 55. The variable speed motors will be preferably squirrel cage type



motors with frequency converters of the VVVF type or slip-ring motors with sub synchronous static converter cascade.

High-voltage motors will be designed as slip-ring motors using liquid rheostats. These motors will be of Protection Class IP55, using heat exchangers (air-to-air or air-to-water) for cooling. Motors of the IEC rating (300 kw) and larger shall be high voltage motors. Motors smaller than IEC rating 225 kW shall be low voltage motors.

Direct-on-line starting may be applied for low voltage motors if technically allowable. It is assumed that motors of rating 132 kW or larger will require a starter in order to limit the starting current.

All motors shall be furnished with class F insulation. The required motor size shall be determined on the basis of a loading according class B temperature increase. If motors are de-rated due to ambient factors, IEC-as well as reduced data shall be indicated on nameplates.

The specified ambient temperature (50 Deg.C for plant motors and 60 Deg.C Kiln Main Drive) shall be considered for motor design. The applicable ambient temperature for control panels is the specified room temperature plus 10°C.

5.12.2.8 Low Voltage Motors

Induction motors shall be used for constant speed drives. All motors shall be totally enclosed fan cooled (TEFC) or closed circuit air-cooled with air-to-air heat exchangers of the protection or better.

The individual drive's specific starting and operating requirements shall be carefully considered. To minimize maintenance, squirrel cage motors shall be applied where possible. To cope with high inertia drives, squirrel cage motors in conjunction with fluid couplings or electronic soft-start devices are preferred. Slip ring motors shall be provided for drives with heavy starting characteristic. Separate ventilation of the slip ring section is preferred. Slip ring motors shall be provided with automatic remote-controlled starting resistors of the air-cooled or oil-immersed contactor-controlled design.

5.12.2.9 Variable Speed Drives

The kiln and large fans shall be equipped with variable speed drive systems with Variable Voltage Variable Frequency (VVVF) convertors and AC drive systems.

The torsion analysis as well as harmonic analysis of the complete rotating parts (incl. driven equipment and coupling) for variable speed drives shall be considered. The motors shall be totally enclosed with air-to-air heat exchangers. Temperature sensors PT 100 shall be mounted in the stator winding and in the bearings.

5.12.2.10 Converter and Control Panel

The panels shall be of the enclosed freestanding, self-ventilated design, preferably without back access. Individual drive- and overload-requirements shall be matched along the total power path, e.g. for transformer, IGBT or other bridge and motor. All variable speed drive systems shall be designed to remain in uninterrupted operation during transient line disturbances. Transformers shall be suitable for frequency/ voltage convertor operation.



The transformer vector groups shall be selected in view of reducing the higher harmonics content on the feeding busbar.

5.12.2.11 Lighting And Small Power Distribution And Socket Outlets

Centralized lighting transformers arranged in the various electrical rooms shall provide the required supply for all departmental lighting equipment as well as for plug sockets.

Emergency lighting has been foreseen for major areas, emergency escapes, stairs etc.

Welding supply sockets will be fed directly from the auxiliary LV-distribution section of the individual departments with the required voltage level.

The lighting and power installation comprises the whole plant illumination including distribution boards and emergency lighting as well as power distribution boards and receptacles for hand tools, welding machines etc. It comprises all plant and quarry buildings, any ancillary buildings such as power distribution, service and social buildings, roads and places, etc. Separate distribution boards shall be provided for each building or parts of large buildings.

Warning lights for aircrafts shall be provided according to regulations.

The system shall further inform and guide the truck drivers with regard to the cement loading activities.

Special traffic signalling equipment might also be required at unloading stations (e.g. crusher hopper, feed hoppers for coal, additives etc.) Such signalling may either utilize large clear text displays or normal traffic lighting system. Special care shall be paid to the visibility in dusty environment.

5.12.2.12 Cabling

Following type of cable shall be used in the plant

Power (MV)	:	11 kV (UE) PVC sheathed XLPE insulated Aluminium cables
Power (LV)	:	1.1 kV PVC sheathed XLPE insulated Aluminium & Copper cables
Control	:	1.1 kV PVC sheathed PVC insulated copper cables 1.5 and 2.5 mm ²
Instrumentation	:	0.6 kV screened PVC insulated copper cables, 0.5 and 1.0 mm ²

Overhead cable structures have been envisaged for main substation to departmental substation and further to process buildings.

The technical concept include all cables for all the different purposes of the plant, grouped in high/ medium voltage cables, low voltage cables, control and extra low voltage cables, further, all necessary cable installation materials such as cable trays or ladders, conduits,



fasteners, cable connection materials, etc. as well as all necessary grounding and lightning protection works. All cables shall have copper conductors.

Cables will be standardized according to voltage level. All cables shall be dimensioned according to the load of the equipment connected and the short circuit conditions of the plant's network. Connections to and from transformers shall be able to carry its full rated capacity.

Extra low voltage cables shall be capable to carry analogue and digital signals in multi conductor cables and are, therefore, arranged in twisted pairs, overall shielded and not armoured. The multi conductor cables serve for extra low voltage control and instrumentation purposes. Communication cables are considered as special cables.

5.12.2.13 Earthing and Lightning Protection

System earthing and earthing of MV and LV equipment are considered for safety of operating personnel as well as for proper operation as per the requirements. The MV system shall be earthed through resistance.

(GI/CI Earthing) connected together with strip shall form the main earth mat, which shall be interconnected together.

Earth continuity conductor shall be run along with major cable routes to provide grounding to the equipment. Tall structures like preheater tower and storage silos shall be protected against lightning by use of horizontal mesh of conductors and vertical spikes. All the lightning rods, lightning mesh wires and down conductors shall be of stranded copper.

Also a separate electronic earth mat and network shall be considered for PLC and other associated control panels.

5.12.2.14 Plant Grounding

For the plant grounding, the system "foundation grounding" with emphasis on potential equalization shall be preferred.

5.12.2.15 Lightning Protection

A comprehensive lightning protection system shall be installed to cover all buildings and structures. The Faraday-cage type shall be applied. The lightning protection system shall be connected to the plant grounding system by separate tapping points. Such connections shall be at the outside of the building walls, and shall be individually, directly connected to the foundation grounding.

5.13 CONTROL AND INSTRUMENTATION

DCS control system comprising of programmable controllers and operator stations with peripherals are considered for remote operation of plant from central control or local control rooms.

5.13.1 Plant Control System

The plant automation system will be concentrated in the Central Control Room (CCR) for the entire cement plant except Packing Plant. The configuration and hierarchical structure



of the PLC based process control system will be arranged to allow for independent operation of the following departments at cement plant:

- Raw material reclaiming, feeding to raw mill feed bins and raw material grinding and homogenizing.
- Kiln feed system, kiln/ preheater/ precalciner, clinker cooler, kiln/ clinker cooler.
- Cement mills feed and clinker grinding.
- Auxiliary and supporting departments such as process and cooling water recirculation and treatment, compressed air and power distribution.
- Raw material crushing system
- Packing plant shall have dedicated local control station.

For sequential control of drive and supervision of various process variables distributed processor based control system has been considered. An elaborate instrumentation comprising of field sensors, transducers etc. shall be set up for monitoring processes.

The control, system envisaged shall incorporate following essential features for safe operation of the plant and machinery and provide necessary operating data to evaluate the plant performance and fault monitoring

- Client /server configuration for easy configuration of maintenance.
- Programmable controllers for sequence interlocking and automatic closed loop control through PI and PID action.
- Serial bus connectivity for MCCs', drives, sub-control panels and MV drives.
- Operator stations with colour graphic and alphanumeric display with equipment fault monitoring system and plant remote control.
- Kiln refractory management system with kiln shell temperature measurement through kiln scanner.
- Process optimization systems to achieve process stability.
- An engineering station, which shall provide engineering tools to update PLC programmes.
- An energy management system for control and monitoring of electrical energy.
- MIS (Management Information System), which shall generate reports and provide process mimics as well.

For control and instrumentation, the control system configuration as shown in enclosed **Drg. No. 20151-05A-IU-1-20** for cement plant is considered.

The plant automation and control system shall be structured as under:

The department control level (level 1): using the process stations (PS) with their process input/ output devices, assuring the safe operation of machines, of the production process and provide all required communication interfaces to other control levels.



The operator level (level 2): using the operator stations (OS), assuring a simple and efficient human/ machine interface for the remote operation of the plant. Further this level comprises any operator station as required for high level automation.

The supervisory level (level 3): using management stations (MS) with their peripheral devices and software tools, optimization and management information.

The high degree of automation applied will enhance and ease plant operation. The application of PLC based process control at the department control level will also provide all information on process values required for safe operation of the plant and protection of equipment and personnel during normal operation as well as during emergency operation.

Direct digital closed loop control (DDC) shall be performed with software modules integral with the PLC-system. Controller input will be using treated analogue signals from process instrumentation. PLC integrated alarm and monitoring system will generate detailed alarm and messages, which will allow the operator and maintenance personnel to locate faults and cause of trouble quickly and efficiently and thus reduce the downtime of the plant to a minimum.

At the operator level (CCR) stations shall be foreseen assuring a simple and efficient man/ machine interaction for the remote operation of the plant. The supervisory level shall consist of management stations with their peripheral devices and software tools, assuring high-level automation, optimization and management information. Due consideration will be given to integration of this system into SAP or other administrative and commercial systems that might be employed by the Plant. The MIS system shall be included as part of the automation system.

5.13.2 Process Instrumentation

Necessary field sensors shall be installed to monitor process variables like pressure, temperature, flow, level and speed. The sensors and field devices shall be linked to Control System, through field transmitters/ transducers to display the parameters on Operator Station and exercise controls. The broad technical features of sensors and instruments are described below:

5.13.2.1 Temperature; Pressure, Differential Pressure, Flow & Level Transmitters

Transmitters shall be employed for measuring of pressure, temperature and flow at various locations in preheater, clinker cooler, clinker grinding, raw material grinding plant.

Smart Transmitters shall be used which shall be configured calibrated and tested from the control room itself. Transmitters shall provide very high accurate values and shall have robust field housing.

5.13.2.2 Pyrometers

For temperature measurement in hot zones such as, kiln-burning zone, kiln inlet etc. non-contact type radiation pyrometers shall be used. Pyrometers shall include air purging and water-cooling arrangements.

5.13.2.3 CCTV (Closed Circuit Television Viewing)



In addition CCTV cameras shall be installed for the process and at all strategic points of the plant where visual monitoring is required. The system shall be complete with camera, its special housing and protection, remote control and monitors in the control room. Either black and white or colour systems may be used. The process cameras shall include the Kiln camera system and the clinker cooler camera system.

5.13.2.4 Level Sensors

RF admittance type sensors for point level control and for continuous level ultrasonic/electromechanical type of instruments shall be used.

Special designed level sensors shall be deployed for monitoring and control of material level in clinker discharge hoppers.

5.13.2.5 Speed Switches

These shall be deployed to achieve zero speed protection for various equipments. The unit chosen shall have built in initial by-pass time delay and designed to operate over a range of speed. The primary sensor shall be non-contact type designed to achieve unlimited number of operations. The unit as well as sensor shall have a high degree of environment protection.

5.13.2.6 Gas Analyzers

Microprocessor based gas analysers shall be installed for combustion control in kiln. The analyzers shall monitor and control NO₂, CO and O₂ gases at the kiln inlet, CO & O₂ gases at preheater outlet and PC outlet.

Carbon monoxide analyzer shall be based on absorption on infrared radiation and oxygen analyzer would be based on paramagnetic properties of oxygen.

The chosen analyzer shall provide high degree of stability, quick response and required construction for operating in harsh environment. The analyzer shall include automatic purging and cleaning unit.

5.13.2.7 Dust Emission Monitoring

A Microprocessor based monitoring devices shall be deployed which shall provide concentration of particles in exhaust stacks. The equipment shall have built in air purge system.

The measurement points shall be located at the kiln, cooler and any other stacks where dust is emitted. It shall be based on the in-situ optical method. Depending on the required sensitivity either a system with light transmission or light scattering measurement shall be used.

5.13.3 Intercommunication and Telephone system

Mobile telephones or Public Address System with paging and party facility for CCR operator to contact the field operator and vice versa has been considered in order to facilitate plant operations.

For administrative purpose and inter-department communication a telephone exchange is considered which shall also supplement the public address system. PABX (Public



Automatic Branch Exchange) and telephone system with sufficient number of trunk lines and connection to public network has been considered.

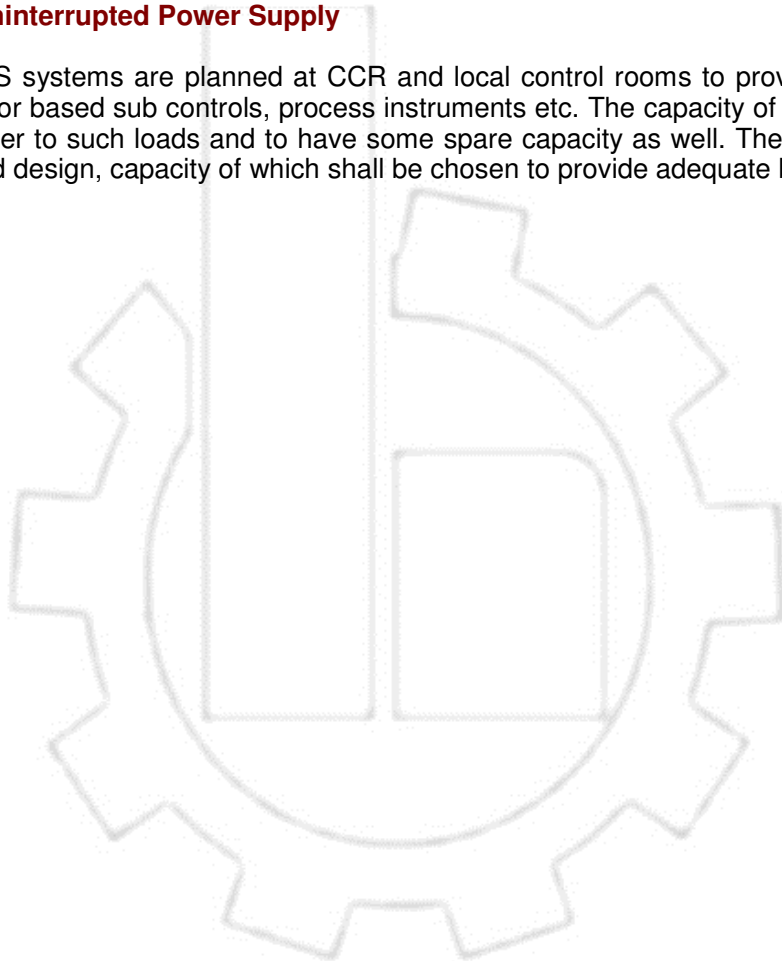
Radio Communication system for stacker reclaimer operations shall also be provided.

5.13.4 Fire Alarm and Fire Detection System

Fire detection of fires in electrical buildings, cable cellars, switchgear rooms and control rooms etc., suitable designed detectors shall be installed. Multizone type fire alarm panel shall be deployed for audio-visual alarm.

5.13.5 Uninterrupted Power Supply

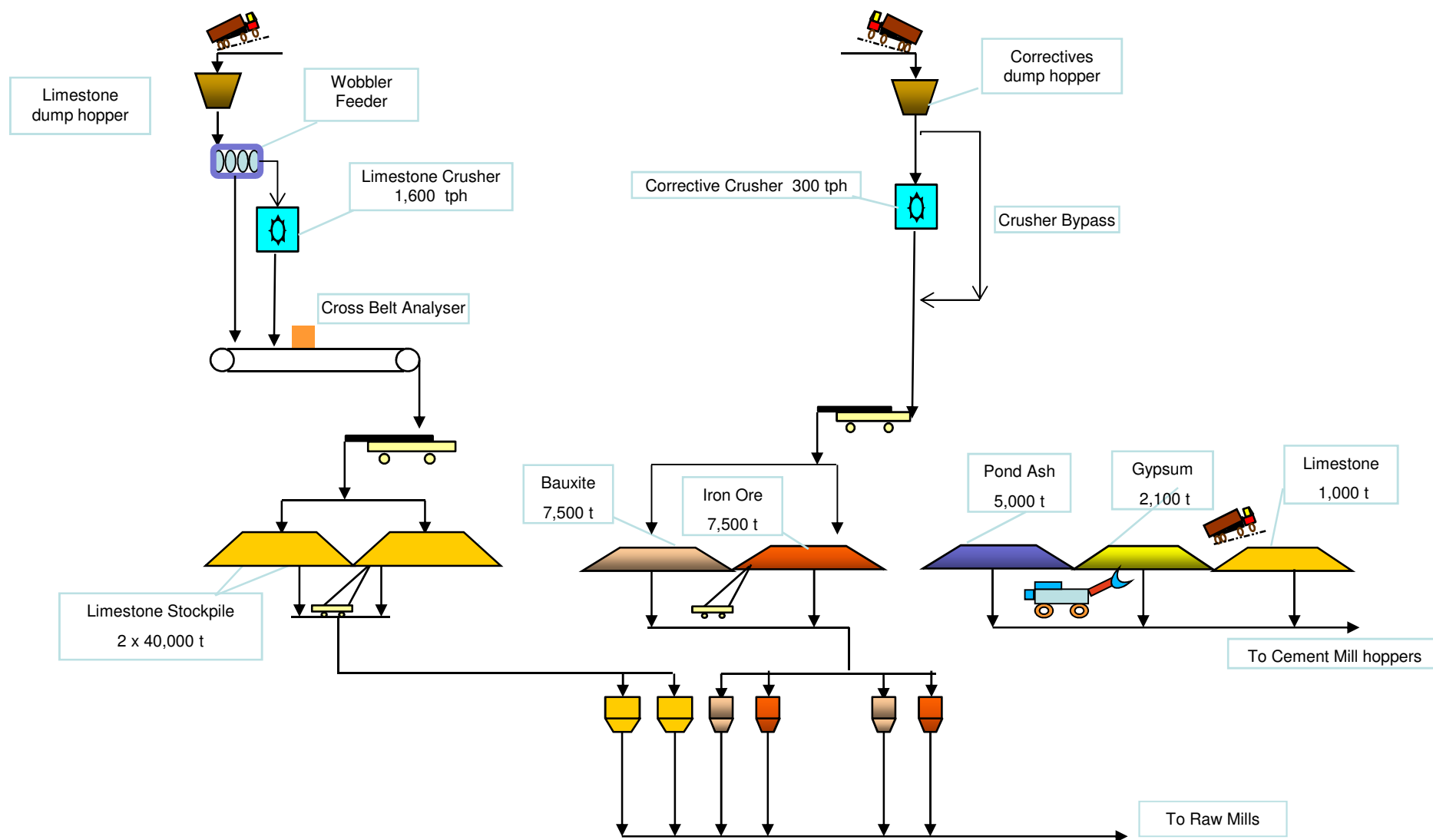
Separate UPS systems are planned at CCR and local control rooms to provide power to microprocessor based sub controls, process instruments etc. The capacity of UPS shall be chosen to cater to such loads and to have some spare capacity as well. The battery bank shall be Ni-Cd design, capacity of which shall be chosen to provide adequate backup time.





MATERIAL FLOW DIAGRAM - IU

Annexure 5A.1

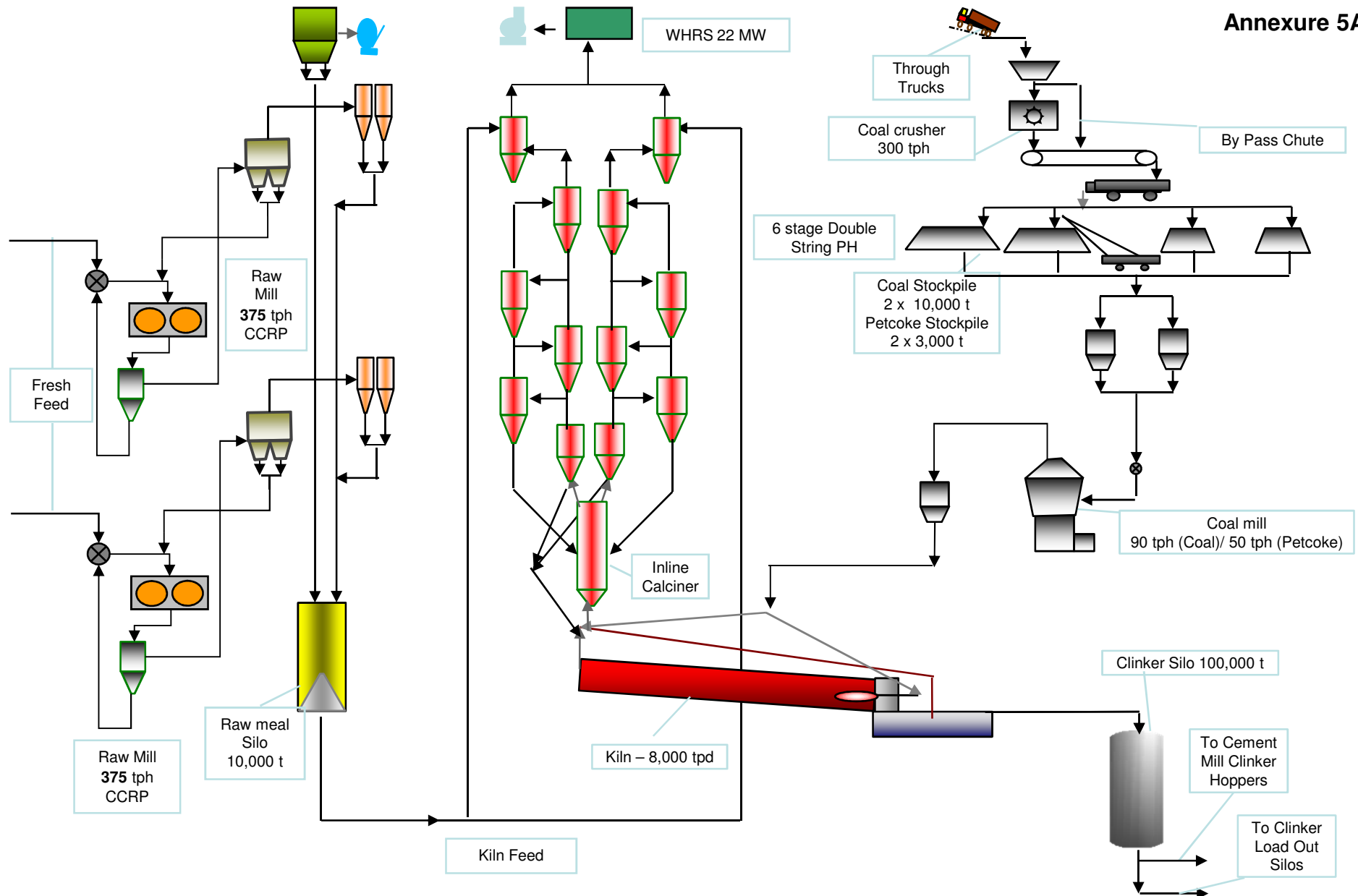




TEFR for a Greenfield Integrated Cement Plant in Panna, Madhya Pradesh
Jaykaycem (Central) Limited



Annexure 5A.1

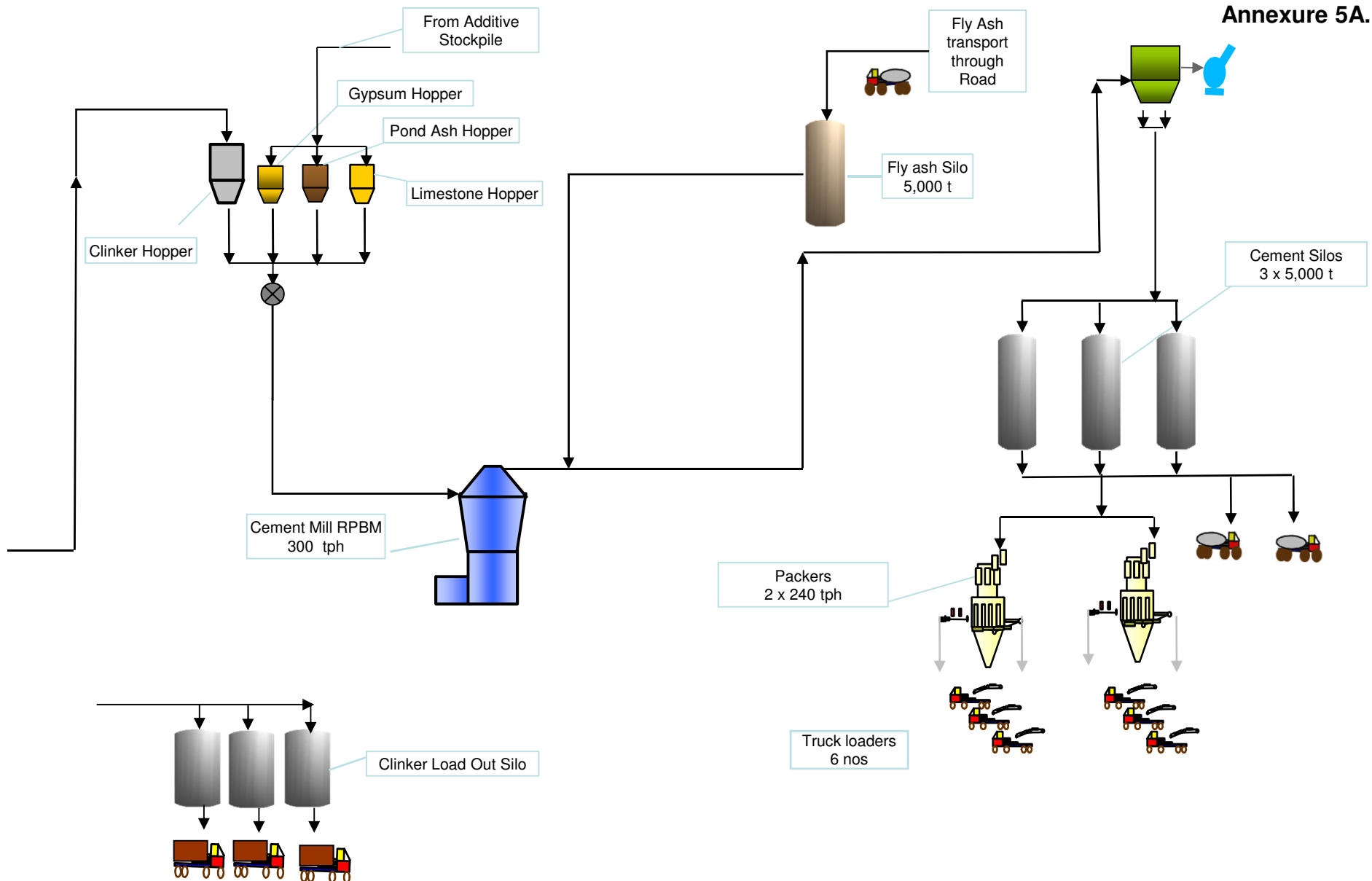




TEFR for a Greenfield Integrated Cement Plant in Panna, Madhya Pradesh
Jaykaycem (Central) Limited



Annexure 5A.1





CAPACITIES OF MAJOR EQUIPMENT & STORAGES - IU

Operation	Equipment/ Storage	Unit	Basis	Required Capacity	Recommended Capacity
Raw Material Preparation	Limestone crusher	tph	Clinker capacity per day x Clinkerisation factor x (% in raw mix/100) x ((100- % moisture in dry limestone)/(100- % moisture in limestone feed)) x (1/(1-% loss/100)) x Design safety factor x Kiln operating days per week/working hrs per week	1,656	1,600 (25% screening by wobbler)
	Limestone Storage	t	Clinker capacity per day x Clinkerisation factor x (% in raw mix/100) x (100-moisture in dry limestone)/(100-moisture in limestone feed) x (1/(1-% loss/100)) x Storage norms	37,025	2 x 40,000
	Corrective Crusher	tph	Clinker capacity per day x Clinkerisation factor x material% in raw mix x (100-%moisture in dry material)/(100- %moisture in feed material) x (1/(1-% loss/100)) x Design safety factor x kiln operating days per week/ working hrs per week	55	300
	Bauxite storage	t	Clinker capacity per day x Clinkerisation factor x material % in raw mix x (100-moisture in dry material)/(100-moisture in feed material) x (1/(1-% loss/100)) x Storage norms	4,762	7,500
	Iron Ore storage	t	Clinker capacity per day x Clinkerisation factor x material % in raw mix x (100-moisture in dry material)/(100-moisture in feed material) x (1/(1-% loss/100)) x Storage norms	2,324	7,500
	Raw mill (CCRP)	tph	Clinker Capacity per day x clinkerisation factor x (100 - % moisture in dry)/(100 - % moisture in feed)x Design safety factor/ mill run hrs per day	688	2 x 375
	Raw meal storage	t	Clinker Capacity per day x clinkerisation factor x Storage norms	25,886	10,000
Pyro Processing	Rotary kiln	tpd	Clinker Capacity per day	8,000	8,000
	Clinker cooler	tpd	Clinker Capacity per day	8,000	8,000
	Clinker storage	t	Clinker capacity per day x storage norms	80,000	100,000
	Coal crusher	tph	(Clinker capacity tpd x Sp heat cons / NCV) x (100- %moisture in dry coal)/(100-%moisture in feed coal) x (1/(1-% loss/100)) x (kiln operating days per week/ working hrs per week) x Design safety factor	166	300
	Pet Coke stockpile	t	(Clinker capacity tpd x Sp heat cons / NCV) x (100- %moisture in dry coal)/(100-%moisture in feed coal) x (1/(1-% loss/100) x storage norms x Fraction Used	2,333	2 x 3,000
	Coal stockpile	t	(Clinker capacity tpd x Sp heat cons / NCV) x (100- %moisture in dry coal)/(100-%moisture in feed coal) x (1/(1-% loss/100) x storage norms x Fraction Used	8,121	2 x 10,000
	Coal mill (VRM)	tph	Clinker capacity in tpd x (Sp heat cons / NCV of fuel) x ((100- % moisture in dry coal)/(100- %moisture in fine coal)) x Design safety factor/ Mill run hours per day	78	90 (Coal)/ 50 (Petcoke)
Clinker Grinding	Gypsum storage	t	(Cement production tpa/(annual working dpa) x (% gypsum in product & raw mix/100) x (100-moisture in dry gypsum)/(100-moisture in feed fypsum) x (1/(1-% dust loss/100)) x Storage norms	2,522	2,100
	Limestone storage	t	(OPC production tpa/(annual working dpa) x (% Limestone in product /100) x (100-moisture in dry limestone)/(100-moisture in feed limestone) x (1/(1-% dust loss/100)) x Storage norms	387	1,000
	Fly ash storage	t	(PPC production per annum/ annual working days) x % fly ash in product x (100-moisture in dry fly ash)/(100-moisture in fly ash) x (1/(1-% loss/100)) x Storage norms	5,248	5000 Flyash + 5,000 Pond Ash
	Cement grinding (VRM)	tph	(Cement production per annum/ Annual grinding mill hrs) x Design safety factor	332	1 x 300
	Cement silos	t	(Cement production per annum/ working days per annum) x Storage norms	18,182	3 x 5,000 (RCC)
Packing & Despatch	Packing	tph	(Cement production per annum/ Packer's available hrs per annum) x % bagging x Design safety factor	463	2 x 240



SUGGESTED QUALITY CONTROL PLAN FOR SAMPLING AND TESTING OF VARIOUS RAW MATERIALS, INTERMEDIATE PRODUCTS AND FINAL PRODUCT (IU)

Sn	Material	Sampling point	Sampler	Sampling frequency	Control parameters	Remarks
A Quarry						03 samples from each batch at 1 hour frequency to be analysed.
1	Limestone (All types)	Mines	Drill hole dust	From blast holes	Complete chemical analysis	
B Correctives / Additives						
1	Correctives/ Additives/ Fuel	At storage	Manual	From each batch	Complete chemical analysis In case of fuel oil: Moisture, Calorific value, Sulfur	
C Raw material preparation and preblending control						
1	Limestone	Crusher outlet	Auto sampler, CBA	1 hourly, Continuous	Size fraction analysis, Complete chemical analysis, Moisture	
2	Correctives/Additives	Batch	Manually	From each batch, 1 hourly	Size fraction analysis, Moisture	
3	Raw meal	Before raw meal silo	Auto sampler	1 hourly	Residue on 90 and 212 micron sieves, Complete chemical analysis	
				Composite daily sample	Residue on 90 and 212 micron sieves, Complete chemical analysis	
4	Kiln feed	In front of bucket elevator	Auto sampler	1 hourly	Residue on 90 and 212 micron sieves, Complete chemical analysis, Moisture	
				Composite daily sample	Residue on 90 and 212 micron sieves,Complete chemical analysis, LOI, Moisture	
D Pyro processing						
1	Clinker	Cooler outlet	Manual	1 hourly	Litre weight, Free lime	
				1 per shift	Complete chemical analysis, Free lime	
				Composite daily sample	Litre weight, Free lime, Complete chemical analysis	
E Cement						
1	Cement grinding	Mill outlet	Auto sampler	1 hourly	Fineness (Blaine, residues), SO3, Setting time, if necessary	
				Composite daily sample	All physical and chemical testings as per relevent standards	
2	Cement despatch	At silo extraction	Manual	1 per shift	Fineness (Blaine, residues), SO3, Setting time, if necessary	
				Composite daily sample	All physical and chemical testings as per relevent standards	
3	Pilot cement mill (Laboratory mill)	-	Manual	Composite daily sample of clinker + Gypsum	All physical and chemical testings as per standards	

Note :

- Complete chemical analysis covers: CaO, SiO₂, Al₂O₃, Fe₂O₃, MgO, Alkalies (Na₂O & K₂O), SO₃, & Chloride (Cl)
- To carry out the defined complete chemical analysis, it is presumed that plant will have the XRF facility in the laboratory.



CHAPTER-5B : PLANT TECHNICAL CONCEPT (GU)

5.1 PLANT CAPACITY

A clinker Grinding Unit (GU) of **2.0 mio tpa** rated cement production plant capacity has been considered for plant technical concept.

Following operating parameters are envisaged:

- Cement production capacity (rated) : 2.0 mio tpa
- Applicable Standard : IS 1489 (Part-1):2015 for PPC
- Product mix : 100% PPC
- With latest technology and development, the cement grinding units are usually available for 330-345 days per annum for operation. However, for Techno-Economic Report formulation purposes, working days have been considered to be 330 days per annum for cement production. Packing and loading operations have been considered to be 360 days per annum with a view to continuously supply material into the market.

Based on the prevailing product constituent proportions at **JCL**'s existing cement plant, the raw material proportions for the cement manufacturing process considered in the formulation of this Report being:

Cement Type	Component			Product mix proportion	Cement Volume	
	Clinker	Gypsum*	Flyash**		tpd	(mio tpa)
PPC	60%	5%	35%	100%	6,060	2.0

Table 5.1 | Product Mix, Proportion and Cement Volume

* % Addition of gypsum shall depend upon the quality of clinker and purity of gypsum however for sizing of equipment & storages, gypsum addition as per **JCL** suggested parameters has been considered.

** Flyash and pond ash can be added in the cement manufacturing process upto 35% depending upon quality of clinker and flyash procured. **JCL** envisages to utilize a combination of flyash and pond ash upto 35%. The same has been considered for the purpose of the Report formulation. Flyash and pond ash shall comply with requirement stipulated in IS:3812 and other relevant BIS codes of practice.

The sizing of main machinery and equipment, in this report, has been done considering the above parameters.

5.2 TECHNICAL GUIDELINES

- Choice of process and main machinery best fitting the prevailing circumstances
- Layout and design appropriate for the site conditions including:
 - Geography and topography
 - Climate



- Standardization
 - Future expansion
 - Skill levels and training of personnel
- Flexibility for future plant development and expansion, cement additives and product variations
- Low investment cost
- Low production cost based on:
- Selecting efficient, reliable and well proven equipment with:
 - ÷ Low electrical energy consumption
 - ÷ High availability
 - ÷ Low maintenance demand
 - High degree of mechanization and process control automation
 - ÷ Balance mass flow
 - ÷ Adequate equipment capacities
 - ÷ Sufficient storage volumes
 - Ease of maintenance
 - ÷ Adequate maintenance access and hoisting facilities
 - ÷ Optimised layout
 - Environmental protection measures in accordance with applicable national/ international norms and standards i.e.,
 - ÷ Maximum dust emissions in cleaned exhaust gas envisaged to be < 20 mg/Nm³
 - ÷ Noise level below limits set forth by international standards
 - ÷ Health and safe workplace by selecting equipment with zero risk to the employees thus meeting targets set for lost time due to accidents and injuries
 - ÷ Reliance as far as possible on domestic services, contractors, material and equipment supply

The above objectives are partly interrelated and conflicting, thus priority shall be given to the most cost-efficient solution incorporating the trends and developments in the internationally operating cement industry, which are considered to be representative in this field.

Specific Electrical Energy Consumption

Estimated specific power consumption: ~**32 kWh/t Cement** for PPC @3,600 Blaine

Plant Selection & Concept



The plant technical concept conceptualizes use of modern energy efficient and environment friendly material transport, handling, storage, grinding, packing and dispatch systems. The core grinding circuit is envisaged to constitute of inbound material unloading and handling through bulk receiving units with truck tipping systems; optimized and just-sufficient material storages; vertical roller mill for grinding; rotary packing machines with truck & bulk loading systems, and a suitable hot gas generator for moisture mitigation and mill operations. The plant technical concept envisages to have suitable and adequate infrastructure along with stipulated green belt provisions.

5.3 CAPACITY OF MAIN MACHINERY AND STORAGES

The main machinery and storages have been sized in accordance with operating norms, local conditions for operation of plant coupled with **HOLTEC's** experience for similar capacity plants and specific requirements of **JCL**.

The operating hours and safety factor considered for arriving at the capacity of plant and machinery is given in **Table 5.2** below:

Sn	Department	Operating			Design/Safety Factor
		Hrs/Day	Days/Year	Hrs/Year	
1	Cement mill	21	330	6,930	1.05 - 1.10
2	Packer	15	360	5,400	1.20 - 1.25

Table 5.2 | Operating hours and safety factors for plant & machinery

The provision of storages varies from plant to plant, depending upon the following:

- Lead distance of respective sources of raw/blended material from the grinding unit
- Ownership of source, i.e., whether captive or purchased
- Transport, handling and regulatory guidelines or specifications
- Sourcing and landed cost of respective resources, along with its general demand-supply scenario in the region
- Future expansion provisions
- Operators' comfort
- Inventory cost, working capital & overall plant financial considerations
- Seasonality

JCL plans to have the following storage capacity provisions for the major material:

Sn	Raw Material	Storage days' range
1	Clinker	6 - 7
2	Gypsum	6 - 7
3	Fly ash & Pond ash	3 – 4 (both, combined)
4	Cement #	1.5 - 2
5	Coal (for hot air generator)	6 - 7



Table 5.3 | Envisaged range of Storages Days for major raw material

(#) JCL planned capacity (Though suggested to plan higher capacity main silos rather than now considered 2x5,000 t)

The moisture content considered in the raw materials at the time of feed to the cement mill is tabulated in **Table 5.4** below:

Sn	Raw Material	Approx. Moisture content on as received basis	Desired Moisture content at Mill / HAG feed point
1	Gypsum	Upto 15%	< 8%
2	Flyash	Upto 2%	< 1%
3	Pond ash	Upto 25%	< 10%
4	Clinker	Upto 2%	< 1%
5	Coal	Upto 15%	< 10%

Table 5.4 | Approx. Moisture content in raw materials

5.4 PLANT SYSTEMS

The estimated and/or JCL envisioned major equipment and storage capacities are in Table 5.6 hereunder:

Type	Equipment/Storage	Unit	Capacity #	Remarks, if any
Major Equipment	Cement Mill	tph	1 x 300	Envisaged to be a VRM with suitably sized HAG
	Rotary packers	tph	2 x 240	
	Truck loaders	nos.	2 x 3	
	Bulk loaders	nos.	1	250 tph capacity
Material Storages	Clinker storage	t	1 x 25,000	RCC silo
	Gypsum storage	t	1 x 2,500	Common linear covered shed
	Pond ash storage	t	1 x 2,500	
	Fly ash storage	t	1 x 5,000	RCC silo
	Coal storage	t	1 x 1,000	Linear covered shed
	Cement storage	t	2 x 5,000 & 1 x 1,000	2 nos. RCC silos & 1 no. Steel silo

Rounded-off capacities as envisaged by JCL to cater to their plant's requirements and synergies with other sister plants

Table 5.6 | Envisaged Sizing for Main Equipment and Storages

Few of the afore-mentioned systems have been touched upon in brief to convey the preliminary and basic technical concept in the following sub-sections.



5.4.1 Clinker, Gypsum and Coal | Handling, Transport & Storage

The technical concept envisions receiving clinker, gypsum and coal by 2 nos. of bulk receiving units (BRU) equipped with truck tipplers. The combination system shall have approx. 300tph design capacity bulk receiving unit (box feeder) in conjunction with 100t truck tipping facility.

Adequate de-dusting system shall be provided for dust suppression at the material unloading, transfer points, storages, etc.

Clinker

Unloaded clinker shall be transported to the clinker silo through a set of belt conveyors for stock-storage. Clinker from the silo shall be extracted and transported to the clinker hopper of the cement mill section through a set of discharge gate and belt conveyor. Clinker shall be fed into the mill by weigh feeder system installed beneath the clinker hopper.

The clinker requirement based on specified product mix and proportion works out as approx. **3,640 tpd** without factoring in the transit & handling losses and inherent moisture considerations. **JCL** envisages to have a clinker silo of **25,000 t** capacity, equivalent to about **6 to 7 days** mill requirement.

Gypsum and Coal

Both, gypsum and coal, are planned to be procured in pre-crushed and rightly sized form by trucks. Accordingly, the plant is not envisaging to install any crushing system for the same.

Gypsum and coal shall be manually unloaded and transported from the storage shed to respective hoppers through dump hopper and set of belt conveyor. These two material are envisaged to be reclaimed by payloaders and fed to the conveying feed conveyor via set of ground hoppers mounted suitably over the receiving material transport belt conveyors. Gypsum shall be transported to cement mill hopper, while coal shall separately be conveyed to the HAG.

Stocks of gypsum shall need to be fulfilled efficiently by the plant's material procurement team as the storage at plant shall cater to about 6 to 7 days mill requirement only, while the material is to be sourced from the east-coast of India. Since numerous cement manufacturing plants have regular networks of this mode of gypsum sourcing, maintaining stocks should not be a problem as such, but which shall need efficient planning always.

Environmental control shall be by virtue of having totally closed "material storage shed", bag filters at transfer points and bag filters at all discharge points of conveyors.

5.4.2 Fly ash & Pond ash | Handling, Transport & Storage

The plant envisions to utilize dry fly ash as well as semi-dry pond ash which shall meet the stipulated quality benchmarks in cement manufacturing process. However, since the probable and nearest source of TPS ash is an under construction modern entity, it is envisaged that requisite quantum of dry fly ash shall be available without much requirement of handling semi-dry pond ash.



Fly ash shall be received in the plant through tankers/ bowzers. The dry flyash is envisaged to be pneumatically pumped to the flyash silo for storage, wherefrom, the material shall be fed to the cement mill through a solid flow meter for continuous metering.

Pond ash, whenever available, shall be transported by open self-tipping trucks in semi-dry state, and point-stacked in the earmarked place in the common shed besides gypsum.

The daily flyash requirement based on specified product mix and proportion works out as about 1,940 t without considerations of moisture and handling losses, etc. **JCL** proposes to have an RCC silo of **5,000 t** storage capacity for dry fly ash. has been envisaged equivalent to about 2.5 days mill requirement. Besides dry fly ash, about **2,500 t** of pond ash storage shall also be available for use to the plant, as per storage provisions envisioned in the plant layout and system concept.

Fineness of the flyash is assumed to be around 200-250 m²/kg. The expected moisture in flyash is envisaged to be limited to less than 1% max. Load cells shall be provided for online check weighing/ calibration of solid flow meter.

The quality requirement of flyash required for production of PPC, as per IS 3812 (Part 1): 2003, second revision are as given below in **Table 5.7**:

Parameter	Unit	Value, as per IS 3812 (Part 1): 2003, second revision
Chemical		
LOI	%	5, max
SiO ₂	%	35, min
Reactive silica, optional test	%	20, min
R ₂ O ₃ - Fe ₂ O ₃	%	-
Fe ₂ O ₃	%	-
SiO ₂ +Fe ₂ O ₃ +Al ₂ O ₃	%	70, min
CaO	%	-
MgO	%	5.0, max
SO ₃	%	3.0, max
Na ₂ O	%	-
K ₂ O	%	-
Available alkalies as Na ₂ O	%	1.5, max
IR	%	-
Free carbon	%	-
Cl	%	0.05, max
Physical		
Moisture	%	5
Fineness, sieve residue		



Parameter	Unit	Value, as per IS 3812 (Part 1): 2003, second revision
+ 45 micron	%	34.0, max (Wet sieving)
+ 90 micron	%	-
+ 212 micron	%	-
Fineness, Blaine	m ² /kg	320, min
Lime reactivity	MPa	4.5, min
Compressive strength at 28 days	N/mm ²	Not less than 80% of the strength of corresponding plain cement mortar cubes
Autoclave expansion, max.	%	0.8, max
Drying shrinkage, max.	%	-

Table 5.7 | Typical quality of Fly ash suitable for blending with clinker

5.4.3 Cement Grinding System

Cement to be produced = 2.0 mio tpa (~6,060 tpd based on 330 days operation per annum)

To produce 2.0 mio tpa cement based on specified product mix and envisaged product blaine of 3,600 kg/sqcm, the cement mill capacity works out as about 290 tph based on 21 hours per day and 330 days operation, but without considering any design/safety/seasonality margin, the factor for which as per generic cement industry norms is generally considered anywhere between 105% to 115%.

Based on above, JCL proposes to set up a Cement Mill of 300 tph rated capacity for PPC at an average 3,600 Blaine.

Theoretically, a design/safety/seasonality factor of about 105% be available in the grinding circuit, which might restrain the grinding circuit to have relatively higher throughput in time of need unless the mill's average running hours per day are achieved beyond 21 hpd or the annual mill operation days are achieved beyond 330 dpa. This should not be a problem for an efficiently maintained grinding unit of an established cement player in India.

For cement grinding, the following four main alternatives are usually available:

- Vertical Roller Mill (VRM)
- Closed Circuit Ball Mill (CCBM)
- Ball Mill With Roller Press (BMRP)
- Close Circuit Roller Press (CCRP)

Technically, all of these cement grinding options, viz., VRM, CCBM, BMRP and CCRP are acceptable in the cement industry. However, final selection of one of the available options, or their variants thereof, depend upon various factors like Customer's experience, consultant's recommendations, initial as well as operating cost parameters, etc. to name a few. However due to lower specific power consumption, ease of operation, compact layout and high moisture drying capacity, choice of a vertical roller mill (**VRM**) has been considered.



Cement Mill Hoppers (Proportioning Station)

RCC/ Steel hoppers of following capacities are envisaged at the proportioning station:

Sn	Description	Approx. Feed Hopper Capacity (t)	Construction
1	Clinker hopper	1 x 400	RCC/Steel
2	Gypsum hopper	1 x 75	RCC/Steel
3	Pond ash hopper	1 x 150	Steel

Table 5.8 | Indicative Hopper capacity at Cement Mill proportioning station

Cement Grinding Circuit

The brief technical details of the cement grinding system are as follows:

- Cement Mill Bin(s) : RCC/ Steel hoppers for mill system comprising of a 400 t capacity for clinker, a 75 t for additive gypsum, and a 150 t for additive pond ash is proposed. A 50 t feed bin for additive flyash may also be considered.
- Cement Mill Feeding : Weigh-feeders have been considered for extraction of clinker, and gypsum in required proportion under the cement mill hoppers. Weigh feeders shall feed the material on a belt conveyor, which shall feed the material to mill.
- Mill System : The shortlisted **VRM of 300 tph** capacity by **JCL** shall be designed with high grinding efficiency. VRM shall be equipped with the new generation high efficiency separator. A bucket elevator for external material circulation shall be provided. The external circulation system shall be equipped with bin for reject tramp metal and shall also be used for calibration of weigh feeders. The reject bin shall have controlled material extraction. The VRM shall be designed for low-pressure drop of the mill and low power consumption. The mill shall be equipped with planetary gearbox.
- Mill exhaust gas shall be transported to Baghouse and cleaned gas from Baghouse filter shall be transported by Baghouse filter fan to the stack.
- Product Collection : Material (product) collected at the bottom of bag house shall be transported to the cement storage silos with the help of bucket elevator and air slides.

5.4.4 Hot Air Generator

A coal fired hot air generator (HAG), also commonly known as hot gas combustor generator (HGG), is envisaged to be deployed for drying of raw material as well for an auxiliary to the cement mill. Suitable quality of coal shall be transported by road to plant site through trucks and shall be stacked in the allocated storage yard nearby gypsum



storage area. The approximate coal requirement for the HAG is envisioned to be around 8 tph by **JCL** based on material properties and ongoing discussions with the equipment & system suppliers.

5.4.5 Cement Storage

Cement from the cement grinding section shall be transported to the storage silos by a system of air slides and bucket elevator. The cement silos shall be designed as mass-flow silos with inverted cones at the bottom and aerated extraction system and de-dusting of the silo and cone.

JCL intends to set up 2 nos. of 5,000 t each RCC silos for storing cement. In addition, and a 1,000 to 2,000 t steel silo is also envisaged to be set up in near future, and has been considered as part of the capex estimate in this report for provisioning purposes.

This total cement storage capacity, theoretically, works out to just about 2 days of mill output when running for 21 hpd average. To meet the BIS stipulations and/or guidelines of being able to ensure 3 days of stock on cement of any particular batch, **JCL** envisions to have the stock of any particular batch in a mix of silo(s), transit warehouse and/or their main channel partners. **JCL** shall need to establish such a system on their own so as to meet the necessary stipulations/guidelines put forth by BIS.

Provision of space has been kept in the layout to take care of any future expansion for having additional cement storage silo(s).

From the silos, cement shall be transported to the packers, with the help of a set of airsides and bucket elevators. Provision for bulk loading shall be provided keeping in view the demand for bulk cement.

5.4.6 Cement Packing, Loading & Dispatch

Cement Silos Extraction

The cement silos shall be designed and constructed of being capable of getting completely emptied by an appropriate design of the silo bottom and the aeration system.

Silo extraction systems with multiple outlets and collecting hoppers shall be provided.

Cement Transport to Packing Plant

Transport of cement from cement silo to packing machines by means air slides and bucket elevators has been considered.



Cement Packing Plant

Rated production capacity of the plant	:	2.0 mio tpa
Working days per annum (average)	:	360 days
Effective working hours in 3 shift operation (average)	:	15 hours per day
Theoretical packing capacity based on 100% bagging and 125% design/seasonality factor	:	463 tph

The packing requirement is envisaged to be met by installing **2 nos. of 240 tph capacity 16 spout twin discharge rotary electronic packers.**

6 nos. truck loaders for loading of bags to road trucks have been considered. From the rotary packer outlet up to loading of the packed bags, suitable system with flat transport belts and diverters has been considered.

For loading of cement in bulkers, **1 no. bulk loader of 250 tph** is considered connected to one of the cement silos or one of the packers, and conveyed onto one of the bays of the packing plant.

The package shall include cement silo equipment, extraction & transport system, packing & truck loading.

5.5 PLANT LAYOUT AND FLOW SHEETS

Based on the technical concept, the plant layout and flow sheet is enclosed:

- Plant layout : Drg. No. 20151-05-GU-1-01
- Flow sheets : Drg. No. 20151-05-GU-1-02 to 20151-05-GU-1-09
- Power Distribution Scheme : Drg. No. 20151-05-GU-1-10
- Control System Configuration : Drg. No. 20151-05-GU-1-11

An indicative Material Flow Diagram (MFD) is furnished under **Annexure 5B.1**

5.6 QUALITY CONTROL

The quality control department at the proposed Cement Grinding Unit shall have the following facilities:

5.6.1 Laboratory

The laboratory shall have the provision of chemical and physical testing facilities for cement, clinker, gypsum, fly ash, pond ash, etc.



For chemical analysis

Bench Top X-Ray Fluorescence (XRF)

Cement is a blend of several minerals. It is critical to control the elemental composition to control properties like strength, setting time and colour. For this purpose, a bench top XRF is proposed to be used to analyze incoming material, and finally finished cement.

Conventional, Chemical analysis equipment

For physical analysis

Facilities/ apparatuses shall be provided for testing physical properties like sieve analysis, setting time, soundness, fineness, CCS, grindability, moisture content, lime reactivity & drying shrinkage, etc.

Particle Size Distribution (PSD)

For determining the particle size distribution of cement, etc. a laser diffraction type PSD analyzer shall be installed having typical particle size range of 0.3 mm - 400 micron.

5.6.2 Quality Control

To produce good quality cement, it is imperative that sampling & testing of various raw materials, in-process materials and the final product is carried out regularly at the required intervals for taking corrective action timely.

To ensure consistent product quality and to permit the trouble free and cost-effective operation, the quality control plan for sampling & testing of various raw materials, in-process materials and the final product is given in Table below.

While proposing the methods and procedures for quality control, the following aspects have been taken into account:

- Requirements and norms, particularly in cement testing
- Corrective measures to be undertaken as quickly as possible in the process operation
- Desired degree of automation
- Available raw materials and process equipment

Sn	Material	Sampling point	Transport To Lab	Sampling frequency	Control parameters
1.0	Raw Materials				
1.1	Additives	Before feeding to the stockpiles	Manual	2 Hourly	Size fraction analysis, Complete chemical analysis.
1.2	Clinker	Before feeding to the	Manual	1 hourly	Complete chemical analysis, free lime, LSF, SM and AM.



Sn	Material	Sampling point	Transport To Lab	Sampling frequency	Control parameters
		stockpiles			
2.0	Cement				
2.1	Cement grinding	Silo feed elevator	Manual	Once in 8 hours	Fineness, complete chemical analysis and setting time
			Composite daily sample		All physical and chemical testing, as per requisite standards
2.2	Cement dispatch	At silo extraction	Manual	1 hourly	As stipulated in the requisite standard
			Composite daily sample		As stipulated in the requisite standard
2.3	Lab cement sample (Pilot cement mill)	-	Composite daily sample of clinker + Gypsum		As stipulated in the requisite standard

Table 5.9 | Broad Quality Control measures

5.7 UTILITY SYSTEMS

5.7.1 Power System

This part has been detailed in **para 5.11** (Electrical Engineering) of this section.

5.7.2 Water Supply

Water is required for equipment cooling, drinking, sanitation, horticulture, etc. The water demand is estimated as following:

Area / Department	Qty (m ³ /day)
Cement grinding unit (Plant operations)	250 to 260
Horticulture	25 to 35
Drinking & Sanitation	15 to 20
Indicative total requirement	290 to 315

Table 5.10 | Indicative water requirement

JCL proposes to draw and meet the requisite water requirement from ground water resources in conjunction with adopted rainwater harvesting measures. Recharging of ground water by rainwater harvesting is envisaged. All necessary permissions and approvals for utilizing ground water must be obtained beforehand.

Depending upon the quality, water shall be treated to remove impurities and minerals to make it suitable for plant use. A suitably designed water treatment system is envisaged to be installed. Water shall be stored in a combination of underground and overhead tanks. For plant equipment, water shall be re-circulated after cooling to avoid any wastage and only losses shall be made up from fresh water.



The water distribution system shall include:

- Process Water Circuit
- Cooling water (required for machine cooling)
- Make-up water shall be provided while re-circulating water shall be in a close loop
- Potable Water (for drinking, etc.)

Water Treatment, Storage and Distribution System

The water storage and distribution system at the cement grinding plant shall essentially be designed to fulfill requirements of plant process and cooling, Firefighting system, Potable drinking water supply to various locations in plant premises, Water supply for sanitation purpose, Horticulture and Cleaning etc.

5.7.3 Compressed Air Supply

Compressed air is required mainly for dust collection equipment and operation of pneumatic valves. Blowers shall be used for aeration of silos.

Centralized compressor room(s) are proposed for the Cement Grinding Unit. Blowers may be suitably accommodated under buildings/ silos near points of utility.

5.7.4 Central Control Room (CCR)

A CCR building is envisaged to be constructed which shall primarily have centralized controls for the operation of the grinding unit. It is envisaged that the envisaged future expansion of the GU shall also be catered to from the same CCR.

The CCR building shall have some of the key offices of Unit Head besides few head of departments of major sections of the unit as well.

5.7.5 Fire Fighting System

A complete firefighting system shall be provided comprising of the following:

- A suitable high-pressure system of fire hydrants consisting of suitable number of fire hydrants.
- Heavy-duty ABC powder type fire extinguishers shall be hung at particularly important electrical equipment areas.
- Portable CO₂ extinguishers shall be provided throughout the plant.

5.7.6 Auxiliary Infrastructural Facilities

Cranes, Monorails & Pulley Blocks

Adequately sized maintenance cranes/ hoists, monorails and pulley blocks are envisaged to be provided at all suitable locations for ease of maintenance and operation.



Common Building for Offices (Technical, Administrative, Logistics, Canteen, etc.)

An adequately sized common building to house various functional offices and utilities. The building shall house the technical office, administrative office, logistics & dispatch office, besides offices for human resource, industrial relations, corporate social responsibility, liaisoning, etc. The building shall also have the executive canteen and the first-aid centre too. The physical and chemical laboratory shall either be housed in this common building or in the CCR.

General Store

A store building shall be constructed for storing tools, spare parts, consumables, etc., which shall have provision of an open and/or semi-covered yard also alongwith for storing some of the bigger sized machinery, cable drums, construction materials, etc.

Time and Security Office

At the entrance of the plant, a time office and a security office shall be constructed.

Dispensary

A small dispensary with first aid facilities shall be provided in the common building housing administrative and other offices itself.

Weigh Bridges

Three to four nos. of electronic weighbridges for incoming raw material and for cement dispatches are envisaged. One no. inline weigh bridge may also be provisioned for bulk loading of cement into the bulkers.

Bags Godown

Provision of a bags godown is envisaged to be furnished in the packing plant and truck loading structure itself.

Drainage

Necessary drainage network shall be provided being a mix of hume pipes and open cut drain sections.

Parking Space

Adequate parking space shall be provided in the plant premises for the office staffs' light motor vehicles (LMVs) as well as the trucks on-call waiting for their turn to get loaded with cement dispatches.

Residential Infrastructure

Hamirpur city and its suburbs are within approachable distance from the proposed GU location, and as such, a dedicated colony is not envisaged as part of this project. Plant personnel are envisaged to reside in habitable localities in reasonable vicinity to the plant.



5.8 ENVIRONMENT PROTECTION

The plant design shall be carried out taking cognizance of prevalent environmental laws and the importance to maintain environmental standards.

Protection from dust pollution

Efficient collection of dust at sources, their dedusting with efficient filters and recycling the dust to the process is the prime objective.

The Cement Grinding Unit shall be provided with bag filters capable to contain the dust content in the exhaust air to less than 20 mg/ Nm³.

Sewage and effluent treatment

The proposed plant shall have a provision of a sewerage system for the collection and disposal of sewage from the premises. Individual soak pits are envisaged for handling, storage and evacuation of the human waste.

There are no process effluents in the cement grinding plant.

Plant landscape and green belt

Due care has to be taken to keep-up the natural settings/ greenery in and around the plant. For the purpose of landscaping, it is intended to provide a green belt with trees and bushes wherever possible in the Cement Grinding Unit.

Pollution control equipment

As described in this chapter, the installation of following pollution control equipment is envisaged:

- Cement mill bag filter
- Bag filters for dedusting of storages and auxiliaries at different sections
- Bag filters for dedusting of all the feeding/ transfer points

Pollution monitoring equipment

- Offline dust emission monitoring kit

Noise Emissions

All equipment considered in technical concept shall be designed to operate within the prescribed noise levels as defined by relevant standards. Where necessary special sound enclosures shall be considered.

Roads

All roads and paved places planned for traffic movement within the proposed GU are envisaged to have rolled and compacted subsurface. A mix of bituminous and concrete



paved surfaces is envisaged to be provided in order to reduce dust generation and protect the roads against damage.

Rainwater Harvesting

JCL shall practice rainwater harvesting at priority level. The plant shall have the required network of pipes to collect the rainwater from the plant building area. The collected rainwater shall be diverted to the proposed rainwater harvesting pits for recharging the ground water.

5.9 CIVIL ENGINEERING CONSIDERATIONS

This section briefly outlines the civil engineering considerations relating to the prevailing site conditions and indicative design criteria broadly conceptualized for this project based on the envisaged technical concept pertaining to the proposed Grinding Unit.

5.9.1 Site Conditions

Topography

The overall land extents for the proposed GU can be broadly categorized as flat. The land is mainly private agricultural one, bears a layer of soil cover that is organic in nature, which shall need to be removed. The demarcated plant area shall need to be developed by removing the top layer of organic soil cover.

It is suggested to carry out the necessary site-specific investigation studies, viz., topographic survey, geotechnical & hydrological investigations, etc. to ascertain site-specific details together with quantum of site preparation & development works.

A nominal lumpsum provision for site grading and levelling has been considered in the cost estimate.

Subsurface Conditions

Site-specific subsurface investigations have not been carried out yet. Based on the information gathered during the site visit, it is inferred that relatively moderate-to-dense strata shall be encountered at moderate depths of the order of 3 to 7m below the average ground level. However, the exact spectrum of the sub-surface shall be known only upon conducting the detailed soil investigation studies.

For the purpose of cost estimates, a safe bearing capacity (SBC) of the order of 60 t/sqm has been assumed at depth of about 3-5m below the average design/finish ground level at the Plant-site. Foundations shall be provided at least 1.5 m below ground level on well-prepared hard soil/ disintegrated rock type sub-surface. The type of foundations shall however depend upon the loading intensity configuration of the loading points at foundation level. Depending upon the loading intensity, isolated/ combined/ strap/ raft foundations shall be considered for respective structures.

On account of paucity of site-specific investigative details, provision of pile foundations has not been considered for any of the structure or building at this stage of Report formulation. However, in case the geotechnical investigations recommend use of pile foundations, the Civil works related capex may increase by about 10 to 20% depending upon the design



criteria that would entail details like numbers, types, depths, diameter and related details of pile foundations.

Seismicity

Based on guidelines of Indian Standard IS 1893 (Part I), the proposed plant site area falls in the Seismic Zone III. Corresponding zone factor should be duly factored in during detailed engineering stage and the structures be designed accordingly.

5.9.2 Design Criteria

General Design Principle

In general, the civil design and construction of structures in the plant have to meet the load data conditions and functional requirement as stipulated by the main machinery suppliers.

As a matter of practice, most of the structures and buildings are envisaged to be primarily designed and constructed in reinforced cement concrete (RCC) with suitable masonry and/or metal sheet roofing and cladding. Extensive structural steel usage shall mainly be limited to sheds, conveyor galleries, duct supports and working platforms or where flexibility of stage-wise constructions is constrained. All the silos, except clinker silo, are being envisaged as non-prestressed silos.

Emphasis has also been laid to keep the civil cost optimized to the extent possible. As such, the plant structures, non-plant & office buildings are envisaged to be built following the 'moderate-finish-low-cost model' of construction practices. The linear storages are envisaged to be light-weighted gantries primarily with corrugated galvanized iron roofing and suitable cladding/ louvers.

Infrastructural elements like the roads, drains, etc. are envisaged to be of all-weather, but moderate cost type constructions.

Loads & Impacts

All the relevant loading and impact details like wind load, earthquake load & level, static loads, loads from machinery & equipment, dynamic loads, hoist loads, other calculated loads, etc. shall be duly taken into consideration during the detailed engineering process.

Codes of Practice and Standards

Indian Standards shall be used for all design and detailing work unless otherwise specified.

5.9.3 General Construction Methodology

Earthworks

The site preparation and development works shall predominantly be carried out by mechanized means taking into cognizance the inputs from the topographic survey, design benchmarks and overall plant design principle & layout.

For earthworks relating to buildings and structures, the excavation levels shall be requirement specific as per design and should have additional adequate working space for construction purpose. Mechanized means shall be employed for most of the excavation



purposes barring excavation towards final level-dressing of the foundations, or small footings, or any other requirement-specific condition, etc. Any excavation, if inadvertently is carried out below the required design level(s) under any circumstances, shall be filled and made good with plain cement concrete fill.

For backfilling, good quality excavation products of soil can be used after objectionable materials are removed from therein. Back filling material should be free of like bigger sized boulders, organic materials, clay balls, any kind of constructional or non-constructional debris, and other objectionable inorganic matter, etc. Backfilling should be done in layers of not more than maximum 300 mm and each layer should be well watered and compacted by mechanized and manual means. The boundary of any compacted back-fill material shall extend at least 1.00 m (0.50 m from each side) beyond the foundation footprint.

Disposal of surplus earth, if any, shall be done taking into account the needful permissions, agreements, etc. from local authorities/ bodies/ etc., as the case may be.

Substructure & Superstructure elements

The substructure and superstructure elements shall primarily be guided by the overall plant design principle together with other necessary design elements like individual structure's/ building's design calculations, site conditions, architectural/aesthetic inputs, etc.

Based on the assumptions and considerations adopted for the formulation of this Report, isolated, combined and/ or raft foundations of shallow-to-moderate depth are envisaged for the plant structures and buildings in general.

The depth and size of the foundations of the respective plant and non-plant structures shall however depend upon numerous design parameters like loading data and conditions; type & height of structure; wind, earthquake and other related forces acting upon various structure elements. In general, the dimensions of isolated footings should at least be 300 mm more than that of RCC column cross-sectional dimensions from all sides. The minimum size of RC Footing shall be 1,000 mm and the thickness should not be less than either 400 mm or the minimum acting column dimension.

The structures shall be framed (tied) with rigid tie beams in RCC and/or structural steel to connect isolated footings. Basement or tunnels walls must be designed with reinforced concrete and flexible joints to be provided in the tunnel footing connections. The reinforced concrete skeleton buildings shall have plain cement concrete floors over well-compacted sub-base for ground floors and shall generally be 150 mm thick. The floor at higher levels shall either be of RCC or structural steel depending upon the design criteria and other work progress related factors.

Finishing and Aesthetics

The proposed plant shall have all the basic industry-prevailing facilities and infrastructure. The aesthetics and type of finishes for the superstructure are envisaged to be contemporary but of moderate scale so as to keep the project cost optimized

Health, Safety and Environment (HSE)

All necessary measures towards maintaining high standards of Health, Safety and Environment during entire construction period must be enforced at site, and adhered to by the contracting agencies.



5.9.4 Civil Cost Estimates

Based on the conceptualized plant technical concept, interactive exchange with **JCL** personnel, together with HOLTEC database, the civil cost estimates have been estimated for the purpose of carrying out the project financial analysis.

Based on available inputs & data at this stage of the project conceptualization together with logically foreseeable implementation scenario for the project, the unit rates for the civil works have been considered. Average unit rates for major work items that are envisaged to include discounted (special) landed cost of building material, contractors' costs and overheads, allied taxes on the building material, etc. are tabulated below:

Sn	Item of work	Unit	Unit Rate (Rs.)
1	Earthworks (ordinary soils)	m ³	350
2	Earthworks (hard & dense soils)	m ³	750
3	Earthworks (soft rock & hard soils)	m ³	1,400
4	Earthworks (hard rocks)	m ³	2,000
5	PCC M10	m ³	4,450
6	PCC M15	m ³	4,800
7	RCC M20	m ³	5,600
8	RCC M25	m ³	6,350
9	RCC M30	m ³	7,150
10	RCC M35 / M40	m ³	7,650
11	Plain formwork	m ²	750
12	Slip formwork & Special formwork	m ²	1,150
13	Reinforcement steel work	t	55,000
14	Structural steel work	t	84,000
15	Sheeting work (plain+colour coated)	m ²	1,450
16	Brick+Block masonry	m ³	6,650
17	Stone masonry	m ³	6,350

Table 5.11 | Unit Rates of major complete work items (material + labour rates)

The item rates mentioned above are the average rates considered for the complete item works and are inclusive of the basic material cost. These rates are inclusive of respective construction material costs and the GST component on the purchase of the construction material. However, these unit rates do not include the GST component on the "Contractors' Services" part, which are capitalized separately in the civil cost estimate at an average rate of 18% (on the 40% component of the overall estimated civil cost).

The average basic cost of the major materials considered for costing purpose, on as landed at plant site gate basis (material cost+taxes+freight), are as tabulated below:



Sn	Material base price	Unit Rate (Rs./ t)
1	Cement (at special discounted price from JCL plants)	5,000
2	Reinforcement steel (various types & diameters)	44,500 to 47,500
3	Structural steel (various types & sections)	45,000 to 49,500

Table 5.12 | Average basic cost of major three building materials

5.10 ELECTRICAL ENGINEERING

5.10.1 Power Requirement and Source

Based on estimated specific power consumption of **approx. 32 kWh/t Cement**, the maximum power demand for the GU is estimated as **12 MW**, which is envisaged to be met from the grid substation of U.P. Power Transmission Corporation Limited (UPPTCL).

The nearest Power Feeder Station of UPPTCL (132/33kV) is at Sumerpur which is about 6 km aerial distance from the proposed Grinding Unit.

To meet the emergency power requirement, 1,250 kVA DG set has been envisaged in the investment cost estimate.

5.10.2 Power Distribution

The power at 33 kV shall be brought to Main Receiving Substation in the plant from grid substation of UPPTCL located at Sumerpur and distributed to different process departments as described below:

Medium Voltage (11 kV) Distribution System

The power to plant loads shall be distributed via Load Centers, located close to the electrical loads in the different process departments.

11 kV has been envisaged to feed the plant HT loads. The single bus switchboards in the load centers shall be fed from the Main Substation.

The power at 11 kV shall be stepped down to 415 V at these load centers through 11/ 0.415 kV distribution transformers and connected to LT switchboards to cater to LT loads of the plant. 11 kV motors shall be fed directly from 11 kV boards located at the respective Load Centers.

Radial system of plant power distribution has been considered as it is economical, safer and allows expansion if needed.

11 kV MV Switch Boards

The MV switchboard shall be provided with lockable handle operated switches with key arrangement such that additional safety is ensured in event of man working over the system.

The MV switchboard and distribution transformers shall be located in the following departmental substations:

- Main Substation



– Cement Mill sub-station

The MV switchboards shall be assembled in a line-up of factory fabricated; metal clad cubicles with draw out type SF₆/ Vacuum circuit breakers. Each switch gear shall have necessary metering, control, and its operating status feedback (i.e., “Off”, “On”, Test) to suit the application through multifunction composite microprocessor based numeric relay having serial connection with the Automation system.

Low Voltage (415 V) Distribution System

The power supply at 11 kV shall be stepped down to 415 V by the distribution transformers at the departmental substations and fed to the Low Voltage (LV) loads of the respective sections through the LV Distribution boards and departmental Motor Control Centres (MCCs). The entire low voltage power distribution system shall be designed to guarantee selective fault isolation and isolating a faulty circuit from the main electrical system. Suitable nomenclature shall be provided to each of MCC sub feeders such that the particular nomenclature shall represent the respective load.

11/ 0.415 kV Distribution Transformers

3 Phase Dyn11 vector group mineral oil filled natural air cooled (ONAN) copper wound distribution transformers complete with off load tap changer and all necessary accessories have been considered to feed the low voltage loads at the respective departmental MCCs.

To attain transformer standardization, the transformers shall have rating of 630 kVA, 1,000 kVA, 1,250 kVA, 1,600 kVA 2,000 kVA and 2,500 kVA. Special transformers for variable speed drives may deviate from above standardization. The transformer capacity shall be selected within above-mentioned sizes and shall not be less than total connected load but include some 20 % spare capacity.

HT & LT terminations for distribution transformers shall be by means of cables of suitable grade & conductor size. Hence, suitable cable terminal box arrangement with copper bus bar extensions and holes for cable terminations by means of termination lugs shall be provided with proper colour code or demarcation for three phases.

Motor Control Centers (MCCs)

Department wise intelligent MCCs controlling a group of interconnected and simultaneously operated loads during the process are envisaged and shall be located in decentralised electrical rooms in the respective departmental substations/ plant buildings.

Each feeder module of the MCCs shall incorporate a mini-processor for serial bus connectivity and shall be connected to the CPU through daisy-chain serial data link. Further, the MCCs shall comprise of all equipment for a safe remote control of the different plant sections and consist of process power feeders only.

The major load bearing and critical function modules in MCC's shall have protection and control functions as per the applicability through microprocessor based numeric relays.

Power Factor Correction

For maintaining a high overall power factor, static power factor improving capacitors of suitable KVAR rating and voltage grades shall be considered.



In the envisaged scheme, suitably sized capacitors shall be directly connected across the stator switch terminals of respective 11 kV MV motors. For compensation of LV loads, multi-step automatically controlled capacitor banks integral to the LV Board or the respective departmental MCCs to improve the power factor to 0.98 or above would be provided.

110V DC System

The control voltage for the MV Switchgears shall be 110 V DC to be obtained from Nickel-Cadmium alkaline batteries and solid-state battery charger. The battery charger panel shall have regulated output and suitable DC distribution board. The battery charger shall have float and boost charging facilities.

5.10.3 Electrical System Component

Drives

The types of drives shall be considered based on following requirements:

- Speed/ torque characteristics of the driven equipment
- Enclosure protection depending on the work environment
- Performance characteristics, i.e., high power factor and efficiency at operating points
- Accuracy and range of speed control required for specific application
- All motors, generally above 300 kW shall be connected at 11 kV

The high torque HT and LT motors having wide range of speed variations should preferably have medium voltage (MV) variable frequency drive for speed control for this, the system shall be taken from reputed manufacturers. The duties of LRS/ GRS and MV drives shall be selected accordingly.

Illumination

An energy efficient illumination scheme for the plant premises shall be provided. LED lighting system to be considered). Adequate lux level shall be maintained for safety and ease of plant operation.

Sufficient numbers of lighting distribution boards are considered for automatic control of lighting fixtures at the various locations of the plant. For powering the street light illumination underground cables of suitable ratings shall be used. Energy saving lamps, luminaries over the sleek lighting poles equally spaced has been considered for the purpose of street lighting.

Cabling

Following type of cables shall be used in the plant:

Power (MV)	: 11 kV (UE) PVC sheathed XLPE insulated AL cables
Power (LV)	: 1.1 kV PVC sheathed XLPE insulated and AL cables
Control	: 1.1 kV PVC sheathed PVC insulated copper cables 1.5 and 2.5 mm ²
Instrumentation	: 1.1 kV screened PVC insulated copper cables, 0.5 and 1.0 mm ²



All the power MV, LV and control cables shall be armoured. Wherever, XLPE cables are used, armouring shall be round wire or strip of GI wire. The cables markers shall be embossed at a distance of 1 meter over the cables for proper identification.

The routing of electrical power and control cables shall be so selected that the parallel running of these cables in the close vicinity with instrumentation cables is avoided otherwise the instrumentation cables are likely to pick up noise/ erratic signals from electrical duty cables causing malfunctioning of instrumentation and controls.

For main cable routing outside plant process buildings Overhead cable gallery has been envisaged. Inside the process buildings the cables shall be routed in the cable trenches or along the columns/ beams.

Earthing/ Lightning Protection

System and Equipment earthing are considered for safety of operating man and machinery as well as for the stability of the electrical system. The MV system shall be earthed through resistance.

Earth continuity conductor shall be run along with major cable routes to provide grounding to the equipment. Tall structures like storage silos shall be protected against lightning by use of horizontal mesh of conductors and vertical spikes. All the lightning rods, lightning mesh wires and down conductors shall be of stranded copper.

A separate electronic earth matting, and network has been considered for DCS and other associated control panels. Each category of earthing system i.e., Electrical, Instrumentation and Lightning protection shall be independent and isolated from each other. This shall be ensured to cater to safety, security and overall protection.

Although, copper is most widely used conducting material for earthing but considering the local conditions, GI strips, flats and plates may be preferred for carrying earth discharge in most beneficial manner.

GI strips/ plates of three times more in cross-sectional area than the prescribed size of copper strips/ plates serve better. GI strips are much more robust, hence long lasting, free from deterioration owing to formation of sulphate and are not prone to pilferage. However, in the case of use of GI plates there may be constrained to dig large size earth pits. Depending upon the terrain and sub soil condition use of GI as the earthing material can be considered.

5.11 CONTROL AND INSTRUMENTATION

Distributed control system comprising of programmable controllers and operator stations with peripherals are considered for remote operation of plant from a central control room.

5.11.1 Plant Control System

For sequential control of drive and supervision of various process variables, distributed microprocessor-based control system has been considered.

An elaborate instrumentation comprising of field sensors, transducers, etc. shall be set up for monitoring of processes.



The Control system envisaged shall incorporate following essential features for safe operation of plant & machinery and provide necessary operating data to evaluate the plant performance and fault monitoring:

- Client/ server configuration for easy configuration and maintenance.
- Programmable controllers for sequence interlocking and automatic closed loop control through PI and PID action.
- Serial bus connectivity for MCC, Drives, Sub-controls and MV Drives.
- Operator stations with colour graphic and alphanumeric display with equipment fault monitoring system and plant remote control.
- Process optimization system to achieve improved process stability.
- An engineering station, which shall provide engineering tools to update PLC, programmes.
- An energy management system for control and monitoring of electrical energy.
- MIS station which shall generate reports and provide process mimics as well.

5.11.2 Process Instrumentation

Necessary field sensors shall be installed to monitor process variables like pressure, temperature, flow, level, speed etc. The sensors shall be linked to Plant Control System through field transmitters/ transducers to display the parameters on Operation Station and exercise the desired controls.

5.11.3 Intercommunication Equipment

Public Address System with paging facility for CCR operator to contact the field operator and vice versa has been considered in order to facilitate plant operations. For administrative purpose and interdepartmental communication, a telephone exchange is considered which shall also supplement the public address system.

5.11.4 Fire Alarm and Detection System

For detection of fires in electrical buildings, cable cellars, switchgear rooms, and control rooms etc., suitable designed detectors shall be installed. Multizone type fire alarm panel shall be deployed for audio-visual alarm.

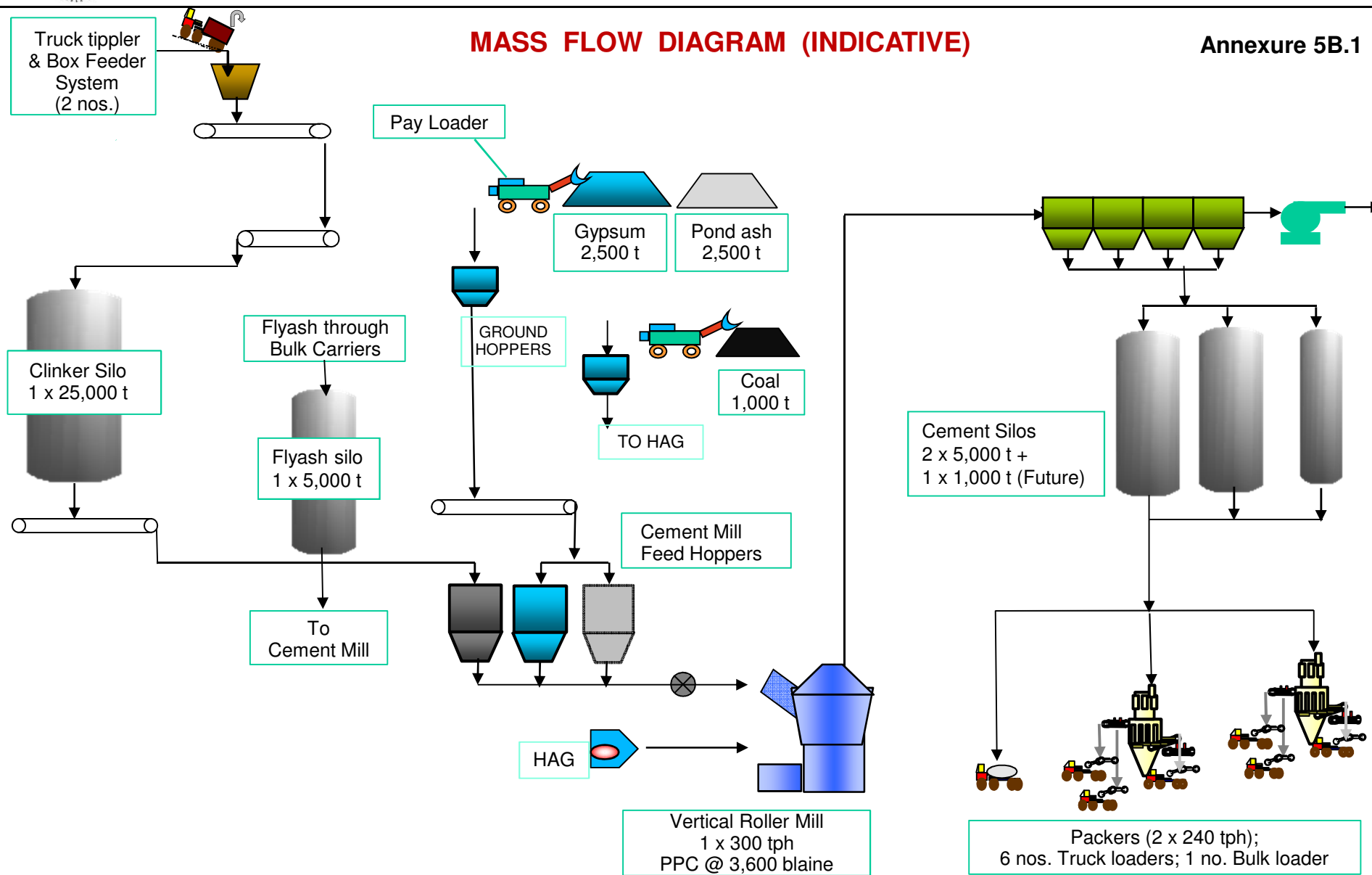
5.11.5 Uninterrupted Power Supply

Each location housing automation equipment shall have its own UPS and shall also provide power to microprocessor-based sub controls, process instruments etc. The capacity of UPS shall be chosen to cater to such loads and to have some spare capacity as well. The battery bank shall be Ni-Cd alkaline type to provide adequate backup time.



MASS FLOW DIAGRAM (INDICATIVE)

Annexure 5B.1





CHAPTER 6A: HUMAN RESOURCES (IU)

6.1 INTRODUCTION

This chapter covers the details of human resources required for this project. The suggested details of human resources have been given separately for the following two phases:

- Project implementation period.
- Plant operation period.

6.2 BASIS

The suggested details of human resources for each period consider the following:

- Project technical concept.
- Smooth and efficient plant operation.
- Effective inter-departmental co-ordination.
- Optimum organization with well defined job responsibility.
- Optimum utilisation of different levels of workmen and supervisory staff.
- Training needs of the personnel, wherever required, will be taken care of by **JCL**.
- Manpower requirement for marketing office (other than plant) staff, have not been included and will be taken care by **JCL**.
- Manpower requirement in certain categories like fitters, welders, khalasis, helpers, peons, canteen staff, guesthouse attendants, etc. can be met through contractor(s).
- Certain activities such as mines operation, WHR, loading unloading, plant cleaning job, packing, security for plant & colony, colony maintenance, etc. may be assigned to specialized agencies/ contractors.
- Unskilled/ semi skilled manpower can be sourced from the local area and skilled manpower shall have to be sourced from outside.

6.3 PROJECT IMPLEMENTATION PERIOD

The total manpower requirements during project implementation are estimated as 65. The details of suggested manpower for this phase are given at **Annexure 6A.1**.

6.4 PLANT OPERATION PERIOD

The total manpower requirements during plant operation period are estimated as 450. The detail of suggested manpower for this phase are given at **Annexure 6A.2**.



6.5 SALARY AND WAGES – IMPLEMENTATION PHASE

As per the prevailing rates of human resources in this area, the average salary and wages during implementation period have been considered as given in **Table 6.1**:

Sn	Category	Nos.	Salary per staff/ p.m. (Rs.)	Total Expenses for 24 months (Rs)
1	Top management	1	750,000	20,250,000
2	Senior management	2	550,000	29,700,000
3	Middle management	13	375,000	131,625,000
4	Specialist/ Engineer/ Officers	21	135,000	76,545,000
5	Supervisors	12	50,000	16,200,000
6	Operators/ Attendants	16	25,000	10,800,000
	TOTAL	65		285,120,000
				28 crores

Table 6.1: Salaries and wages for staff during implementation period

6.6 SALARY AND WAGES – OPERATION PHASE

As per the prevailing rates of human resources in this area, the average salary and wages during implementation period have been considered as given in **Table 6.2**:

Sn	Category	Nos.	Salary per staff/ p.m. (Rs.)	Annual Expenses (Rs)
1	Top management	1	750,000	9,000,000
2	Senior management	3	550,000	19,800,000
3	Middle management	16	375,000	72,000,000
4	Specialist/ Engineer/ Officers	52	135,000	84,240,000
5	Supervisors	40	50,000	24,000,000
6	Operators/ Attendants	164	35,000	68,880,000
7	Workmen/ Labor	174	25,000	52,200,000
	TOTAL	450		330,120,000
				33 crores

Table 6.2: Salaries and wages for staff during operation period



6.7 SUMMARY

A summary of the manpower requirement for the plant are as given below in **Table 6.3**:

Phase	Manpower			Remarks
	General shift	Shifts	Total	
	(A)	(B)	(A + B)	
Implementation Period	65	-	65	Total no. of persons will be 65. Of this, 9 persons may be taken on contract.
Operation Period	125	325	450	Total no. of persons will be 450. Of this, 183 persons may be taken on contract

Table 6.5: Summary of manpower requirement



IMPLEMENTATION PERIOD

Estimated Manpower Requirement

Sn	Department	Manpower	Persons required	Remarks
1	Project	Project head	1	
1.1	Mines	Mines head/	1	
		Engineer/ Geologist	2	
1.2	Technical	Technical head	1	
1.2.1	Mechanical	Manager	2	
		Engineer	3	
1.2.2	Electrical & Instrumentation	Manager	2	
		Engineer	3	
1.2.3	Process	Manager	1	
		Engineer	3	
1.2.4	Quality control	Manager	1	
		Chemist	1	
1.2.5	Civil	Manager	1	
		Engineer	3	
1.3	Commercial	Commercial head	1	
1.3.1	Stores and Purchase	Manager	1	
		Staff	4	
1.3.2	Personal and Administration	Manager	1	
		Officer	1	
		Staff	2	
		Receptionist	1	
1.3.3	EDP	Manager	1	
		Staff	1	
1.3.4	Accounts	Manager	1	
		Officer	1	
		Staff	2	
1.3.5	Security	Officer	2	
		Guards	15	On contract
1.3.6	Dispensary	Doctor	1	
		Staff	2	
1.3.7	Telephone exchange	Operator	1	
1.4	Safety	Officer	2	
Total:			65	Total no. of persons will be 65. Of this, 15 persons may be taken on contract



OPERATION PERIOD

Estimated Manpower Requirement

Sn	Department	Manpower	No. of persons		Remarks
			General shift	Shift	
1	Plant	Unit head (Overall)	1	-	
1.1	Mines				
1.1.1	Executives	Mine Manger (Head)	1	-	
		Mining Engineer (Operation Head)	1	-	
		Mechanical Engineer (Maintenance Head)	1	-	
		Mining Geologist	1	-	
		Mechanical Engineer	1	-	
		Mining Engineer	2	2	
		Surveyor	1	-	
		Blasting Foreman	1	-	
		Mechanical Foreman	-	2	
1.1.2	HEM Operation	Dilling machine operator	-	4	
		Excavator & Loader Operator	-	4	
		Dump Truck Operator	-	16	
		Dozer Operator	-	2	
		Misc operator for rock breaker, etc	-	8	
		Blaster	-	1	
1.1.3	Maintenance Staff	Mechanic	-	4	
		Electrician	-	-	
		Welders	1	-	
		Auto Electrician	-	2	
1.1.4	Workshop	In-Charge	1	-	
		Helpers	-	4	
		Turners	-	2	
		Blacksmith	-	1	



Sn	Department	Manpower	No. of persons		Remarks
			General shift	Shift	
		Hammerman	-	1	
		Sampler	1	-	
1.2	Technical	Technical head	1	-	
1.2.1	Mechanical	Manager	1	-	
		Engineer	2	8	
		Foreman	2	4	
		Draftsman/ designer	-	-	
		Crusher Operator	-	3	
		Crusher Attendant	-	3	
		Fitter	2	6	On Contract
		Utility operator	-	3	On Contract
		Welder	2	3	On Contract
		Workshop	4	-	
		Khalasi	2	3	On Contract
		Loader driver	-	4	
		Dumper driver	2	-	
		Crane operator	-	-	
		Helper	2	6	On Contract
1.2.2	Electrical & Instrumentation	Manager	1	-	
1.2.2.1	Electrical	Engineer	1	4	
		Foreman	1	2	
		Power distribution foreman	1	-	
		Electrician	3	6	On Contract
		Helper	3	6	On Contract
1.2.2.2	Instrumentation	Engineer	1	4	
		Foreman	1	1	
		Mechanic	3	6	
1.2.3	Process & quality control	Manager	1	-	
1.2.3.1	Process	Engineer	1	3	
		CCR operator	-	16	
		Pyro attendant	-	8	
		Mills attendant	-	16	
		Helper	-	12	On Contract
1.2.3.2	Quality control	Manager	1	-	
		Chemist	2	-	



Sn	Department	Manpower	No. of persons		Remarks
			General shift	Shift	
1.2.4	Civil	Analyst	1	4	
		Sampler	1	4	
		Gauger	2	0	
		Manager	1	-	
		Engineer	1	-	
		Masons	2	-	On Contract
		Carpenter	1	-	On Contract
		Plumber	1	-	On Contract
1.2.5	Packing Plant	Manager	1		
		Supervisor	-	4	
		Tally checker	-	4	
		Operator	-	12	On Contract
		Loaders	-	60	On Contract
		Helper/ Diverters	-	16	On Contract
1.2.6	CPP				
1.2.6.1	Management	Manager	1	-	
1.2.6.2	Operation	Engineer	4	-	
		Supervisor	-	4	On Contract
		Operator	-	8	On Contract
1.2.6.3	Maintenance	Engineer	-	3	
		Technicians	-	8	
1.3	Commercial	Commercial head	1	-	
1.3.1	Stores and Purchase	Manager	1	-	
		Officers	1	-	
		Staff	2	-	
1.3.2	Personnel and Administration	Manager	1	-	
		Officer	2	-	
		Staff	2	-	
		Receptionist	1	-	
		Secretaries	2		
1.3.3	EDP	Manager	1	-	
		Staff	2	-	
1.3.4	Excise	Officer	1		
1.3.5	Accounts	Manager	1	-	
		Officer	2	-	
		Staff	3	-	
1.3.6	Security	Officer	1	-	
		Guards	2	9	On Contract



Sn	Department	Manpower	No. of persons		Remarks
			General shift	Shift	
1.3.7	Dispensary	Doctor	2	-	
		Staff	2	-	
		Nurse	3	-	
1.3.8	LMV	Driver	-	3	On Contract
1.3.9	Telephone exchange	Operator	1	-	
1.3.10	Guest house	Staff	1	-	
		Attendent	6	-	On Contract
1.4	Safety	Manager	1	-	
		Supervisor	2	-	
		Petrollers	-	6	
1.5	CSR & Liasoning	Manager	1	-	
		Officers	2	-	
		Clerk/ Staff	2	-	
1.6	Logistics	Manager	1	-	
		Officer	2	-	
		Clerk/ Staff	4	-	
Total			125	325	Total no. of persons will be 450. Of this, 183 people may be taken on contract.
			450		



CHAPTER-6B : HUMAN RESOURCE (GU)

6.1. INTRODUCTION

This chapter covers the details of human resources required for the proposed **JCL** project. The suggested details of human resources have been given separately for the following two phases:

- Project implementation phase
- Plant operation phase

6.2. BASIS

The actual manpower requirement in any plant would depend on the following:

- Size & location of the plant
- Technological status of the plant, viz., plant layout, type and number of equipment, etc.
- Type of automation, control & instrumentation
- Management and administration control philosophy
- Outsourcing of certain services (On contract) like, security, maintenance, packing, etc.
- HR policies of the company and other statutory requirements

The suggested estimates of human resources are based on the following considerations:

- Project technical concept
- Smooth and efficient plant operation
- Effective inter-departmental co-ordination
- Optimum organization with well-defined job responsibility
- Optimum utilization of different levels of workmen and supervisory staff
- Training needs of the personnel, wherever required, will be taken care of by **JCL**
- Manpower requirement for marketing office and facilities like guesthouse etc. have not been included and shall be taken care of by **JCL**
- Manpower requirement in certain categories like fitters, welders, khalasis, helpers, peons, canteen staff, etc. can be met through contractor(s)
- Certain activities shall be assigned to specialized agencies/ contractors. These shall include loading unloading, plant cleaning job, packing, security for plant, maintenance, etc.
- Unskilled/ semiskilled manpower can be sourced from nearby areas, and skilled manpower can be sourced through contractors and pan India as well.



6.3. PROJECT IMPLEMENTATION PHASE

For the project implementation phase, the total requirement of human resources for the proposed Grinding Unit is estimated as **30**.

The details of human resources suggested for this phase have been furnished under **Annexure 6B.1**

6.4. PLANT OPERATION PHASE

Total number of persons for Operation Phase is estimated as **204** out of which about 69 persons in general shift and remaining 135 in shift operations have been envisaged. Of the total 204 personnel, 89 persons may be taken on contractual basis.

The details of suggested manpower for this phase have been given at **Annexure 6B.2**

6.5. SALARY AND WAGES (IMPLEMENTATION & OPERATION PHASE)

Remuneration for the human resources including the salaries and various other benefits as may be offered by the Company to the personnel has been computed and shown in **Table 6.1 and Table 6.2** below:

- Implementation Phase**

Sn	Category	No. of Staff	CTC /month (Rs.)	Total HR cost per month (Rs.)
1	Top management	1	7,50,000	7,50,000
2	Senior management	2	4,00,000	8,00,000
3	Middle management	10	3,00,000	30,00,000
4	Specialist/ Engineer/ Officers	7	2,00,000	14,00,000
5	Supervisors/ Foreman/ Staff	6	50,000	3,00,000
6	Workmen/ Labor	4	20,000	80,000
	Total	30		63,30,000

Table 6.1 : Salaries and Wages for Staff during Implementation Phase

Total wages considered for a phased recruitment for Implementation period of 18 months has been estimated as:

(Rs.63,30,000 per month x 18 months implementation period x 60% recruitment factor) =
Approx. Rs.680 Lakhs



- Operation Phase

Sn	Category	No. of Staff	Salary Per Person (Rs/ Month)	Gross Salary (Rs. / Annum)
1	Top management	1	7,50,000	90,00,000
2	Senior management	2	4,00,000	96,00,000
3	Middle management	8	3,00,000	2,88,00,000
4	Specialist/ Engineer/ Officers	16	2,00,000	3,84,00,000
5	Supervisors/ Operators/ Foremen	62	50,000	3,72,00,000
6	Attendants/ Technicians	62	30,000	2,23,20,000
7	Workmen/ Labor	53	20,000	1,27,20,000
	Total	204		15,80,40,000 Say, 1580 Lakhs

Table 6.2 | Salaries and Wages for Staff during Operation Phase

6.6. SUMMARY

A summary of the manpower requirement for the cement grinding unit is furnished in **Table 6.3** below:

Unit	Manpower		
	General shift	Shifts	Total (A + B)
	(A)	(B)	
Implementation Phase	30	-	30
Operation Phase	69	135	204

Table 6.3 |: Summary of Manpower Requirement



Annexure 6B.1

**ESTIMATED MANPOWER REQUIREMENT
(IMPLEMENTATION PHASE)**

Sn.	Department	Manpower	Persons required
1	Plant	Unit head (Overall)	1
1.2	Technical	Technical head	1
1.2.1	Mechanical	Manager	1
		Engineer	1
1.2.2	Electrical	Manager	1
		Engineer	1
1.2.3	Instrumentation	Manager	1
		Engineer	1
1.2.4	Process	Manager	1
		Engineer	1
1.2.5	Quality control	Manager	1
		Chemist	1
1.2.6	Civil	Manager	1
		Engineer	1
1.3	Commercial	Commercial head	1
1.3.1	Stores and Purchase	Manager	1
		Staff	1
1.3.2	Personal and Administration	Manager	1
		Officer	1
		Staff cum Receptionist	1
1.3.3	EDP	Manager	1



Jaykaycem (Central) Limited

Sn.	Department	Manpower	Persons required
		Staff	1
1.3.4	Accounts	Officer	1
		Staff	1
1.3.5	Secretaries	Staff	2
1.3.6	Security	Guards	4
1.3.7	Dispensary	Doctor	-
		Staff	-
1.3.8	Telephone exchange	Operator	On contact
Total			30

Note:

It is envisaged that the personnel for Plant Implementation shall be hired in a phased manner during the span of the execution of the proposed Project.



Annexure 6B.2

**ESTIMATED MANPOWER REQUIREMENT
(OPERATION PHASE)**

Sn	Department	Manpower	No of person		Remarks
			General shift	Shift	
1	Plant	Unit head (Overall)	1	-	
1.1	Technical				
1.1.1	Mechanical	General Manager	1	-	
		Manager	1	-	
		Engineer	1	1	
		Foreman	1	1	
		Draftsman/ designer	1	-	
		Crusher Operator	1	-	
		Crusher Attendant	1	-	
		Stacker & Reclaimer Operator	1	-	
		Stacker & Reclaimer Attendant	1	3	
		Fitter	2	2	On Contract
		Utility operator	-	3	On Contract
		Welder	2	1	On Contract
		Workshop operator	2	-	
		Khalasi	2	3	On Contract
		Crane operator	1	-	
1.2.2	Electrical & Instrumentation				
1.2.2.1	Electrical	General Manager	1		
		Manager	1		
		Engineer	1	1	
		Foremen	1	3	
		Power distribution foreman	-	3	
		Electrician	1	3	On Contract
		Helper	1	3	On Contract
1.2.2.2	Instrumentation	Engineer	1	1	
		Foreman	1	3	
		Mechanic	-	3	On Contract
1.2.3	Process & Quality control				
1.2.3.1	Process	Manager	1	-	
		Engineer	1	3	
		CCR operator	3	6	
		Mill attendant	1	3	
		Pay Loader operator	1	3	
		BRU/ Truck Tippler	2	6	



Sn	Department	Manpower	No of person		Remarks
			General shift	Shift	
		operator			
		BRU/ Truck Tippler attendants	-	6	On Contract
		Helper	-	3	On Contract
1.2.3.2	Quality control	Chemist	1	3	
		Analyst	-	3	
		Sampler	-	3	
1.2.4	Civil	Manager	1	-	
		Engineer	1	-	
		Mason	-	1	On Contract
		Carpenter	-	1	On Contract
		Plumber	-	1	On Contract
1.2.5	Packing Plant	Manager	1	-	
		Supervisor	1	2	
		Tally checker	2	4	
		Operator	-	12	On Contract
		Truck & Bulk Loaders	-	21	On Contract
1.3	Commercial				
1.3.1	Stores and Purchase	Manager	1	-	
		Officers	1	-	
		Staff	2	-	
1.3.2	Personnel and Administration	Manager	1	-	
		Officer	1	-	
		Staff	2	-	
1.3.3	EDP	Officer	1	-	
		Staff	1	-	
1.3.4	Excise	Officer	1	-	
		Staff	1	-	
1.3.5	Accounts	Manager	1	-	
		Officer	2	-	
		Staff	3	-	
1.3.6	Secretaries	Staff	3	-	
1.3.7	Security	Officer	1	-	
		Guards	-	12	On Contract
1.3.8	LMV	Driver	2	4	On Contract
1.4	Safety	Officer	1	2	
1.5	Logistics	Officer	1	2	
Sub-Total			69	135	
Total			204		



CHAPTER 7A: IMPLEMENTATION SCHEDULE (IU)

7.1 KEY FACTORS/ STRATEGY

The key factors that would facilitate successful and timely project implementation are:

- ❑ Proper choice of technology and machinery suppliers
- ❑ Adequate diligence in formulating the technical concept and system design/ selection of the plant
- ❑ Proper choice of contractors for civil construction and erection of equipment
- ❑ Formulation of an effective project team led by an experienced Project Manager
- ❑ Establishment of an efficient system for project planning & monitoring including reporting procedures for progress review and co-ordination
- ❑ Customization of project execution plan to suit the promoter's profile.

The benefits of recognizing and addressing the aforementioned key factors have been successfully demonstrated in most cement projects executed in the recent past/ currently under implementation.

Learning's from the implementation strategies adopted in successful projects have been dovetailed with the profile of the promoters in order to evolve the most appropriate implementation strategy for the proposed project. The salient features of the proposed strategy are summarized below:

7.2 IMPLEMENTATION STRATEGY

Typically any project has four core dimensions viz:

- ❑ Engineering: this directly impacts the smooth operations of the plant over its entire life.
- ❑ Procurement: is critical on account of the impact that it has on investment and performance benchmarks and also in ensuring the choice of appropriate technology.
- ❑ Construction : is critical in terms of its impact on completion quality and the duration of the project phase
- ❑ Project Management: other than its obvious impact on project timeliness it also contributes to risk minimization for the promoter.

“Zero date” for a project is generally reckoned as the date on which the contract for “main machinery” becomes effective.

The plant & machinery for a project can be procured in three modes:

- ❑ Turnkey/ Semi-turnkey
- ❑ Package
- ❑ Shopping



The three procurement modes are described below:

Turnkey/ Semi-turnkey : In the Turnkey mode, one single contractor is responsible for all project activities concluding with the handing over of the plant to the owner. The role of the owner is limited to appointing the turnkey contractor and making payments (for details refer **Annexure 7.1**).

A variant of this is the Semi-turnkey mode. In this case there are usually two agencies, one the supplier and the other the contractor. The supplier is responsible for all activities that occur off shore, i.e. outside the country/ project site. The contractor is responsible for all activities that occur on shore i.e. within the country/ project site (for details refer **Annexure 7.2**).

Package : In this case the plant is split up into functional Process departments and procured accordingly. Several main suppliers are responsible for the detailed engineering, manufacture and supply. Similarly, multiple contractors are appointed for carrying out on shore activities (for details refer **Annexure 7.3**).

Shopping : In this case the client/ consultant formulate the basic design for the project and specify & procure equipment by discipline/ type (for details refer **Annexure 7.4**).

The pros and cons of these modes are described in **Annexure 7.5** and summarized in **Table 7.1** below:

Sn	Characteristics	Procurement Modes		
		Turnkey/ Semi-turnkey	Package	Shopping
1	Efforts on Co-ordination	Low	Medium	High
2	Execution Period	Low	Medium	High
3	Project Cost	High	Medium	Low
4	Project Cost Control	High	Medium	Low
5	Supplier Responsibility	High	Medium	Low

Table 7.1: Characteristics of Mode(s) of Procurement

For the **JCL** project, shopping mode of procurement is proposed inline with **JCL**'s earlier projects. The proposed solution shall help **JCL** in optimizing project investment and minimizing entrepreneur risk due to cost escalation.

7.3 PLANNING

It is proposed that “pre-project” activities to be taken up at first instance, immediately after investment decision is taken by **JCL**. These “Pre Project” activities include:

- Obtaining statutory clearance, etc.



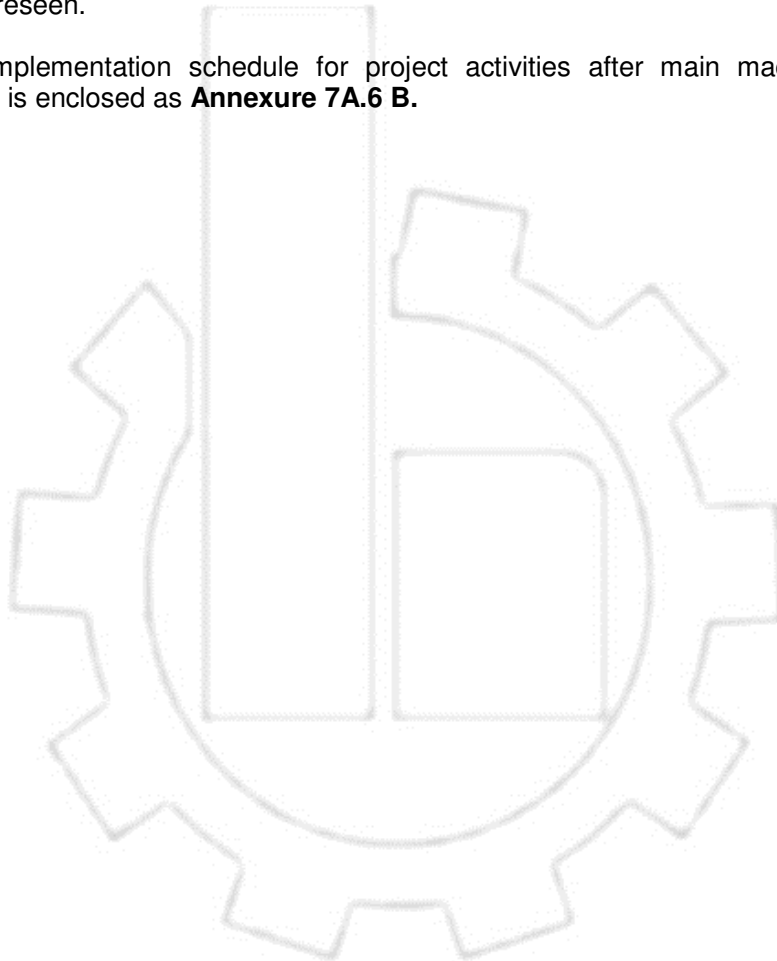
- ❑ Organization of “enabling works”
- ❑ Initiate appointment of “Contractors”.

A broad implementation schedule for the Pre-Project Activities are enclosed as **Annexure 7A.6 A.**

7.4 IMPLEMENTATION SCHEDULE

Based on past experience for similar size and technology plant, an implementation period of **24 months** from the date of signing/ effectiveness of the main equipment supply contract is foreseen.

The broad implementation schedule for project activities after main machinery order placement for is enclosed as **Annexure 7A.6 B.**





CHAPTER-7B : IMPLEMENTATION SCHEDULE (GU)

7.1 KEY FACTORS/ STRATEGY

The key factors that would facilitate successful and timely project implementation are:

- Proper choice of technology and machinery suppliers.
- Adequate diligence in formulating the technical concept and system design/ selection of the plant.
- Proper choice of contractors for civil construction and erection of equipment.
- Formulation of an effective project team led by an experienced Project Manager.
- Establishment of an efficient system for project planning & monitoring including reporting procedures for progress review & co-ordination.
- Customization of project execution plan to suit the promoter's profile.

The benefits of recognizing and addressing the above-mentioned key factors have been successfully demonstrated in most cement projects executed in the recent past/ currently under implementation.

Learning from the implementation strategies adopted in successful projects have been developed with the profile of the respective promoters in order to evolve the most appropriate implementation strategy for the proposed project. The salient features of the proposed strategy are summarized below:

7.2 IMPLEMENTATION STRATEGY

Typically, any project has four core dimensions, viz.:

- Engineering: this directly impacts the smooth operations of the plant over its entire life.
- Procurement: is critical on account of the impact that it has on investment and performance benchmarks and also in ensuring the choice of appropriate technology.
- Construction: is critical in terms of its impact on completion quality and the duration of the project phase.
- Project Management: other than its obvious impact on project timeliness it also contributes to risk minimization for the promoter.

“Zero date” for a project is generally reckoned as the date on which the contract for “main plant and machinery” becomes effective.



The plant & machinery for a project can be procured in four modes:

- Turnkey
- Semi-turnkey
- Package
- Shopping

The four procurement modes are described below:

Turnkey In the Turnkey mode, one single contractor is responsible for all project activities concluding with the handing over of the plant to the owner. The role of the owner is limited to appointing the turnkey contractor and making payments (for details refer **Annexure 7.1**).

Semi Turnkey A variant of turnkey is the Semi-turnkey mode. In this case there are usually two agencies, one the supplier and the other the contractor. The supplier is responsible for all activities that occur offshore, i.e., outside the country/ project site. The contractor is responsible for all activities that occur on shore i.e., within the country/ project site (for details refer **Annexure 7.2**)

Package In this case the plant is split up into functional process departments and procured accordingly. Several main suppliers are responsible for the detailed engineering, manufacture, and supply. Similarly, multiple contractors are appointed for carrying out on shore activities (for details refer **Annexure 7.3**)

Shopping In this case the client/ consultant formulates the basic design for the project and specify & procure equipment by discipline/ type (for details refer **Annexure 7.4**).

The pros and cons of these modes are described in **Annexure 7.5** and summarized in **Table 7.1** below:

Sn	Characteristics	PROCUREMENT MODES		
		Turnkey/ Semi-turnkey	Package	Shopping
1	Efforts on Co-ordination	Low	Medium	High
2	Execution Period	Low	Medium	High
3	Project Cost	High	Medium	Low
4	Project Cost Control	High	Medium	Low
5	Supplier Responsibility	High	Medium	Low

Table 7.1 | Characteristics of modes of procurement



For this proposed project, the **Package mode of procurement** for project execution is envisaged with an assumption that an in-house project team shall be constituted which shall function with due assistance from a professional Project Management agency having relevant cement industry background.

The proposed solution shall help **JCL** in optimizing project investment and minimizing risk on the front of able technical assistance.

7.3 PLANNING

It is proposed that pre-project activities be taken up till the orders for main plant and machinery are awarded. These activities include:

- Acquiring plant land (including all relevant clearances, if deemed required)
- Obtaining industry and other statutory clearances
- Development of Infrastructure at the site
- Site Studies viz. geotechnical, hydrological, etc.
- Organization of “enabling works”
- Appointment of “Consultant”

7.4 IMPLEMENTATION SCHEDULE

Going by the current cement industry scenario, the typical implementation schedule for similar sized clinker Grinding Units is between 15 to 24 months from the date of signing/ effectiveness of the main equipment supply contract.

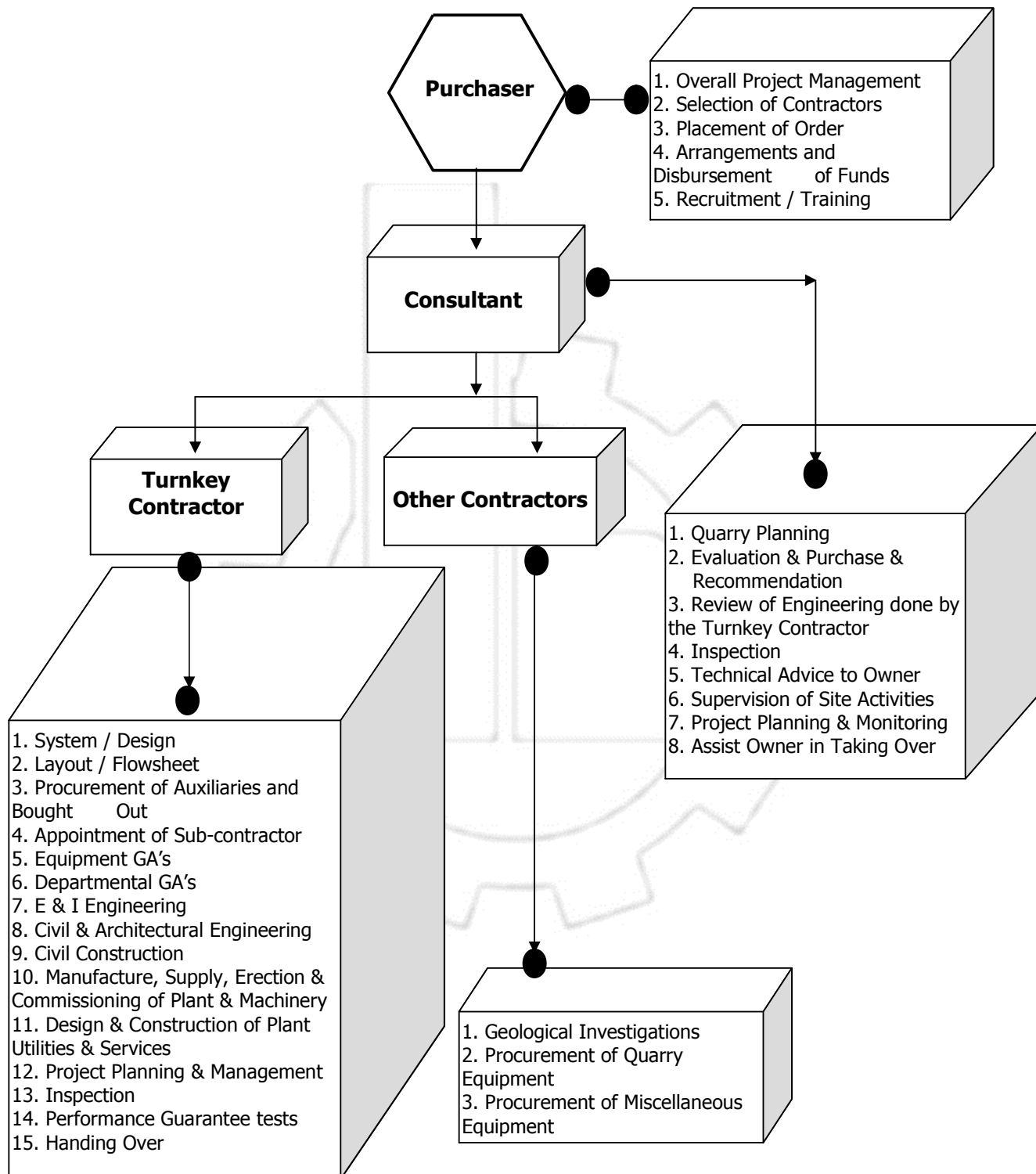
For a player like **JCL, which is a sister concern of the well-established JKCL group**, a most-likely implementation period of **18 calendar months** is envisaged for this project. This is broadly in line with the present industry scenario with respect to the Equipment Suppliers' perspective too who are willing to provide the Plant's equipment if the main orders are placed well in time.

The broad implementation schedule for project activities after main machinery order placement is enclosed as **Annexure 7B.6**



Annexure 7.1

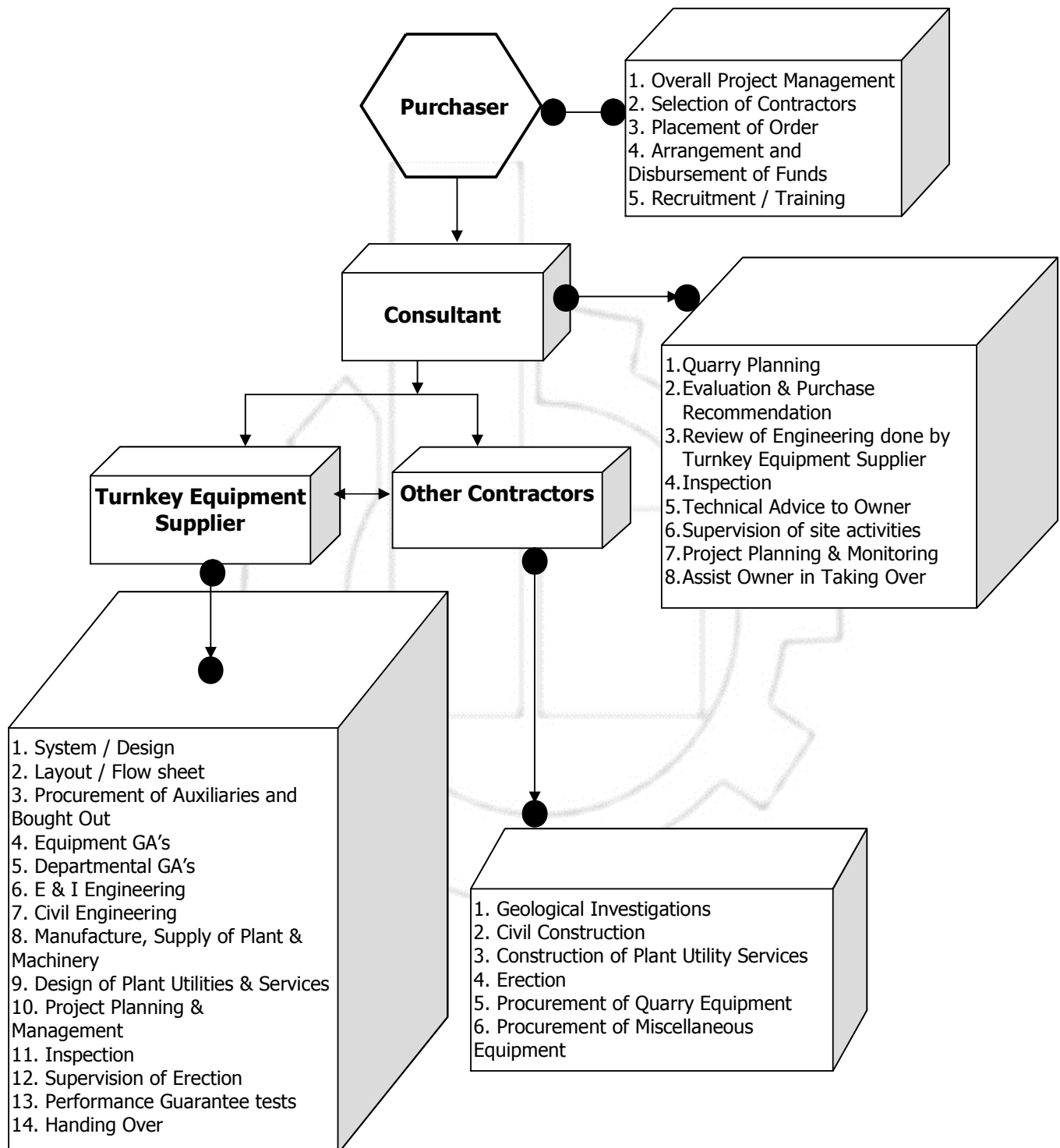
PROJECT EXECUTION: TURNKEY





Annexure 7.2

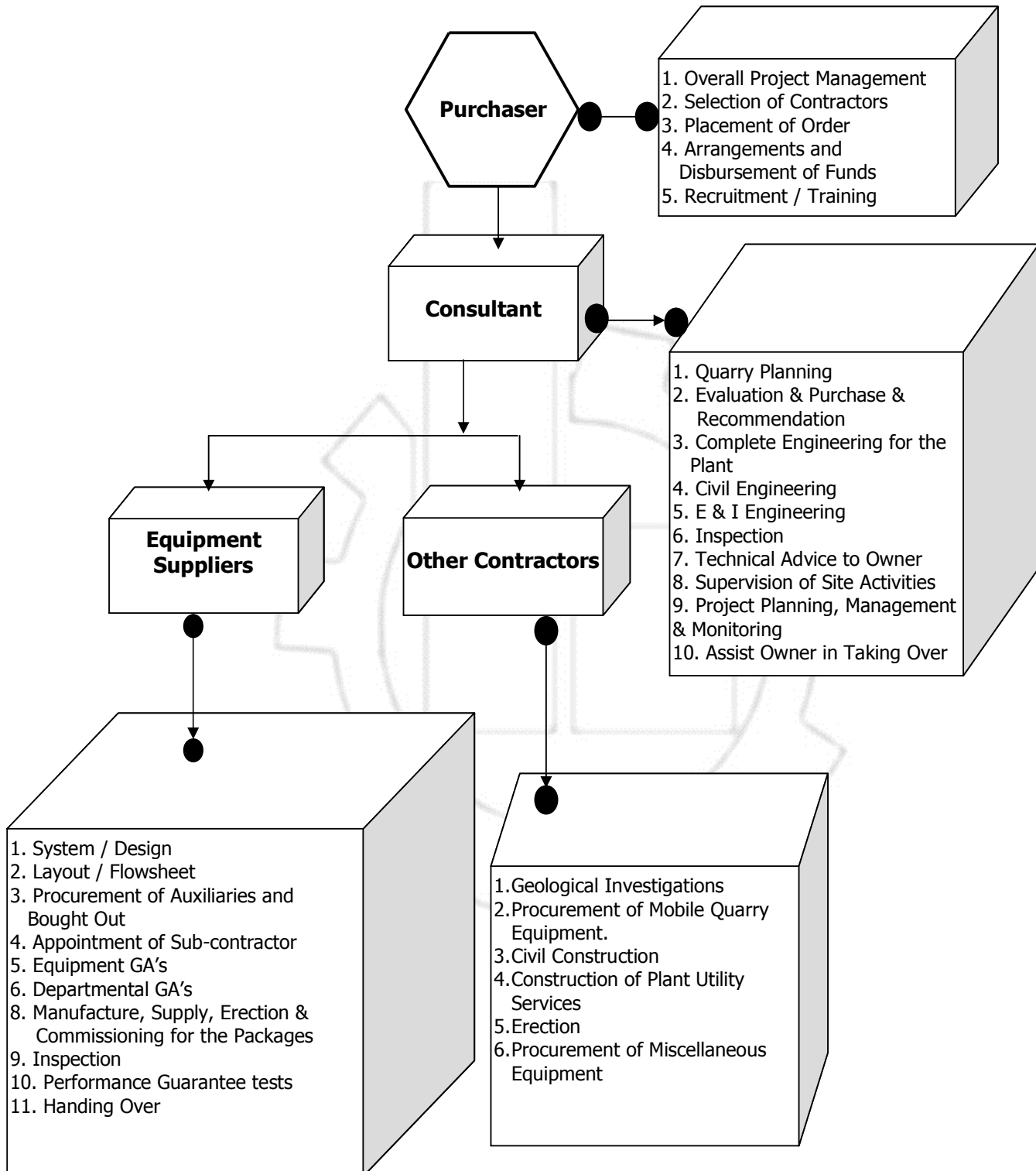
PROJECT EXECUTION: SEMI-TURNKEY





Annexure 7.3

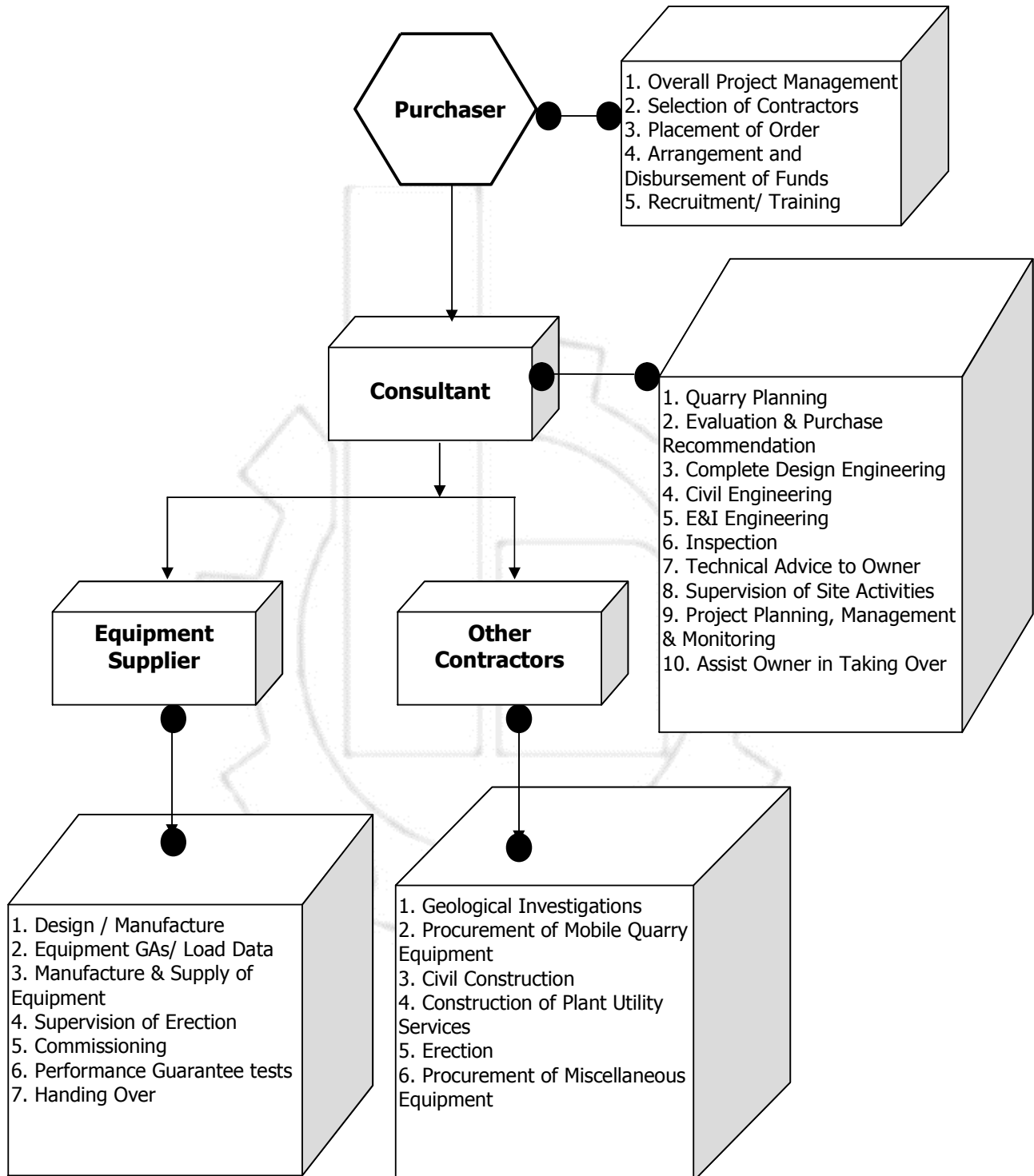
PROJECT EXECUTION: PACKAGE





Annexure 7.4

PROJECT EXECUTION: SHOPPING





Annexure 7.5

COMPARATIVE: PROCUREMENT OPTIONS

Element	Turnkey / Semi Turnkey	Package	Shopping
Choice of Optimum Process Equipment	Limited depending upon Contractor	All main equipment, limited for auxiliaries	Free Choice
Total Investment Costs			
Total Duration			
Performance Guarantee	Entire Plant	By Department	By Department / single machine
Warranty	Undivided	By Package	By Individual machine or group
Execution Responsibility	Undivided	By Package	Consultant, contractor(s), client
Client's Risk			
Final Costs Known	At signing	After last package	During execution or final at commitment
Risk of Cost Overrun			
Risk of Time Overrun	Moderate	Medium	Medium
Overall Risk			
Ability to obtain Insurance			
Client's remedy against Performance Failure	Claims based on total contract value	Limitation by counter claims of each package supplier	Limitation by counter claims of each package supplier
Client's Involvement			
Need to change Organization			
Requirements for Project Management			
Overall			



PROJECT SCHEDULE - IU (PRE-PROJECT ACTIVITIES)

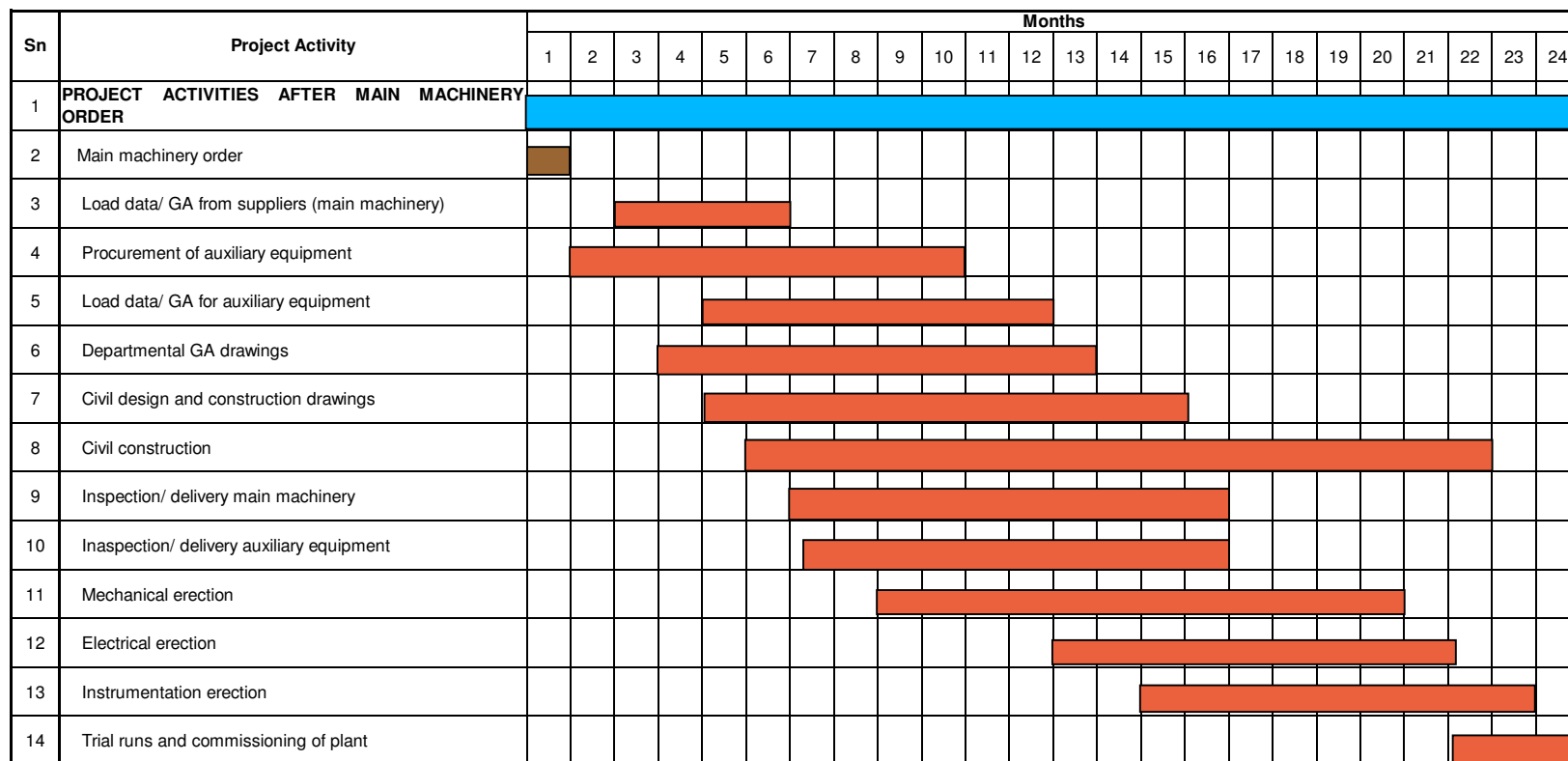
Sn	Project Activity	Months					
		1	2	3	4	5	6
	PROJECT ACTIVITIES AFTER TECHNO ECONOMIC FEASIBILITY						
1	Making financial arrangement for project						
	On site activities						
2	Acquisition of plant Land						
3	Clearance from satutory authorities such as state pollution control board, industry, etc						
4	Soil investigation of land						
5	Hydrological investigation of Land						
	Off site activities						
6	Preparation of tender documents						
7	Receipt of offer from bidder						
8	Offer evaluation and ordering						

LEGENDS

- Summary
- Task
- Milestone



IMPLEMENTATION SCHEDULE - IU PROJECT ACTIVITIES AFTER MAIN MACHINERY ORDER PLACEMENT



LEGENDS

- Summary
- Task
- Milestone

**INDICATIVE PROJECT SCHEDULE (PRE-PROJECT ACTIVITIES)**

Sn	Project Activity	Months					
		1	2	3	4	5	6
	PROJECT ACTIVITIES AFTER TECHNO ECONOMIC FEASIBILITY						
1	Making financial arrangement for project						
	On site activities						
2	Statutory clearances from authorities such as environment, industry, etc.						
3	Finalisation of Plant Layout & Infrastructure plan						
4	Initial reconnaissance of the site						
5	Site investigations (Topographical, Geotechnical, Hydrological)						
6	Site development works (general grading & preparation)						
7	Enabling Works (Road & basic drainage network)						
	Off site activities						
8	Preparation of tender document						
9	Receipt of offer from bidder						
10	Offer evaluation and ordering						

 Summary

 Task

**INDICATIVE PROJECT IMPLEMENTATION SCHEDULE
(PROJECT ACTIVITIES AFTER MAIN MACHINERY ORDER PLACEMENT)**

Sn	Project Activity	Months																	
		M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18
1	PROJECT ACTIVITIES AFTER MAIN MACHINERY ORDER																		
2	Main plant and machinery order																		
3	Load data/ GA drawing from suppliers (main plant and machinery)																		
4	Procurement of auxiliary equipment																		
5	Load data/ GA drawing for auxiliary equipment																		
6	Departmental GA drawings																		
7	Civil design and construction drawings																		
8	Civil construction																		
9	Inspection/ delivery of main plant and machinery																		
10	Inspection/ delivery of auxiliary equipment																		
11	Mechanical erection																		
12	Electrical erection																		
13	Instrumentation erection																		
14	Trial runs and commissioning of plant																		

Summary **Task** **Milestone**



CHAPTER 8: FINANCIAL APPRAISAL

8.1 INTRODUCTION

Jaykaycem (Central) Limited (JCL) proposes to set up 2.0 mio tpa cement integrated unit (IU) at Panna, Madhya Pradesh and 2.0 mio tpa cement grinding unit (GU) at Hamirpur, Uttar Pradesh..

This chapter addresses the financial feasibility of the project encompassing:

- ❑ Estimates of Investment Cost
- ❑ Estimates of Operational Cost
- ❑ Financial statements including Profit and Loss Statement, Projected Cash Flow Statement, etc.
- ❑ Financial viability based on the following indicators:
 - Internal Rate of Return on Total Investment
 - Break Even Point
 - Payback Period

8.2 INVESTMENT COSTS & MODE OF FINANCING

The total capital cost estimate for the proposed project works out to **Rs. 2,970 Crores**.

The estimated Investment Cost for the project has been based on the requirement of fixed and non-fixed assets.

To cater to any risk of variability in the investment cost due to change in cost of capital equipment, construction cost, etc., Contingency margin of 7.5% has been considered on the overall estimated CAPEX for undertaking the financial analysis of the project.

The details of total investment are shown in **Table 8.1**, which also indicates the mode of financing.

The financing of the project has been considered on the basis of Equity and Term Loans from Financial Institutions. The debt : equity ratio has been considered as 1.3 : 1.

Interest on Term Loan has been considered at 7.5% pa. Term Loan has been assumed to be repaid over 13 years including a moratorium of 2 years after the commissioning of the plant. The interest on Working Capital Loan has been considered at 7.5% pa.



Figures in Rs Lakhs

DESCRIPTION	COST			
	IU	GU	Common Expenses	TOTAL
Land and Site Development	47,495	2,270		49,765
Buildings and Civil Structures	37,863	8,205		46,068
Plant and Machinery	1,28,524	21,163		1,49,687
Engineering & Know How	1,100	400		1,500
Expense on Training and Foreign Technicians	750	50		800
Miscellaneous Fixed Assets	3,018	210		3,228
Pre-Operative Expenses including interest during construction period			24,778	24,778
Contingency @ 7.5%			19,710	19,710
Margin Money for Working Capital			1,494	1,494
Total	2,18,750	32,298	45,982	2,97,029
Sources of Funds				
Debt		1,67,886		
Equity		1,29,143		
Total		2,97,029		

Source: Holtec Analysis

Table 8.1: Total capital cost & project financing

Cost of foundation for plant & machinery has been considered as building and civil structure in TEFR. However, for accounting purpose, cost of such foundation related to plant & machinery are considered under the head of Plant & Machinery for the calculation of depreciation as per accounting norms.

8.3 OPERATING COSTS

The operational costs have been worked out considering the following assumptions:

8.3.1 Raw Materials & Consumables

The cost of raw materials is given in the table below:

In Rs/ton

Raw Materials	Amount	
	IU	GU
Limestone (Average all grades)	181	-
Bauxite	1,500	-
Iron Ore	1,100	-
Clinker	-	3,300
Fly Ash	681	350
Gypsum	3,700	4,500



Jaykaycem (Central) Limited

Raw Materials	Amount	
	IU	GU
Consumables	85	35

Table 8.2: Cost of raw materials

The raw meal to clinker factor is considered as 1.510. For running the financial analysis, average of the following raw material proportions has been considered:

Raw materials	Raw Mix
Limestone	96.60%
Bauxite	2.20%
Iron Ore	1.20%

Table 8.3: Raw Mix

JCL proposes to produce 80% PPC and 20% OPC on the overall volume. Product mix at IU is 60% PPC and 40% OPC and at GU it is 100% PPC. Blending ratios are as follows:

Raw materials	OPC	PPC
Clinker	90%	60%
Gypsum	5%	5%
Blending Limestone	5%	-
Flyash	-	35%

Table 8.4: Grinding ratios

8.3.2 Utilities

- ❑ Specific power consumption has been considered as 48 kWh/t for Clinker, 80 kWh/t for OPC and 65 kWh/t for PPC. Specific power consumption at GU is considered as 32 kWh/ t for PPC.
- ❑ The project envisages utilizing 80% Indian coal and 20% imported Petcoke as the fuel mix, the weighted average cost of which has been estimated to be Rs. 5,376/ t landed at the plant. The weighted average NCV of fuel has been considered to be around 5,067 kcal/kg while the specific heat consumption has been considered as 680 kcal/kg clinker.
- ❑ The cost of electricity is considered from the combination of WHR and Grid @ Rs. 3.35 / kWh at Panna IU. The cost of electricity at Hamirpur GU is considered from Grid @ Rs.7.70 / kWh
- ❑ The expense on water supply has been considered as Re. 1/ t.

8.3.3 Manpower

The manpower cost at IU is considered as Rs. 3,300 Lakhs p.a. The manpower cost for GU is considered around 1,580 Lakhs p.a.



8.3.4 Other Costs

Packing expenses have been considered as Rs.200/ t of cement. Factory overhead has been considered as Rs.70/ t of clinker and Rs.100/ t of cement at IU and Rs. 50/ t of Cement at GU.

Administration expenses have been considered as Rs.50/ t of clinker and Rs.35/ t of cement at IU and GU, respectively. Sales & Distribution expenses have been considered as Rs.200/ t of cement.

8.3.5 Achievable Volumes & Capacity Utilization

As mentioned in **Chapter 2**, in most likely scenarios **JCL**'s both units (IU and GU) are expected to achieve 100% capacity utilization from Year 4. However, for the financial analysis purpose capacity utilization is as follows;

The commercial operation date has been considered as 1st Feb 2023 for GU and 1st Apr 2023 for IU.

Year	Achievable Sales Volumes			Capacity Utilisation		
	IU	GU	Total	IU	GU	Total
Total Capacity	2.00	2.00	4.00			
FY 23 (Two Months)	-	0.17	0.17	-	-	-
FY 24	1.4	1.4	2.8	70%	70%	70%
FY 25	1.6	1.6	3.2	80%	80%	80%
FY 26	1.8	1.8	3.6	90%	90%	90%
FY 27	1.9	1.9	4.0	95%	95%	95%

Source: Holtec Analysis

Table 8.5: Achievable volumes and Capacity Utilisation

8.3.6 Ex Factory Realization

As mentioned in **Chapter 2**, the average realization per bag of **JCL** is given in **Table 8.6**:

Figures in Rs. / bag

Particulars	IU		GU
	OPC	PPC	PPC
Retail Price	6,441	6,241	6,475
GST @ 28%	1,409	1,365	1,416
Margins	500	500	500
Freight	894	894	623
Realisation, Rs./ t	3,638	3,482	3,936
Realisation, Rs./ Bag	182	174	197

Source: Holtec Analysis

Table 8.6: Ex factory Realization of JCL



8.4 RESULTS

Annexures 8.0 – 8.10 details the estimated Capital Expenditure (CAPEX) for the project
Annexures 8.11 – 8.20 detail the following:

- Annexure 8.11 : Unit cost of production (IU)
- Annexure 8.12 : Unit cost of production (GU)
- Annexure 8.13 : Interest calculations and repayment schedule for Term Loan
- Annexure 8.14 : Working results & profitability computations
- Annexure 8.15 : Working Capital requirements
- Annexure 8.16 : Projected Funds Flows
- Annexure 8.17 : Projected Balance Sheets
- Annexure 8.18 : Internal Rate of Return on Total Investment
- Annexure 8.19 : Internal Rate of Return on Equity
- Annexure 8.20 : Break Even Point & Indicators of Performance (DSCR)

Incentives

Following incentives have been considered for the plants:

Investment Promotion Assistance - 15,000 Lakhs to be reimbursed over 7 years as per the Madhya Pradesh Incentive Policy has been considered for the IU.

The GU envisages to utilize the incentives available under Uttar Pradesh State's 'UP Incentive Policy - IIEPP 2017' and allied 'Accelerated Investment Promotion Policy – 2020'. For the purpose of TEFR's project financial appraisal, 70% State GST (SGST) exemption has been taken into account, which is permitted to go up to 300% of the proposed Fixed Capital Investment over a period of 15 years. As per the **Accelerated Investment Promotion Policy – 2020**, this benefit would be limited to an annual ceiling of 20% of capital investment or actual tax deposited, whichever is lower.

8.5 FINANCIAL ANALYSIS

Financial analysis reveals the performance results as given in the table that follows:

Sn	Indicator	Results
1	IRR on Total Investment	16.4%
2	NPV (@10% discount rate) – Rs. Crores	1,603
3	IRR on Equity	24.3%
4	Payback Period	6 Years 6 Months
5	Average Debt Service Coverage Ratio	2.38

Source: Holtec Analysis

Table 8.7: Performance indicators



8.6 CONCLUSION

The project exhibits an Internal Rate of Return on Total Investment of 16.4%. The Average Debt Service Coverage is 2.38. These returns are taking into account the incentives provided by the government mentioned in the earlier section.

In view of the acceptable level of returns, the project is financially viable.





SUMMARY OF INVESTMENT COST ESTIMATES
(In Lakh INR Unless Specified Otherwise)

SN	DESCRIPTION	COST			
		IU	GU	Common Expenses	TOTAL
1	Land and Site Development	47,495	2,270	-	49,765
2	Buildings and Civil Structures	37,863	8,205	-	46,068
3	Plant and Machinery	128,524	21,163	-	149,687
4	Engineering & Know How	1,100	400	-	1,500
5	Expense on Training and Foreign Technicians	750	50	-	800
6	Miscellaneous Fixed Assets	3,018	210	-	3,228
7	Pre-Operative Expenses including interest during construction period	-	-	24,778	24,778
8	Contingency @ 7.5%	-	-	19,710	19,710
9	Margin Money for Working Capital	-	-	1,494	1,494
	Total Project Cost	218,750	32,298	45,982	297,029

Breakup of Pre-operative Expenses

7.0	Pre-Operate Expenses	IU	GU	TOTAL	Remark
7.1	Establishment	250	100	350	
7.2	Rent and Taxes	185	50	235	
7.3	Traveling Expenses	150	50	200	
7.4	Loan processing Fee	293	43	336	0.2% of Loan Amount
7.5	Insurance during construction	100	30	130	
7.6	Lender's Independent Engineer (LIE) Fee & Expenses	30	-	30	
7.7	Energy cost during construction	950	-	950	
7.8	Miscellaneous Expenses (Post / Mail / Legal, initial studies, travelling, printing, stationary, recruitment, etc.)	772	150	922	
7.9	Salaries during implementation period	2,800	680	3,480	
7.10	Interest During Construction	11,253	1,779	13,031	
7.11	Start up Expenses	159	50	209	
7.12	Diesel for DG sets & Kiln lightup	325	-	325	
7.13	Expenses for CSR activity (over 3 years)	4,580	-	4,580	
	TOTAL	21,846	2,932	24,778	



SUMMARY OF INVESTMENT COST ESTIMATES - IU
(In Lakh INR Unless Specified Otherwise)

SN	DESCRIPTION	TOTAL COST
1	Land and Site Development	47,495
2	Buildings and Civil Structures	37,863
3	Plant and Machinery	128,524
4	Engineering & Know How	1,100
5	Expense on Training and Foreign Technicians	750
6	Miscellaneous Fixed Assets	3,018
	Total Cost	218,750



INVESTMENT COST ESTIMATES - IU

(In Lakh INR Unless Specified Otherwise)

SN	DESCRIPTION	TOTAL COST	REMARKS
1.0	Land and site development		
1.1	Land cost for plant (Govt land)	42,420.00	Total cost estimated by JCL
1.2	Land cost for plant (Private land)		
1.3	Land cost for mining area (Govt land)		
1.4	Land cost for mining area (Private land)		
1.5	Mines development expenses	124.00	Refer Chapter 3A
1.6	Site preparation, leveling and grading	150.00	Refer Annexure 8.3
1.7	Geo-technical, hydrological investigation & Topographic survey	60.00	Lumpsum
1.8	Boundary wall	733.00	Refer Annexure 8.3
1.9	Gates, security pickets, etc.	30.00	Lumpsum
1.10	Approach road	627.00	Refer Annexure 8.3
1.11	Plant internal roads	1,341.00	Refer Annexure 8.3
1.12	Truck parking, logistics offices & other semi-paved areas	1,109.00	Refer Annexure 8.3
1.13	Plant drainage	861.00	Refer Annexure 8.3
1.14	Landscaping and provision of green belt	40.00	Refer Annexure 8.3
	Sub-total	47,495.00	
2.0	Buildings and other civil structures		
2.1	Main factory buildings	8,565.00	Refer Annexure 8.3
2.2	Silos, hoppers, storages, covered gantry, etc.	6,945.00	Refer Annexure 8.3
2.3	Auxiliary services	2,864.00	Refer Annexure 8.3
2.4	Office/ Non-factory buildings & Mines Buildingd	752.00	Refer Annexure 8.3
2.5	Residential colony	6,405.00	Refer Annexure 8.3
2.6	Equipment foundations cost	2,985.00	Refer Annexure 8.3
2.7	Deep foundations cost provisioning on account of possibility of weaker soil bearing capacity (based on preliminary findings of soil investigations)	3,340.00	Refer Annexure 8.3
2.8	Indicative GST component on civil works	6,007.00	Refer Annexure 8.3
	Sub-total	37,863.00	
3.0	Plant and Machinery		
3.1	Total cost of Mechanical and Electrical equipment	89,510.88	Refer Annexure 8.4
3.2	Equipment for Distribution of Power	14,862.83	Refer Annexure 8.5
3.3	Waste Heat Recovery System (WHRS) based Power Plant	20,000.00	~ 22 MW
3.4	Mining machinery	4,150.00	Refer Chapter 3A
	Sub-total	128,523.71	
4.0	Engineering & Know How (Various Consultants)	1,100.00	
4.1	Expenses on foreign technicians and training abroad of local technicians	750.00	
	Sub-total	1,850.00	
5.0	Miscellaneous Fixed Assets (MFA)		
5.1	Furniture	200.00	
5.2	Office Machinery and Equipment including RFID & IT	150.00	
5.3	Miscellaneous Tools and Tackles	200.00	
5.4	Vehicles and vehicle expenses	150.00	
5.6	Captive Power Plant	-	Not Envisaged
5.8	Railway Siding	-	Not Envisaged
5.9	Equipment for Water Supply & Water intake	300.00	
5.10	Sewage collection, transport to Sewage treatment Plant	60.00	
5.11	Laboratory Equipment	210.00	
5.12	Workshop Equipment	150.00	
5.13	Fire Fighting Equipment & Fire Hydrant System	400.00	
5.14	Road Weigh Bridges	173.00	
5.15	Office Computers, RFID & IT	955.00	
5.16	Front End Loaders (2 Nos)	70.00	
	Sub-total	3,018.00	
	Total	218,750	

**COST OF BUILDINGS AND OTHER CIVIL STRUCTURES - IU**

(In Lakh INR Unless Specified Otherwise)

SN	DESCRIPTION	BUILDING COST	EQUIP. FND. COST
1.0	Main Factory Building		
1.1	Limestone crusher complex (including retaining wall, ramp, stone pitching, etc.)	1,090	135
1.2	Correctives & Additive crusher house (including short ramp, pitching, etc.)	100	25
1.3	Raw mills complex	1,040	210
1.4	Raw mill bag house & stack support structure	720	90
1.5	Preheater tower (Six stage, Double string)	2,415	35
1.6	Rotary Kiln Piers, Walkways, TA duct support	185	410
1.7	Clinker cooler house (including Dedusting structures & Stack supporting structure)	770	180
1.8	Coal Crusher House (incl. short retaining wall, ramp, stone pitching, etc.)	60	35
1.9	Coal mill house	745	205
1.10	HAG supporting structure	225	25
1.11	Cement mill house (including Dedusting structures & Stack supporting structure)	675	225
1.12	Packing plant, truck & bulk loading, bags godown	540	5
	SUB TOTAL (1.0)	8,565	1,580
2.0	Silos, Hoppers, Storages, Covered Gantry, etc.		
2.1	Limestone preblending stockpile (linear, covered, with S/R foundations)	350	450
2.2	Correctives storage (linear, covered, with S/R foundations)	155	195
2.3	Solid fuel storage (linear, covered, with S/R foundations)	185	465
2.4	Raw mill hoppers & building	340	10
2.5	Blending (Raw Meal) silo	630	20
2.6	Clinker silo & transport supporting structure	2,175	20
2.7	Unburnt clinker silo		
2.8	Clinker load-out silos (4nos.)	295	15
2.9	Gypsum, pond ash and sweetener storage (linear, covered)	290	0
2.10	Cement mill hoppers & building	340	10
2.11	Flyash silo	400	10
2.12	Cement silos	1,385	15
0.13	AFR Storage	400	15
	SUB TOTAL (2.0)	6,945	1,225
3.0	Auxiliary Services		
3.1	Switch yard	45	60
3.2	Main indoor substation	145	20
3.3	CCR, including Lab, Technical Offices, etc.	542	5
3.4	Load centres & MCC rooms	530	20
3.5	Electrical/ Mechanical Workshop & Yard	72	10
3.6	Compressor house & rooms	75	10
3.7	OLBC	0	0
3.8	Belt conveyors, TTs, etc. (plant internal; partly with gallery & partly locally covered)	715	0
3.9	Water Storage (UG+OH)	265	5
3.10	Weigh Bridges & Weigh Rooms	35	25
3.11	Overhead cable galleries	250	0
3.12	Dump hoppers & Truck tippler foundations	130	20
3.13	Cable Tunnels, Trenches, etc.	60	0
	SUB TOTAL (3.0)	2,864	175
4.0	Office/ Non factory buildings, etc		
4.1	Administrative & Services building	210	-
4.2	Gate house, Time & Security office	30	-
4.3	Sales, Dispatch & Logistics offices	45	-
4.4	General store & yard	95	-
4.5	Canteens (Executive, Workers, Truckers, etc.)	35	-
4.6	Shift units/ washrooms (in general/common areas)	40	-
	SUB TOTAL (4.0)	455	0
5.0	Mines offices, buildings, services, etc.		
5.1	Mines offices & basic workshop (Basic provisioning only)	217	-
5.2	Mines load centre	35	5
5.3	Magazine building	40	-
5.4	Mines garage	Future	-
	SUB TOTAL (5.0)	292	5
6.0	Land & Site development		
6.1	Site preparation, leveling, grading & development (Lumpsum provision)	150	-
6.2	Boundary wall + Fencing (Main Plant & Mines offices)	733	-
6.3	Approach Road to Plant (WBM+Bituminous; approx. 20,000sqm)	627	-
6.4	Plant Internal Roads (WBM+Bituminous; approx 42,666 sqm paved area)	1,341	-
6.5	Truck parking, transport offices & other semi-paved areas (~30,000 sqm)	1,109	-
6.6	Plant internal drainage	861	-
6.7	Landscaping and provision of green belt	40	-
	SUB TOTAL (6.0)	4,861	0
7.0	Residential Colony & Social Amenities		
7.1	Unit Head's Villa - 1 no. of ~250 sqm	65	-
7.2	TH/CH House - 02 nos of ~225 sqm	110	-
7.3	Type A Quarters - 8 nos. of ~200 sqm each	325	-
7.4	Type B Quarters - 16 nos. of ~150 sqm each (Multi Storey)	475	-
7.5	Type C Quarters - 32 nos. of ~125 sqm each (Multi Storey)	900	-
7.6	Type D Quarters - 40 nos. of ~100 sqm each (Multi Storey)	800	-
7.7	Type E Quarters - 120 nos. of ~80 sqm each (Multi Storey)	0	-
7.8	Bachelor Executives' Hostel - 1 no.	175	-
7.9	Workers' Dormitories - 2 nos.	70	-
7.10	Occupational Health Centre	80	-
7.11	Temple complex	250	-
7.12	Community hall, playground, shops, etc.	150	-
7.13	Guest house	400	-
7.14	Club, gymnasium, recreation, etc	125	-
7.15	School building & allied facilities	1,000	-
7.16	Other services (STP, WTP, roads, drains, water supply, green areas, etc.)	1,480	-
	SUB TOTAL (7.0)	6,405	0
8.0	Total (1.0+2.0+3.0+4.0+5.0+6.0+7.0)	30,387	2,985
9.0	Deep foundations cost-provisioning (Indicative 10% lumpsum provisioning considered as Geotechnical investigations at proposed plant site are at preliminary level only)	3,040	300
10.0	Indicative GST component on Civil works (average approx. 18% of total civil cost considered for TEFR formulation purpose)	5,470	537
11.0	Total Civil Works Cost (7.0+8.0+9.0)	38,897	3,822
			42,719

**COST OF MECHANICAL AND ELECTRICAL EQUIPMENT - IU**

(In Lakh INR Unless Specified Otherwise)

SN	DESCRIPTION	F.O.B.	F.O.R.
1.0	Mechanical Equipment		
1.1	Crushers		
1.1.1	Limestone crushing and wobbler	-	2,000
1.1.2	Coal Crushing	-	100
1.1.3	Additive/ Corrective Crusher	-	150
1.2	Stockpiles stackers & Reclaimers including the following:		
1.2.1	Limestone Storage, Stacker & Reclaimer including shed	-	2,666
1.2.2	Corrective Storage Stacker & Reclaimer including shed	-	1,701
1.2.3	Coal storage stacker and reclaimer including shed	-	1,573
1.3	Material Grinding and Pyroprocessing including the following:		
1.3.1	Raw Material and Coal Drying and Grinding including Baghouse	2,315	9,260
1.3.2	Blending Silo feed B/Ele, Silo, kiln feed, Clinkerisation (upto clinker silo extraction), Fine coal firing from silo extraction including ESP	2,500	10,000
1.3.3	Clinker transport to mill through DPC, Clinker drying & grinding (Upto cement silo feed B/E) including Baghouse	2,800	4,200
1.4	Cement Silo's and packing plant		
1.4.1	Clinker extraction system	-	150
1.4.2	Cement extraction from cement silo upto rotary packers including steel cement silo		764
1.4.3	Packing, truck loaders and bulk loading.		860
1.4.4	Clinker loading to trucks		250
1.4.5	AFR system with Shed		2,077
1.4.6	Flyash Silo	-	150
	Sub-total of Main Machinery (1.0)	7,615	35,901
2.0	MECHANICAL AUXILIARY EQUIPMENT(S)		
2.1	Steel for Duct/ Chute/hoppers/chimneys 8,000 t @ Rs 46200/ t	-	3,696
2.2	Plant belt conveyors including belting 3,500 m @ Rs 45,000/ m	-	1,575
2.3	Over Land belt conveyor (OLBC) 000 m @ Rs 55,000/ m	-	
2.5	Refractory & Castable 8,000 t @ Rs 35,000/ t	-	2,800
2.6	Insulation 70,000 m2 @ Rs 1130/ sq. m	-	791
2.7	Lubricants	-	160
2.8	Passenger Lifts (4 nos)	-	150
2.9	Roots Blowers	-	
2.10	Compressors & Driers including piping	-	350
2.11	Misc. items like Water Tank, Water Pump, Water Piping, Compressed Air Piping, etc.	-	462
2.12	BRU & Truck Tippler (4 nos.)	-	280
2.13	Cranes/Hoists and other misc items including HAG, N2 system etc.	-	650
	Sub-total of Mechanical Auxiliary Equipment (2.0)	0	10,914
	Total of Mechanical Equipment (1.0 + 2.0)	7,615	46,815
3.0	Electrical and Instrumentation		
3.1	HT Motors	-	960
3.2	LV & MV AC variable Speed Drives	-	1,505
3.3	LT Motors	-	627
3.4	Cross Belt Analyser, XRF, XRD, etc	250	481
3.5	Control & Automation and Field Instruments & Robo Lab	-	2,457
	Total Electrical and Instrumentation (3.0)	250	6,030
	Total Mechanical and Electrical equipment (1.0+2.0+3.0)	7,865	52,845
4.0	Landed cost of equipment		
4.1	Imported equipment		
4.1.1	F.O.B Cost		7,865
4.1.2	Ocean Freight, Insurance, etc. @ 6 % of (4.1.1)		472
4.1.3	Basic import duty @ 7.5 % of (4.1.1 + 4.1.2)		625
4.1.4	IGST @ 18 % of (4.1.1 to 4.1.3)		1,613
4.1.5	Clearing/ Loading/ Inland freight, etc. @ 5 % of (4.1.1 + 4.1.2)		417
	Sub-total of imported equipment (4.1)		10,992
4.2	Indigenous Equipment		
4.2.1	F.O.R cost		52,845
4.2.2	GST @ 18 % on F.O.R.		9,512
4.2.3	Freight, handling, insurance, etc. @ 5 % of 4.2.1		2,642
	Sub-total of indigenous equipment (4.2)		64,999
	Total landed cost of equipment (4.1 + 4.2)		75,991
5.0	Spare parts @ 5 % of F.O.B. + F.O.R.		3,035
6.0	Fabrication of Duct/ Chute/hoppers/chimneys 8,000 t @ Rs 20,000/ t		1,600
7.0	Erection, commissioning & supervision charges @ 12 % of (F.O.R. + F.O.B)		7,285
8.0	GST @18% on (6.0+7.0)		1,599
	Total cost of Mechanical and Electrical equipment		89,511
A	TOTAL COST OF EQUIPMENT (4.1+ 4.2+5.0+6.0+7.0+8.0)		89,511
B	IGST+GST		12,725
C	TOTAL LANDED COST OF EQUIPMENT (NET of IGST+GST)		76,786

**COST OF POWER DISTRIBUTION EQUIPMENT - IU**

(In Lakh INR Unless Specified Otherwise)

SN	DESCRIPTION	F.O.B.	F.O.R.
1.0	Power distribution equipment	-	
1.1	132 kV Transmission line ~45 Km	-	2,250
1.2	132 kV yard at sub-station	-	100
1.3	Development charges/Security deposit	-	490
1.4	Supervision charges SEB (10% of line cost)	-	225
1.5	Incomer switchyard and power transformer	-	587
1.6	11 KV Switch board with Capacitor Bank	-	661
1.7	11/0.433 kV , Distribution transformer with bus duct	-	544
1.8	LT switchboards and bus trunkings	-	445
1.9	MCC & Push button Station	-	709
1.10	LV Capacitor	-	180
1.13	Earthing, cable trays & erection hardware	-	600
1.14	Cables - Power, Control & Instrumentation	-	1,818
1.15	Plant Illumination with LDB	-	372
1.16	Battery and Battery Charger with LRS	-	83
1.17	Ventilation System for Electrical Building	-	143
1.18	Air Conditioning	-	185
1.19	Fire Detection System	-	74
1.20	PA system for intercom and Telephone exchange	-	45
1.21	Mine Power Distribution	-	0
1.22	DG Sets for Construction (2 MW)	-	113
1.23	Construction Power	-	261
1.24	EMS/Synchronisation/load shedding	-	75
1.25	Non-plant buildings electrification	-	85
1.26	Misc. Electricals	-	50
	Sub total	0.00	10,455.00
2.0	Landed cost of equipment		
2.1	F.O.R cost	0.00	10,455
2.2	GST @ 18 % on F.O.R.	-	1,882
2.5	Freight, handling, insurance, etc. @ 5 % of 4.2.1	-	523
	Total landed cost of equipment	0.00	12,859.65
3.0	Spare parts @ 5 % of FOR cost	-	523
4.0	Erection, commissioning & supervision charges @ 12% of F.O.R.	-	1,255
5.0	GST @ 18% of 4.0	-	226
A	Total cost of power distribution equipment	0.00	14,862.83
B	GST		2,107.73
C	TOTAL COST OF POWER DISTRIBUTION EQUIPMENT NET OF GST		12,755.10



SUMMARY OF INVESTMENT COST ESTIMATES - GU

(In Lakhs INR Unless Specified Otherwise)

Sn	DESCRIPTION	TOTAL COST
1	Land and Site Development	2,270
2	Buildings and Civil Structures	8,205
3	Plant and Machinery	21,163
4	Engineering & Know How	400
5	Expense on Training and Foreign Technicians	50
6	Miscellaneous Fixed Assets	210
	Total Cost	32,298

**INVESTMENT COST ESTIMATES - GU****(In Lakhs INR Unless Specified Otherwise)**

Sn	Description	Total Cost	Remarks
1.0	Land and Site Development		
1.1	Capital Cost of procured land for setting up the plant	900	Total cost estimated by JCL
1.2	Site preparation & development	50	Refer Annexure 8.8
1.3	Site enabling investigations (Topographical, Geotechnical & Hydrological)	50	Lumpsum
1.4	Boundary Wall	125	Refer Annexure 8.8
1.5	Gates, Security Pickets, etc.	30	Lumpsum
1.6	Approach Road to Plant	190	Refer Annexure 8.8
1.7	Plant Internal Roads	400	Refer Annexure 8.8
1.8	Truck Parking & Logistics Office	370	Refer Annexure 8.8
1.9	Plant Drainage	135	Refer Annexure 8.8
1.10	Landscaping and Provision of Green Belt	20	Refer Annexure 8.8
	Sub-total (1.0)	2,270	
2.0	Buildings and other civil structures		
2.1	Main Factory Buildings	1,785	Refer Annexure 8.8
2.2	Silos, Hoppers, Storages, Covered Gantry, etc.	3,100	Refer Annexure 8.8
2.3	Auxiliary Services	1,220	Refer Annexure 8.8
2.4	Office/ Non-factory buildings	250	Refer Annexure 8.8
2.6	Deep foundations cost provisioning on account of possibility of weaker soil bearing capacity (Soil investigations yet to take place)	400	Refer Annexure 8.8
2.7	Indicative GST component on civil works	1,450	Refer Annexure 8.8
	Sub-total (2.0)	8,205	
3.0	Plant & Machinery related		
3.1	Total Cost of Mechanical and Electrical Equipment (Net of GST)	14,930	Refer Annexure 8.9
3.2	GST component on Plant & Machinery (approx. provisioning)	2,450	Refer Annexure 8.9
3.3	Equipment for Distribution of Power (Net of GST)	2,560	Refer Annexure 8.10
3.4	GST component on Power distribution (approx. provisioning)	420	Refer Annexure 8.10
3.5	Equip. Foundations' (Machine Fnds.) civil cost component	423	Refer Annexure 8.8
3.6	Secondary Equipment:		
3.4.1	Laboratory equipment & setup	85	
3.4.2	Fire-fighting equipment & hydrant system	40	
3.4.3	Water treatment system	50	
3.4.4	Multi-utility equipment (front-end loader, fork lifts, truck-mounted lifting crane)	130	
3.4.5	Weighbridges	75	
	Sub-total (3.0)	21,163	
4.0	Expenses on technical know-how & training		
4.1	Engineering & know-how (various consultants & agencies)	400	
4.2	Training & skill upgradation related expenses (technicians & others)	50	
	Sub-total (4.0)	450	
5.0	Miscellaneous Fixed Assets (MFA)		
5.1	Office furniture, machinery & equipment	70	
5.2	Office gadgetary (computers, printers, LAN peripherals, etc.)	30	
5.3	Generic tools & tackles	50	
5.4	Light motor vehicles for office use	60	
5.5	Railway track/ siding	-	
	Sub-total (5.0)	210	
	Estimated Total Project Cost (1.0+2.0+3.0+4.0+5.0)	32,298	

**COST OF CIVIL STRUCTURES AND FOUNDATIONS - GU****(In Lakhs INR Unless Specified Otherwise)**

Sn	Description	Building Cost	Equip. Fnd. Cost (Machine Fnds.)
1.0	Main Factory Building		
1.1	HAG supporting structure	220	30
1.2	Cement mill house & dedusting building	1,025	225
1.3	Packing plant, truck loading, bags godown	540	5
	SUB TOTAL (1.0)	1,785	260
2.0	Silos, Hoppers, Storages, Covered Gantry, etc.		
2.1	Foundation network for linear & covered storage sheds for Gypsum, Pond ash & Coal	110	-
2.2	Clinker silo & transport supporting infrastructure	1,365	20
2.3	Support structure for cement mill hoppers (hoppers excluded)	210	10
2.4	Dry Flyash silo	460	10
2.5	Cement silos (2nos. RCC silos)	850	10
2.6	Cement silo (1no. Steel silo)	105	5
	SUB TOTAL (2.0)	3,100	55
3.0	Auxiliary Services		
3.1	Switchyard & Main receiving substation	90	30
3.2	CCR, Technical office, Laboratory, etc.	380	0
3.3	MCC rooms & Load centres	210	10
3.4	M&E Workshop (Not envisaged at this stage)	Future	-
3.5	Compressor house	45	8
3.6	Foundations & pedestals for belt conveyor galleries & transfer towers	150	-
3.7	Water storage (UG+OH) & Water treatment plant	110	10
3.8	Weigh bridges & weigh rooms	5	15
3.9	BRU & truck tippler foundations with common ramp for receiving clinker & gypsum	165	35
3.10	Foundations & pedestals for Overhead cable galleries	45	0
3.11	Cable tunnels & trenches, etc.	20	0
	SUB TOTAL (3.0)	1,220	108
4.0	Office/ Non factory Buildings, etc		
4.1	Administration & services office block	65	-
4.2	Time, security & dispatch offices block	20	-
4.3	Executives' & workers' canteens	65	-
4.4	General store & yard	80	-
4.5	Shift units/ washrooms (in general/common areas)	20	-
	SUB TOTAL (4.0)	250	0
5.0	Land & Site Development		
5.1	Site preparation, leveling & grading (presumptive nominal lumpsum provision only)	50	-
5.2	Boundary Wall (approx. 1,700m long; RCC framing with masonry & barbed wire top)	125	-
5.3	Approach Road to Plant (WBM+Concrete; Approx.300m long & 15.5m wide)	190	-
5.4	Plant Internal Roads (WBM & Bituminous+RCC; approx 10,000sqm paved area)	400	-
5.5	Truck parking area (WBM & Bituminous+RCC; (approx. 12,000sqm) & Logistics office	370	-
5.6	Plant drainage network (approx. 2,200m long with varying invert sections)	135	-
5.7	Landscaping & provision of green belt (lumpsum provision)	20	-
	SUB TOTAL (5.0)	1,290	0
6.0	Residential Colony & Social Amenities		
6.1	Not envisaged at this stage	-	-
	SUB TOTAL (6.0)	0	0
7.0	Total (1.0+2.0+3.0+4.0+5.0+6.0)	7,645	423
8.0	Deep foundations cost-provisioning (<i>Indicative 5% lumpsum</i> provisioning considered; Geotechnical investigations at proposed plant site not carried out yet)	380	20
9.0	Indicative GST component on Civil works (average approx.18% of total civil cost considered for TEFR formulation purpose)	1,375	75
10.0	Total Civil Works Cost (7.0+8.0+9.0)	9,400	518
		9,918	



Annexure 8.9

COST OF MECHANICAL AND ELECTRICAL EQUIPMENT - GU

(In Lakhs INR Unless Specified Otherwise)

Sn.	Description	F.O.B.	F.O.R.
1.0	Mechanical Equipment		
1.1	Gypsum & Pond ash handling, storage and transport to mill feed hoppers	-	75
1.2	Dry Flyash handling, transport, storage & feeding to mill	-	150
1.3	Coal handling, storage, feeding and transport (including HAG system)	-	205
1.4	Clinker transport, handling, storage, extraction & feeding system	-	225
1.5	Clinker grinding circuit & feeding to cement silos	2,400	3,600
1.6	Cement mill dedusting	-	600
1.7	Cement extraction from silos upto packers	-	310
1.8	Packing, loading & dispatch (2 packers, 6 truck loaders and 1 bulk loader)	-	810
	Sub-total of Main Machinery (1.0)	2,400	5,975
2.0	MECHANICAL AUXILIARY EQUIPMENT(S)		
2.1	Structural Steel for sheds, hoppers, conveyors, ducts, chutes, etc. (approx. 2,250 t @Rs.50,000/ t)	-	1,125
2.2	Material conveying system (approx.1200m @Rs.40,000/ m)	-	480
2.3	Insulation (approx.8,500sqm @Rs.1000/ sqm)	-	85
2.4	Auxiliary bag filters (approx. 12nos.)	-	60
2.5	Lubricants	-	15
2.6	Material receiving system (Bulk receiving units with truck tippler facility, 2 nos.)	-	210
2.7	Passenger lift (for CCR)	-	25
2.8	Roots blowers	-	35
2.9	Compressors & dryers	-	60
2.10	Misc. items like water pump & pipeline, compressed air piping, etc.	-	60
2.11	Cranes/Hoists and other miscellaneous items, etc.	-	100
	Sub-total of Mechanical Auxiliary Equipment (2.0)	0	2,255
	Total of Mechanical Equipment (1.0 + 2.0)	2,400	8,230
3.0	Electrical and Instrumentation		
3.1	HT motors	-	235
3.2	LV & MV AC variable Speed Drives	-	165
3.3	LT motors	-	105
3.4	Table-top XRF	-	70
3.5	Control & Automation	-	260
	Total Electrical and Instrumentation (3.0)	0	835
	Total Mechanical and Electrical equipment (1.0+2.0+3.0)	2,400	9,065
4.0	Landed cost of equipment		
4.1	Imported Equipment		
4.1.1	F.O.B. Cost		2,400
4.1.2	Provisioning for Ocean Freight, Insurance, etc. (approx.@6% of 4.1.1)		145
4.1.3	Basic Import Duty provision (approx. @7.5% of 4.1.1 & 4.1.2)		190
4.1.4	GST (all taxes assumed to be clubbed under GST, approx.@18% of 4.1.1 to 4.1.3)		490
4.1.5	Clearing/ Loading/ Inland Freight, etc. (approx.@5% of 4.1.1 + 4.1.2)		125
	Sub-total of Imported Equipment (4.1)		3,350
4.2	Indigenous Equipment		
4.2.1	F.O.R. cost		9,065
4.2.2	GST provisioning on F.O.R. cost (@18% of 4.2.1)		1,630
4.2.3	Provisioning for freight, handling, insurance, etc. (approx.@5% of 4.2.1)		455
	Sub-total of Indigenous Equipment (4.2)		11,150
	Total Landed Cost of Equipment (4.1 + 4.2)		14,500
5.0	Provisioning for Spares (approx. @5% of F.O.B. & F.O.R. landed cost)		725
6.0	Fabrication of Str. Steel as in 2.1 above (2,250 t @Rs.20,000/ t)		450
7.0	Erection, Commissioning & Supervision Charges (approx.@12 % of F.O.R. + F.O.B.)		1,375
8.0	GST on Fabrication, erection & supervision charges (approx.@18% on (6.0+7.0))		330
	Total cost of Mechanical and Electrical equipment		17,380
A	Total landed cost of equipment		17,380
B	Total landed cost of equipment (Net of GST)		14,930
C	GST component on Plant & Machinery (approx. provisioning)		2,450



Annexure 8.10

COST OF POWER DISTRIBUTION EQUIPMENT - GU

(In Lakhs INR Unless Specified Otherwise)

Sn.	Description	F.O.B.	F.O.R.
1.0	Power distribution equipment		
1.1	Transmission line from Grid substation (33kV, approx.6 km)	-	360
1.2	Incomer switchyard & power transformer	-	200
1.3	6.6 kV switchboard	-	180
1.4	6.6 /0.433 kV distribution transformer	-	100
1.5	LT switchboard & trunking	-	120
1.6	MCC & push button Station	-	210
1.7	LV capacitors & control panel	-	35
1.8	Lighting transformer & main lighting distribution board	-	60
1.9	Cables (Power, Control & Instrumentation)	-	375
1.10	Construction power cables	-	35
1.11	Earthing, lighting protection & erection hardware	-	150
1.12	Plant Illumination	-	15
1.13	UPS, battery & battery charger	-	25
1.14	Ventilation system for electrical buildings	-	20
1.15	Air conditioning	-	20
1.16	PA system for intercom	-	5
1.17	Fire detection system	-	15
1.18	DG set for construction & emergency power supply	-	125
1.19	Miscellaneous electricals	-	25
	Sub total (1.0)	0	2,075
2.0	Landed cost of equipment		
2.1	Imported Equipment		
2.1.1	F.O.B. Cost		0
2.1.2	Ocean Freight, Insurance, etc. (approx.@6% of 2.1.1)		0
2.1.3	Basic Import Duty (@7.5% of 2.1.1 & 2.1.2)		0
2.1.4	GST (all taxes assumed to be clubbed under GST, approx.@18% of 2.1.1 to 2.1.3)		0
2.1.5	Clearing/ Loading/ Inland Freight, etc. (approx.@5% of 2.1.1 + 2.1.2)		0
	Sub-total of Imported Equipment (2.1)		0
2.2	Indigenous Equipment		
2.2.1	F.O.R. cost		2,075
2.2.2	GST provisioning on F.O.R. cost (@18% of 2.2.1)		375
2.2.3	Provisioning for freight, handling, insurance, etc. (approx.@5% of 2.2.1)		105
	Sub total (2.0)		2,555
	Total Landed Cost of Equipment (2.1 + 2.2)		2,555
3.0	Provisioning for Spares (approx. @5% of total landed cost)		130
4.0	Erection, Commissioning & Supervision Charges (approx.@12 % of 2.1.1 + 2.2.1)		250
5.0	GST on erection & supervision charges (approx.@18% of 4.0)		45
A	Total landed cost of Power Distribution Equipment (2.0+3.0+4.0+5.0)		2,980
B	Total landed cost of Power Distribution Equipment (Net of GST)		2,560
C	GST component on Power distribution (approx. provisioning)		420



UNIT CASH COST OF PRODUCTION (IU)

UCOP IN YEAR NUMBER : 5

Details		Units	Rate	Qty/ Unit			Cost (INR/ t)		
				Clinker	OPC	PPC	Clinker	OPC	PPC
Raw Materials & Consumables									
a)	Cement Grade Limestone	INR/ t	181	1.46	1.31	0.88	264	238	159
b)	Bauxite	INR/ t	1,500	0.03	0.03	0.02	50	45	30
c)	Iron ore	INR/ t	1,100	0.02	0.02	0.01	20	18	12
d)	Gypsum	INR/ t	3,700	-	0.05	0.05	-	185	185
e)	Flyash	INR/ t	681	-	-	0.35	-	-	238
f)	Consumables Cement	INR/ t	85	-	1.00	1.00	-	85	85
g)	Consumables Clinker	INR/ t	60	1.00	-	-	60	-	-
Total		-	-	-	-	-	394	571	709
Utilities				-	-	-	-	-	-
a)	Power	INR/ kWh	3.35	48.0	80.0	65.0	161	268	218
b)	Fuel	INR/ t	5,376	13.4%	12.1%	8.1%	721	649	433
c)	Water	INR/ t	1.0	1.0	1.0	1.0	1.0	1.0	1.0
							883	918	652
Wages & Salaries							-	-	-
a)	Wages Clinker	INR/ t					109	-	-
b)	Wages Cement	INR/ t					-	109	109
							109	109	109
Factory Overheads							-	-	-
a)	Overheads Cement	INR/ t					70	105	105
							70	105	105
Administrative Expenses							-	-	-
a)	Admin Expenses Cement	INR/ t					-	53	53
b)	Admin Expenses Clinker	INR/ t					35	-	-
							35	53	53
Selling & Distribution Expenses							-	-	-
a)	S&D Expenses	INR/ t					-	200	200
							-	200	200
Packing Expenses							-	-	-
a)	Packing Expenses IU	INR/ t					-	200	200
							-	-	-
Unit Cash Cost of Production							1,490	2,155	2,027



TEFR for a Greenfield Integrated Cement Plant in Madhya Pradesh with
split located grinding unit in Uttar Pradesh
Jaykaycem (Central) Limited



Annexure 8.12

UNIT CASH COST OF PRODUCTION (GU)

DESCRIPTION		UNIT	Rs/UNIT	Qty/ Unit (PPC)	Cost (Rs/ t) (PPC)
Raw Materials & Consumables					
a)	Clinker	Rs/ t	3,300	60%	1,980
b)	Gypsum	Rs/ t	4,500	5%	225
c)	Fly ash & Pond ash	Rs/ t	350	35%	123
d)	Consumables	Rs/ t	35	1.0	35
	Total				2,363
Utilities					
a)	Power	Rs/ kWh	7.70	32.0	246
b)	Coal	Rs/ t	4,500	2.0%	90
c)	Water	Rs/ t	1.00	1.00	1.00
					337
Wages & Salaries					
a)	Wages	Rs/ t			83
					83
Factory Overheads					
a)	Overheads	Rs/ t			53
					53
Administrative Expenses					
a)	Admin expenses	Rs/ t			37
					37
Selling & Distribution Expenses					
a)	SGA expenses	Rs/ t			200
					200
Packing Expenses					
a)	Packing expenses	Rs/ t			200
Unit Cash Cost of Production		Rs/ t			3,273



LOAN REPAYMENT & INTEREST SCHEDULE

(in INR Lakhs unless specified otherwise)

Term Loan 1	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11	YR 12	YR 13	YR 14	YR 15
Interest Rate	7.50%														
Loan (Outstanding)	21,554	167,886	167,886	167,886	162,850	156,134	142,703	125,915	109,126	92,337	75,549	58,760	41,972	25,183	8,394
Interest	269	12,591	12,591	12,450	11,962	11,206	10,073	8,814	7,555	6,296	5,037	3,777	2,518	1,335	178
Moratorium	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No
Repayment	-	-	-	5,037	6,715	13,431	16,789	16,789	16,789	16,789	16,789	16,789	16,789	16,789	8,394
Closing Balance	21,554	167,886	167,886	162,850	156,134	142,703	125,915	109,126	92,337	75,549	58,760	41,972	25,183	8,394	(0)

Working Capital	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11	YR 12	YR 13	YR 14	YR 15
Interest Rate	7.50%														
Loan (Outstanding)	1,184	4,899	5,527	6,156	6,470	6,470	6,470	6,470	6,470	6,470	6,470	6,470	6,470	6,470	6,470
Interest	89	367	415	462	485	485	485	485	485	485	485	485	485	485	485
Moratorium	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Repayment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Closing Balance	1,184	4,899	5,527	6,156	6,470	6,470	6,470	6,470	6,470	6,470	6,470	6,470	6,470	6,470	6,470



PROFIT & LOSS ACCOUNT

(in INR Lakhs unless specified otherwise)

Descriptions	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11	YR 12	YR 13	YR 14	YR 15	YR 16
Total Sales Qty																
Cement																
IU																
OPC IU Bag		5.60	6.40	7.20	7.60	7.60	7.60	7.60	7.60	7.60	7.60	7.60	7.60	7.60	7.60	7.60
PPC IU Bag		8.40	9.60	10.80	11.40	11.40	11.40	11.40	11.40	11.40	11.40	11.40	11.40	11.40	11.40	11.40
Total Cement Sale IU	0.00	14.00	16.00	18.00	19.00	19.00	19.00	19.00	19.00	19.00	19.0	19.0	19.0	19.0	19.0	19.0
GU 1																
PPC GU 1 Bag	1.67	14.00	16.00	18.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00
Total Cement Sale GU 1	1.67	14.00	16.00	18.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00
Total Cement Sale	1.67	28.00	32.00	36.00	38.00	38.00	38.00	38.00	38.00	38.00	38.00	38.00	38.00	38.00	38.00	38.00
Total Cement Production IU + GU	1.67	28.00	32.00	36.00	38.00	38.00	38.00	38.00	38.00	38.00	38.00	38.00	38.00	38.00	38.00	38.00
Clinker																
Clinker Sale	0.0	8.4	9.6	10.8	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4
Total Clinker Sale	0.0	8.4	9.6	10.8	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4
Revenue																
Cement																
IU																
OPC IU Bag	-	36,070	41,223	46,376	48,953	48,953	48,953	48,953	48,953	48,953	48,953	48,953	48,953	48,953	48,953	48,953
PPC IU Bag	-	52,426	59,915	67,405	71,149	71,149	71,149	71,149	71,149	71,149	71,149	71,149	71,149	71,149	71,149	71,149
GU 1																
PPC GU 1 Bag	10,792	90,649	103,599	116,549	123,024	123,024	123,024	123,024	123,024	123,024	123,024	123,024	123,024	123,024	123,024	123,024
Clinker																
Clinker Sale	-	22,680	25,920	29,160	30,780	30,780	30,780	30,780	30,780	30,780	30,780	30,780	30,780	30,780	30,780	30,780
Gross Sales	10,792	201,826	230,658	259,490	273,906	273,906	273,906	273,906	273,906	273,906	273,906	273,906	273,906	273,906	273,906	273,906
GST on Cement																
OPC	-	7,890	9,018	10,145	10,708	10,708	10,708	10,708	10,708	10,708	10,708	10,708	10,708	10,708	10,708	10,708
PPC	2,361	31,298	35,769	40,240	42,475	42,475	42,475	42,475	42,475	42,475	42,475	42,475	42,475	42,475	42,475	42,475
Total GST	2,361	39,188	44,786	50,385	53,184	53,184	53,184	53,184	53,184	53,184	53,184	53,184	53,184	53,184	53,184	53,184
Net Sales	8,431	162,638	185,872	209,106	220,722	220,722	220,722	220,722	220,722	220,722	220,722	220,722	220,722	220,722	220,722	220,722
Expenditure																
Raw Materials & Consumables																
Cement Grade Limestone	-	4,885	5,583	6,280	6,629	6,629	6,629	6,629	6,629	6,629	6,629	6,629	6,629	6,629	6,629	6,629
Bauxite	-	921	1,052	1,184	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250	1,250
Iron ore	-	368	421	474	500	500	500	500	500	500	500	500	500	500	500	500
Gypsum	375	5,740	6,560	7,380	7,790	7,790	7,790	7,790	7,790	7,790	7,790	7,790	7,790	7,790	7,790	7,790
Flyash	204	3,717	4,248	4,779	5,045	5,045	5,045	5,045	5,045	5,045	5,045	5,045	5,045	5,045	5,045	5,045
Consumables Cement	58	1,680	1,920	2,160	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280	2,280
Consumables Clinker	-	500	571	643	678	678	678	678	678	678	678	678	678	678	678	678
Clinker	3,300.0	27,720.0	31,680.0	35,640.0	37,620.0	37,620.0	37,620.0	37,620.0	37,620.0	37,620.0	37,620.0	37,620.0	37,620.0	37,620.0	37,620.0	37,620.0
Sub Total	3,938	45,531	52,035	58,540	61,792	61,792	61,792	61,792	61,792	61,792	61,792	61,792	61,792	61,792	61,792	61,792
Utilities																
Power	411	8,130	9,292	10,453	11,034	11,034	11,034	11,034	11,034	11,034	11,034	11,034	11,034	11,034	11,034	11,034
Coal	150	14,593	16,677	18,762	19,805	19,805	19,805	19,805	19,805	19,805	19,805	19,805	19,805	19,805	19,805	19,805
Water	2	36	42	47	49	49	49	49	49	49	49	49	49	49	49	49
Sub Total	562	22,759	26,011	29,262	30,888	30,888	30,888	30,888	30,888	30,888	30,888	30,888	30,888	30,888	30,888	30,888
Salaries & Wages																
Wages Cement	263	3,643	3,643	3,643	3,643	3,643	3,643	3,643	3,643	3,643	3,643	3,643	3,643	3,643	3,643	3,643
Wages Clinker	-	1,238	1,238	1,238	1,238	1,238	1,238	1,238	1,238	1,238	1,238	1,238	1,238	1,238	1,238	1,238



PROFIT & LOSS ACCOUNT

(in INR Lakhs unless specified otherwise)

Descriptions	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11	YR 12	YR 13	YR 14	YR 15	YR 16
Factory Overheads																
Overheads Cement	167	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Overheads Clinker	-	798	798	798	798	798	798	798	798	798	798	798	798	798	798	798
Cost Of Production	4,930	76,968	86,724	96,480	101,358	101,358	101,358	101,358	101,358	101,358	101,358	101,358	101,358	101,358	101,358	101,358
Administrative Expenses																
Admin Expenses Cement	117	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700
Admin Expenses Clinker	-	399	399	399	399	399	399	399	399	399	399	399	399	399	399	399
Selling Expenses																
S&D Expenses	333	5,600	6,400	7,200	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600
Packing Expenses IU	333	5,600	6,400	7,200	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600	7,600
Freight	1,038	21,239	24,273	27,307	28,824	28,824	28,824	28,824	28,824	28,824	28,824	28,824	28,824	28,824	28,824	28,824
Channel Margin	833	14,000	16,000	18,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000	19,000
Incentives	-	7,728	7,728	7,728	7,728	7,728	7,728	7,728	5,586	5,586	5,586	5,586	5,586	5,586	5,586	4,759
EBDITA	846	44,860	51,704	58,548	61,970	61,970	61,970	61,970	59,827	59,827	59,827	59,827	59,827	59,827	59,827	59,001
Depreciation	298	12,234	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	11,919
EBIT	548	32,626	39,547	46,391	49,813	49,813	49,813	49,813	47,670	47,670	47,670	47,670	47,670	47,670	47,670	47,082
Financial Expenses																
Interest on TL 1	269	12,591	12,591	12,450	11,962	11,206	10,073	8,814	7,555	6,296	5,037	3,777	2,518	1,335	178	0
Interest on Wk Cap	89	367	415	462	485	485	485	485	485	485	485	485	485	485	485	485
Total Interest	358	12,959	13,006	12,911	12,447	11,692	10,558	9,299	8,040	6,781	5,522	4,263	3,004	1,820	663	485
PBT	190	19,667	26,541	33,479	37,366	38,121	39,254	40,513	39,630	40,889	42,148	43,407	44,666	45,850	47,007	46,597
Tax Payable	40	4,162	5,617	7,086	7,908	8,068	8,308	8,574	8,387	8,824	11,730	12,314	12,860	13,355	13,816	13,798
PAT	150	15,504	20,923	26,394	29,457	30,053	30,946	31,939	31,242	32,065	30,418	31,093	31,806	32,495	33,191	32,799
Input Tax Credit (ITC)	2,361	21,318	1,481	-	-	-	-	-	-	-	-	-	-	-	-	-
Net Cash Accruals	2,809	49,057	34,562	38,551	41,615	42,211	43,104	44,097	43,400	44,223	42,575	43,251	43,964	44,652	45,349	44,718



SCHEDULE FOR WORKING CAPITAL REQUIREMENT

(in INR Lakhs unless specified otherwise)

Description	No. of Days	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11	YR 12	YR 13	YR 14	YR 15	YR 16
A CURRENT ASSETS																	
Raw Materials & Consumables																	
Cement Grade Limestone	3	-	44	51	57	60	60	60	60	60	60	60	60	60	60	60	60
Bauxite	15	-	42	48	54	57	57	57	57	57	57	57	57	57	57	57	57
Iron ore	15	-	17	19	22	23	23	23	23	23	23	23	23	23	23	23	23
Gypsum	7	48	122	139	157	165	165	165	165	165	165	165	165	165	165	165	165
Flyash	4	7	35	40	45	47	47	47	47	47	47	47	47	47	47	47	47
Clinker	10	420	967	1,106	1,244	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313	1,313
Other Consumables																	
Consumables	5	32	70	80	90	95	95	95	95	95	95	95	95	95	95	95	95
S&D Expenses	30	61	339	388	436	461	461	461	461	461	461	461	461	461	461	461	461
Packing Expenses	10	61	170	194	218	230	230	230	230	230	230	230	230	230	230	230	230
Power	30	224	739	845	950	1,003	1,003	1,003	1,003	1,003	1,003	1,003	1,003	1,003	1,003	1,003	1,003
Coal	0	11	15	17	20	21	21	21	21	21	21	21	21	21	21	21	21
Labour & Factory Overheads																	
Salaries & Wages	30	144	444	444	444	444	444	444	444	444	444	444	444	444	444	444	444
Factory Overheads	30	91	345	345	345	345	345	345	345	345	345	345	345	345	345	345	345
Finished Goods																	
Cement in Silo	3	179	577	650	722	758	758	758	758	758	758	758	758	758	758	758	758
Bagged Cement GU	2	279	550	629	708	747	747	747	747	747	747	747	747	747	747	747	747
Accounts Receivable																	
Sundry Debtors	20	3,924	12,232	13,979	15,727	16,600	16,600	16,600	16,600	16,600	16,600	16,600	16,600	16,600	16,600	16,600	16,600
TOTAL CURRENT ASSETS		5,480	16,709	18,973	21,237	22,369	22,369	22,369	22,369	22,369	22,369	22,369	22,369	22,369	22,369	22,369	22,369
B CURRENT LIABILITIES																	
Creditors	30	3,902	10,177	11,603	13,030	13,743	13,743	13,743	13,743	13,743	13,743	13,743	13,743	13,743	13,743	13,743	13,743
WORKING CAPITAL REQUIREMENT		1,578	6,532	7,370	8,207	8,626	8,626	8,626	8,626	8,626	8,626	8,626	8,626	8,626	8,626	8,626	8,626
WK Cap Margin Money		395	1,633	1,842	2,052	2,157	2,157	2,157	2,157	2,157	2,157	2,157	2,157	2,157	2,157	2,157	2,157
Wk Cap Borrowings		1,184	4,899	5,527	6,156	6,470	6,470	6,470	6,470	6,470	6,470	6,470	6,470	6,470	6,470	6,470	6,470
Increase in Current Assets		1,578	4,954	838	838	419	-	-	-	-	-	-	-	-	-	-	-
Increase in WK Cap Borrowings		1,184	3,716	628	628	314	-	-	-	-	-	-	-	-	-	-	-



PROJECTED CASH FLOW STATEMENT

(in INR Lakhs unless specified otherwise)

DESCRIPTION	CONSTRUCTION PERIOD		OPERATION PERIOD (complete year)														
	YR 1	YR 2 GU Operation 2 Months	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11	YR 12	YR 13	YR 14	YR 15
Sources of Funds																	
Equity	51,945	77,198	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Debt	67,529	100,358	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EBIDTA	-	846	44,860	51,704	58,548	61,970	61,970	61,970	61,970	59,827	59,827	59,827	59,827	59,827	59,827	59,827	59,001
Wk Cap Borrowings	-	4,482	837	628	418	104	-	-	-	-	-	-	-	-	-	-	-
ITC	-	2,361	21,318	1,481	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Sources	119,474	185,245	67,015	53,813	58,967	62,075	61,970	61,970	61,970	59,827	59,827	59,827	59,827	59,827	59,827	59,827	59,001
Application of Funds																	
Fixed Asset Purchases	119,474	176,062	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Increase in Wk Cap	-	5,976	1,116	838	558	139	-	-	-	-	-	-	-	-	-	-	-
Repayment of Term Loan	-	-	-	-	5,037	6,715	13,431	16,789	16,789	16,789	16,789	16,789	16,789	16,789	16,789	8,394	-
Payment of Interest on Term Loan	-	269	12,591	12,591	12,450	11,962	11,206	10,073	8,814	7,555	6,296	5,037	3,777	2,518	1,335	178	0
Payment of Interest on Wk Cap Loan	-	89	367	415	462	485	485	485	485	485	485	485	485	485	485	485	485
Taxation	-	40	4,162	5,617	7,086	7,908	8,068	8,308	8,574	8,387	8,824	11,730	12,314	12,860	13,355	13,816	13,798
Total Application	119,474	182,436	18,237	19,461	25,592	27,210	33,190	35,655	34,662	33,216	32,393	34,041	33,365	32,652	31,964	22,873	14,283
Surplus Deficit	-	2,809	48,778	34,352	33,375	34,865	28,780	26,315	27,308	26,611	27,434	25,787	26,462	27,175	27,864	36,955	44,718
Opening Cash & Bank Balance	-	-	2,809	51,587	85,939	119,314	154,179	182,959	209,274	236,582	263,193	290,627	316,414	342,876	370,051	397,914	434,869
Closing Cash & Bank Balance	-	2,809	51,587	85,939	119,314	154,179	182,959	209,274	236,582	263,193	290,627	316,414	342,876	370,051	397,914	434,869	479,587



PROJECTED BALANCE SHEET

(in INR Lakhs unless specified otherwise)

(in INR Lakhs unless specified otherwise)																	
DESCRIPTIONS	CONSTRUCTION PERIOD		OPERATION PERIOD (complete year)														
Liabilities	YR 1	YR 2 GU Operation 2 Months	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11	YR 12	YR 13	YR 14	YR 15
	31-Mar-22	31-Mar-23	31-Mar-24	31-Mar-25	31-Mar-26	31-Mar-27	31-Mar-28	31-Mar-29	31-Mar-30	31-Mar-31	31-Mar-32	31-Mar-33	31-Mar-34	31-Mar-35	31-Mar-36	31-Mar-37	31-Mar-38
Equity	51,945	129,143	129,143	129,143	129,143	129,143	129,143	129,143	129,143	129,143	129,143	129,143	129,143	129,143	129,143	129,143	129,143
General reserves	-	150	15,654	36,578	62,971	92,429	122,482	153,428	185,367	216,610	248,675	279,092	310,185	341,992	374,486	407,677	440,476
Debt	67,529	167,886	167,886	167,886	162,850	156,134	142,703	125,915	109,126	92,337	75,549	58,760	41,972	25,183	8,394	(0)	(0)
Working Capital Loan	-	4,482	5,319	5,947	6,365	6,470	6,470	6,470	6,470	6,470	6,470	6,470	6,470	6,470	6,470	6,470	6,470
ITC	-	2,361	23,679	25,159	25,159	25,159	25,159	25,159	25,159	25,159	25,159	25,159	25,159	25,159	25,159	25,159	25,159
Total Liabilities	119,474	304,021	341,681	364,713	386,488	409,335	425,957	440,115	455,265	469,719	484,996	498,625	512,929	527,947	543,653	568,450	601,249
Assets																	
Gross Fixed Assets	119,474	295,535	295,535	295,535	295,535	295,535	295,535	295,535	295,535	295,535	295,535	295,535	295,535	295,535	295,535	295,535	295,535
Less ITC																	-
Less Accumulated Dep.	-	298	12,533	24,690	36,848	49,006	61,163	73,321	85,478	97,636	109,793	121,951	134,108	146,266	158,424	170,581	182,500
Net Block	119,474	295,237	283,002	270,845	258,687	246,530	234,372	222,215	210,057	197,900	185,742	173,585	161,427	149,269	137,112	124,954	113,035
Working Capital Assets	-	5,976	7,092	7,929	8,487	8,626	8,626	8,626	8,626	8,626	8,626	8,626	8,626	8,626	8,626	8,626	8,626
Cash Balance	-	2,809	51,587	85,939	119,314	154,179	182,959	209,274	236,582	263,193	290,627	316,414	342,876	370,051	397,914	434,869	479,587
Total Assets	119,474	304,021	341,681	364,713	386,488	409,335	425,957	440,115	455,265	469,719	484,996	498,625	512,929	527,947	543,653	568,450	601,249



INTERNAL RATE ON RETURN (IRR) - ON TOTAL INVESTMENT

(in INR Lakhs unless specified otherwise)

DESCRIPTIONS		CONSTRUCTION PERIOD		OPERATION PERIOD (complete year)														
		YR 1	YR 2 GU Operation 2 Months	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11	YR 12	YR 13	YR 14	YR 15
Inflows																		
PAT		-	150	15,504	20,923	26,394	29,457	30,053	30,946	31,939	31,242	32,065	30,418	31,093	31,806	32,495	33,191	32,799
Add: Depreciation		-	298	12,234	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	11,919
Add: Interest		-		12,959	13,006	12,911	12,447	11,692	10,558	9,299	8,040	6,781	5,522	4,263	3,004	1,820	663	485
ADD: ITC		-	2,361	21,318	1,481	-	-	-	-	-	-	-	-	-	-	-	-	-
Less: Change WC Internal Accrual		-	-	1,239	209	209	105	-	-	-	-	-	-	-	-	-	-	-
Terminal Value																		275,065
Total Inflows		-	2,809	60,777	47,358	51,253	53,957	53,902	53,662	53,396	51,440	51,004	48,097	47,513	46,967	46,472	46,012	320,268
Outflows																		
Capex		119,474	177,556	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Outflows		119,474	177,556	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Net Flow																		
Cash Flow		(119,474)	(174,747)	60,777	47,358	51,253	53,957	53,902	53,662	53,396	51,440	51,004	48,097	47,513	46,967	46,472	46,012	320,268
IRR on Investment	16.4%																	
NPV	160,266																	



INTERNAL RATE ON RETURN (IRR) - ON EQUITY

(in INR Lakhs unless specified otherwise)

DESCRIPTIONS		CONSTRUCTION PERIOD		OPERATION PERIOD (complete year)														
		YR 1	YR 2 GU Operation 2 Months	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11	YR 12	YR 13	YR 14	YR 15
Inflows																		
PAT		-	150	15,504	20,923	26,394	29,457	30,053	30,946	31,939	31,242	32,065	30,418	31,093	31,806	32,495	33,191	32,799
Add: Depreciation		-	298	12,234	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	11,919
Less: Loan Repayment				-	-	-	5,037	6,715	13,431	16,789	16,789	16,789	16,789	16,789	16,789	16,789	16,789	8,394
ADD: CENVAT		-	1,026	9,269	644	-	-	-	-	-	-	-	-	-	-	-	-	-
Less: Change WC Internal Accrual		-	-	1,239	209	209	105	-	-	-	-	-	-	-	-	-	-	-
Terminal Value																		223,250
Total Inflows		-	1,474	35,769	33,515	38,342	36,474	35,495	29,673	27,308	26,611	27,434	25,787	26,462	27,175	27,864	28,560	259,573
Outflows																		
Capex		51,945	77,198	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Outflows		51,945	77,198	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Net Flow																		
Cash Flow		(51,945)	(75,724)	35,769	33,515	38,342	36,474	35,495	29,673	27,308	26,611	27,434	25,787	26,462	27,175	27,864	28,560	259,573
IRR on Equity	24.3%																	



DEBT SERVICE COVERAGE RATIO (DSCR) & BREAK-EVEN POINTS (BEP)

(in INR Lakhs unless specified otherwise)

DESCRIPTIONS		YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11	YR 12	YR 13	YR 14	YR 15
BEP Calculations																
Net Sales		8,431	162,638	185,872	209,106	220,722	220,722	220,722	220,722	220,722	220,722	220,722	220,722	220,722	220,722	220,722
Variable Expenses		6,704	109,129	124,719	140,309	148,104	148,104	148,104	148,104	148,104	148,104	148,104	148,104	148,104	148,104	148,104
Contribution		1,726	53,509	61,153	68,797	72,619	72,619	72,619	72,619	72,619	72,619	72,619	72,619	72,619	72,619	72,619
PV Ratio		20%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%
Fixed Expenses		1,537	41,570	42,341	43,046	42,982	42,226	41,093	39,834	38,575	37,316	36,056	34,797	33,538	32,355	31,197
Fixed Cash Expenses		1,238	29,336	30,183	30,888	30,824	30,069	28,935	27,676	26,417	25,158	23,899	22,640	21,381	20,197	19,040
BEP		7,504	126,352	128,693	130,837	130,641	128,345	124,901	121,074	117,247	113,419	109,592	105,765	101,938	98,341	94,823
BEP in %	73%	89%	78%	69%	63%	59%	58%	57%	55%	53%	51%	50%	48%	46%	45%	43%
Cash BEP		6,046	89,166	91,740	93,885	93,689	91,393	87,948	84,121	80,294	76,467	72,640	68,813	64,985	61,389	57,871
	52%	72%	55%	49%	45%	42%	41%	40%	38%	36%	35%	33%	31%	29%	28%	26%
DSCR Calculations																
PAT		150	15,504	20,923	26,394	29,457	30,053	30,946	31,939	31,242	32,065	30,418	31,093	31,806	32,495	16,596
Depreciation		298	12,234	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	12,158	6,079
Total Interest		358	12,959	13,006	12,911	12,447	11,692	10,558	9,299	8,040	6,781	5,522	4,263	3,004	1,820	663
Total		806	40,698	46,087	51,463	54,062	53,902	53,662	53,396	51,440	51,004	48,097	47,513	46,967	46,472	23,337
Total Interest		358	12,959	13,006	12,911	12,447	11,692	10,558	9,299	8,040	6,781	5,522	4,263	3,004	1,820	663
Total Term Loan Repayment		-	-	-	5,037	6,715	13,431	16,789	16,789	16,789	16,789	16,789	16,789	16,789	16,789	8,394
Total		358	12,959	13,006	17,948	19,163	25,123	27,347	26,088	24,829	23,570	22,310	21,051	19,792	18,609	9,057
DSCR		2.25	3.14	3.54	2.87	2.82	2.15	1.96	2.05	2.07	2.16	2.16	2.26	2.37	2.50	2.58
Average DSCR	2.38															
Minimum DSCR	1.96															



HOLTEC

HOLTEC CONSULTING PRIVATE LIMITED

'Holtec Centre'

A Block, Sushant Lok,
Gurgaon - 122 001, Haryana, India
Phones : +91-0124-4047900, 2358095, 2385096*
Fax : +91-0124-2385114, 2385116,
(from Delhi prefix '95124')
Email : info@holtecnet.com

Registered Office

01-0103 Imperial Tower, C-Block Community Centre, Naraina, New Delhi-110028
Phone : 25771002 Fax : ++91-11 25771001