PROJECT MANAGEMENT CONSULTANCY FOR IMPLEMENTATION OF SMART CITY MISSION PROJECTS FOR MANGALURU CITY DRAFT DETAILED PROJECT REPORT OF MANGALA STADIUM (Phase 1) MANNAGUDDA, MANGALURU



CLIENT



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1 SALIENT FEATURES

1	Title of the project	Proposed Upgradation of Mangala Stadium (Phase 1)
2	Details of the project	
	i. District	Dakshina Kannada
	ii. Taluk	Mangaluru
	iii. Corporation	Mangaluru
	iv. Assembly Constituency	Mangaluru South
3	Implementing agency/SPV	Mangaluru Smart City Limited
4	DPR prepared by	Kumarchandra & Associates
		Ashtadik Infrastructure Planning Consultants Pvt. Ltd
5	Project outlay	Rs. 10,00,00,000.00
5	Budget provision	Rs. 10,00,00,000.00
7	Administrative sanction	From Mangaluru Smart City Limited (MSCL)
8	Nature of the project	Upgradation of the existing stadium to community level stadium with national/international standard facilities for athletic sports events and training and spectators' seating area with necessary amenities. Providing walking track behind the spectator
		seating.
9	Need for the project	Refer Introduction
10	Details of the Proposal	
	i. Total area of built-up	1705 Sqm
	ii. Total area of building	1328 Sqm
	iii. Length of walking track	75 m
11	Total estimated cost with item wise cost break up and details of Schedule of Rates	Attached





2 **INTRODUCTION**

2.1 PROJECT BACKGROUND

Mangala stadium, built in the 1980, is an athletics stadium having a seating capacity of approximately 12000 seats. This along with its vicinity areas have been one of the most important athletic facilities in the region for decades. The State Government through its Karnataka Sports Policy 2018 promotes growth of sports through four pillars namely-Governance and Institutions, Eco-System, Hard Infrastructure and Soft Infrastructure. In line with the current State Sports Policy 2018, this proposal aims to develop the existing hard infrastructure, athletic and sports facilities around the Mangala Stadium to create a healthy sport ecosystem. In order to achieve this task, a master plan preparation for exploring the challenges and opportunities of Mangala stadium was proposed by the Smart City Mangaluru. The master plan will enable identifying actionable outcomes and help deliver them in a phase wise manner.

2.2 PROJECT PURPOSE

The Mangala stadium is a public sports and athletics stadium located in the heart of Mangaluru city. It is one of the only designed stadium in both Udupi and Dakshina Kannada district. This athletics stadium is part of a larger multi - sports complex, hereafter referred to as the Mangala Stadium Sports Complex (MSSC). The MSSC has, besides the athletics facility, other sports and training facilities like

- 5 lane swimming pool,
- well-equipped gymnasium,
- indoor badminton and basketball courts,
- tennis courts,
- skating rink,
- Walking tracks.

Mangala Stadium Sports Complex (MSSC)serves all these sports facilities in one campus. It offers programs and facilities that help benefit the public and civic health.

Mangaluru has produced many eminent sports persons over the years, who have gone onto make the nation proud with their outstanding achievements. Each of their stories to stardom is unique and one filled with lot of hardship. These athletes have mesmerized the world with their talent and proved that determination and persistence are all you need to succeed in any endeavour.

Figure 2 Grand finale of taluk level athletics held at Mangala Stadium in 2017



Source - Google Images

Figure 1 Grand opening ceremony of 19th Federation cup national senior athletics championship 2015 held in Mangala Stadium





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Figure 4 17th National Youth Festival 2012, held at Mangala Stadium



Source - Google Images

Figure 3 Annual sports meet held by different schools and colleges in the stadium



Source - Google Images

2.3 PROJECT BRIEF

In the master plan, the existing facilities of Mangala Stadium Sports Complex (MSSC) have been broadly classified into various zones. Each zone has been studied and issues have been identified. Interventions on a conceptual level have been proposed for each zone keeping in mind the requirements of each sport facilities as well as the overall master plan development. The development of each of these zones can be taken up in a phase wise manner.

The outcomes of the master plan development of the Mangala Stadium Sports Complex (MSSC) will ensure creation of a "Multi-Sport" state of the art sports infrastructure comparable to National and International standards.

The existing stadium has various athletic facilities for track and field, covered seating pavilion complex housing toilets and offices as well as open seating stands developed over an earthen embankment. The roof of the covered seating stands has deteriorated over a period of time and now requires remedial measures and retrofitting. Apart from the above, the interior spaces of the existing covered seating pavilion complex require up gradation for immediate use.

After due consultation with MSCL, it has been decided to prepare a basic layout plan of the whole stadium, identify one part, estimated at Rs.10 crores, to be constructed immediately and undertake execution of this project. For this first phase of this development, the Mangaluru Smart City Limited (MSCL) has allocated a fund of Rupees Ten Crore for which this proposal is prepared.

The Department of Youth Empowerment and Sports (DYES), which operates the stadium, has met with stakeholders and users and identified requirements of Full Stadium and requirements of Phase 1 of the stadium (for which this DPR is prepared). The last minutes of the meeting with DYES with the said requirements is attached.

Requirements such as store room, gym, changing rooms, and related facilities are urgently required in this phase. These requirements have been scrutinized and are proposed to be





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provided in a new block beside the existing pavilion. This new block shall also have covered seating stands for spectator seating facing the athletics ground. This new block will be a model block for future development of the entire seating stand around the stadium during the later phase of works. The development of the pavilion and athletics grounds will form part of future phases of development of the stadium.

The objective of first phase of the project is to provide for the immediate needs of the sports facilities of Mangala stadium. The AEC consultants, based on the assessment of the existing needs have prepared a proposal for the development under Mangaluru Smart City Limited. This proposal is planned as per recommendations, rules and regulations of Zonal Regulations of Mangalore, National Building Code of India and International Association of Athletics Federations(IAAF) as specified by Sports Authority of India (SAI).

2.4 PROJECT DELIVERABLES

The Project deliverables are broadly

- 1. Preparation of the Concept Report for Mangala Stadium Sports Complex (MSSC).
- 2. Defining scope of the project
- 3. Preparation of Detailed Project Reports
- 4. Bid Process Management including preparation of RFP/Concession agreements, Bid evaluation, finalization of contractor for implementation
- 5. Implementation of works including Quality Assurance, Quality Control and Certification

This report shall focus on part Upgradation of the Mangala Athletics Stadium i.e. Construction of a new block of 2910sqm near the existing pavilion by partial demolition of the existing earthen embankment for provision of facilities such as covered seating stands, gym, changing rooms. This new block will serve as a model block in planning of the full stadium as the next phase of development.

The concept report of the comprehensive development of the Mangala Stadium Sports Complex (MSSC) was presented before the Technical Committee. Based on the inputs from the Committee, this Detailed project Report (DPR) is prepared for the development of one segment of 2910 sqm of the spectator seating area estimated at Rupees Ten Crore only.





3 DEFINING AIMS , OBJECTIVES AND SCOPE OF PROJECT

The original scope of the project was the proposed upgradation of the Mangala Stadium <u>pavilion only</u> consisting of Department of Youth Empowerment and Sports (DYES) offices and spectator seating only, since it was in dilapidated condition.

After inspection of the pavilion, the surroundings and discussions with DYES, a concept note was prepared suggesting upgradation of the complete stadium complex. This proposal was approved by the Technical Committee as mentioned in the:

<u>Proceedings of Technical Committee meeting held on 11.09.2019 under the Chairmanship of General Manager (Tech), KUIDFC:</u>

Project 2: Up-gradation of Mangala Stadium(Concept Report)

PMC presented the Concept of for the proposed project "Proposed up-gradation of Mangala Stadium". The salient features of the proposal are as follows:

- a. The total area of the stadium is 9.80 acres. It is located in the heart of Mangaluru City and being managed by Department of Youth Affairs and Sports.
- b. The existing Stadium has various athletic facilities for track and field, covered seating pavilion complex housing toilets and offices as well as open seating stands developed over an earthen embankment.
- c. The allocated fund for up-gradation of Mangala Stadium and construction of Indoor stadium for Kabaddi and Stadium Badminton near Urwa market is 10.00 Cr in the revised SCP.
- d. Existing facilities:
 - i. Track for running, long jump, shot put, javelin and hammer throw cage
 - ii. Volleyball court: Three outdoor clay volleyball courts
 - iii. Swimming pool: Five lanes swimming pool
 - iv. Basketball court: Indoor court and outdoor practice court
 - v. Tennis court: Two concrete tennis courts
 - vi. Badminton Indoor Court: Four indoor courts
- e. A master plan is envisaged for development of the facilities in Mangala Stadium campus to develop it into a state-of-the-art International Standards sports centre with a seating capacity of 30,000 people.
- f. The proposed development is planned into 4 phases.

Phase 1: Rehabilitation measures and retrofitting of the existing pavilion complex and construction of partial seating stands at a cost of 5.00 Cr.

Phase 2: Construction of partial seating stands, development of walking track, volleyball playgrounds and services at a cost of 50.00 Cr

Phase 3: Construction of partial seating stands, development of Karavali ground area, Tennis skating rink, services etc at a cost of 40.00 Cr.

Phase 4: Landscaping and development of other zones within the campus.

g. Present condition: The main pavilion structure is in deteriorated condition, unpaved pathways and unshaded seating area.





h. As the allocated fund for up gradation of Mangala stadium is Rs. 5.00 Cr, only rehabilitation measures and retrofitting of the existing pavilion complex and construction of partial seating stand is now being presented to the T.C.

After perusal of the concept plan, the TC suggested the following:

- a. The allocation made for this project is grossly insufficient. Hence enhanced fund allocation for comprehensive development of stadium from the line department i.e. Youth affairs and sports department/ CSR fund/ re-allocation of funds in SCM may be explored, after dropping in-feasible projects.
- b. Concept report for entire master plan to be considered and works to be taken up in phases after proper prioritization without hampering the existing sports activities. The proposed retrofitting of the existing pavilion may be kept on hold and be considered in the later phase. As there is no space for relocating the existing sports activities, at least 2 model blocks may be taken up in Phase 1 on priority basis.

After detailed discussion, the T.C. accorded "In Principle" approval to the Concept report of Phase – 1 of the "Upgradation of Mangala Stadium" proposal, subject to compliance of the suggestions aforementioned. TC advised the PMC & MSCL to submit the updated Concept report and draft DPR in the next TC Meeting, along with the reallocated fun details to cover at least the proposed Phase – 1 completely.

3.1 STUDY OF EXISTING FEATURES:

THE MANGALA STADIUM SPORTS COMPLEX (MSSC):

- a. the seating capacity of the stadium currently is 11,000 only.
- b. The complete stadium complex consists of
 - i. The athletic stadium, open to sky stepped seating: This can be upgraded with seating and roof over seating.
 - ii. Warm-up/practice area
 - iii. Volleyball court (3 Nos.), skating rink, basketball court around the stadium
 - iv. Swimming pool
 - v. A library building
 - vi. A walkway around the stadium that connects all the above facilities.
 - vii. Parking area available in the Karavali Utsav grounds: about 250 cars and 100 nos. 2 wheelers.
- c. The whole Mangala Stadium Sports Complex (MSSC) is bounded on all sides by roads.

USERS:

a. The stadium is used by athletes of the district training for district /state/national /international level competitions.

b. Community users consisting of education institutions, local athletic/ social clubs, association celebrating sports events etc form the bulk of the users occupying more than 50% of the usage of the stadium. The number of users, including athletes and spectators here has not exceeded 500 at any time in the last 15 years.





c. District level events are held for about 7 days in a year. State level athletics events may be held once in three or five years. For national level athletics events, the facilities and other requirements are not sufficient in number and quality. The maximum number of users here is estimated to be up to 5000, as discussed with DYES.
d. There is a large number of walkers and users from the surrounding areas of the city who use the walkway around the stadium on a daily basis.

e. Users of other facilities such as volleyball, skating, basketball, swimming etc have separate associations/groups with independent access to their respective arenas and are unconnected to the athletics stadium.





REQUIREMENTS OF DEPARTMENT OF YOUTH EMPOWERMENT AND SPORTS: MINUTES OF THE MEETING WITH DYES:



ಆ) ದಾಸ್ತಾನು ಕೊಠಡಿ-25X 10 ಮೀಟರ್ ಮತ್ತು ಕನಿಷ್ಠ ಎತ್ತರ 6 ಮೀಟರ್.

ಬಳಸುವುದು ಸೂಕವಾಗಿದೆ.





ಇ) ಕ್ರೀಡಾಪಟುಗಳಿಗೆ ವಸ್ತ್ರ ಬದಲಾವಣೆ ಕೊಠಡಿಗಳು (ಶೌಚಾಲಯದೊಂದಿಗೆ)
 ಈ) ತೀರ್ಪುಗಾರರು/ತರಬೇತುದಾರರ ಕೊಠಡಿ(ಶೌಚಾಲಯದೊಂದಿಗೆ)
 ಉ) ಜಿಮ್ನಾಶಿಯಂ/ ಕಂಡೀಶನಿಂಗ್ ಕೊಠಡಿ (ಕನಿಷ್ಠ 20 ಮಂದಿಗೆ)
 ಊ) ಪ್ರಥಮ ಚಿಕಿತ್ಸೆ/ ಶುಶ್ರೂಷಾ ಕೊಠಡಿ–1.

ಮೇಲಿನ ಸೌಲಭ್ಯಗಳನ್ನು 6ನೇ ಹಂತದ ಕಾಮಗಾರಿ ಕೈಗೆತ್ತಿಕೊಳ್ಳುವ ಸಂದರ್ಭದಲ್ಲಿ ಮತ್ತು ಕ್ರೀಡಾಂಗಣದ ಕಾಮಗಾರಿ ಪೂರ್ಣ ಪ್ರಮಾಣದಲ್ಲಿ ನಡೆಸುವ ಸಂದರ್ಭದಲ್ಲಿ ಪುನರ್ ನಿಗದಿಪಡಿಸಬಹುದಾಗಿದೆ ಎಂದು ಮಾಹಿತಿ ನೀಡಿದರು

ಕೊನೆಯಲ್ಲಿ ವಂದನಾರ್ಪಣೆಯೊಂದಿಗೆ ಸಭೆ ಮುಕ್ತಾಯಗೊಳಿಸಲಾಯಿತು.

ಶ್ರೀ ಪ್ರದೀಪ್ ಡಿ'ಸೋಜ, ಉಪನಿರ್ದೇಶಕರು, ಯುವ ಸಬಲೀಕರಣ ಮತ್ತು ಕ್ರೀಡಾ ಇಲಾಖೆ, ಮಂಗಳೂರು.

3.2 AIMS AND OBJECTIVES OF THE PROJECT:

After a detailed study of the stadium its surroundings and existing facilities and discussions with DYES regarding phasing of works (refer minutes of meeting, attached), the following are the observations:

The fully completed stadium after upgradation shall fulfil the following aims:

- a. Provide for **international/national class of athletics facilities** in terms of grounds, equipment, warm up areas and rooms. This will greatly help athletes practicing here when they participate in national and international events.
- b. Provide access and crowd control, accommodation, storage, VIP and spectator seating etc facilities to **enable DYES to conduct district/ state level athletics events**.
- c. Provide for facilities to enable comfortable and secure use of the **stadium for use by local communities**, association and education institutions as this forms bulk of the usage of the stadium.
- d. Provide for **facilities required by Dept of Youth Empowerment Services** such as changing rooms, hostels, halls and kitchen etc to run their regular youth/ sports hostels and programs.
- e. Provide all facilities so as to **allow DYES to generate income** to finance the operating expenses of the stadium.
- f. Provide a comfortable **walkway outside the stadium** which will link the athletics stadium with all surrounding sports facilities. This will also act as access control area during major events. This walkway will be used by the local community and residents for their daily walks.
- g. Individually assess and **upgrade each of the sports facilities outside the stadium** in consultation with the appropriate association / authority.
- h. Provide rooms for offices of the DYES and various sports associations.
- i. Provide for **parking**, **access provisions**, **landscape** features and other requirements suitable to the size and style of the stadium.





The objective of first phase of the project is to provide for the immediate needs of the sports facilities of Mangala stadium. The AEC consultants, based on the assessment of the existing needs have prepared a proposal for the development under Mangaluru Smart City Limited. This proposal is planned as per recommendations, rules and regulations of Zonal Regulations of Mangalore, National Building Code of India and International Association of Athletics Federations(IAAF) as specified by Sports Authority of India (SAI).

3.3 DEFINING CAPACITY OF STADIUM

The capacity of the stadium is about 11,000 seats currently as per actual measurements and survey conducted on site. The footprint of the proposed development will be on the same outline of the existing facility.

Due to this and factors mentioned below, it is proposed to design the stadium to cater to seating of not more than 8,000 spectators.

3.3.1 Availability of parking facilities

The proposed site for parking is identified as grounds used for the Karavali Utsav programmes. The area of the ground is approximately 18,130 Sq.m. The DYES has already identified an area for developing warm-up tracks for athletes use. So the available land area for parking is 10,320 Sqm.

As per Zonal Regulations 2011 of Mangaluru, Table – 8 Off Street parking, SI no.5

'Assembly / Auditorium space, minimum one car parking space of 2.5 m x 5.0 m shall be provided for every 15 seats subject to minimum of 20 car parks or 50 Sq.m of floor area, whichever is more.'

As per Zonal Regulations 2011 of Mangaluru, Clause 19.1.1,

Each off-street parking spaces (parking bay) provided for motor vehicles shall not be less than 12.5 m² area (2.5 m X 5 m) and for scooter parking space provided shall not be less than 2.0 m² (2.0 m x 1.0 m) and it shall be additional 25% of the no. of car parks required as per Table -8. The minimum width of drive way shall be 3.5m, aisles and such provisions required for adequate monitoring of vehicles shall be exclusive of parking space stipulated.

Considering a driveway of 6 m wide, it is calculated that 228 cars and 378 two-wheelers (OR 286 two-wheelers and 6 buses) only can be parked in this space. Optionally, a multi-level car parking was suggested which was not approved by the authority.

Hence, the following calculations were considered for parking and spectator capacity :

CASE 1

As per Table 8 of ZR 2011,

Vehicle	No. of Vehicle	People considered	Total No. of People
Car	228	15	3420

9





	PROP	OSED UPGRADA	TION OF MANGALA	STADIUM (PHASE 1)
	2-Wheeler	378	2	756
	TOTAL			4176
CASE	2			
	Vehicle	No. of Vehicle	People considered	Total No. of People
	Car	228	15	3420
	2-Wheeler	286	2	572
	Bus	6	30	180
	TOTAL			4172

Hence, the stadium can be designed to cater to a spectator capacity of 4500 maximum.

3.3.2 Public transport facilities

The mode of public transport in this area is buses, auto rickshaws and taxis. The stadium is easily accessible from bus stops and auto-stands around it. Considering space available for auto stands and bus parking spaces an additional 2000 seats may be considered.









3.4 SIZE OF PROJECT

The size of the project as defined by the budgetary allocation of Rs.10 crore will be restricted to development of a new model block 1705 Sq.M near the existing pavilion with provision of typical stadium facilities such as covered seating stands for around approximately 700 spectators, toilets, access controls along with particular requirements of gym, changing rooms, store rooms defined by DYES. These facilities are considered for community level events. This will allow the stadium management authority to keep these blocks open on daily basis for the use of athletes and during community level sports events.





4 **APPLICABLE STANDARDS**

The literature for the applicable standards has been primarily split into the following:

- 1. Mangalore Zonal Regulations, 2011
- 2. National Building Code of India 2016
- 3. International Association of Athletics Federations(IAAF)

4.1 MANGALORE ZONAL REGULATIONS, 2011

Figure 5 - Landuse map showing site and context



Commercial Institutional Residential Parks & Open spaces

4.1.1 Land Use

The Land Use Zones as part of Section 3.1 show the following classification of Land into various zones:

- Residential (R)
- Commercial (C)
- Industrial (I)
- Public and Semi Public (P & SP)
- ASHTADIK

- Public Utilities (PU)
- Parks & Open spaces (P)
- Transport and Communication (T & C)
- Agriculture land, water sheet (A, W)



As this Project envisions or explores Civic Amenities (Sports Complex), Recreational/ Public Use Areas, Commercial Areas (Offices, cafe, and Hotels), the following could be the applicable categories under the Permissible Land Use.

Table 1	- Applicable	land use	categories
---------	--------------	----------	------------

Section	Category	Particulars	Category
			Code
3.2.2	Commercial	 a. Education Coaching Centers, Hostels b. Eateries c. Gyms, Yoga Center d. Retail Shops e. Grocery Shops 	C2
3.2.2	Commercial	 a. Recreational Clubs b. Restaurants and Hotels c. Commercial and Corporate Offices d. Banks, Consulting Offices e. Department Stores f. Hospitals, Nursing Homes 	C3
3.2.2	Commercial	 a. Kalyana Mantaps b. Commercial and Corporate offices c. Shopping Complexes d. Convention Centers, Banquet Halls e. Financial Institutions f. Cinemas and Multiplexes g. Entertainment, Amusement centers h. Social Clubs and amenities i. Exhibition centers 	C4
3.2.4	Public and Semi- Public	a. Parks, Playgroundsb. Cultural Complexesc. Public Library	P&SP 3

Source -Mangaluru Zonal Regulations 2011

Notes:

- Category Code C4 includes allows all uses of C1, C2 and C3. Likewise, C3 includes all uses of C1 and C2 and so forth.
- Uses permitted in all the above categories are subject to space standards

1

• Before permitting any uses permissible under special circumstances, the authority shall publish the proposals calling for public objections in at least two leading local daily newspapers giving stipulated time of fifteen days. The objections received within the stipulated period shall be placed before the authority and the reasons for accepting/rejecting the objections shall be recorded in the proceedings based on which the authority may take appropriate decision.





4.1.2 Public and Semi-Public (P&SP)

This Zone includes Government owned complexes and civic amenities and large infrastructure facilities of health, education, sports, cultural and social institutions.

Note: - In case any private property is included within the boundary of any existing Public and Semi Public building and if the owner can establish the ownership of such property vests with him/her, then the land use adjoining the Public & Semi Public building may be assigned to such private property by the Authority.

P&SP \$	3
•	Dobhighat
•	Dharmashala, hostels
•	Parks, play grounds, maidans and stadiums (no area limit)
•	Middle school, high schools, integrated Residential schools
•	Places of worship/congregation
•	Research institutions
•	Government buildings, auditoriums, cultural complexes
•	Higher educational institutions, colleges
•	Fire stations
•	Broadcasting & Transmission stations
•	Public library
•	All uses of P&SP and P&SP2 are permitted
L	Source -Mangaluru Zonal Regulati

Table 2 Permissible land use in Public and Semi Public Category

Note:

1. Uses permitted in all the above categories are subject to space standards as given in Table-2

2. Uses similar to those mentioned above may be permitted in the respective categories by the Authority

4.1.3 Parks and open spaces

The natural and man made features for environmental conservation and preservation, including water bodies, forests and drains; parks, playgrounds, burial and crematoria.





4.1.3.1 *Permissible land uses:*

i. Uses permissible include: Sports grounds, stadium, playgrounds, parks, swimming pools, cemeteries, garden land and crematoria.

ii. Uses permissible under special circumstances by the authority: Open air theatres, indoor recreational uses, dwelling for watch and ward, sports clubs, water front tourism development projects (subject to CRZ regulations), libraries, milk booths, HOPCOMS, public toilets, the area of such use shall not exceed 5% of the total area and shall not be more than G + 1 floor, with required parking facility.

iii. Setbacks for the above will be decided by the Authority taking into account the surrounding development and traffic scenario in that area.

iv. Parks, playgrounds and open spaces may be permitted in all other land use zones as permissible use.

4.1.4 Floor Area Ratio

The Floor Area Ratio (FAR) means the quotient of the ratio of the combined gross floor area of all floors, except the areas specifically exempted under these regulations, to the total area of the plot.

The road flanking the Project area on north side has a width of existing 22 meters and is proposed 30m wide, with a Project area over 12,462 sq. m approximately. Consequently, the applicable FAR based on proposed Land uses is given in Table .

Table 3 Applicab	le FAR
------------------	--------

ea (Ro wi	ad dth	e FAR				se -II			Allowable Landuses		
Plot Ar (sq.m	Existing	Proposed	Permissibl	Premium FAR	TDR	rotal Far	Land u In MP.	R	С	I	P&SP	T&C
					•		R	R	C3	I-2	P&SP3	T2
							С	R	C5	I-3	P&SP3	T3
	12m	18m	2.3	1.0	0.5	3.8	I	R	C5	-4	P&SP3	T3
							P&SP	_	-	-	P&SP4	-
Over 4000							T&C	-	-	-	-	T4
							R	R	C3	I-2	P&SP3	T2





							С	R	C5	I-3	P&SP3	T3
	12m	24m	2.5	1.0	0.5	4.0	l	R	C5	I-5	P&SP3	T3
							P&SP		-	-	P&SP4	-
							T&C	-	-	-	-	T4

Source -Mangaluru Zonal Regulation 2011

Note:

1. All the uses permitted under equivalence table are subject to space standards.

2. Additional FAR availed by amalgamation of properties or from TDR / DR originated from the same property shall be permitted over the total FAR prescribed in the Table subject to maximum FAR of 4, if the proposed road width is 12m and above.

3. Car parking has to be provided as per Table – 8 for different land uses permitted.

4. The minimum road width criteria should be a combination of existing and proposed road width in the Table. Proposed road width shall be as in the Master Plan or as proposed by the local authority.

5. If the width of any existing road which the plot faces falls between two different categorized width of existing roads, then the lower road width shall be considered for calculating the FAR.

6. The FAR of the individual plots in an approved layout shall be governed by the proposed width of the approach road (widest among the approach roads in case of multiple approach roads) to the layout or the road abutting the plot, whichever is lesser.

7. FAR shall be calculated for the entire plot area after deducting the portion surrendered for road widening.

4.1.5 Space Standards

The following table provides the space standards for various buildings and uses:

Common to all permissible zones	Minimum size of plot (Sq.m)
Kalyana Mantaps/Conference hall	
(Up to 500 seats)	1000
(Above 500 seats)	2000
Game centers, convention centers, truck terminals	4000

Table 4 Space standards for Various proposed uses





Social clubs and amenities	1000
Multi storied car parking,	4000
Petrol pumps / Fuel stations	750
Hotels and lodges	1000
Service Apartments	1000
Public libraries	300
Community hall	1000
Star hotels (up to 3 star)	2000
Star hotels (above 3 star)	8000
Office buildings in C3 and above	500
Uses in C5 (excluding C1, C2, C3 & C4)	4000

Source -Mangaluru Zonal Regulations 2011

4.1.6 Parking Requirement

Each off-street parking spaces (parking bay) provided for motor vehicles shall not be less than 12.5 m^2 area ($2.5 \text{ m} \times 5 \text{ m}$) and for scooter parking space provided shall not be less than 2.0 m^2 ($2.0 \text{ m} \times 1.0 \text{ m}$) and it shall be additional 25% of the no. of car parks required as per Table 8.

The minimum width of drive way shall be 3.5m. Aisles and such provisions required for adequate monitoring of vehicles shall be exclusive of parking space stipulated. The width of driveway with entry to parking bays shall be:

Table 5 Wid	th of drivewa	y with entry	y to parking	g bays
-------------	---------------	--------------	--------------	--------

Width of driveway	Width of parking bay
4.5m	2.5m
4.0m	2.75m
3.5m	3.0m

Source -Mangaluru Zonal Regulations 2011





Table 6 Requirement for off street parking spaces based in occupancy types

SI.No	Occupancy	Minimum one car parking space of 2.5 M x 5.0 M for every
1.a	Residential buildings upto 4 dwelling units.	No parking required for a floor area less than100M ² 1 tenement exceeding 100 M ² to 200 M ² floor area. 1/2 tenement exceeding 200 M ²
1.b	Multi dwelling apartments building.	2 tenements each are having a floor area of less than 75 M ² 1 tenement exceeding 75 to 175 M ² floor area. 1/2 tenement exceeding 175 M ²
2	Lodging establishments, homes, hotels	4 rooms or 50 M ² of floor area, whichever is more.
3	Educational	150 M ² floor area or fraction thereof.
4	Hospital Nursing homes	100 M ² floor area or fraction thereof. 75 M ² floorarea or fraction thereof.
5	Assembly/Auditorium	15 seats subject to minimum of 20 car parks or 50sq.m of floor area, whichever is more.
6	Banks and other Retail business	50 sq.m floor area or fraction thereof
7	Industrial	100 M ² floor area or fraction thereof plus one lorry parking (3.5 M x 7.5 M)
8	Storage/Wholesale Business	150 sq.m up to 600 M ² floor area and every 200M ² thereafter or fraction thereof. Additional one loading/unloading bay (3.5 M x 7.5 M) for every1000 sq.m
9	Community Hall /Kalyana Mantapa	50 sq.m of floor area or fraction thereof.
10	Office building(Government or Private)including IT & BT	75 sq.m of floor area or fraction thereof.
11	Restaurant serving food and beverage (exc. toilet)	50 M² of floor area
12	Hostels	10 rooms or 100 M ² of floor area whichever is more

Source - Mangaluru Zonal Regulations 2011

Note:

i. For multi storied buildings, an additional 10% of the required car parking space shall be provided for visitors/ guest parking within the plot





4.1.7 Setback and Height

As the Plot in question for the Project is surrounded by roads of width of 24 m and 12 m on the west and east side respectively, 18 m on the south side and 30m on the North side. The following tables show the relationship between the widths of the road, the setback required and the building line distance from the center of the road.

Table 7 Minimum front setbacks for building with respect to road width

Proposed Road width	Minimum Front set backs	Building line from center of road
12.0m	3.5m	9.5m
18.0m	3.5m	12.5m
24.0m	3.5m	15.5m
30.0m	4.0m	19.0m

Source -Mangaluru Zonal Regulations 2011

Table 8 Minimum front setbacks for buildings with respect to height of the building

Height of Buildings (m)	Minimum space	n exterior open es/setbacks	Maximum pl	ot coverage%
	Front (m)	Rear and Sides (m)	Residential	Non-residential (except industrial)
7 up to 9.99	2.0	1.5	75	80
10 up to 11.99	3.0	2.5	70	75
12 up to 14.99	4.0	3.0	70	75
15 up to 17.99	5.0	5.0	65	70
18 up to 20.99	5.0	6.0	65	70
21 up to 23.99	6.0	7.0	60	65
24 up to 26.99	6.0	8.0	60	65
27 up to 29.99	7.0	9.0	55	60
30 up to 34.99	7.0	10.0	55	60

7





35 up to 39.99	8.0	11.0	50	55
40 up to 44.99	8.0	12.0	50	55
45 up to 49.99	9.0	13.0	45	50
50 up to 54.99	9.0	14.0	40	50
55 and above	10.0	16.0	35	45

Source - Mangaluru Zonal Regulations 2011

Note:

- 1. Front setback is essentially with regard to the road width and height of the building and side and rear setbacks are with reference to the height of the buildings.
- 2. Front setback should be provided in the remaining plot after deducting area for road widening as mentioned in the Master Plan. If the road widening is not touching / crossing the frontage of the plot, the front setback shall be provided in the plot itself.
- 3. Front setbacks prescribed shall be considered from the frontage of the plot abutting the road only and side and rear setbacks prescribed shall be considered from all other boundaries of the plot.
- 4. Front setback line shall be considered as the building line beyond which no portion of the building should be projected, either below the ground or above the ground except for balcony projections mentioned in the rules herein. However, cantilever porches and steps to ground floor entry may be permitted depending upon the site condition.
- 5. However, such projection should in any case not be beyond 0.5m from the road widening line.
- 6. In the case of corner sites, both the sides facing the road shall be treated as front side and regulations applied accordingly.
- 7. In case of site facing roads both in front and rear, both the sides facing roads should be treated as front and other two sides not facing the roads should be treated as sides and the setbacks be applied accordingly.
- 8. In case of more than one building proposed on a single site, the set-backs shall be applied with respect to the height of the individual buildings or the road width whichever is higher subject to access and fire requirements of the taller building being satisfied.

4.1.8 Means of Access

Table 9 Width of corridors, ramps and staircases for different types of buildings

Building use or type	Minimum width of the corridor(m)	Minimum Staircase width(m)	Minimum Ramp width(m)
Assembly buildings such as auditorium, community hall etc.	2.0	2.0	2.0
Commercial buildings such as	1.5	1.5	1.5





retail shops, private office, nursing homes, lodges,etc.			
All other buildings	1.5	1.5	1.5

Source -Mangaluru Zonal Regulations 2011

4.1.9 Public Toilets

In any commercial complex, neighborhood shops and assembly buildings, public toilet blocks shall be provided compulsorily. Such public toilet shall be of minimum 1.5 percent of the total commercial floor area if the total commercial floor area is above 10000 Sq.m and of minimum 2 percent of the total commercial area if the total commercial area is less than 10000 Sq.m. Minimum size of common toilets should be 1.0 m x 1.25 m.

4.1.10 Distance of Building from Electrical Lines

Table 10 Distance of the building from electrical lines

Description	Vertical distance from maximum sag of electrical line(m)	Horizontal distance from the edge of the electrical line(m)	Electric line corridor width(m)
L.T.line	3.5	1.8	4.5
H.T. line of 11KV	4.5	1.8	4.5
H.T. line of 33KV	4.5	2.5	15.0
H.T. line of 66KV	4.58	3.0	18.0
H.T. line of 110KV	5.0	3.2	22.0
H.T. line of 132KV	5.0	3.5	27.0
H.T. line of 220KV	6.2	4.2	35.0
H.T. line of 400KV	Subject to clearanc	50.0	

Source -Mangaluru Zonal Regulations 2011





4.1.11 Solar Water Heater Requirements

Table 11 Solar water heater requirements

Type of use	100 litres per day shall be provided for every unit
Restaurants service food and drinks with seating/serving area of more than 100 m ² and above.	40 m ² of seating or serving area
Lodging establishments and tourist homes	3 rooms
Hostel and guesthouses	6 beds / persons capacity
Kalyana Mantapa, community hall and convention hall (with dining hall and kitchen)	30 m ² of floor area
Recreational clubs	100 m ² of floor area

Source -Mangaluru Zonal Regulations 2011

4.1.12 SUMMARY OF APPLICABLE STANDARDS

• Floor Area Ratio (FAR): Based on our Analysis of the applicable standards, the available FAR is (2.5 + 1.0 + 0.5) = 4.0

Table 12 Permissible FAR for this project

FAR(Unit)	Calculation	Applicable BUA
2.5	40000*2.5	1,00,000sq. m. or 10.76 lakh sq.ft.
4.0	40000*4.0	1,60,000sq. m. or 17.21 lakh sq.ft.

- Ground Coverage (GC): Permissible range is 75%
- Setbacks and Height Permissible: For a Total Height of +12M from Ground Level, setback considered is 3M on the front. A Setback of 2.5m is considered as rear and side setbacks.

4.2 GUIDELINES BY NATIONAL BUILDING CODE 2016

Refer Annexure A.

4.3 GUIDELINES BY INTERNATIONAL ASSOCIATION OF ATHLETIC FEDERATION

Refer Annexure B.





4.4 BARRIER FREE DESIGN -

Barrier-free building modification consists of modifying buildings or facilities so that they can be used by people who are disabled or have physical impairments. Freeing a building of barriers means:

- Recognizing the features that could form barriers for some people
- Thinking inclusively about the whole range of impairments
- Reviewing everything from structure to smallest detail
- Seeking feedback from users and learning from mistakes

General disability groups are wheelchair users, ambulant disabled, deaf and hard of hearing, visually handicapped, mentally handicapped.

4.4.1 Wheelchair User

- There are two basic types of wheelchair users- the independent user and the user who is pushed by someone else.
- The width and space requirements of a wheelchair determine the minimum width of door openings, turning spaces and lobbies. The use of wheels means that the changes in level must be negotiated by means of ramps or lifts, and that floor surfaces should be smooth and hard.

4.4.1.1 Transport and parking

- Local public is generally unsuitable for wheelchair users; most, therefore, will arrive at a building either in a private vehicle or in a special coach or ambulance for club or group sessions.
- There should be a clearly marked parking area, not more than 40 m away from the building.
- To cater assisted wheelchair users the preferred width of the bays is 3.6 m (minimum 3.2 m). If adjacent spaces are provided, an access area 1.2 m wide between two standard 2.4 m wide bays can be marked to show that vehicles should be parked either side.





Figure 6 Footpath and ramp widths, Pavement

crossing point, kerb ramped at crossing







Figure 7- Ramp design

If spaces are provided at 0 the end of a row, sufficient pavement width should be provided (minimum 1.2 m)

4.4.1.2 *Footpaths and ramps*

The preferred minimum width for footpaths and ramps where wheelchairs and prams may pass each other in 2 m.



- For short paths with no passing traffic the minimum should be 1.2m.
- Outdoor signs are preferred height is 1400 mm and 1700 mm.

4.4.1.3 Entrance areas

- The main entrance should be clearly recognizable and the sign posted but preferably well sheltered from the weather.
- The standard access symbol should be prominently displayed outside the entrance, a buzzer or a bell should be installed if necessary.
- Entrance door should give a clear opening width of not less than 800mm.
- Automatic opening doors are ideal for wheelchair users but must remain open as long as the user is within the opening area.
- Minimum distance of 2100mm between sets of automatic sliding doors and 2500mm between sets of automatic swing doors.

4.4.1.4 *Lifts*

- The internal depth of any lift should not be less than 1400mm Figure 9 Handrail design • and the width not less than 1100mm to accommodate a single wheelchair and helper.
- There should be a clear space of at least 1500 x 1500 mm in front of the lift door.
- Internal lift dimensions of 1400 x 1600 mm are preferred, with space in front of the door at least 1800 x1800mm.
- Lift doors should have a minimum clearance of 800mm.









2.2 A main entrance with drop-off point protected by a car

2.17 Handrails provided on both sides of a circulation route: hurchtown Farm, Bodmii



2.18 Handrail design: diameters are 35 mm for support rails, and 45-50 mm for stair handrails







Figure 10 - Toilet design

Figure 11 - Lift design



4.4.1.5 *Means of escape*

- Fire escape ramps should not have a gradient more than 1:10.
- All doors and hallways should be wide enough to accommodate wheelchairs.

4.4.1.6 *Toilets and showers*

- Not less than 2000mm X 1500mm and are equipped.
- At least one WC in a row of cubicles should be large enough for wheelchair users.
- There should be rails next to the WC for the user to move from the wheelchair and back.
- To allow for lateral transfer from a Wheelchair to a WC pan, the distance from the rear wall to the front of the pan should be at least 720mm.
- Showers need a minimum space of 1200 x 1200mm and controls should be at the maximum 1400mm.

4.4.2 AMBULANT DISABLED

4.4.2.1 *Steps and entrance areas*

- Tread should not be than 280mm and be uniform.
- Risers should not be more than 150mm.
- A handrail should be provided on either side.

4.4.2.2 Internal circulation

- Handrails should be provided alongside the wall and the diameter should be between 45 and 50mm.
- Showers and toilets should have side rails as well.

4.4.3 DEAF AND HARD OF HEARING

4.4.3.1 Acoustics and communication

• The main concern is to reduce the reverberation time, if the reverberation time is too short, speech may be too quiet.





 If the reverberation time is too long, background noise and echo will create an environment which may not only prevent people with hearing impediments from understanding speech but may also be unbearably confusing and unpleasant for them

4.4.3.2 Visually handicapped

- Using well lit spaces
- Using Braille translated signs for the blind
- Change in texture to demarcate areas
- Usage of Audio based information Hazard warnings





5 EXISTING SITE CONDITIONS

5.1 CONTEXT STUDY OF THE CITY

Mangaluru is a chief port city in the state of Karnataka and is known as the gateway to Karnataka. It is situated on the west coast of the country. The Western Ghats span the city of Mangalore on its eastern side. It is the district headquarters of Dakshina Kannada District. It lies on the backwaters formed by the Gurupura River and Netravati river.

Mangalore derives its name from the local Hindu Goddess Mangaladevi. It developed as a port on the Arabian Sea – remaining, to this day, a major port of India. Lying on the backwaters of the Netravati and Gurupura rivers, Mangalore is often used as a staging point for sea traffic along the Malabar Coast.

Mangalare Mangalare Source - Google Images

Figure 12- Location map

Mangalore is spread over an area of 184.85 sq.km and houses about a population of approximately 8 lakhs. A rich history of trade coupled with industrial growth has led to the formation of dynamic civic and economic zones historically within the city core. In Mangalore, the people, culture and its festivals form an integral part of the city.

Mangalore is connected to Bengaluru and other major urban centers in India by air routes. International link is also established to gulf region of the Middle East. The Mangalore International airport is located near Bajpe around 20 km north-east of the city. Mangalore is a major all-weather harbour linked to other major national and international harbours. The harbour also links areas served by the inland transport facility in Netravathy and Gurpur Rivers. The Old Bunder (port) is a relatively small-scale freight and fishing harbour. New Mangalore Port is also an all-weather port situated at Panambur handling imports and exports.

5.2 IMPORTANT LANDMARKS

Figure 13- Landmarks and distances from site



Source - Google Maps




5.3 **CLIMATE**

Mangaluru belongs to the tropical/ mega thermal zone and is under the direct influence of the Arabian Sea branch of the south- west monsoon.

5.3.1 Temperature

Mangaluru has a tropical climate; summer and winter months experience similar temperature conditions, with average temperature ranging from 27 deg C (81 deg F) to 34 dea C (93 dea F).







5.3.2 Wind

Moderate to gusty winds occur during the day time and gentle winds at night. Winds are strong and are mainly westerly and south-westerly in the southwest monsoon months. In the rest of the year, winds are mainly from north-east in the fore-noon and westerly and northwesterly in the afternoon.

5.3.3 Precipitation

Mangalore receives about 90 per cent of its total annual rainfall within a period of about six months from May to October, while remaining relatively dry from December to March.

The annual precipitation in Mangalore is 4,242.5 millimetres (167 inches). Humidity is approximately 78 per cent on an average, and peaks during May, June and July. The maximum average humidity is 93 per cent in July and average minimum humidity is 56 per cent in January. The relative humidity is generally very high reaching saturation levels during the summer period.









Source -www.weather-and-climate.com

The climate is tropical in Mangalore. There is significant rainfall in most months of the year. The short dry season has little effect on the overall climate.

- The average annual temperature in Mangalore is 27.0 °C.
- The rainfall here averages 3783 mm

5.3.4 Sun Path

Figure 16 - Summer and Winter Solstice - Sunpath



SUMMER SOLSTICE- 21ST JUNE

WINTER SOLSTICE – 21ST DECEMBER

5.3.5 Climate Graph / Weather By Month Mangaluru

Figure 17 - Wind direction - January 2019- December 2019





5.3.6 Wind Direction

From the month of January 2019 to December 2019, 38% of winds travels from east to west, whereas, 28% of winds travels from west to east. These have been considered as the prominent wind directions for the site.

5.3.7 Average Temperature Mangaluru

The driest month is January. There is 0 mm of precipitation in January. With an average of 1143 mm, the most precipitation falls in July.





Table 13 - Average temperature of Mangaluru



Table 14 - Average temperature in Mangaluru



With an average of 29.1 °C, April is the warmest month. July has the lowest average temperature of the year. It is 25.7 °C.

5.3.8 Topography





Site is elevated at 87ft from sea level





5.4 **CULTURAL MAPPING**

The Mangalore Dasara, is a festival in the Indian city of Mangalore organized by Kudroli Shri Gokarnanatheshwara Temple.

It is also referred as Navarathri Festival, Vijayadashami. The tiger dance, lion dance and bear dance are the main attractions.

The city is decorated with lights for the 10 days of the occasion. The procession passes through the main roads of the city including Kudroli, Mannagudda, Ladyhill, Lalbagh, K S Rao road, Hampanakatta, Car Street and Alake.

5.5 SITE STUDY

Stadiums are an important part of the city life as the true spirit of every sport is realized Figure 20- View of athletic track and seating in such stadiums. Mangala stadium is the only major public stadium in the vibrant city of Mangalore.

- It is a public sports and athletics stadium located in the heart of Mangalore City, Karnataka, India, managed by Karnataka State Department of Youth Affairs and Sports.
- The term Mangala Stadium also refers to the various sports facilities adjacent to the stadium, which includes a swimming pool and a gymnasium.
- There is vacant ground adjoining the stadium which is used for various sporting as well as non-sports related events such as trade fairs, carnivals, commercial expositions and other cultural events called the Karavali grounds.
- The stadium is at least 30 years old, and over the course of time it has become a centre for athletic activity in Mangalore.

Figure 18 - Dasara Procession



Figure 19 - Kudroli Temple



Source -Google Images



Figure 21 - Site of proposed project



ANGAI URU



Description of Land

- Total area : 9.8 acres (40,000 sq.m approx.)
- North boundary: Mahatma Gandhi road
- South boundary: Nehru avenue road, Canara English
- higher primary school
- East boundary: Nehru avenue cross road
- West boundary: Kulur ferry road
- The site can be accessed through 2 primary roads and 2 secondary roads.
 - These roads are peripheral to the site boundary.

Distance from transportation nodes

- Mangalore international airport (IXE) 11.3 kms
- Mangalore central railway station 4.4 kms
- Mangalore junction railway station 8.6 kms
- New Mangalore port trust 6 kms
- Mangalore KSRTC bus stand 1.3 kms

Figure 22 - Graphical section of Kulur Ferry road







5.6 EXISTING FEATURES OF MSSC

Figure 23 - Existing features of the MSSC







5.7 SITE SURROUNDING OF MSSC

Figure 24 - Features around the site of MSSC







Ladyhill English

5.8 SITE ANALYSIS OF MANGALA STADIUM



Total Area of the Stadium:12462 sqm approx.

Phase -1 area: 1705 sq.m

The Stadium, at present, has a lobby, changing rooms, sports storage rooms, toilets, pavilion, running tracks, seating area and field.

While analyzing the issues n site, we noticed the structural deterioration of the main pavilion. The pathways were unpaved making it difficult for daily walkers to walk on the side of the stadium. The seating areas of the stadium were unshaded.

The possible design interventions are improving the walkways, developing commercial units and shading the seating areas.





Figure 1 - View of entrance gate and parking area in front of the Pavilion Complex $% \left({{{\rm{P}}_{{\rm{P}}}} \right)$



Figure 2 - Existing Pavilion Complex



Figure 4 - View of staircase and lobby in Pavilion Complex



Figure 7 -View of the ground from Pavilion Complex







Figure 3 - View of the Pavilion complex seating and roof



Figure 5- View of the stadium from first floor of Pavilion



Figure 6 - View of the Pavilion from seating area on Southern part





Figure 33 - View of Services building



Figure 34 - View of unpaved walking track





Figure 35 - Graphical section of road and stadium









Figure 37 - Plan showing the scope of work in this phase



Phase -1 (Section of seating Pavilion)

Phase -2,3,4 (Rest of the stadium)







Figure 38 - Site level plan showing the scope of work in this phase

Figure 39 - Schematic view of existing stadium seating and walking pathway







5 CASE STUDY

5.1 INTRODUCTION

A large amount of relevant literature pertaining to sports complex projects was collected, analyzed and subsequently incorporated into this Report. A selection of Case Studies is provided in the sections below alongside their key practices and learning.

5.2 THYAGARAJ SPORTS COMPLEX, NEW DELHI

Table 16 - Thyagaraj Sports Complex: Details

Architects	PTM of Australia and Kapoor & Associates of Delhi	
Site area	16.5 Acres	
Capacity	5883 persons	
Sports Facilities	 Netball Athletic track Kabbadi Table tennis etc 	
Additional Facilities	Currently, the stadium houses the Education Department of Government of Delhi.	





Source - Kapoor & Associates

Figure 40 - Interior View



Source - Indian Express

It is India's first-ever model Green Venue built with latest green building technologies. The stadium has an R.C.C. structure with steel roofing. The stadium has maple wood flooring in the central arena. Flooring materials in other areas are granite, recycled PVC, carpets, epoxy and Kota stone. In terms of power efficiency, the Stadium will be setting a benchmark. Lighting will be provided using solar energy. Additionally, building-integrated photovoltaic cells will allow the stadium to feed electricity to the grid.





Heat insulation through walls with hollow concrete blocks/ cavity walls, glazing with double insulated glass and thermal insulation on roof and wall. They have used fly ash bricks in construction. The stadium also features water management system such as rainwater harvesting, sewage treatment with a capacity of 2,00,000 litres. Water conservation methods like use of recycled water for flushing and horticulture, dual knob flushing cisterns, gas based turbine and vapour absorption machine.

The stadium was a venue for netball competition and athletics training for the Delhi 2012 Commonwealth games. It has also won prestigious awards for the design and features. This Sport Complex is awarded Gold rating by Indian Green Building Council for its Green Features.

Figure 43 – Kabaddi Stadium



Source - Twitter

Figure 42 - Athletic track & pavilion



Source - Khel Now

5.3 JAWAHARLAL NEHRU STADIUM, NEW DELHI

It is a 60,000 seat stadium, designed and constructed to meet the international standards for stadiums set by the Asian Football Confederation (AFC), the International Federation of Association Football (FIFA) and the International Association of Athletics Federations (IAAF).

In terms of seating capacity, it is the fourth largest stadium in India, 27th largest stadium in Asia and the 103rd largest stadium in the world.

Table 17 - Jawaharlal Nehru Stadium : Details

Architects	Gerkan, Marg and Partners
	Schlaich Bergermann & Partner
Capacity	78,000 (Reduced to 60, 254 after renovation)
Sports Facilities	Athletic events and ceremonies,
	Football,
	Cricket,
	Concerts





Additional Facilities	Warm up track area, toilets and accessible toilets,
	parking area, tunnel concourse for performers to
	be used during opening and closing ceremonies

In case of emergency, the construction allows spectators to evacuate within 6 minutes.

A steel compression ring that weighs more than 8,500 tons and extends 71 meters into the stands, supports the tensile roof's cable net system and membrane panels without any perpendicular support from inside the stadium. The cable net system features 443 tons of prestretched cables with a length of 2,220 km in varying diameters from 40 mm to 95 mm. There are 88 membrane panels that form the facility's 54,000 square meter tensile roof that spans over 240 meters.

The stadium features an open-air roofing system formed from PTFE SHEERFILL® Architectural Membrane. PTFE SHEERFILL Architectural Membrane, manufactured by Saint-Gobain Performance Plastics, is the first ENERGY STAR® qualified and Cool Roof Rating Council (CRRC) certified architectural fabric membrane. As an ENERGY STAR product, SHEERFILL can help lower air conditioning requirements in buildings, reducing peak cooling demand by 10-15 percent.

The stadium has 14 ramps for upper seating, 4 interior ramps for lower seating, stairs, lifts and escalators. There are sports lighting and Public addressing system from suspended catwalk. Toilets and food kiosks are provided near entrances to seating.

Figure 45 - View of the stadium in the evenings during an event



Source - Wild films India





Source -Times of India





Figure 46- View of the stadium during an event



Source - Indivibe

5.4 BIRSA MUNDA ATHLETICS STADIUM

Birsa Munda Athletics Stadium is a stadium in Ranchi, India, used mostly for association football matches and for athletics. It hosted the opening and closing ceremonies of the 2011 National Games of India. It has seating capacity of 35,000 spectators.

Table 18 - Birsa Munda Athletics Stadium: Details

Architects	Arun Lamba Consultants
7 diciniocity	
Site Area	275 Acres
SIIC AICU	2/0/40103
Capacity	35,000
Cupucity	55,000
Sports Facilities	Football and athletics
Spons raciines	
Additional Facilities	Lounges with all necessary facilities.
	Dormitories, VIP Jounge, Pressbox

Birsa Munda Athletics Stadium was the inspiration behind the renovation of Jawaharlal Nehru Stadium, Delhi that hosted the opening and closing ceremonies of the 2010 Commonwealth Games.

Among the ideas adopted by CWG organisers was the imported, dust and fireproof roof that has been used in the Ranchi stadium, which boasts a seating capacity of 35,000.

With its many elliptical pylons and ramps that lead to the upper tiers, it adds to the futuristic look of the area that houses seven other smaller stadiums.





The stadium's fire-, dust- and rust-proof roof is made of polytetrafluoroethylene (PTFE). Designed by an Australian firm, the 11,550 square metres (124,300 sq ft) roof material was imported from Japan for ₹ 80 million and took four months to fix. It is maintenance free and has a 15-year warranty. The stadium has two such roofs, one at the VVIP section and one at the press box.

Four towers of high-lux lights are installed for conducting sports events at night.

As many as 12 double lifts have been fitted in the stadium. Four towers in the corners connect to middle and upper galleries. The pathways are designed to allow wheelchairs till the upper tier. Visitors will take this route. But, there will be no overcrowding or security problems when VVIPs and players enter the stadium. The disabled, too, can reach the top gallery without any difficulty.

An air-conditioned enclosure inside houses a six-lane warm-up track of 80 meters. No athletics stadium in India has such tracks. Participants can use this half-an-hour before their events.

The synthetic track, designed according to international standards, is imported from Switzerland. The grass, however, is home-grown – from Chennai.

Doing away with cemented pillars, 62 elliptical pylon columns of 20 metres (66 ft) in height surround the stadium, which, from some angles, resemble a spaceship.

Thirty-six lounges, with all basic facilities, are being prepared on the ground floor to accommodate state contingents. Besides, there are 32 dormitories that can accommodate 1,000 people.



Figure 47 - Bird's eye view of the stadium

Source -Facebook







Figure 48 - View of the stadium and seating

Source - Facebook

5.5 KAFTANZOGLIO STADIUM , THESSALONIKI, GREECE

Table 19–Kaftanzoglio Stadium : Details

Architects	G.Pantzaris
Site Area	106.53 Sqm
Capacity	27,770
Sports Facilities	Football and athletics

The stadium was known for being the most luxurious stadium of the south-eastern Europe in 1960's when it hosted the World Athletics Final. After its renovation in 2004 to host the Athens Olympics 2004, it is now one of the modern and fully equipped stadium for both sports events and training facilities.

This stadium hosted the Summer Olympics, qualifying matches of FIFA World Cup, UEFA Cup Winner's Cup. It also hosted various athletic events during Mediterranean Games, European Cup in athletics and was the host stadium for the 2009 IAAF World Athletics Final.

Only 12% of the seats are shaded by roof. There are 670 VIP seats, 150seats for photographers and 390 seats for the press. The stadium is also used by the Aristotelian University, Department of Sports and the Military Academics. It also hosts art events, concerts, sports conventions and day conferences.







Figure 50 - View of the stadium during an event

Figure 51 - View of the stadium and seating stands



Source -Wikimapia

5.6 AL SALAM STADIUM, EGYPT

It has hosted Egyptian Premier League, 2009 FIFA U-20 World Cup and Cup of African Nations in 2009.

Table 20 Al Salam Stadium, Cairo, Egpyt : Details

Capacity

30,000

Sports Facilities

Football and athletics

Figure 52 - View of seating stands and exitways



Source - Ahram Online

It has a capacity of 30,000 people divided across nine stands. There are provisions for electronic scoreboards, giant TV screen, VIP hall and compartment with VIP Balcony.





An exclusive press conference room for 9 people with 4 interpretation booths and a place for media professionals and journalists with all necessary facilities.



Figure 53 - View of pavilion and seating stands

Source - World of Stadium

Figure 54 - View of the football playing area and seating stands



Provision of cabins for broadcasters with well equipped audio-video control room is also given. There are four towers to light the stadium. Four dressing rooms are provided for the players and one room for referees. Doping room, toilets for the masses (men/women/disabled), cafeteria in all terraces, parking for the main cabin, first class and the rest are also provided.





5.7 KEY INFERENCES AND OBSERVATIONS :

Table 21 - Key Inferences and Observations

Parameters	Inferences
Context	• The structure could follow the architecture of the surrounding buildings, yet stand out and be iconic landmark.
Accessibility	 Access to public transport plays an important role in the location of a sports facility. It should be easily accessible to all age groups.
Parking	 Onsite parking should be implemented for the public. Basement parking can be proposed if the site is constrained.
Zoning	 Changing and locker rooms should be in proximity to the courts. Dorms/ guest rooms can be proposed within the facility. Commercial spaces such as retail shops can be proposed to create a self-sustaining economic structure.
Circulation	The column layout should not hinder visibility from the seating areas.





6 SUSTAINABLE DESIGN CONCEPTS

6.1 INTRODUCTION

This section covers the certain elements that have been proposed in the project to make it sustainable. This would not only make the project environment friendly, but also reduce the present and future cost leading to a win-win situation. Construction of a building requires a lot of energy consumption, even more so, during its lifetime in terms of maintenance. The sustainable design concepts help to reduce that energy consumption footprint. Conventional materials and building practices would be replaced by energy efficient products making it a project for the future that the residents of Mangalore city can be proud of.

6.2 ENERGY EFFICIENT GLASS

Double and triple layer glass windows with air gaps, are a type of energy efficient glass that are designed to provide higher levels of resistance to heat transfer acting as an extra thermal insulator against climatic effects. A generic working is provided in the figure below:



Source - Reuters

The benefits are:

- 1. Warmer in winter & cooler in summer keeps comfortable temperature all year and saves overall HVAC load.
- 2. Lowers energy consumption resulting in lesser greenhouse gas emissions.
- 3. Sound insulation: Double glazed windows improve sound insulation.
- 4. Enhances resale value: Double glazing is an excellent way to increase the resale value of property.
- 5. Preserves items inside the space from fading by reducing UV radiation.

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Figure 55 - Energy Efficient Glass

Increases security: Discourages intruders and adds to safety and security. It is difficult for intruders to break in through double glazed windows, particularly if you include laminated or toughened glass.

6.3 ENERGY CONSERVATION BUILDING CODE

The Energy Conservation Building Code (ECBC), was launched by Ministry of Power, Government of India in May 2007, as a first step towards promoting energy efficiency in the building sector.

The ECBC was developed by an Expert Committee, set up by India's Bureau of Energy Efficiency.

The purpose of the Energy Conservation Building Code (Code) is to provide minimum requirements for the energy-efficient design and construction of buildings. The Code also provides two additional sets of incremental requirements for buildings to achieve enhanced levels of energy efficiency that go beyond the minimum requirements.

The Code is applicable to buildings or building complexes that have a connected load of 100 kW or greater or a contract demand of 120 kVA or greater and are intended to be used for commercial purposes.

The ECBC provides design norms for:

- Building envelope, including thermal performance requirements for walls, roofs, and windows;
- Lighting system, including day lighting, and lamps and luminaries performance requirements;
- HVAC system, including energy performance of chillers and air distribution systems;
- Electrical system; and
- Water heating and pumping systems, including requirements for solar hot-water systems.

The provisions of this code do not apply to plug loads, and equipment and parts of buildings that use energy for manufacturing processes, unless otherwise specified in the Code.

The code provides three options for compliance:

- 1. Compliance with the performance requirements for each subsystem and system;
- 2. Compliance with the performance requirements of each system, but with tradoffs between subsystems; and
- 3. Building-level performance compliance.

During the development of ECBC, analysis conducted through energy simulation indicated that ECBC-compliant buildings may use 40 to 60% less energy than similar buildings being designed and constructed at that time.

This Code is applicable for buildings in hospitality, healthcare, assembly, business, educational, shopping and mixed-use sectors.





6.4 ALTERNATIVE POWER SOURCE IN ROOFTOP SOLAR PANELS

These systems generate power during the day, which is utilized by powering captive loads and feed excess power to the grid. In case power generated is not enough, the captive loads are served by drawing power from the grid. The concept is based on the scale of the PV plant rather than if it is situated on a roof/terrace or not. Hence, the definition of RTS also includes small solar plants on the ground.

Figure 56 - Solar rooftop panel



Source - Trina Solar

The benefits are:

- 1. Utilization of available vacant roof space that produces renewable energy and supports energy needs from other conventional sources.
- 2. Non-polluting and have a long life of around 30 years.
- 3. Cost effective and needs less capital to maintain.
- 4. Lower transmission and distribution losses.
- 5. Improvement in the tail-end grid voltages and reduction of system congestion and long-term energy and ecological security by reduction in carbon emission.

6.5 UNCONVENTIONAL METHODS SUCH AS AUTOCLAVE AERATED CONCRETE BLOCKS

AAC blocks are a lightweight, load-bearing, high-insulating and durable building product, available in wide range of sizes and strengths.

Figure 57- Standard sizes of AAC Blocks

Size (mm)	Block
Length	600
Thickness	75,100,120,150,200,240,250,300
Height	250

The benefits are:

- 1. AAC Blocks is lightweight and compare to the red bricks. Reduces dead load of the building, Hence the overall construction cost also reduces
- 2. Acoustic insulation offers more privacy for occupants
- 3. These are fire resistant, pest resistant, and long lasting
- 4. They provide high thermal insulation & have high compressive strength;
- 5. Have high resistance to water penetration and are moisture resistant.





6. No pollutants or hazardous wastes are generated in the process make it's more environment friendly and almost zero carbon footprint.

Figure 58 - Autoclave Aerated Concrete Blocks



Source - Generic Image

Sustainable concepts adopted in the project are:

- Locally available materials like laterite stone, bricks, granite aggregates, sand shall be used.
- > Lightweight cement concrete blocks
- > Solar water heating system for hot water requirements.
- > Use of recycled PVC and plastics for seats and other accessories.
- Use of minimum 3-star rated and low energy consuming electrical appliances such as air conditioning, refrigeration, water coolers, fans, blowers etc.
- > Use of LED lights for all lighting needs.
- > Use of green mix concrete using higher content of fly ash / GGBS
- > Use of energy efficient glass for air conditioning spaces.
- > Use of solar panels for energy generation.





Figure 59 - Connectivity to Site

7 DESIGN FOR MANGALA STADIUM

7.1 DESIGN BASIS APPROACH AND CONNECTIVITY

The site is located near Ladyhill circle which is a residential and commercial locality within the city limits of Mangalore. The stadium is part of the comprehensive development of Mangala Stadium and Sports Complex (MSSC). The sports complex is surrounded with roads on four sides. The site can be primarily accessed from Kulur Ferry road on the east or the Mahatma Gandhi road on the south and has access from Nehru Avenue road on the north and Nehru Avenue cross road on the west. The site is gradually sloping down towards north. The site has a medium traffic density around .Main access to the stadium is taken from the Mahatma Gandhi road and Kulur Ferry road.



Source - Google Map

The stadium is now managed by Department of Youth Empowerment and Sports (DYES). The existing Stadium has various athletic facilities for track and field, covered seating pavilion complex housing toilets and offices as well as open seating stands developed over an earthen embankment.

The requirement includes the design of the Mangala stadium in concept and Phase I of the stadium shall be detailed to suit the allocated budget of 10 crore by Mangaluru Smart City Limited (MSCL)

7.2 DESIGN COMPONENTS FOR LAYOUT PLAN

Major components of the design incorporated in the layout plan may be summarized as follows.

- Spectator seating
- Sports equipment room
- Spectator toilets
- Athletes changing rooms and toilets
- Coaches changing room and toilet
- Storerooms
- First aid and treatment room
- Gymnasium
- Rooms





7.3 DESIGN CONCEPT PROPOSAL

- The total area of the Mangala Stadium Sports Complex is 21 acres approx. Stadium alone is around 9.8 acres. It is located in the heart of Mangaluru City and being managed by **Department of Youth Empowerment and Sports**.
- The existing Stadium has various athletic facilities for track and field, covered seating pavilion complex housing toilets and offices as well as open seating stands developed over an earthen embankment.
- The allocated fund for up-gradation of Mangala Stadium and construction of Indoor stadium for Kabaddi and Stadium Badminton near Urwa market is **10.00 Cr** in the revised SCP.
- It is proposed to design the full Mangala Stadium in concept.
- **Phase I** of the stadium shall be designed to suit the allocated budget of 10 crore by Mangaluru Smart City Limited (MSCL).

7.4 DESIGN CONSIDERATIONS

Table 22 - Design Considerations

SI No	OBJECTIVES OF THE NEW DEVELOPMENT	REQUIREMENTS AND DESIGN CONSIDERATIONS TO SUIT THE OBJECTIVES
1	To create a stadium with world class track & field facilities.	 International / National class of athletic facilities in grounds, equipment, warm up areas and rooms. Will help athletes, PRACTICING here when they participate in national and international events.
2	To create an EVENTS STADIUM - suitable for district level and state level athletics meets.	 As per Sports Authority of India and IAAF approved facilities. Provide access and crowd control, accommodation, storage, VIP and spectator seating upto 8000 people. Facilities to conduct district/ state level athletics events.
3	To create A COMMUNITY SPORTS FACILITY - for Local community users, Schools, Colleges, Institutions & Sports Clubs.	 These are the MAIN USERS of the stadium today. To provide for community level users of upto 500 people including athletes.
4	To create provision for a SPORTS COMPLEX Mangala Stadium Sports Complex (MSSC) by linking all sports facilities existing around the stadium.	 Create walking track around the stadium to LINK stadium, volley ball, basketball, skating and badminton courts around and swimming pool. to act as ACCESS CONTROL area during major events. as a WALKING TRACK FOR MANGALORE CITIZENS.





SI No	OBJECTIVES OF THE NEW DEVELOPMENT	REQUIREMENTS AND DESIGN CONSIDERATIONS TO SUIT THE OBJECTIVES
5	To create FACILITIES FOR DYES - Dept of Youth Empowerment Services.	 Provide rooms for offices of the DYES, various sports associations, hostels, halls and kitchen etc to run their regular youth/ sports hostels and programs. Provide facilities to enable DYES to generate income to finance the operating expenses of the stadium.
6	To create a LANDMARK PROJECT FOR MANGALURU	 Parking, access provisions, Eco & Enviro features, landscaping and other requirements suitable to the size and style of the stadium.

Parking Requirements:

The Karavali Utsav grounds will be reserved for private parking during events.

7.5 CONSTRAINTS

- The maximum number of parking available in the ground is 278 cars and 378 2wheelers, as per Zonal Regulations 2011 of Mangaluru, clause 5 of Table – 8 (Off Street parking). This will allow a design of the stadium of 4800 seats only.
- After discussions with MSCL and DYES, it is decided that the stadium will be designed for 8000 seats capacity.







7.6 PROPOSED PLAN OF MANGALA STADIUM – MASTER PLAN (ALL PHASES)

ASHTADIK

Figure 61 - Proposed Plan of Mangala Stadium 1) SPECTATOR SEATS WITH SPECTATOR TOILETS BELOW 1) ADDITIONAL CABINS FOR VISITING IF POSSIBLE PRACTICE TRACK IN THE BASEMENT 6) EQUIPMENT STORE ROOM SHIFTED FROM SECTION > VIP SEATING ROOMS WITH TOILET 1) STADIUM/D.Y.E.S. OFFICES CABINS 1) ATHLETES RESTROOMS WITH ATTACHED TOILETS FACING OUTER SIDE OF STADIUM (5 ROOMS WITH ATTACHED TOILETS) 2) BOARD ROOMS- 50 PERSONS DINING HALL WITH KITCHEN RECREATION ROOM INCLUDING LIBRARY ETC. 6) COMMON TOILET FACILITIES 3) OFFICE STAFF- 15 PERSONS FIRST FLOOR- 380 SQM OFFICIALS (IF POSSIBLE) GROUND FLOOR- 468 SQM WASHROOM + TEA AREA 4) RECORD ROOM5) SUPPORT STAFF ROOM FACING STADIUM ARENA > MEDIA/PRESS ROOMS > SPECTATOR SEATING SECTION 8.9.10 BM 2) STORE ROOMS 2) STORE ROOM SECTION 12 LOWER LEVEL UPPER LEVEL FIRST FLOOR- 650 SQM 6 Ŀ 1 --Ć ATHLETES ENTRY FACILITIES (AS PER IAAF NORMS) 1) CHANGING ROOMS AND COACHES ROOM 2) ENTRY FROM PRE- PRACTICE AREA 3) CALL ROOM 1 & 24) SHOWER & TOILET FACILITIES BASEMENT + GF (1484 SQM) SECTION 6 8 7 SPECTATOR SEATING 12 5 1) OFFICES FOR SPORTS OFFICIALS + COMMON 2) MEETING HALL (20-30 PEOPLE) 3) CAFETERIA/ MESS WITH KITCHEN & STORE FIRST FLOOR- 1500 SQM DORMITORIES FOR BOYS AND GIRLS WITH COMMON TOILET FACILITIES ĉ 1) STORE ROOM- MIN 20M X 15M X 6M HT VEHICLE ACCESS REQUIRED (GF+FF) DORMITORIES FOR GIRLS AND BOYS MASSAGE, FIRST AID AND TREATMENT. GROUND FLOOR- 1815 SQM > REFEREE AND COACHES (ABOUT 3)) CHANGING ROOMS WITH SHOWERS SECTION 2 (MIXED ZONE AREA) WITH COMMON TOILET FACILITIES FACILITIES INCLUDING TESTING (NATIONAL ANTI DOPING AGENCY GROUND FLOOR- 610 SQM 2) ROOMS FOR PHYSIOTHERAPY, GROUND FLOOR- 605 SQM FIRST FLOOR- 500 SQM > GYMNASIUM 2) TOILET FACILITIES FOR SECTION 3, 4 6 5 FIRST FLOOR- 500 SQM SECTION 1 (PHASE 1) > ATHLETES (MIN 12 + 12) ROOM AND TOILETS WASHROOM SPECTATORS AND TOILET 3) NADA

7.7 PROPOSED PLAN OF MANGALA STADIUM – MASTER PLAN DETAILS (ALL PHASES)



MANGALURU

сı

Proposed Segment of the seating pavilion 7.8



7.9 **PROPOSED PHASE-1 DEVELOPMENT** Figure 63 - Phase 1 Development







7.9.1 GROUND FLOOR PLAN (PHASE 1 DEVELOPMENT)



7.9.2 FIRST FLOOR PLAN (PHASE 1 DEVELOPMENT)



7.10 VIEW OF MANGALA STADIUM (ALL PHASES)

Figure 66 - Bird's eye view of fully completed Mangala Stadium (including Phase 1 and 2) from Kulur Ferry Road



7.11 MATERIALS USED

- 1. Building Rcc frame with laterite and block stone masonry with cement plastering within the ambit of SoR.
- 2. Spectator seating Readymade high quality HDPE seats with UV resistance from vendors who have supplied to stadium projects in Karnataka, Kerala and other states.
- 3. Roofing over Spectator seating- Tensile membrane roofing over MS Steel frame with epoxy painting. Membrane roofing is used for its light weight properties, UV resistance, pleasing appearance and choice of colours.
- 4. Outer elevation feature Using UV resistant FRP lattice work available in standard factory made formats and colour completely waterproof, non-fading properties fitted over MS steel frame painted with epoxy coating.





8 ELECTRICAL DESIGN FOR MANGALA STADIUM (PHASE 1)

8.1 SCOPE OF WORK

The objective of this report is to give an overview of services designed by consortium of KUMARCHANDRA & ASSOCIATES AND ASHTADIK INFRASTRUCTURE PLANNING CONSULTANTS PVT. LTD. for the UPGRADATION OF MANGALA STADIUM (PHASE I) - Mangalore Smart City. The designs of Engineering Services undertaken by The consultants includes following:

- Internal Electrical Power and Lighting
- External Electrical System
- Earthing System
- External and Internal electrical Details.

8.2 PROJECT OBJECTIVES

The project objective includes friendly design, centralized grouped location of services installation in future to ensure easy maintenance, fast track installation and compliance to all statutory regulations.

8.3 DESCRIPTION OF PROJECT

Proposed Upgradation of Mangala Stadium – Phase 1. This phase of development includes areas like storage room, gymnasium, changing rooms and shower stalls, toilets for spectators and athletes, spectator seating and walkway for daily walkers/joggers.

8.4 BROAD CONCEPT OF SERVICES

The Services Systems for the project have been conceptualized based on past experience and acceptable International design standards. Effort shall be made to and still provide access to these for accommodating changes in conceal all services requirement in future. Conservation of energy, optimization of resources, Ecotechnology shall be the key factors in the design friendliness and State of the art concept to ensure least downtime and reduce maintenance hassles. Every effort shall be made to design, layout and install equipment in locations which will tend to encourage routine preventive maintenance by providing easy access for operation personnel. Manual isolation will be provided to enable servicing, expansion or renovation of any part of the system without interrupting the services in adjacent areas.

Electrical: The demand load for the building is estimated as approx.. 24 kW. As per the crisis norms all other loads to be switched off when fire pumps are run. We are using an electrical interlock system where in when fire pump feeder operates other loads switch off.

8.5 ELECTRICAL SYSTEMS

a) Bus bars in all distribution panels are specified as tinned electrolytic hard drawn (HD) and high conductivity aluminium bus bars to reduce losses and improve reliability.





b) Copper conductor cables are specified for sizes of 25sq mm and below, this will reduce losses and improve reliability.

c) LED light fixtures shall be used for entire building areas.

d)All cables shall be derated to avoid heating during use. This also indirectly reduces losses and improves reliability

8.6 **REFERENCE STANDARDS**

The following standards and codes shall be followed/ referred during detailed design of the services:

- Local By laws
- National Building Code of India 2016
- Energy Conservation Building Codes 2018
- Relevant codes of Bureau of Indian Standards
- The Indian Electricity Rules, 1956
- Indian Electricity-Act 2003
- IEC 60947 / IS 13947: Specification for low voltage switch gear & control gear

8.7 DESIGN CALCULATIONS

Estimated Electrical Power requirements are calculated and indicated in the end of this section (Table no. 23)

8.8 SOURCES OF POWER SUPPLY

It is understood that the stadium building will be supplied power from Local Supply Company. Based on the available note the LT power shall be available from MESCOM for the project at 433V at present and HT power supply in the future. The stadium building will be supplied power from the Nearest Source of the Area.

8.9 STATE ELECTRICITY SUPPLY

The demand load for the Indoor Stadium is estimated as 24kW.

based on the information available the power shall be available from the power supply company at 11KV. However, specific confirmation shall need to be taken from the relevant power supply company, prior to system design. Metering by the power supply co. shall be carried out at the metering room / Electrical room by client within the premises as per local norms.

8.10 LT POWER DISTRIBUTION SCHEME

LT Power from the supply company shall be brought to the LT METERING PANEL located in the LT Panel room. Power from the main LT panel shall feed to Main Distribution Boards (MDB), At least 20% spare capacity on sub mains and rising mains shall be provided. Sub main protection shall be by circuit breakers, which will discriminate with upstream protective devices. All switch boards shall be Form 3b construction and switching of incoming & outgoing circuits up to 630 amps shall be moulded case circuit breakers and above 630 amps shall be air circuit breakers. Aluminium bus bar shall be provided for all





power distribution panels. Bus Stand Facility- 1 no 3 Phase LT meters. Independent lighting distribution panel shall be provided throughout the building. A dedicated room and associated riser shaft for cables. The effects of electromagnetic radiation on LV System shall be considered in locating of all LV system and cable. Shielding shall be provided where necessary. 15 - 20% spare capacity over maximum demand shall be provided in all services including cables.

Panel will be suitable for indoor installation with IP-54 degree of protection, fully compartmentalized design and will be provided with single bus bar system of copper/AI bus bars rated for short circuit withstand capacity of 50 kA for 1 second. Panel Colour shall be RAL-7032 Siemens Grey.

Main Distribution Boards and Sub-distribution Boards shall incorporate moulded case circuit breakers. Final distribution boards shall incorporate miniature circuit breakers of 10 KA minimum interrupting capacity (MCB) &residual current circuit breaker of 30 mA (RCCB).

Distribution boards shall be located in accessible positions to suit the area of floor within the Facility. Sub Distribution Boards (SDB's) shall be located on area basis including metering system. Final Distribution Boards shall be fed from these MDB's &SDB's by means of either PVC insulated aluminium armoured cables or PVC insulated copper wires in appropriately sized MS/ PVC conduits.

8.11 SYSTEM EARTHING

Earthing system shall be designed in accordance with IS: 3043 for earthing system. Dedicated earthing pits shall be provided for neutral earthing of major equipment Interconnected Earthing pits shall be provided for body earthing of equipment. Distribution earthing shall be carried all along the MV distribution system, and effectively bonding the equipment.

Earthing for light and power points shall be carried out with insulated copper earth wire running throughout the length of the circuit and shall be terminated at equipment, fixtures, etc with effective bonding to main earthing grid.

All the pits and main earthing bars are to be connected to each other to make a common earthing electrode grid. If the resistivity of the soil is very high, earthing calculations shall be done to ensure that the conductivity is maintained at less than 1 Ω .

RECOMMENDED ILLUMINATION LEVELS

The general lighting of various spaces shall be planned by the Interior Designer/ Lighting Consultant. The recommended illumination levels are given below for general guidance:




Table 23 - Stadium: Recommended Illumination Levels

SL.No	Area	Recommended	Illumination Level Lux
		Type of Lamps	
1	Corridors & General Circulation (Service areas)	LED	70-100
2	Public Toilets.	LED	200
3	Offices/Conference Room	LED	300 - 500
4	Plant room/ Service areas	LED	200
5	Staircases	LED	150

8.12 SYSTEM OF WIRING

The system of wiring shall consist of PVC insulated copper conductor stranded flexible FRLS wires of 1100 volts grade of insulation, in metallic conduits for all exposed wiring and PVC/ metallic conduits for all concealed wiring. Minimum size of copper conductor shall be 1.5 sq. mm for lighting and 2.5sqmm for power. Colour code shall be maintained for the entire wiring installation that is Red, Yellow and Blue for the three phases, Black for neutral and Green with Yellow band for earthing.

8.13 INTERNAL LIGHTING

Providing lighting which shall include Ceiling, wall mounted, etc. Cabling &earthling to all the light fixture. Switching for all above light fixture.

8.14 SWITCHING ARRANGEMENT

Switching arrangement at various locations shall be planned to keep in view the ease with which isolation can be achieved and also the level of fault protection desired at the particular current rating. Main distribution panels and sub-distribution panels shall incorporate moulded case circuit breakers. Final distribution panels shall incorporate miniature circuit breakers and earth leakage circuit breakers. All circuits breakers (MCCB) and miniature circuit breakers (MCB) in all breaker of main panel & incoming of all panels shall be of 4 pole for 3 phase power distribution with advance neutral feature for safety, which shall ensure connecting first and breaking last of the neutral contact and avoiding high voltage in the single phase circuits. Four pole breakers shall provide further safety against the unbalance floating current in the neutral, which could be dangerous, especially to the maintenance staff in case floating voltage is more than 50 volts.

8.15 MOULDED CASE CIRCUIT BREAKER (MCCB)

MCCB shall be current limiting and comprise of quick make - break switching mechanism and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. All MCCB's shall be capable of defined variable overload adjustment. All MCCB's upto 250 amps shall have thermal magnetic releases and





above 250 amps shall have microprocessor-based release with adjustable magnetic short circuit pickup. Wherever MCCB with earth fault protection is identified, the protection shall be an integral part of the release with adjustable magnetic short circuit and earth fault protection with time delay. The breaking capacity of MCCB's shall be as asked for on the single line diagram but minimum 25 KA. The breaking capacities specified shall be ICU=ICS.

8.16 MINIATURE CIRCUIT BREAKER (MCB)

Miniature Circuit Breaker shall comply with IEC 60898 / IS 8828. Miniature circuit breakers shall be quick make and break type for 240/415 VAC 50 Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCB's shall be rail mounted. The MCB shall be Current Limiting type (Class-3). MCB's shall be classified as per their Tripping Characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IEC and the manufacturer shall publish the values.

The housing shall be heat resistant and having a high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP and 4 Pole miniature circuit breakers shall have a common trip bar independent to the external operating handle.

8.17 CURRENT OPERATED EARTH LEAKAGE CIRCUIT BREAKER / RESIDUAL CURRENT CIRCUIT BREAKER (ELCB / RCCB)

ELCB / RCCB shall work on the principle of core balance transformer. The incoming shall pass through the torroidal core transformer. As long as the currents in the phase and neutral shall be the same, no electro motive force shall be generated in the secondary winding of the transformer. In the event of a leakage to earth, an unbalance shall be created which shall cause a current to be generated in the secondary winding; this current shall be fed to a highly sensitive miniature relay, which shall trip the circuit if the earth leakage

current exceeds a predetermined critical value. ELCB/RCCB shall be current operated independent of the line voltage; current sensitivity shall be of 30mA/100mA at 240/415 volts AC and shall have a minimum of 20,000 electrical operations.

ELECTRICAL LOAD DETAILS					
SL NO	ITEM	QTY	WATTS	TOTAL POWER IN WATTS	
А	Lighting Load				
1	Slant Batten Holders with LED Lamp	50	12	600	
2	Batten LED tube Light Fittings 1x4'	60	20	1200	
3	10W LED Square Down Light Fittings	30	10	300	
4	20W LED Square Down Light Fittings	10	20	200	
5	LED Post Top Lanterns	12	25	300	
6	LED Flood Light	12	200	2400	

Table 24 - Electrical Power requirement for Complete Facility: Load Details





7	LED Facade Light	24	140	3360
8	LED Down Light	18	18	324
9	Exhaust Fan light duty	20	30	600
10	Exhaust Fan heavy duty	6	250	1500
11	Ceiling Fan	30	75	2250
12	Wall mount fan	8	75	600
13	High bay light	2	50	100
14	6A Socket	20	100	2000
15	13A Socket - Universal Socket	30	100	3000
16	16A Socket	20	500	10000
17	1.5TR AC (Total 11 TR)	1	13200	13200
			Total	41934
	Total single phase load in KW			41.94
	Total Single phase load in 3 phase in KW			24.24
В	Power Load in Three phase			
1	Sump Pump	1	3700	3700
			Total	3700
	Total load in 3 phase in KW			27.94
	Load factor @ 80%			22.30
	Total Load required in KW			24
	Total Connected Load in KW (Rounded	KW	24	





9 FIRE FIGHTING PROVISIONS IN MANGALA STADIUM (PHASE 1)

The standards mentioned in the **National Building Code 2016 (Volume 1, Part 4 - Fire Fighting)** is adopted as the norms for fire fighting and safety in Mangala Stadium.

- The stadium is classified under the category of Subdivision D-5 which shall include any building or structure, permanent or temporary meant for assembly of people not covered by Sub-divisions D-1 to D-4 for example, grandstands, stadia, amusement park structures, reviewing stands and circus tents, arenas, external swimming pools, tennis and similar type of courts as per Clause 3.1.5.
- Arrangement of exits As per Table 5, exits shall be so located that the travel distance on the floor shall not exceed the distance of 30.00 m for an assembly building.

SI No.	SI Occupancy Group Maximum Travel Distantio.				
		Types 1 and 2	Types 3 and 4		
(1)	(2)	(3)	(4)		
i)	Residential (Group A)	30.00	22.50		
ii)	Educational (Group B)	30.00	22.50		
iii)	Institutional (Group C)	30.00	22.50		
iv)	Assembly (Group D)	30.00	30.00		
v)	Business (Group E)	30.00	30.00		
vi)	Mercantile (Group F)	30.00	30.00		
vii) Industrial (Group G)					
	G-1, G-2	45.00			
	G-3	22.50	See Note 3		
viii)	Storage (Group H)	30.00			
ix)	Hazardous (Group J)	22.50 J			
NO	TES				
1 F	or fully sprinklered build	ing, the travel	distance may		
in or	eased by 50 percent of the	values specifie	d		

Figure 67 - Travel distance

Source - National Building Code 2016

• As per Clause 4.4.2.4.1,

' No exit doorway shall be less than 1000 mm in width except assembly buildings, where door width shall be not less than 2000 mm. Doorways shall be not less than 2000 mm in height.'

- As per Table 7 (Page 45), the following provisions are required for Assembly Buildings (Group D) with height less than 10 m and that can accommodate more than 300 persons :
 - Fire Extinguisher
 - First Aid Hose Reel
 - Down Comer
 - Manually operated Electronic Fire Alarm Systems





- 25000 L Terrace Tank over Respective Tower Terrace (x 4 Downcomers = 1,00,000L)
- 900 L/min Pump Capacity at the Terrace Tank Level with Minimum Pressure of 3.5 kg per sqcm.

NOTE : MOEFA System shall also include talk-back system and public address system for the occupancies given in the table for (d) (I) (iii) under A-5, (a) (I) (iv) and (a) (2) under C-I, and (a) (2) under D-1 to D-5, in all buildings 15 m and above in height, except for A-3 and A-4 occupancies where these shall be provided for buildings of height 24 m and above.

• As per Clause 6.4.2.1, the following shall be applicable:

d) Clear aisles not less than 1.2 m in width shall be formed at right angles to the line of seating in such number and manner that no seat shall be more than seven seats away from an aisle.

Rows of seats opening on to an aisle at one end only shall have not more than seven seats. Under the conditions, where all these aisles do not directly meet the exit doors, cross aisles shall be provided parallel to the line of seating so as to provide direct access to the exit, provided that not less than one cross aisle for every 10 rows shall be required. The width of cross-aisles shall be minimum of 1 m. Steps shall not be placed in aisles to overcome differences in levels, unless the gradient exceeds 1 in 10.

q) Seats in places of public assembly, accommodating more than 300 persons, shall be securely fastened to the floor, except as permitted in (r) below. All seats in balconies and galleries shall be securely fastened to the floor, except that in nailed-in enclosures, boxes with level floors and having not more than 14 seats, the seats need not be fastened.

r) Chairs not secured to the floor may be permitted in restaurants, night clubs and other occupancies where the fastening of seats to the floor may not be practicable, provided that in the area used for seating, excluding dancefloor, stage, etc, there shall be not more than one seat for each 1.4 m² of floor area and adequate aisles to reach exits shall be maintained at all times. The arrangements shall be as follows in general:

1) Rows of seats between aisles shall have not more than 14 seats.

2) Rows of seats opening on to an aisle at one end only shall have not more than 7 seats.

3) Seats without dividing arms shall have their capacity determined by allowing 450 mm per person.





10 PLUMBING AND SANITATION DESIGN FOR MANGALA STADIUM (PHASE 1)

10.1 Water Supply

For Phase 1, Water shall be provided from Water supply lines existing at the stadium site. One sump tank of 50,000 Litres is provided as part of Phase 1 works along with 1,00,000 L of Over head Tank as water supply to drinking and wash areas. WATER DEMAND CALCULATION

As per **NBC 2016 (Volume 2, Part 9, Section 1, Table 1)**, it is assumed that a water capacity of 4 Litres/head/day is consumed for domestic purpose and 6 Litres/head/day of water is assumed to be consumed for flushing purpose in a stadium. Hence, it can be considered to assume 10 Litres/head/day of water.

For a capacity of 700 people, it is estimated to have water consumption of 7000 Litres per day.

Water Demand Calculation for Fire fighting is mentioned under Chapter 9 – Fire fighting provisions for Mangala Stadium (Phase 1).

10.2 DRAINAGE -

Phase 1 building having an area of 1328 Sqm shall be connected to existing UGD connection located on Kulur Ferry road on western side of the site.

For Phase 1 building, storm water from ground will be connected to existing storm water drain located 2.3 m below site level on Nehru Avenue road on South of the site. Rainwater from roof tops will be collected and directed to rain water harvesting pits as shown in drawings.





11 COST CHAPTER

Name of work: Estimate for the Proposed Upgradation of Mangala Stadium (Phase 1) in Mangaluru Taluk, Dakshina Kannada District -Block 1 **GENERAL ABSTRACT** Item of Work SI.No Amount A. CIVIL 1 **Construction of Building** 4,60,71,774.02 2 Construction of Pedestrian Walkway + Storm Water Drains 25,47,433.70 3 Providing Water supply and Sanitary Arrangements 13,52,799.60 4 **Providing Sump Tank** 8,63,621.40 5 Providing Electrical supply and Lighting Luminaires 53,26,067.38 6 Providing Rainwater harvesting pits 1,87,417.83 7 **Providing Fire Fighting Requirements** 23,35,967.70 8 **Providing OHT** 22,83,551.05 9 Providing Foundation for DG Set 6,68,841.91 6,16,37,474.59 Total GST @ 12 % 73,96,496.95 Total 6,90,33,971.54 Contingencies and Labour Cess @ 3 % 20,71,019.15 Price Escalation Charges @ 5 % 34,51,698.58 **B. PROVISIONS** Provision for Roofing system 1,06,20,000.00 1 2 Provision for Facade cladding 83,63,250.00 Provision for Precast items - Bollards and benches 3 2,93,230.00 4 **Provision for Spectator Seating** 12,83,250.00 5 Provision for Water Cooler 1,16,000.00 6 **Provision for Signages** 16,815.00 7 Provision for Gym flooring 2,53,800.00 8 Provision for Gym lockers 85,250.00 9 **Provision for Gym Equipments** 27,53,015.00 10 Provision for Shower cubicle 3,68,160.00 11 Provision for motorised rolling shutter 1,11,510.00 12 Provision for wall mural 8,78,400.00 13 Provision for Fire Brigade inlet 14,750.00 TENDER PREMIUM, MISCELLANEOUS AND ROUNDING OFF 2,85,880.74 **GRAND TOTAL** 10,00,00,000.00





12 TOPOGRAPHIC SURVEY







000

13 CADASTRAL MAP







14 SOIL TEST REPORT



सिविल अभियान्त्रिक विभाग

पोध्य संस्थान कर्नाटक. सुरत्कल पोस्ट श्रीनिवासनगर, मंगलुरू - 575 025

DEPARTMENT OF CIVIL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL POST SRINIVASNAGAR, MANGALURU - 575 025

Date: 09.12.2019

GEOTECHNICAL INVESTIGATION REPORT

General: This report is in response to the request made by Mr. Kumarachandra & Associates, vide letter No. 04/KCA/NITK-ST/MSCL-/KC/19 dated 02-12-2019 [Client : The Mangalore Smart City Ltd., (MSCL)]. In his letter, he requested us to carry out geotechnical investigation for the proposed upgradation of Mangala Stadium (GF + 2 Floors) at Mangalore.

Boring and SPT were done by Mr. M. Manohar Rao as per clients requirements.

Soil Investigation:

The following observations were provided to us by the Engineer who carried out boring.

- 1. Boring was done at two locations (bore hole 1 and bore hole 2).
- Water table was not met with till termination depth of 12m. 2.
- Bore holes 1 and 2 were terminated at 12m and 11.5m depth soon after touching the rock. 3.

The SPT soil samples and N values were supplied to us. Bore logs are prepared and are enclosed herewith. Type of soil, thickness of soil strata, observed SPT N values are shown in the enclosed borelogs. To the supplied N values, corrections are applied as per IS codal procedures.

Recommendations:

- i. In bore hole 1 area loose silty soil is present till 3m depth. At this location recommended depth of foundation is 3.3m.
- ii. In bore hole 2 area recommended depth of foundation is 1.5 to 2m.
- iii. Recommended to adopt isolated/combined footings.
- iv. For the design of isolated/combined footings of widths 1.5m, 2m and 3.0m, Safe Bearing Capacity (SBC) of 225kN/m², 215kN/m² and 195kN/m² is recommended.
- Search for loose pockets shall be made before laying the foundation bed. If any pockets v. are found, it shall be compacted well using boulder + sand or lean concrete
- vi. Proper drainage shall be provided to avoid stagnation of water.

Encl: Borelogs 2 Nos.

(SITARAM NAYAK) Professor

Dept. of Civil Engg.

(K. SWAMINA' Professor& Head Dept. of Civil Engg

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15 SOCIAL IMPACT ASSESSMENT

1. Acquisitions and impact on neighbourhood:

There is no land acquisition nor disturbance to other properties of private or non-government users in the implementation or execution of this project.

The project will be constructed within the confinements and boundaries of MSSC. Hence negative impact on neighbourhood and citizens, surrounding establishments will be negligible.

2. Impact on sports development in the region

The development of Mangala Stadium with national or international standard quality or facilities for athletics and associated sports as well as provision of high quality of facilities for athletics and spectators alike is expected to positively benefit all users of the facilities including schools and colleges, sports associations, youth services programs, various associations and organisations which use the stadium as community sports centre. The is expected to have very great impact on sports persons from the district.

3. Impact on Urban Mangaluru

The visual impact of the fully completed stadium is expected to benefit the city of Mangaluru as a landmark of the city and should positively impact tourism in the area.





16 **ANNEXURE A**

GUIDELINES APPLICABLE FROM NATIONAL BUILDING CODE, 2016

Volume 1, Part 4 - FIRE AND LIFE SAFETY

As per the guidelines for fire safety prescribed in NBC-2016, the stadium falls under the category of 'Assembly' Buildings (Group D). Following are the standards to be adopted while designing a stadium:

Clause 3.1.5 , e)

Subdivision D-5 - This subdivision shall include any building or structure, permanent or temporary meant for assembly of people not covered by Subdivisions D-1 to D-4, for example, grandstands, stadia, amusement park structures, reviewing stands and circus tents, arenas, external swimming pools, tennis and similar type of courts.

Clause 3.2.2.2

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The fire zones shall be made use of in land use development plan and shall be designated as follows:

a) Fire Zone No. 1- This shall comprise areas having residential (Group A), educational (Group B), institutional (Group C), assembly (Group D), small business (Subdivision E-1) and mercantile (Group F) buildings, or areas which are under development for such occupancies.

51140.	Structural Element	Fire Resistance Ratings (min) for Type of Construction			
		Type 1	Type 2	Type 3	Type 4
(1)	(2)	(3)	(4)	(5)	(6)
i)	Exterior walls:				
	 a) Fire separation less than 3.7 m: 				
	1) Bearing	240	120	120	60
	Non-bearing	120	90	60	60
	b) Fire separation of 3.7 m or more but less than 9 m:				
	1) Bearing	240	120	120	60
	Non-bearing	90	60	60	60
	c) Fire separation of 9 m or more:				
	1) Bearing	240	120	120	60
	Non-bearing	60	60	60	60
ii)	Fire separation assemblies (like fire check doors)	120	120	120	120
iii)	Fire enclosures of exits	120	120	120	120
iv)	Shafts for services, lift hoistway and refuse chutes	120	120	120	120
v)	Vertical separation between adjacent tenant spaces	60	60	60	60
vi)	Dwelling unit separation:				
	 a) Load bearing 	120	120	60	60
	 b) Non-load bearing 	60	60	30	30
vii)	Interior bearing walls, bearing partitions, columns, beams, girders, trusses (other than roof trusses) and framing:				
	a) Supporting more than one floor	240	120	120	120
	b) Supporting one floor only	180	90	60	60
	c) Supporting a roof only	180	90	60	60
viii)	Walls supporting structural members	180	90	60	60
ix)	Floor construction	120	90	60	60
x)	Roof construction:				
	a) 5 m or less in height to lowest member	120	90	60	60
	b) More than 5 m but less than 6.7 m in height to lowest member	60	60	60	60
	c) 6.7 m or more in height to lowest member	0	0	0	0
NOTES					

Table 25 - Fire resistance ratings of Structural and Non- Structural elements

1 The above fire resistance rating shall be required to achieve the respective type of construction unless otherwise specified in the respective clauses for different applications/use.



i



Clause 4.2.11

Unless otherwise specified, all the exits and exit passageways to exit discharge shall have a clear ceiling height of at least 2.4 m. However, the height of exit door shall be at least 2.0 m.

4.3 Occupant Load

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For determining the exits required, the number of persons within any floor area or the occupant load shall be based on the actual number of occupants declared, but in no case less than that specified in Table 3.

Table 26 - Occupant Load

	Table 3 Occupant Load (Clauses 4.3 and 4.4.2.1)					
SI No.	Group of Occupancy	Occupant Load Factor (m ² /person)				
		(see Note 1)				
(1)	(2)	(3)				
i)	Group A: Residential	12.50				
ii)	Group B: Educational	4.00				
iii)	Group C: Institutional (see Note 2):					
	 a) Indoor patients area 	15.00				
	b) Outdoor patients area	10.0				
iv)	Group D: Assembly:					
	 Concentrated use without fixed seating 	0.65				
	b) Less concentrated use without fixed seating (see Note 3)	1.40				
	c) Fixed seating	see Note 4				
	 Dining areas and restaurants with seating and table 	1.80				
v)	Group F: Mercantile:					
	 a) Street floor and sales basement 	3.00				
	b) Upper sales floor	6.00				
	c) Storage/warehouse, receiving and the like	20.00				
vi)	Group E: Business	10.00				
vii)	Group G: Industrial	10.00				
viii)	Group H: Storage (see Note 5)	30.00				
ix)	Group J: Hazardous	10.00				

NOTES

1 Gross area shall be the floor area as defined in 2.35. All factors expressed are in gross area unless marked net.

2 Occupant load in dormitory portions of homes for the aged, orphanages, insane asylums, etc, where sleeping accommodation is provided, shall be calculated at not less than 7.5 m² gross floor area/person.

3 These shall include gymnasium, table tennis room, billiard room and other gaming rooms, library, swimming pool and like.

4 In case of assembly occupancy having fixed seats, the occupant load shall be determined by multiplying the number of seats by 1.2.

5 Car parking areas under occupancy other than storage shall also be 30 m² per person.

4.4.2 Exits

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4.4.2.1 Number of exits

The minimum required number of exits in a building shall be determined based on occupant load (see Table 23) and width required per person (see Table 4) as appropriate to the type of exit for respective occupancies, subject to complying with maximum travel distance requirement (see Table 25 here).





ii

4.4.2.2 Arrangement of exits

a) Exits shall be so located that the travel distance on the floor shall not exceed the distance given in Table 5.

b) Travel distance shall be measured from the most remote point within a storey or a mezzanine floor along the natural and un-obstructed path of horizontal or vertical egress travel to the door to an exit.

c) The dead end corridor length in exit access shall not exceed 6 m for educational, institutional and assembly occupancies. For other occupancies, the same shall be 15 m.

d) Exits shall be placed as remote from each other as possible and shall be arranged to provide direct access in separate directions from any point in the area served.

4.4.2.3 Capacities of means of egress

a) Exit capacity is the number of people that can pass through a stairway, and level components (door and corridor) and ramps. The total capacity of all the respective means of egress serving a floor shall be sufficient to allow egress of the entire population of the floor.

b) The unit of exit width, used to measure the capacity of any exit, shall be 500 mm. A clear width of 250 mm shall be counted as an additional half unit. Clear widths less than 250 mm shall not be counted for exit width.

c) Width per person for stairways, and level components and ramps shall be determined using the capacity factors in accordance with Table 24 here.

(1) (2) (3) i) Residential (Group A) 10	Level omponents nd Ramps (4)
(1) (2) (3) i) Residential (Group A) i) Educational (Group A) 10	(4)
i) Residential (Group A) 10	
11) Educational (Group B)	6.5
iii) Institutional (Group C) 15	13
iv) Assembly (Group D) v) Business (Group E)	
v) Busiless (Group E) 10	6.5

Table 27 - Capacity Factors

For example, if an exit doorway measures 1 000 mm in clear width, it would be defined as providing exit capacity for 1 000/6.5 occupants, that is, 153 persons (say 150 persons)





and number of such exit doorways can then be calculated depending on the occupant load.

SI Occupancy Group Maximum Travel No. m			
		Types 1 and 2	Types 3 and 4
(1)	(2)	(3)	(4)
i)	Residential (Group A)	30.00	22.50
ii)	Educational (Group B)	30.00	22.50
iii)	Institutional (Group C)	30.00	22.50
iv)	Assembly (Group D)	30.00	30.00
v)	Business (Group E)	30.00	30.00
vi) vii)	Mercantile (Group F) Industrial (Group G)	30.00	30.00
	G-1, G-2	45.00	
	G-3	22.50	See Note 3
viii)	Storage (Group H)	30.00	500000
ix)	Hazardous (Group J)	22.50	
NO	TES		
1 F	or fully sprinklered build	ing, the travel	distance may

Table 28 - Travel distance - based on occupancy and construction type

4.4.2.4.3.2 - Internal Staircases

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d) The following minimum width shall be provided for staircases for respective occupancies:

1) Residential (A-2) : 1.00 m

NOTE . For row housing with 2 storeys, the minimum width shall be 0.75 m.

2) Residential (A-1, A-3 and A-4) : 1.25 m

3) Residential hotel (A-5 A-6) and : 1.50 m

4) Assembly : 2.00 m

NOTE . The width of stairs may be accepted to be 1.50 min case of assembly occupancy having less than 150 persons.

5) Educational : 1.50 m

6) Institutional : 2.00 m

7) All other occupancies : 1.50 m





4.4.2.4.3.5 Ramps

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a) Ramps shall comply with all the applicable requirements for staircases regarding enclosure, capacity (see also Table 4) and limiting dimensions, except where specified in 6.1 to 6.9 for special uses and occupancies.

b) The slope of a ramp shall not exceed 1 in 12 (8 percent).

c) Ramp(s) shall be surfaced with approved slip resistant materials that are securely attached. No perforations are permissible on ramp floors.

d) Any changes in travel direction in ramp shall be preceded by landings of 1.5 m \times 1.5 m size.

e) Ramps and intermediate landings shall continue with no decrease in width along the direction of egress travel.

f) Outside ramps and landings shall be designed to minimize water accumulation on their surfaces.

g) Ramps shall have landings located at the top, at the bottom, and at doors opening onto the ramp.

h) Every landing shall be not less than 1 500 mm long in the direction of travel.

j) Where the ramp is not part of an accessible route, the ramp landings shall not be required to exceed 1 250 mm in the direction of travel, provided that the ramp has a straight run.

k) Handrails shall be provided on all ramps on both sides.

6.4 Assembly Buildings (Group D)

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6.4.1 Fire Prevention

6.4.1.1 The following shall be applicable:

a) Decorations of places of assembly shall be of non-flammable materials. Fabrics and papers used for such purpose shall be treated with an effective flame-retardant material. Stage settings made of combustible materials shall likewise be treated with fire retardant materials of Class 1 flame spread.

b) Gymnasiums, indoor stadiums and similar occupancies are permitted to have floors/ running tracks of wood, cinder, synthetic or the like.

6.4.2 Life Safety

6.4.2.1 The following shall be applicable:

d) Clear aisles not less than 1.2 m in width shall be formed at right angles to the line of seating in such number and manner that no seat shall be more than seven seats away from an aisle.





V

Rows of seats opening on to an aisle at one end only shall have not more than seven seats. Under the conditions, where all these aisles do not directly meet the exit doors, cross aisles shall be provided parallel to the line of seating so as to provide direct access to the exit, provided that not less than one cross aisle for every 10 rows shall be required. The width of cross-aisles shall be minimum of 1 m. Steps shall not be placed in aisles to overcome differences in levels, unless the gradient exceeds 1 in 10.

q) Seats in places of public assembly, accommodating more than 300 persons, shall be securely fastened to the floor, except as permitted in (r) below. All seats in balconies and galleries shall be securely fastened to the floor, except that in nailed-in enclosures, boxes with level floors and having not more than 14 seats, the seats need not be fastened.

r) Chairs not secured to the floor may be permitted in restaurants, night clubs and other occupancies where the fastening of seats to the floor may not be practicable, provided that in the area used for seating, excluding dancefloor, stage, etc, there shall be not more than one seat for each 1.4 m² of floor area and adequate aisles to reach exits shall be maintained at all times. The arrangements shall be as follows in general:

1) Rows of seats between aisles shall have not more than 14 seats.

2) Rows of seats opening on to an aisle at one end only shall have not more than 7 seats.

3) Seats without dividing arms shall have their capacity determined by allowing 450 mm per person.





PART 3 REQUIREMENTS FOR ACCESSBILITY INBUILT ENVIRONMENT

Table 29 - Key accessibility issues

	Table 7 Key Ac (Clause	e 13.3.3)
SI No. (1)	Key Accessibility Issues	Example (3)
i)	Equitable approach to a building, for example designated parking, clear pedestrian routes separate from vehicles and cyclists, no steps or obstacles, short distances from parking and public transport, good signage, good lighting and good contrast	
ii)	Equitable entry <i>via</i> the same entrances, for example easy to locate main entrances, no steps or obstacles, wide openings, adequate manoeuvring space in front of the door, low operating forces, good signage, good lighting and good visual contrast	
iii)	Equitable use of the same paths in horizontal circulation, for example no steps or obstacles, adequate manoeuvring space, wide door openings, easy to operate doors, resting places, clear layout, good signage, good lighting and good visual contrast	
iv)	Equitable access to the same paths in vertical circulation, for example safe stairs, spacious lifts with easy operation, good signage, good lighting and good visual contrast	



 v) Equitable use of the same rooms, for example ample circulation space and different seating possibilities, good acoustics and hearing enhancement systems, good lighting and good visual contrast



viii) Equitable means of egress, concepts for emergency planning, for example no steps or obstacles, fire protected lifts, good signage, good lighting, good visual contrast, good fire safety, protection and evacuation, accessible means of egress

ix) Important information *via* two senses or more, for example visual, audible and tactile



Table 30 - Minimum Accessibility Provisions in Different Building Occupancies

Table 8 Minimum Accessibility Provisions in Different Building Occupancies

(Clause 13.5)

SI No.	Category	Type of Built Environment Within the Category	Applicability	
(1)	(2)	(3)	(4)	
v)	Assembly buildings	Stadia, theatres, lecture halls, spectator seating in sports centres and all other type of assembly halls with fix seatings, by whatever name called	To all common areas/facilities open to public and staff. Number of designated seating areas to be as per B-12.3 .	





WIDTH OF FOOTPATH- Part 3, Topic 4- Means of Access

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Table 31 - Capacity Of Footpath And Design

Table 2 Capacity of Footpath and Design (Clause 4.3.2.1.1) Design Flow in Number of Persons Per Hour SI Width of Foothpath No. In Both Directions All in One Direction LOSB LOS B LOS C m LOS C (1) (2) (3) (4) (5) (6) 2 835 3 780 4 725 i) 1.8 1 350 1 890 2 0 2 5 ii) iii) 2 700 3 375 2.0 2.5 1 800 2 250 2 520 3 150

Table 32 - Required Width Of Footpath As Per Adjacent Land Use

3 780 4 410

5 0 4 0

4 050 4 725

5 400

2 700 3 150

3 600

3.0 3.5

4.0

iv) v) vi)

Table 3 Required Width of Footpath as per Adjacent Land Use

(Clause 4.3.2.1.1)

Sl No.	Description	Width
(1)	(2)	(3)
i)	Minimum free walkway width and residential/mixed use areas	1.8
ii)	Commercial/Mixed use areas	2.5
iii)	Shopping frontages	3.5 to 4.5
iv)	Bus stops	3
v)	High intensity commercial areas	4

Table 33 - Requirements For Ramp

Table 10 Requirements for Ramp (Clause B-6.2.2)						
SI No.	Level Difference	Maximum Gradient of Ramp	Ramp Width mm	Handrail on Both Sides	Other Requirements	
(1)	(2)	(3)	(4)	(3)	(0)	
i)	150 mm to 300 mm	1:12	1 200	V	—	
ii)	301 mm to 750 mm	1:12	1 500		Landings after every 5 m of ramp run	
iii)	751 mm to 3 000mm	1:15	1 800	V	Landings after every 9 m of ramp run	
iv)	More than 3 000 mm	1:20	1 800	\checkmark	Landings after every 9 m of ramp run	

Figure 68 - Handrails For Steps And Stairs



All dimensions in millimetres.







Figure 69 Typical Handrail Extensions

Figure 70 Examples Of Protection Against Falling



B-12 AUDITORIUMS, CONCERT HALLS, SPORTS ARENAS AND SIMILAR SEATING

B-12.3 Designated Seating Areas for Wheelchair Users

At least 1 percent of seats shall be designated as seating areas (see B-8 for requirements of seating spaces) for wheelchairs users, with a minimum of two. For total seats exceeding 51, it is recommended to provide the designated seating areas in the following manner:

a) Total seats 51 to 100, minimum three designated seating areas for wheelchair users;

b) Total seats 101 to 200, minimum four designated seating areas for wheelchair users;

and

c) One additional seating area should be provided for every two hundred additional seats or part thereof.





These spaces should be integrated among other seats and allow two wheelchair users to stay together. It is recommended that the armrest on the seats at the end of the row lift up to allow people to transfer from the wheelchair onto a seat. To accommodate groups of wheelchair users, in an auditorium with fixed seats, a minimum of 15 seats shall be foldable or removable to increase the number of designated areas for wheelchair users when necessary. Some seats should be wider in order to allow larger size people to sit properly.

B-8 SEATING SPACES

B-8.1 General Seating facilities should be provided in public buildings to provide people with a place to wait and to rest. The location of seats (including reserved areas for wheelchairs) should not disturb the general circulation. Seating facilities shall have a clear and level floor space of not less than 900 mm × 1 200 mm. Seats should be designed with armrests to facilitate sitting down and standing up. The seats should also have back rests.

B-8.2 Seating in Waiting Areas

A range of different types of seating should be provided complying with the following:

- a) Seat height 400 mm to 450 mm,
- b) Back support height 750 mm to 790 mm,
- c) Seat depth 400 mm to 450 mm,
- d) Angle of seat to backrest 100° to 105°,
- e) Armrest height 220 mm to 300 mm above seat,
- f) Armrest set back from front of seat < 75 mm, and
- g) A minimum 150 mm set back under the seat for feet when standing up.

B-12.5 Row and Seat Numbers

The row and seat numbers should be legible to people who have impaired vision. They should be tactile, of

adequate size and have enough visual contrast to the background on which they are mounted.

B-12.6 Accessible Changing Rooms

The minimum number of accessible changing rooms should be provided depending on the type and use of the building. In the event that changing rooms are provided alongside a toilet area, these should comply with the specifications given in B-9.14.

A fixed bench should be set at a height of 450 mm to 480 mm above floor level. The bench should be no less than 500 mm wide, 2 000 mm in length, and be provided with a grab bar at a height of 700 mm to 800 mm with a clearance of between 50 mm and 65 mm from the wall.





A clear space of 1 500 mm × 1 500 mm shall be beside the bench. Coat hooks should be set at different heights, 900 mm to 1100 mm, and additionally at least one hook at 1 400 mm.

Coat hooks, benches, locker handles and other furnishings should offer good colour and tonal contrast to their backgrounds. Non-slip floor surfaces should be used, and good lighting as well as matter finished surfaces and furnishings should be provided. An alarm/call bell/switch may be provided .Changing rooms shall have a minimum area of 4 m².

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Table 34 - Water Requirements for Buildings Other than Residences

Table 1 Water Requirements for Buildings Other than Residences (Clause 4.1.2)				
SI No.	Type of Building	Domestic Per Day litre	Flushing Per Day litre	Total Consumption Per Day litre
(1)	(2)	(3)	(4)	(5)
i)	Factories including canteen where bath rooms are required to be provided	30 per head	15 per head	45 per head
ii)	Factories including canteen where no bath rooms are required to be provided	20 per head	10 per head	30 per head
iii)	Hospital (excluding laundry and kitchen) (see Note 2):			
	a) Number of beds not exceeding 100b) Number of beds exceeding 100c) Out patient department (OPD)	230 per head 300 per head 10 per head	110 per head 150 per head 5 per head	340 per head 450 per head 15 per head
iv)	Nurses' homes and medical quarters	90 per head	45 per head	135 per head
v)	Hostels	90 per head	45 per head	135 per head
vi)	Hotel (up to 3 star) excluding laundry, kitchen, staff and water bodies	120 per head	60 per head	180 per head
vii)	Hotel (4 star and above) excluding laundry, kitchen, staff and water bodies	260 per head	60 per head	320 per head
viii)	Offices (including canteen)	25 per head	20 per head	45 per head
ix)	Restaurants and food court including water requirement for kitchen:			
	a) Restaurantsb) Food court	55 per seat 25 per seat	15 per seat 10 per seat	70 per seat 35 per seat
x)	Clubhouse	25 per head	20 per head	45 per head
xi)	Stadiums	4 per head	6 per head	10 per head
xii)	Cinemas, concert halls and theatres and multiplex	5 per seat	10 per seat	15 per seat
xiii)	Schools/Educational institutions:			
	a) Without boarding facilitiesb) With boarding facilities	25 per head 90 per head	20 per head 45 per head	45 per head 135 per head





xiv)	Shopping and retail (mall)					
	a) Staff	25 per head	20 per head	45 per head		
	b) Visitors	5 per head	10 per head	15 per head		
xv)	Traffic terminal stations (see Notes 3 and 4)					
	a) Airports	40 per head	30 per head	70 per head		
	b) Railway stations (Junctions) with bathing facility	40 per head	30 per head	70 per head		
	c) Railway stations (Junctions) without bathing facility	30 per head	15 per head	45 per head		
	d) Railway Stations (Intermediate) with bathing facility	25 per head	20 per head	45 per head		
	e) Railway Stations (Intermediate) without bathing facility	15 per head	10 per head	25 per head		
	f) Interstate bus terminals	25 per head	20 per head	45 per head		
	g) Intrastate Bus Terminals/Metro Stations	10 per head	5 per head	15 per head		

NOTES

1 For calculating water demand for visitors, consumption of 15 litre per head per day may be taken.

2 The water demand includes requirement of patients, attendants, visitors and staff. Additional water demand for kitchen, laundry and clinical water shall be computed as per actual requirements.

3 The number of persons shall be determined by average number of passengers handled by stations, with due considerations given to the staff and vendors who are using these facilities.

4 Consideration should be given for seasonal average peak requirements.

5 The hospitals may be categorized as Category A (25 to 50 beds), Category B (51 to 100 beds), Category C (101 to 300 beds), Category D (301 to 500) and Category E (501 to 750 beds).

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Table 35 - Provision of toilets for Stadiums

Table 3 Cinema, Multiplex Cinema, Concert and Convention Halls, Theatres and Stadia

(Clause 4.2.5.1)

SI	Fixtures	Public		Staff	
140.		Males	Females	Males	Females
(1)	(2)	(3)	(4)	(5)	(6)
i)	Water closets	1 per 100 up to 400 Over 400 add at 1 per 250 or part thereof	3 per 100 up to 200 Over 200 add at 2 per 100 or part thereof	1 for up to 15 2 for 16 to 35	1 for up to 12 2 for 13 to 25
ii)	Ablution tap	 in each water closet water tap with draining vicinity of water closets 	1 in each water closet g arrangements shall be pr and urinals	1 in each water closet covided for every 50 perso	1 in each water closet ns or part thereof in the
iii)	Urinals	1 per 25 or part thereof	—	Nil up to 6 1 for 7 to 20 2 for 21 to 45	—
iv)	Wash basins	1 per 200 or	part thereof	1 for up to 15 2 for 16 to 35	1 for up to 12 2 for 13 to 25
V)	Drinking water fountain	1 per 100 persons or part thereof			
vi)	Cleaner's sink		1 per	floor	
vii)	Showers/bathing rooms	←	As per trade	requirements	
N 1 2	OTES Some WCs may be Indian s Male population may be ass	style, if desired. sumed as two-third and fem-	ale population as one-third	d.	

We have adopted the following :

Parking Driveway •

Mangalore ZR - 2011

The width of driveway with entry to parking bays shall be: Width of driveway Width of parking bay 4.5 m 2.5 m 4.0 m

3.5 m

2.75 m 3.0 m

We have considered 6 m wide.





• Staircase Width (Internal)

NBC 2016 - Clause 4.4.2.4.3.2

Assembly Building – 2 m wide ; Other Building – 1.5 m wide

• Aisles

NBC 2016 – Clause 6.4.2.1

Clear aisles not less than 1.2 m in width shall be formed at right angles to the line of seating in such number and manner that no seat shall be more than seven seats away from an aisle. Rows of seats opening on to an aisle at one end only shall have not more than seven seats.

• Width of Opening – Spectator seating

NBC 2016 – Clause 4.4.2.3

Capacities of means of egress

c) Width per person for stairways, and level components and ramps shall be determined using the capacity factors in accordance with Table 24 here. Table 36 - Capacity Factors

Table 4 Capacity Factors [<i>Clauses</i> 4.4.2.1, 4.4.2.3(c) <i>and</i> 4.4.2.4.2(a)]				
SI No.	Occupancy Group		Width per Person mm	
			Stairways	Level Components and Ramps
(1)	(2)		(3)	(4)
i) ii)	Residential Educational	(Group A)	10	6.5
iii)	Institutional	(Group C)	15	13
iv) v) vi) vii) viii)	Assembly Business Mercantile Industrial Storage	(Group D) (Group E) (Group F) (Group G) (Group H)	10	6.5
ix)	Hazardous	(Group J)	18	10

For example, if an exit doorway measures 1 000 mm in clear width, it would be defined as providing exit capacity for 1 000/6.5 occupants, that is, 153 persons (say 150 persons) and number of such exit doorways can then be calculated depending on the occupant load. We are providing 5.66 m wide opening, that can handle a capacity 870 people.

Toilets Provision

NBC 2016 VOLUME 2 , PART 9, SECTION 2, TABLE 3

Toilets are designed for a capacity of 700 people of Block 1(full) and Block 2 (Partly) capacities.

As per the NBC 2016, we have to consider two-third population as Male population which is 466 men and remaining one-third population as Female population which is 234 women in this case.





The following is provided :

Fixtures	Male toilet	Female toilet
Water Closet	2	5
Ablution Tap	2	5
Urinals	19	0
Wash Basin	3	2

It is assumed that a larger gathering for various community level sports events would require better facilities. Hence, additional toilets are provided which can be considered for usage after further development of the stadium.

The Department of Youth Empowerment and Sports had suggested to provide 6 changing units each for men and women players. We are able to accommodate 12 changing units each for men and women players considering the number of athletes during community level sports event.

Water Consumption NBC 2016 VOLUME 2 , PART 9, SECTION 1, TABLE 1

As per NBC 2016, 4 Litres/head/day of water is assumed to be consumed for domestic purpose and 6 Litres/head/day of water is assumed to be consumed for flushing purpose in a stadium. Hence, it can be considered to assume 10 Litres/head/day of water.

For a capacity of 700 people, it is estimated to have water consumption of 7000 Litres per day.





ANNEXURE B 17

GUIDELINES AS PER INTERNATIONAL ASSOCIATION OF ATHLETICS FEDERATIONS (IAAF)

17.1 SAFETY OF SPECTATORS AND ATHLETES

17.1.1 CIRCULATION

A strict division of the circulation systems for spectators and for athletes is of particular importance to the safety of the athletes. For facilities with larger spectator capacities, a separation system between the spectator and the sports areas is essential.



Figure 71 Subdivision into individual sections

- 7 Event organisation 8 Stewards and security services 9 Administration maintenance

Source: Planning Principles for Sportsgrounds / Stadia, IAKS Series Sports and Leisure Facilities No. 33

Figure 72 Subdivisions into zones



- Figure 1.8.1a Subdivision into zones
- 1 Central sports / events area 2 Spectator area
- 3 Perimeter zone 4 Approach / public area

Source: Planning Principles for Sportsgrounds / Stadia, IAKS Series Sports and Leisure Facilities No. 33





17.1.2 SAFETY MARGINS

Due to the integration of various facilities for sports into one large complex which is common today and necessary for economic reasons, the provision of certain safety margins between areas for individual disciplines of sports to preclude any dangerous activities, has become particularly important. The same also applies to the keeping of safety areas free from obstructions of all types. Organisers as well as officials, judges and athletes must pay very special attention to these aspects. Sports facilities for track and field athletics are generally used for daily training as well as for staging regional or local competitions.

17.2 TYPES OF COMPETITION FACILITIES

17.2.1 Competition Area for Track Events includes:

- Oval track with at least 4 lanes (400m + 0.04m x 1.22m ± 0.01m) and safety zones measuring not less than 1.00m on the inside and preferably 1.00m on the outside
- Straight with at least 6 lanes (100m + 0.02m x 1.22m \pm 0.01m for sprints and 110m + 0.02m x 1.22m \pm 0.01m for hurdles)
- Starting area: 3m min. (for 110m Hurdles, category V 2.5m min.).
- Run-out: 17m min.
- Steeplechase track as for oval track with a permanent water jump (3.66m x3.66m x 0.50m-0.70m) placed inside or outside the second bend

17.2.2 Competition Area for Jumping Events

The competition area for jumping events includes:

• Facility for Long Jump with runway (40m min. $x 1.22m \pm 0.01m$), take-off board(1.22m $\pm 0.01m \times 0.20m \pm 0.002m \times 0.10m$ max.), placed between 1m and 3m from the nearer end of the landing area, and the landing area 2.75m min. wide with the far end at least 10m min. from the take-off line).

• Facility for Triple Jump as for Long Jump except for a take-off board placed13m min. for men or 11m min. for women from the nearer end of the landing area for international competitions. For any other competition, this distance shall be appropriate for the level of competition.

- Facility for High Jump with a semi circular runway (radius 20m min.) and landing area (6m x 4m min.).
- Facility for Pole Vault with a runway (40m min. $x 1.22m \pm 0.01m$), a box for inserting the pole and landing area (6m x 6m min.) with an additional forward extension.

17.2.3 Competition Area for Throwing Events

The competition area for throwing events includes:

- Facility for Discus Throw with throwing circle (2.50m ± 0.005m diameter), protective cage and landing sector (80m radius, 48m chord)
- Facility for Hammer Throw with throwing circle (2.135m ± 0.005m diameter), protective cage and landing sector (90m radius, 54m chord)





- Facility for Javelin Throw with runway (30m min. x 4m), arc with a radius of 8m and landing sector (100m radius, 50.00m chord)
- Facility for Shot Put with throwing circle (2.135m ± 0.005m diameter) stop board (1.21m ± 0.01m x 0.112m x 0.10m ± 0.02m) and landing sector (25mradius, 15m chord)

Figure 73 IAAF 400 Meter standard track, marking plan



17.2.4 Facilities for Track Events

Track events include sprint, middle and long-distance, hurdle and steeplechase events.

The direction of running is anti-clockwise.



MANGALURU

- The 400m oval track usually forms the basis of a multi-sports arena. Its dimensions are, therefore, dependent on the requirements of other sports. When integrating the straight and the steeplechase into the oval track, deviations will arise in the longitudinal slopes in some areas.
- Although there are a number of different layouts for the 400m oval track, it is IAAF's objective to create uniform criteria, not only with a view to improving the performance parameters necessary for equal opportunities for all athletes and for the suitability for competition but also to simplify the principles of construction, surveying and certification of facilities.
- Experience has shown that the most suitable 400m oval tracks are constructed with bend radii of between 35m and 38m, with an optimum of 36.50m.
- IAAF recommends that all future tracks are constructed to the above specification and this will be referred to as the "400m Standard Track".

17.2.5 Safety of the 400m Standard Track

The 400m Standard Track must have an obstacle-free zone on the inside at least 1.00m wide and should have on the outside an obstacle-free zone at least 1.00m wide. Any drainage system positioned under the kerb must be flush with the surface and level with the track.

The outer obstacle-free zone must also be flush with the surface of the track.

17.3 ROOMS FOR SPORT

17.3.1 Area, Room Schedule, Furnishing and Equipment

- If possible, the ancillary rooms for sports participants should always be arranged at the same level as the sports areas. If differences in levels cannot be avoided, stairs should be installed or, where differences in level are small, ramps.
- National and local building regulations must be observed. This applies, above all, where aspects of safety and the interests of disabled persons, are concerned.
- Air-conditioning or mechanical ventilation systems are needed in all rooms without sufficient natural ventilation.
- All energy-saving measures and, in particular, heat recovery from the outgoing air of ventilation systems and shower water, should be investigated with a view to efficient operation.
- Water-saving measures including dual-flush toilets, low flow efficient shower heads and springloaded taps should be considered even if they are not mandated by local regulations. Roof water may be collected in water tanks for flushing toilets.
- All floor coverings should be resistant to abrasion, easy to clean and anti-slip.
- Walls should generally be designed shockproof, smooth and easy to clean. In wet areas, floors and walls must be waterproof up to a minimum height of 2 m and furnished with a waterresistant surface. Windows in changing and shower rooms etc. should not permit any view into these rooms from the outside. Ceilings should be resistant, for example to balls and, if possible, sound absorbing.
- Wall and ceiling lights must be protected against damage and in wet areas against water spray and humidity.

17.3.2 Entrance Area

Behind the entrance doors, special dirt removing mats should be installed.





Signposts and information boards to guide sports participants and visitors are essential. A generously sized notice board will enable information provision on matters of current interest.

17.3.3 Corridors

Corridors must be at least 1.20m wide and for wheelchairs not less than 1.50m.

A clear line of direction should be established. In addition information boards and signposts should facilitate the orientation of the visitor.

For ventilation systems, a fresh air capacity of 25 m³ to 30 m³ is needed per person per hour.

17.4 Rooms for Athletes and Coaches

Equipping sport grounds and stadia with ancillary rooms, such as showers, washrooms and toilets, must be based on the needs of the user and therefore may have to satisfy very different requirements.

On the one hand there are the minimum requirements for school, leisure and mass participation sport which have to be realised with limited funds, and, on the other hand, there are the demands of top-level sport for rooms, area requirements per athlete and equipment which may require a high degree of comfort.

The following area and room schedule is primarily concerned with the minimum of space, but also gives an indication for higher standards. Consider using rooms at competitions which are normally used for other purposes. Temporary structures can be used to augment the permanent facilities for major competitions.

Space requirements of wheelchair athletes have to be taken into account in accordance with national regulations. Amount of space should be provided in accordance with appropriate demand.

The size of the foyer and reception area for this category of users depends on the number of persons using the rooms in this area. The foyer size is usually calculated on the basis of 15m² per 30 users. This is supplemented by a reception room with counter, 10m² to 15m² in size, a women's toilet (1 lavatory, 1 washbasin) and a men's toilet (1 lavatory, 1 urinal, 1 washbasin).

17.4.1 Changing Rooms

The type of use of a sports area (number of users, mode of operation, sequence of use) determines the necessary number, size and equipment of the changing and sanitary areas and rooms.

This use can only be efficient if the structure of the changing area permits a continuous sequence of sports times (time available to the user on the sports area for his sports activity which is usually governed by a timetable). This inevitably means that sports time is dependent on changing time (time available to the user in the changing and sanitary area for changing and showering / dressing after his sports activity – usually three periods of 15 minutes each)





and clothes position time (time in which the clothes of the user occupy a clothes position – preferably in a closed clothes locker) and, to be cost-effective, needs the following system of utilisation.

For an athletics facility with a large field enclosed by the track, this type of utilisation demands at least 4 changing rooms, each of which is equipped with a clothes locker (0.33m wide, 0.50m deep and 1.80m high) per changing position. If the sports time is equal to or longer than the changing time, (usually 45 minutes) the sports areas can be used continuously. This ensures the full utilisation of the sports areas.

A bench length of at least 0.66m and a width of 0.50m must be provided per sports participant. The minimum distance between benches on opposite sides of the room and between bench and wall is 1.50m. A distance of 1.80m will allow greater freedom of movement for faster changing. Changing room benches should be easy to clean and designed with as few floor supports as possible. Clothes hooks should be recessed to avoid accidents. The furnishings comprise wall mirrors with shelves. Hairdryers and safe deposits for valuables may be considered.

Elements of the changing room:

Changing Positions

As a portion of a changing bench: 0.66m wide (reducible to 0.40m for school sports use) and 0.50m deep with a 0.75m deep changing zone in front of the bench.

Clothes position in the form of a clothes locker: 0.33m wide, 0.50m deep and 1.80m tall (in cold and temperate regions, preferably single-door; in general two-door, 0.90m each).

Clothes positions are also possible in the form of clothes pegs (0.66m wide with double pegs). Since the changing room cannot then be put to variable use and because of the lack of protection from theft, this provision frequently adopted for school sports is not recommended.

The number of changing positions depends on the number of simultaneous users of the athletics facility. At multifunctional sports facilities (athletics facilities combined with pitches), the largest user group in each case is decisive, and in team sports both teams must always be provided for. (See 4.1.2.3 with 4 planning examples, offering 12, 18, 24 or 36 changing positions per changing room.)

Traffic Area

Between changing zone and changing zone or changing zone and clothes locker or wall: at least 0.75m. (In the access area of the changing room, a screen is necessary.)





17.4.2 Showers / Toilets

As part of changing time, the sanitary area is always used after sports time. If this area can be assigned alternately to each changing room, one sanitary area is sufficient for 2 changing rooms.

Elements of the sanitary area:

Shower Positions

- Open rows of showers: 0.80m wide and 0.80m deep.
- Open rows of showers with splash screens: 0.95m wide and 0.80m deep.
- Open rows of showers with privacy partitions: 0.95m wide and 1.40m deep.

The distance between shower heads is at least 0.80m. Only slanted showers with nonadjustable shower heads 1.80m above the floor level should be used.

An automatic cut-off to limit the duration of the shower is recommended.

Number of Shower Positions, Washbasins and Toilets

- At least 1 shower position per 2.5 changing positions.
- At least 1 WC per 20 shower positions.
- At least 1 washbasin per 2 shower positions.

Washing Positions

0.60m wide and 0.80m deep.

In the washbasin area, the distance between the taps is at least 0.60m; installation height above floor level 0.75m.

Further advice relevant to installation:

- Safety thermostat to limit temperature
- Tap with hose connection for cleaning the room
- Water treatment system for therapy pool as required
- Shelves and boards for soap and other washing utensils must be suitably placed

Basis of calculation for hot water supply:

- Withdrawal temperature of hot water maximum 40°C
- Water consumption per shower 10 litres per minute
- Duration of shower per person 4 minutes
- Heating up period for hot water preparation: for school operation 50 minutes, for team sports 100 minutes
- Hot water storage temperature maximum 50°C

The floor of the shower room has the same design as that of the drying area. For ventilation systems, a fresh air capacity of 25 to 30m³ is required per person per hour.





To avoid the moist air passing into the changing room and then outside, the ventilation system in the drying and shower area should be operated on low pressure.

Electrical switches and sockets must be placed outside the shower room.

Drying Area

In terms of its characteristics, the drying area is a wet area. Accordingly, it is usually open towards the shower room, opposite the changing room separated by a door.

The floor covering should be designed such that no water can flow into the adjoining rooms (tub-like floor design, 2% slope, floor drains). Plastic or rubber gratings are recommended in this area. Wooden gratings are not suitable for reasons of hygiene.

Walls must be fitted with robust hand towel hooks or rails and shelves or boards for depositing washing utensils.

Toilets

WC: 0.90m wide and 1.20m deep (doors opening outwards) or 1.40m deep (doors opening inwards)

Slab urinal: 0.50m x 0.60m

Bowl urinal: 0.75m x 0.80m

Washbasin: 0.60m x 0.80m

For reasons of hygiene, toilets should be accessible from the changing room and not from the drying area of the shower room.

To facilitate room cleaning, wall-mounted water closets are recommended.

In addition to the washbasin, roll-shaped holders, clothes hooks, hand towel holders, paper towels or electrical hand-dryers are desirable.

Traffic Area

Between shower positions or between washing positions: at least 1.10m.

All other traffic areas at least 1.00m wide.

17.4.3 Weight Training Room

Modern athletics training systems recommend the use of weight lifting and other body building devices. A weight training facility can range from a relatively small room (approximately 24m²) to a fairly large hall (approximately 240 m²). Its equipment may range from a common weight lifting platform to specialised training machines and up to 12-station training machines.

The type of apparatus for heavy exercise must be decided upon at an early stage.




The access (door or gate) must be sufficiently large to allow all equipment to be moved in and out.

For the floor, either a cross-grained wooden or polyurethane covering on cast asphalt or a very durable PVC surface is advised.

The equipment consists of freestanding and wall-mounted weight training machines, wall bars and hand apparatus.

If heavy dumbbells are available for free use, part of the floor area must be fitted with additional protective surface. For ventilation systems, a fresh air capacity of at least 30m³ is needed per person per hour.

17.5 First Aid Room and Station for Medical Services

First Aid Room

1 room at least 15m² including washbasin and toilet, for first aid and for treating minor injuries.

17.6 Other Areas

Athletics Equipment Room

Doorways must be at least 2.20m wide and have a clear through height of 2.20m.

Large floor areas readily accessible to the arena are required for the storage of jumps landing areas and hurdles on purpose-built trolleys. Other apparatus required for the conduct of events is stored on the floor or shelves.

A suitable desk is required for the official responsible for the control of equipment and a long enough bench for the implement measuring apparatus.

Subject to the type of design selected for the floor and the wall, a hose connection is required for cleaning the room and apparatus as well as a tap with washbasin and cleaning water basin.

The electrical fittings comprise 2 to 4 sockets.

17.7 Functional Grouping

Figures 4.1.2.1a and 4.1.2.1b show diagrams of the layout of rooms and the traffic routes to and within the areas and rooms for athletes. Figure 4.1.2.1a refers to training and 4.1.2.1b to competition.





Figure 74 Allocation of areas and rooms for athletes in the stage of training



Figure 4.1.2.1a - Allocation of areas and rooms for athletes in the stage of training Source: Planning Principles for Sportsgrounds / Stadia, IAKS Series Sports and Leisure Facilities No. 33

After reaching the facility by public or private transport, the athlete proceeds to the changing room and from there to the sports areas (thick access lines) or to the weight training room (dotted lines marking internal routes). On returning from the sports areas (thin return lines) he proceeds to the sanitary area with showers and toilets, in some cases via the sauna and relaxation area, again via the internal routes marked with dotted lines.

It should be stressed at this point that the diagram does not represent a site plan or ground plan of a facility. The sole purpose of this drawing is to show the organizational relationship between the various areas and rooms used by the athlete. When designing such a sports facility, such diagrams (and the same applies to other illustrations of the same kind in this chapter) are used as a planning aid and as a means of checking the organization of installations and rooms.







Figure 75 Allocation of areas and rooms for athletes, officials, first-aid and doping control in the stage of competition

Source: Planning Principles for Sportsgrounds / Stadia, IAKS Series Sports and Leisure Facilities No. 33

Figure 4.1.2.1b illustrates the allocation of rooms and areas for athletes and officials at a competition. In this case, access to the relevant areas and rooms is afforded along routes strictly separated from those used by spectators (including distinguished guests) and the media.

Figure 76 Allocation, installation and furnishing of doping control rooms



xxvi

Figure 4.1.2.1c Allocation, installation and furnishing of doping control rooms 1 Access control 2 Waiting room 3 Magazines 4 Television

- 5 Refrigerator / drinks
- 6 Doping Control Officers' room 7 Equipment table and cupboard
- 8 Lockable refrigerator
- 9 Toilets





PROPOSED UPGRADATION OF MANGALA STADIUM (PHASE 1)

By referring to the above introductory explanation of the diagram's purpose, the reader will understand the interrelationships indicated by the different lines representing the access route, return route and internal routes. As an example, the athlete's route from the car park (or team bus) is: he proceeds to the changing room and, depending on how the event is organized, goes to the sports area directly or via the warm-up area and call room. After competing, the route takes him via the Mixed Zone back to the changing room or from the sports area to the doping control area and from there to the changing room. There he will find, as in the training set-up, the usual sanitary installations and possibly a sauna and relaxation area. The route from the changing room then leads back to the team bus or straight to the exit from the athletes' area.

The doping control area shown simply as a square in Figure 4.1.2.1b (with the internal routes between the sports area and changing room) is broken down into its various functional rooms in Figure 4.1.2.1c. The athlete proceeds past the entrance control to the waiting room where he awaits his call to the working room, and from there to the toilets.

Where both males and females are to be tested, it would be preferable to have two separate toilet areas leading off the working room. In selecting accommodation for doping control security, privacy, cleanliness and relative comfort should be the priorities.

Where, due to lack of an alternative, it is not possible to have a suite comprising all three areas (working, waiting and WC) it is permissible to use a nearby area for waiting but there must be a tight security screen on that area and athletes selected for doping control must be accompanied when passing from one area to the other.





Diagram of Planning Examples of Changing and Sanitary Areas for Sports Users

The following planning examples outline in each case the alternate use of the sanitary area with 2 changing rooms and its capability to be partitioned into 2 separate rooms if the changing rooms can be subdivided for use by teams. The planning examples differ in offering 12, 18, 24 or 36 changing positions per changing room, each equipped with 2 clothes lockers per changing position, and with 6, 8 10 or 14 shower positions and each with 1 sanitary room for 2 changing rooms.

Planning example 1

Figure 77 Planning example 2 for changing and sanitary areas with 2 x 18 changing positions

This example shows 2 changing rooms, each of them partitionable, each containing 12 changing positions (0.66m), 8m of changing bench (2 x 4m), 24 clothes lockers and each with 1 divisible sanitary area containing 6 shower positions, 2 toilets and 4 washbasins. The required space of about $75m^{2}$ is composed of 2 x $27.50m^{2} + 1 x 22.50m^{2}$

Figure 78 Planning example 1 for changing and sanitary areas with 2 x 12 changing positions



Figure 4.1.2.3.1 Planning example 1 for changing and sanitary areas with 2 x 12 changing positions

1 Changing room I with lockers, subdivisible

2 Shower room with wash basins and toilet

3 Changing room II, equipment as for I

Source: Basic Data for Sports Facilities, IAKS



Figure 4.1.2.3.2 Planning example 2 for changing and sanitary areas with 2 x 18 changing positions

1 Changing room I with lockers, subdivisible 2 Shower room with wash basins and toilet

3 Changing room II, equipment as for I

Source: Basic Data for Sports Facilities, IAKS

Planning example 2

This example shows 2 changing rooms each containing 18 changing positions (0.66m), 12m of changing bench, 36 clothes lockers and one sanitary area containing 8 shower positions, 2 toilets and 4 washbasins.

The required space of about 100m 2 is composed of 2 x 37.50m 2 + 1 x 27.50m 2 The changing room





provides 30 changing positions (0.40m) at a time for 1 class of school children.

Planning example 3

This example shows 2 changing rooms, each containing 24 changing positions (0.66m), 16m of changing bench, 48 clothes lockers and one sanitary area containing 10 shower positions, 2 toilets and 6 wash-basins.

The required space of about $145m^2$ is composed of $2 \times 55m^2 + 1 \times 35m^2$.

Figure 79 Planning example 3 for changing and sanitary areas with 2 x 24 changing positions



Figure 4.1.2.3.3 - Planning example 3 for changing and sanitary areas with 2 x 24 changing positions

1 Changing room I with lockers, subdivisible

2 Shower room with wash basins and toilet

3 Changing room II equipment as for I

Source: Basic Data for Sports Facilities, IAKS

Planning example 4

This example shows 2 changing rooms, each containing 36 changing positions (0.66m), 24m of changing bench, 72 clothes lockers and one sanitary area containing 14 shower positions, 2 toilets and 8 wash-basins.

The required space of about $195m^2$ is composed of $2 \times 75m^2 + 1 \times 45m^2$.





PROPOSED UPGRADATION OF MANGALA STADIUM (PHASE 1)

Figure 80 Planning example 4 for changing and sanitary areas with 2 x 36 changing positions



Figure 4.1.2.3.4 - Planning example 4 for changing and sanitary areas with 2 x 36 changing positions

1 Changing room I with lockers subdivisible

2 Shower room with wash basins and toilet

3 Changing room II equipment as for I

Source: Basic Data for Sports Facilities, IAKS

17.8 Sightlines

For athletics, the sightline focus should be the centre of the outer lane of the track or the centre of the outer Long Jump pit where this is located outside the track. The minimum "C" value should be 60mm where "C" is the vertical difference between the sightlines from standard spectator figures seated in adjoining tiered rows. It is accepted that advertising



signage 1200mm high placed around the arena at IAAF meets will affect these sightlines. Designers should also ensure that all spectators are also able to see at least one result scoreboard.

17.9 TECHNICAL SERVICES

17.9.1 Lighting and Power

17.9.1.1 USER REQUIREMENTS

The users of Track and Field facilities can be categorised according to their activities:

Athletes, Competition Judges and Team Officials

They must be able to see clearly all that is going on in the competition area so that they can produce their best possible performances, and/or make accurate decisions.

Spectators

They should be able to follow the performances of the athletes and other action in an agreeable environment. It follows that they must be able to see not only the competition area but also its immediate surroundings. The lighting should also enable spectators to safely enter and leave the sports facility.

17.9.2 Lighting Recommendations

	Horizontal Illuminance	Uniformity		Colour Properties of Lamps	
Activity Level	Eh ave. (lux)*	U1 Emin./Emax.	U2 Emin./Eave.	Colour Temperature Tk (K)	Colour Rendering Ra
Recreational & training	75	0.3	0.5**	> 2000	> 20
Club Competitions	200	0.4	0.6	> 4000	≥ 65
National & International Competitions	500	0.5	0.7	> 4000	≥ 80

Figure 81 Minimum requirements for non-televised events

Glare Rating (GR)	≤ 50
Uniformity Gradient (UG) per 5 m (Only for National and International Competitions)	<u><</u> 20%

17.9.3 Anti-Panic Lighting

For the purpose of safety and orientation for the spectators, in the event of a main power failure or emergencies, it is recommended to maintain an illumination of at least 25 lux in the stands.



18 ANNEXURE C

• DESIGN BASIS REPORT – BUILDING

• DESIGN BASIS REPORT – ROOFING





Report No: NC/M stadium/SR-01

Date: 11.01.2020

PROJECT:

PROPOSED UPGRADATION OF MANGALA STADIUM (PHASE-1) MANGALORE D.K DISTRICT.

TITLE:

DESIGN BASIS REPORT

CLIENT:

M/s Mangalore Smart City Ltd., (MSCL), Mangalore



Structural Consultants:

M/S.NAGESH CONSULTANTS

Consulting Structural Engineers #2, 6th Cross, Ashoknagar, BSK Ist Stage, Bangalore - 560 050. Tel Fax : 080 – 26617865, 26617866 Email- <u>nageshconsultants18@gmail.com</u>

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- 7. Load Factors For Design
- 8. Analysis Method
- 9. Design Methodology
- 10. Materials and Grade
- 11. Exposure Condition
- 12. Cover to Reinforcement
- 13. Codes and Standards

1.0 GENERAL DETAILS

PROJECT : PROPOSED UPGRADATION OF MANGALA STADIUM (PHASE-1) MANGALORE D.K DISTRICT.

CLIENT : M/s Mangalore Smart City Ltd., (MSCL), Mangalore

2.0 <u>NO. OF FLOORS</u>

A. PROPOSED INDOOR STADIUM

S NO	NO OF FLOORS	TOTAL HEIGHT(M)
1	GF+FF (2 SLABS)	8.20M
2	TENSILE FABRIC FOR GALLARY	AS PER VENDOR DETAILS



3.0 STRUCTURAL SYSTEM

1. RCC frame structure

2. Tensile fabric Light roof for Stadium gallery steps (As per vendor details)

4.0 SBC OF SOIL AND FOUNDATION

Geotechnical investigation is carried out by; NITK, Surathkal,

Foundation with bearing capacity of 200KN/m2 is proposed

5.0 LOADINGS

5.1 Dead Loads (As per IS: 875 (Part-1)-1987, IS 2185 part 1)

Densities of different materials considered for design are as follows: -	
Density of reinforced concrete	25 kN/ cu.m
Density of plain concrete	24 kN/ cu.m
Density of Brickbat filling with interstices filled with mortar	20 kN/ cu.m

5.2 Dead Loads (As per IS 875 (Part-1) -1987)

The Super Imposed Dead loads are as follows -

Item	Intensity in KN/m ² of plan area
Floor finish	2.5

5.3 Live Loads (As per IS 875 (Part-2 -1987)

The live load is assessed based on the occupancy classifications as per IS: 875 (Part -2) -1987 and are listed as below.

Occupancy Classification	UDL (KN/m²)
Gym	5.0
Gallery steps	5.0
Corridor	5.0
Staircase	5.0
Terrace	1.5

5.4. EARTHQUAKE LOAD

Earth quake loads are calculated as per seismic co-efficient method as suggested in IS 1893-(Part 1) - 2016 & IS 1893(Part1)-2002.

Mangalore comes in Zone III

The design horizontal seismic co-efficient for a structure is determined As per CL. 6.4.2

	A _h	=	<u>ZI</u> 2 R	<u>Sa</u> g	
	Z	-	Zone fa Modera	ctor for Zone III te Seismic Intensity	= 0.16
	I	-	Importa	nce factor	= 1.2
	R	-	Ordinar	y RC Structural walls	= 5.0
	<u>S</u> a g		–Averag types, n	ge response acceleration co-efficient values.	which depends on soil
	т	-	0.075h Where, h=Heigh	1 ^{0.75} as per IS 1893 (Part-1): 2016, Clau It of Building in meters.	se 7.6.2
Soil Typ)e	-	Type II		

6.0 BASIC LOADS AND LOAD COMBINATIONS

The various loads are combined in accordance with the stipulations in IS:875 (Part 5)-1987. Wherever imposed load is combined with earthquake load the appropriate part of the imposed load as specified in IS:1893 (Part-1) : 2016/2002, is adopted both for evaluating earthquake effect and for combined load effects, used in such combination. Analysis will be carried out using ETABS 2013–13.2.2 Version software.

DL+LL DL+EQX DL-EQX DL+EQY DL-EQY DL+LL+EQX DL+LL-EQX DL+LL+EQY DL+LL-EQY

FACTORED LOAD CASES

1.5[DL+LL] 1.5[DL+EQX] 1.5[DL+EQY] 1.5[DL+EQY] 1.2[DL+LL+EQX] 1.2[DL+LL+EQX] 1.2[DL+LL+EQY] 1.2[DL+LL+EQY]

7.0 LOAD FACTORS FOR DESIGN

Description of Load	Load Factor	for Primary Loa	d Cases	
Combination	Dead Load	Live	Wind	Seismic
		Loa	Load	Load
		d		
Dead load + Live load	1.5	1.5	0.0	0.0
Dead load + / - Wind load	1.5 / 0.9	0	1.5	0.0
Dead load + /- Seismic load	1.5 / 0.9	0	0	1.5
Dead load + Live load + / -Wind load	1.2	1.2	1.2	0.0
Dead load +Live load + / - Seismic load	1.2	1.2	0	1.2

8.0 ANALYSIS METHOD

The structure is analyzed for Gravity Load and Lateral loads, and its combinations using ETABS V 13.2.2.



3D Views from Etabs Analysis

9.0 DESIGN METHODOLOGY

All RCC members will be designed according to the Limit State Method as specified in IS: 456-2000. Appropriate loads and its combinations, as per relevant clauses in Code IS 456:2000 Code IS 875 (Part-5) 1987, for the most critical effects are chosen for design.

10.0 MATERIALS AND GRADES

10.1 <u>Concrete</u>

1.	Footing		- M:30
2.	Columns/Beams & Slabs		- M:30
2	Other Structural Flements	not specified Above	- M-30

3. Other Structural Elements, not specified Above - M:30

10.2 <u>Reinforcement</u>

Steel reinforcement shall be of Grade Fe 500 conforming to IS: 1786-1985..

11.0 EXPOSURE CONDITION

Structural elements below ground level and Exterior External faces of walls are designed for <u>Moderate exposure condition</u> and internal faces of walls, floor beams and slabs are designed for <u>Moderate exposure condition</u> as per Table 16 of IS 456-2000.

12.0 COVER TO REINFORCEMENT

As per IS: 456-2000.

MEMBER	CLEAR COVER (mm)
Footing & Pedestal	50 mm
Column	40 mm
Beam	30 mm
Slab	25 mm

13.0 CODES & STANDARDS

All the designs are conforming to the relevant Indian Standards. Some of the relevant Indian Standard Codes, which have been followed for the structural designs, are given below.

Code	Description
IS:875 (Part-1)-1987	Code of Practice for Design Loads (Other than Earthquake) for Building and Structures-Unit Weights of Buildings Materials and Stored Material.
IS:875 (Part-2)-1987	Code of Practice for Design Loads (Other than Earthquake) for Building and Structures-Imposed loads.
IS:875 (Part-3)-2015	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures –Wind Load.
IS:875 (Part-5)-1987	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures - Special Loads and Load Combinations.
IS:456-2000	Code of Practice for Plain and Reinforced Concrete.
IS:1893 (Part-1)-2016 & IS:1893 (Part-1)-2002	Indian Standard Criteria for Earthquake Resistant Design of Structures.
IS:13920-2016	Ductile design & Detailing of RCC structures subjected to seismic forces
IS:432 (Part-1)-1982	Specification of Mild Steel and Medium Tensile Steel bars and Hard drawn Steel Wire for concrete reinforcement –Mild Steel and Medium Tensile Steel Bars.

IS:432 (Part-2)-1982	Specification of Mild Steel and Medium Tensile Steel bars and Hard drawn Steel Wire for concrete reinforcement –Hard drawn Steel Wire.
IS:1786-1985	Specification for High Strength Deformed Steel Bars and Wires for Concrete Reinforcement.
IS:1904	Indian Standard Code of practice for Design & Construction foundations in Soil: General Requirements.
IS:1642-1989	Indian Standard Code of practice for Fire Safety Of Buildings (General) : Details Of Construction.



DESIGN CALCULATION

Of

REC

TENSILE FABRIC SHADE STRUCTURE

65.4 x 19.2 Mtr

Project: Construction of Tensile Roof Shade @ **Bengaluru** Rev - 00

Page **1** of **64**



SUMMARY

Materials:

The following materials are proposed for this structure. The adequacy of each of them is checked against the load acting on it – Please refer to the design calculation of respective elements.

CHS members Material	-	CHS section conforming IS.
Anchor Bolts	-	Gr. 8.8
Connecting Bolt	-	Gr. 8.8
Tensile fabric	-	PVC FERRARI 902 Tensile Strength (Warp) – 420daN/5cm Tensile Strength (Weft) – 400daN/5cm

ISO View of the Structure





Wind load Calculations (IS 875 Part-3)

Sr.No.	DESCRIPTION		UNITS
1	SELF WIEGHT (Fabric) Ignored. Steel applied in NDN		KN/M2
2	PRESTRESS - L1	1.1	KN/M2
	THE STRUCTURE IS PRESTRESSED IN BOTH DIRECTIONS TO STABILISE THE FABRIC, PRESTRESS IS GIVEN TO ENSURE THAT A CLEAN AND TAUGHT SURFACE IS ACHIEVED.THESE LOADS VARY ALONG THE GEOMETRY OF THE STRUCTURE.		
3	LIVE LOADING - L3		
	A MINIMUM LIVE LOAD	0.25	KN/M2
4	WIND IS 875 PART 3 (Table 15)		
	wind speed	44	M/Sec.
	(5.3.1) RISK Level (k1) (25 years mean life)	1	
	(5.3.2) terrain category(3) and height class "C" 10M (k2)	0.91	
	(5.3.3) Local Topography (K3)	1	
	(5.3.4) Importance factor (k4)	1	
	site design wind speed Vz = Vb x K1x K2 x k3 x K4	40	M/Sec.
	design wind pressure = $0.6 \times (Vz)^2$	962	N/M2
		0.96	KN/M2



METHODOLOGY FOR ANALYSIS AND DESIGN

Summary: The FABRIC CANOPY shade structure consists of connected fabric panels - with structural members supporting them at different locations. The fabric shape could be idealized into a duo-pitch canopy roof.

Load Calculation: Wind load calculations have been made as per IS 875-Part-3.

Analysis & Design:

Membrane is specially developed software for Tensile Membrane Industry. On the Membrane software many of the landmark Tensile Membrane Structure around the world such as the membrane roof on the Millennium Dome in Greenwich, England, the Great Hall Tent Structure at the Denver International Airport, and many of the membrane roof stadiums around the world.

This Membrane model is analyzed for member forces and reactions. Member design is performed using BS: 5950-2001.



Top View of the Structure



Front View of the Structure





Side View of the Structure



Iso View of the Structure





LOADING ON FABRIC SURFACE



1. P Prestress and D.L









3. W Wind 1.0 Uniform









5. W Wind 0.96 Dir: -1,0



6. W Wind 0.96 Dir: 0,-1





0 r p

W Wind 0.96 Dir: -1,1 7.



W Wind 0.96 Dir: -1,-1 8.





FABRIC ANALYSIS DETAILS



0 r p

Membrane stress in warp direction under Prestress load (LC-1)



Membrane stress in weft direction under Prestress load (LC-1)





p

Membrane stress in warp direction under Live load (LC-2)



Membrane stress in weft direction under Live load (LC-2)





Membrane stress in warp direction under wind load -03



Membrane stress in weft direction under wind load -03





p

Membrane stress in warp direction under wind load -04



Membrane stress in weft direction under wind load -04





Membrane stress in warp direction under wind load -5



Membrane stress in weft direction under wind load -5




Membrane stress in *warp* direction under wind load -6



Membrane stress in weft direction under wind load -6





Membrane stress in *warp* direction under wind load 7



Membrane stress in weft direction under wind load -7





Membrane stress in *warp* direction under wind load 8



Membrane stress in weft direction under wind load -8





Fabric Stresses & selection of fabric

Maximum stress in the fabric

a) In warp Direction	on =	6.7	KN/m
b) In weft direction	= ר	5.1	KN/m
Tensile Strength of the fabric	- PVC FERRARI 902		
a) In warp D	irection = =	420 daN 84 KN/m	l/5cm
b) In weft dir	ection = =	400 daN 80 KN/m	I/5cm
Factor of Safety for t a) In warp D	he fabric stresses irection = =	84 / 6.7 12.5> 5, I	Hence acceptable
a) In weft Di	rection = =	80 / 5.1 15.5> 5, ł	nence acceptable

Hence, proposed fabric is $\ensuremath{\mathsf{SAFE}}$



Fabric Stresses & selection of fabric

Maximum stress in the fabric





STEEL STRUCTURE -ANALYSIS & DESIGN



Steel Structure Top view



Steel Structure front view





Steel Structure Side view



Steel Structure Isometric view





Steel Member Sizes of Structure.



Steel Member Utilization Ratio.





Beam Axial Force (Envelope)



Beam MY (Envelope)





Beam MZ (Envelope)



Beam SY (Envelope)





Beam SZ (Envelope)



Beam TOR (Envelope)





Steel Structure Fix Node No.





Design

Basic Load Cases	Basic Load Combinations
1. P Prestress and D.L.	1. 1.50D + 1.50L + 0.00W + 0.00E + 0.00T
2. L LL 0.25 Uniform	2. 1.50D + 0.00L + 1.50W + 0.00E + 0.00T
3. W Wind 0.96 Uniform	3. 1.20D + 1.20L + 1.20W + 0.00E + 0.00T
4. W Wind 0.96 Dir: 0,1	4. 1.50D + 1.50L + 0.00W + 0.00E + 1.00T
5. W Wind 0.96 Dir: -1,0	5. 0.90D + 0.00L + 1.50W + 0.00E + 0.00T
6. W Wind 0.96 Dir: 0,-1	6. 1.50D + 0.00L + 0.00W + 1.00E + 0.00T
7. W Wind 0.96 Dir: -1,1	7. 1.20D + 1.20L + 0.60W + 1.00E + 0.00T
8. W Wind 0.96 Dir: -1,-1	
Combination Load Cases	
1. 1.50(1) + 1.50(2)	
2. 1.50(1) + 1.50(3)	
3. 1.50(1) + 1.50(4)	
4. 1.50(1) + 1.50(5)	
5. 1.50(1) + 1.50(6)	
6. 1.50(1) + 1.50(7)	
7. 1.50(1) + 1.50(8)	
8. 1.20(1) + 1.20(2) + 1.20(3)	
9. 1.20(1) + 1.20(2) + 1.20(4)	
10. 1.20(1) + 1.20(2) + 1.20(5)	
11. 1.20(1) + 1.20(2) + 1.20(6)	
12. 1.20(1) + 1.20(2) + 1.20(7)	
13. 1.20(1) + 1.20(2) + 1.20(8)	
14. 1.50(1) + 1.50(2)	
15. 0.90(1) + 1.50(3)	
16. 0.90(1) + 1.50(4)	
17. 0.90(1) + 1.50(5)	
$18. \ 0.90(1) + 1.50(6)$	
$19. \ 0.90(1) + 1.50(7)$	
20. 0.90(1) + 1.50(8)	
$\begin{array}{c} 21. \ 1.50(1) \\ \hline 22. \ 1.20(1) + 1.20(2) + 0.00(2) \\ \hline \end{array}$	
22. $1.20(1) + 1.20(2) + 0.60(3)$	
23. $1.20(1) + 1.20(2) + 0.60(4)$	
24. $1.20(1) + 1.20(2) + 0.60(5)$	
25. $1.20(1) + 1.20(2) + 0.60(6)$	
20. $1.20(1) + 1.20(2) + 0.00(7)$	
27. 1.20(1) + 1.20(2) + 0.60(8)	



Reaction Forces

Node	LC	X-Force	Y-Force	Z-Force	X-Moment	Y-Moment	Z-Moment
No	No	(kN)	(kN)	(kN)	(kN-m)	(kN-m)	(kN-m)
				axial			
1	1	-30.081	67.385	43.195	-0.27	0.086	-0.008
1	2	28.697	-63.532	-38.371	0.036	0.363	1.069
1	3	9.627	-21.221	-12.213	0.019	0.201	0.564
1	4	16.802	-37.177	-22.08	0.003	0.25	0.723
1	5	28.073	-62.163	-37.527	0.022	0.36	1.036
1	6	10.763	-23.823	-13.797	0.071	0.183	0.463
1	7	19.211	-42.655	-25.411	0.123	0.231	0.603
1	8	15.522	-34.195	-20.465	-0.053	0.38	0.917
1	9	0.266	-0.346	0.462	-0.066	0.251	0.512
1	10	6.006	-13.111	-7.432	-0.079	0.29	0.64
1	11	15.023	-33.1	-19.789	-0.064	0.378	0.89
1	12	1.175	-2.428	-0.805	-0.025	0.236	0.432
1	13	7.933	-17.494	-10.097	0.017	0.275	0.544
1	14	-19.688	44.087	27.993	-0.186	0.099	0.034
1	15	32.854	-72.852	-44.452	0.07	0.368	1.086
1	16	13.784	-30.54	-18.294	0.053	0.206	0.581
1	17	20.959	-46.497	-28.161	0.037	0.256	0.74
1	18	32.23	-71.482	-43.608	0.056	0.365	1.053
1	19	14.92	-33.142	-19.878	0.104	0.188	0.48
1	20	23.368	-51.975	-31.492	0.157	0.236	0.62
1	21	-10.393	23.298	15.203	-0.084	-0.013	-0.042
1	22	-0.114	0.537	0.965	-0.101	0.23	0.472
1	23	-7.742	17.462	11.428	-0.107	0.165	0.27
1	24	-4.872	11.079	7.481	-0.114	0.185	0.334
1	25	-0.364	1.085	1.303	-0.106	0.229	0.459
1	26	-7.288	16.421	10.795	-0.087	0.158	0.23
1	27	-3.908	8.888	6.149	-0.066	0.177	0.286
	MAX	32.854	67.385	43.195	0.157	0.38	1.086



	MIN	-30.081	-72.852	-44.452	-0.27	-0.013	-0.042
2	1	41.202	-64.762	5.58	29.298	24.795	3.125
2	2	-11.703	85.044	-4.161	-40.389	-8.246	11.445
2	3	-1.448	31.072	-0.319	-14.469	-1.662	6.565
2	4	-4.833	51.867	-2.186	-24.697	-3.869	8.384
2	5	-18.769	82.497	-2.737	-39.699	-8.986	10.471
2	6	-3.059	34.032	0.336	-15.531	-2.381	5.547
2	7	-8.202	57.801	-0.636	-26.61	-5.544	6.864
2	8	6.9	54.568	-1.25	-26.503	3.628	11.305
2	9	15.104	11.39	1.823	-5.767	8.894	7.402
2	10	12.396	28.026	0.33	-13.95	7.129	8.856
2	11	1.247	52.53	-0.112	-25.951	3.035	10.526
2	12	13.816	13.758	2.347	-6.617	8.32	6.587
2	13	9.701	32.773	1.57	-15.48	5.789	7.64
2	14	30.765	-40.799	4.089	18.279	18.787	2.906
2	15	-15.878	94.63	-4.757	-44.797	-10.649	11.357
2	16	-5.622	40.658	-0.916	-18.877	-4.065	6.478
2	17	-9.008	61.453	-2.782	-29.105	-6.272	8.296
2	18	-22.944	92.083	-3.334	-44.107	-11.39	10.384
2	19	-7.233	43.618	-0.26	-19.939	-4.784	5.459
2	20	-12.377	67.387	-1.232	-31.018	-7.947	6.776
2	21	10.437	-23.964	1.491	11.019	6.008	0.219
2	22	15.756	10.964	1.01	-5.94	9.329	6.815
2	23	19.858	-10.624	2.547	4.428	11.962	4.863
2	24	18.504	-2.306	1.801	0.337	11.08	5.59
2	25	12.929	9.946	1.58	-5.664	9.032	6.425
2	26	19.214	-9.44	2.809	4.003	11.675	4.456
2	27	17.156	0.067	2.42	-0.428	10.409	4.982
	MAX	41.202	94.63	5.58	29.298	24.795	11.445
	MIN	-22.944	-64.762	-4.757	-44.797	-11.39	0.219
	I						
3	1	-1.995	2.046	-5.58	0.739	0.003	0.276
3	2	1.701	-3	6.979	-0.632	-0.348	-0.135
3	3	0.486	-0.852	2.168	-0.192	-0.159	-0.063
3	4	0.981	-1.689	4.065	-0.37	-0.224	-0.102
3	5	3.009	-8.127	13.671	-0.475	-0.546	0.129
3	6	0.685	-0.909	2.396	-0.238	-0.097	-0.134
3	7	1.286	-1.783	4.434	-0.441	-0.137	-0.205
3	8	0.538	-1.68	3.697	-0.286	-0.338	0.036



Design

3	9	-0.434	0.038	-0.152	0.066	-0.187	0.094
3	10	-0.038	-0.631	1.366	-0.077	-0.239	0.062
3	11	1.584	-5.782	9.05	-0.161	-0.497	0.247
3	12	-0.275	-0.007	0.03	0.029	-0.138	0.037
3	13	0.205	-0.707	1.661	-0.133	-0.169	-0.02
3	14	-1.512	1.473	-3.969	0.507	-0.036	0.228
3	15	1.894	-3.229	7.624	-0.725	-0.364	-0.154
3	16	0.679	-1.081	2.812	-0.285	-0.175	-0.082
3	17	1.174	-1.918	4.709	-0.463	-0.239	-0.121
3	18	3.202	-8.356	14.315	-0.569	-0.562	0.11
3	19	0.879	-1.138	3.04	-0.331	-0.113	-0.153
3	20	1.479	-2.013	5.078	-0.534	-0.152	-0.225
3	21	-0.483	0.573	-1.611	0.233	0.039	0.048
3	22	-0.336	-0.251	0.261	0.06	-0.184	0.109
3	23	-0.822	0.608	-1.664	0.236	-0.108	0.138
3	24	-0.624	0.274	-0.905	0.164	-0.134	0.122
3	25	0.187	-2.302	2.938	0.122	-0.263	0.215
3	26	-0.742	0.586	-1.573	0.217	-0.083	0.11
3	27	-0.502	0.236	-0.757	0.136	-0.099	0.081
	MAX	3.202	2.046	14.315	0.739	0.039	0.276
	MIN	-1.995	-8.356	-5.58	-0.725	-0.562	-0.225
4	1	-34.61	95.4	58.737	-0.245	0.057	0.084
4	2	47.299	-129.35	-76.985	-0.292	0.213	0.712
4	3	19.725	-53.921	-31.523	-0.126	0.127	0.37
4	4	29.421	-80.472	-47.535	-0.243	0.135	0.477
4	5	45.728	-125.046	-74.405	-0.321	0.199	0.699
4	6	20.471	-56.05	-32.787	-0.091	0.099	0.278
4	7	32.597	-89.349	-52.808	-0.105	0.119	0.343
4	8	26.114	-71.118	-42.229	-0.235	0.269	0.654
4	9	4.055	-10.775	-5.86	-0.102	0.2	0.38
4	10	11.812	-32.016	-18.67	-0.196	0.206	0.466
4	11	24.857	-67.675	-40.165	-0.258	0.258	0.643
4	12	4.651	-12.479	-6.871	-0.074	0.178	0.306
4	13	14.352	-39.118	-22.888	-0.085	0.193	0.359
4	14	-24.633	67.926	41.467	-0.123	0.09	0.095
4	15	51.29	-140.339	-83.892	-0.244	0.226	0.717
4	16	23.716	-64.91	-38.43	-0.077	0.141	0.375
4	17	33.412	-91.462	-54.443	-0.194	0.148	0.481
1	18	49.718	-136.036	-81.312	-0.272	0.213	0.703

Project:-	Location:-	Date:- 26-12-2019
Roof design	Bengaluru	Rev :- 00 Design By:- Santosh

4	19	24.461	-67.04	-39.695	-0.043	0.112	0.282
4	20	36.587	-100.339	-59.715	-0.056	0.132	0.348
4	21	-9.976	27.474	17.269	-0.122	-0.033	-0.011
4	22	3.204	-8.389	-4.528	-0.167	0.17	0.365
4	23	-7.826	21.783	13.657	-0.1	0.136	0.228
4	24	-3.947	11.162	7.252	-0.147	0.139	0.271
4	25	2.575	-6.667	-3.496	-0.178	0.165	0.359
4	26	-7.528	20.931	13.151	-0.086	0.125	0.191
4	27	-2.677	7.612	5.143	-0.092	0.133	0.217
	MAX	51.29	95.4	58.737	-0.043	0.269	0.717
	MIN	-34.61	-140.339	-83.892	-0.321	-0.033	-0.011

5	1	38.054	-97.93	7.593	48.006	19.632	1.409
5	2	-46.218	150.745	-18.903	-78.027	-24.279	3.73
5	3	-18.406	64.234	-7.255	-33.089	-9.653	1.712
5	4	-28.191	94.962	-12.759	-49.638	-15.009	2.271
5	5	-46.702	150.544	-16.304	-76.813	-24.201	4.087
5	6	-19.437	66.423	-6.859	-33.879	-10.234	0.686
5	7	-31.921	104.128	-10.77	-52.929	-16.74	0.789
5	8	-22.77	85.704	-9.902	-44.59	-11.551	4.272
5	9	-0.521	16.495	-0.584	-8.639	0.15	2.657
5	10	-8.348	41.077	-4.987	-21.878	-4.135	3.104
5	11	-23.158	85.543	-7.823	-43.619	-11.489	4.558
5	12	-1.345	18.246	-0.268	-9.271	-0.316	1.836
5	13	-11.333	48.41	-3.396	-24.511	-5.52	1.919
5	14	27.905	-70.773	7.059	35.148	14.736	1.509
5	15	-50.278	161.609	-19.117	-83.17	-26.237	3.771
5	16	-22.466	75.098	-7.469	-38.232	-11.611	1.752
5	17	-32.251	105.825	-12.973	-54.781	-16.967	2.311
5	18	-50.762	161.408	-16.517	-81.957	-26.159	4.128
5	19	-23.497	77.286	-7.073	-39.022	-12.193	0.726
5	20	-35.981	114.992	-10.984	-58.072	-18.698	0.829
5	21	10.149	-27.157	0.534	12.858	4.896	-0.101
5	22	-0.223	14.543	-2.128	-8.236	0.119	2.74
5	23	10.901	-20.062	2.531	9.74	5.969	1.932
5	24	6.988	-7.771	0.33	3.12	3.827	2.156
5	25	-0.417	14.462	-1.088	-7.75	0.15	2.882
5	26	10.489	-19.186	2.69	9.424	5.737	1.522
5	27	5.495	-4.104	1.126	1.804	3.134	1.563



	MAX	38.054	161.609	7.593	48.006	19.632	4.558
	MIN	-50.762	-97.93	-19.117	-83.17	-26.237	-0.101
6	1	-0.794	2.003	-5.922	0.944	0.31	0.016
6	2	2.455	-6.732	14.599	-1.438	-0.514	-0.065
6	3	1.097	-2.763	6.101	-0.606	-0.176	-0.073
6	4	1.614	-4.174	9.212	-0.927	-0.288	-0.086
6	5	6.109	-16.983	28.533	-1.298	-0.506	-0.022
6	6	1.298	-2.822	6.305	-0.645	-0.106	-0.148
6	7	1.971	-4.461	9.876	-1.008	-0.203	-0.189
6	8	1.13	-3.474	7.715	-0.782	-0.341	0
6	9	0.043	-0.299	0.916	-0.116	-0.07	-0.007
6	10	0.457	-1.428	3.404	-0.373	-0.16	-0.017
6	11	4.054	-11.675	18.862	-0.67	-0.334	0.034
6	12	0.204	-0.346	1.079	-0.148	-0.014	-0.067
6	13	0.743	-1.657	3.936	-0.438	-0.091	-0.1
6	14	-0.918	2.196	-5.439	0.702	0.199	0.041
6	15	2.406	-6.655	14.793	-1.535	-0.559	-0.055
6	16	1.047	-2.686	6.294	-0.703	-0.22	-0.064
6	17	1.564	-4.097	9.405	-1.024	-0.332	-0.076
6	18	6.06	-16.906	28.726	-1.394	-0.55	-0.013
6	19	1.248	-2.744	6.498	-0.742	-0.151	-0.139
6	20	1.921	-4.384	10.069	-1.105	-0.247	-0.179
6	21	0.124	-0.193	-0.483	0.241	0.111	-0.024
6	22	0.198	-0.859	1.682	-0.11	-0.091	0.016
6	23	-0.346	0.729	-1.718	0.223	0.045	0.013
6	24	-0.139	0.164	-0.473	0.094	0	0.008
6	25	1.66	-4.959	7.255	-0.054	-0.087	0.033
6	26	-0.265	0.706	-1.636	0.207	0.073	-0.017
6	27	0.004	0.05	-0.208	0.062	0.034	-0.034
	· · · · · · · · · · · · · · · · · · ·						
	MAX	6.109	2.196	28.726	0.944	0.31	0.041
	MIN	-0.918	-16.983	-5.922	-1.535	-0.559	-0.189
		T					
7	1	-28.073	98.583	59.282	-0.289	0.01	0.127
7	2	38.883	-135.62	-78.824	-0.131	0.233	0.4
7	3	16.017	-55.864	-31.891	-0.051	0.13	0.205
7	4	24.467	-85.359	-49.251	-0.126	0.146	0.27
7	5	37.981	-132.462	-76.976	-0.155	0.219	0.405
7	6	17.256	-60.291	-34.486	-0.039	0.093	0.123
7	7	27.396	-95.817	-55.353	-0.032	0.111	0.124



7	8	21.628	-75.152	-43.577	-0.122	0.247	0.415
7	9	3.335	-11.348	-6.031	-0.059	0.166	0.259
7	10	10.094	-34.944	-19.919	-0.119	0.178	0.311
7	11	20.906	-72.626	-42.098	-0.142	0.236	0.419
7	12	4.326	-14.89	-8.107	-0.049	0.136	0.193
7	13	12.438	-43.31	-24.8	-0.043	0.15	0.194
7	14	-19.96	70.131	41.817	-0.156	0.043	0.123
7	15	42.128	-147	-85.809	-0.077	0.246	0.399
7	16	19.262	-67.245	-38.877	0.002	0.144	0.204
7	17	27.711	-96.74	-56.237	-0.073	0.159	0.268
7	18	41.226	-143.843	-83.961	-0.101	0.232	0.403
7	19	20.501	-71.672	-41.472	0.014	0.106	0.121
7	20	30.641	-107.198	-62.339	0.022	0.124	0.123
7	21	-8.112	28.452	17.465	-0.134	-0.033	0.004
7	22	2.83	-9.524	-5.062	-0.124	0.141	0.257
7	23	-6.317	22.378	13.711	-0.092	0.1	0.179
7	24	-2.937	10.58	6.767	-0.122	0.106	0.205
7	25	2.469	-8.261	-4.322	-0.133	0.136	0.259
7	26	-5.821	20.608	12.673	-0.087	0.085	0.146
7	27	-1.765	6.397	4.327	-0.084	0.092	0.146
	MAX	42.128	98.583	59.282	0.022	0.247	0.419
	MIN	-28.073	-147	-85.809	-0.289	-0.033	0.004
8	1	30.861	-101.227	6.799	49.421	15.252	1.158
8	2	-38.479	157.935	-16.823	-80.793	-18.583	2.424
8	3	-14.907	66.492	-6.413	-33.922	-7.017	1.059
8	4	-23.665	100.482	-11.241	-51.747	-11.543	1.363
8	5	-39.132	158.857	-14.001	-80.049	-18.816	2.797
8	6	-16.515	71 393	6 125	26.066	7 002	0.037
8			71.555	-0.133	-20.000	-7.992	
8	7	-27.288	111.789	-9.698	-56.316	-13.293	-0.138
	7	-27.288 -19.511	111.789 90.565	-9.698 -8.65	-56.316 -46.408	-7.592 -13.293 -8.932	-0.138 2.938
8	7 8 9	-27.288 -19.511 -0.653	111.789 90.565 17.411	-0.133 -9.698 -8.65 -0.322	-56.316 -46.408 -8.911	-7.332 -13.293 -8.932 0.322	-0.138 2.938 1.846
8 8	7 8 9 10	-27.288 -19.511 -0.653 -7.66	111.789 90.565 17.411 44.603	-0.133 -9.698 -8.65 -0.322 -4.184	-56.316 -46.408 -8.911 -23.171	-7.332 -13.293 -8.932 0.322 -3.299	-0.138 2.938 1.846 2.089
8 8 8	7 8 9 10 11	-27.288 -19.511 -0.653 -7.66 -20.033	111.789 90.565 17.411 44.603 91.303	-0.133 -9.698 -8.65 -0.322 -4.184 -6.392	-56.316 -46.408 -8.911 -23.171 -45.812	-7.332 -13.293 -8.932 0.322 -3.299 -9.118	-0.138 2.938 1.846 2.089 3.236
8 8 8 8	7 8 9 10 11 12	-27.288 -19.511 -0.653 -7.66 -20.033 -1.939	111.789 90.565 17.411 44.603 91.303 21.331	-0.133 -9.698 -8.65 -0.322 -4.184 -6.392 -0.1	-56.316 -46.408 -8.911 -23.171 -45.812 -10.626	-7.992 -13.293 -8.932 0.322 -3.299 -9.118 -0.458	-0.138 2.938 1.846 2.089 3.236 1.028
8 8 8 8 8	7 8 9 10 11 12 13	-27.288 -19.511 -0.653 -7.66 -20.033 -1.939 -10.558	111.789 90.565 17.411 44.603 91.303 21.331 53.648	-0.133 -9.698 -8.65 -0.322 -4.184 -6.392 -0.1 -2.95	-56.316 -46.408 -8.911 -23.171 -45.812 -10.626 -26.826	-7.992 -13.293 -8.932 0.322 -3.299 -9.118 -0.458 -4.699	-0.138 2.938 1.846 2.089 3.236 1.028 0.888
8 8 8 8 8 8 8	7 8 9 10 11 12 13 14	-27.288 -19.511 -0.653 -7.66 -20.033 -1.939 -10.558 22.476	111.789 90.565 17.411 44.603 91.303 21.331 53.648 -72.978	-0.133 -9.698 -8.65 -0.322 -4.184 -6.392 -0.1 -2.95 6.405	-56.316 -56.316 -46.408 -8.911 -23.171 -45.812 -10.626 -26.826 36.102	-7.992 -13.293 -8.932 0.322 -3.299 -9.118 -0.458 -4.699 11.336	-0.138 2.938 1.846 2.089 3.236 1.028 0.888 1.203
8 8 8 8 8 8 8 8 8	7 8 9 10 11 12 13 14 15	-27.288 -19.511 -0.653 -7.66 -20.033 -1.939 -10.558 22.476 -41.834	111.789 90.565 17.411 44.603 91.303 21.331 53.648 -72.978 169.235	-0.133 -9.698 -8.65 -0.322 -4.184 -6.392 -0.1 -2.95 6.405 -16.98	-56.316 -56.316 -46.408 -8.911 -23.171 -45.812 -10.626 -26.826 36.102 -86.12	-7.992 -13.293 -8.932 0.322 -3.299 -9.118 -0.458 -4.699 11.336 -20.15	-0.138 2.938 1.846 2.089 3.236 1.028 0.888 1.203 2.442
8 8 8 8 8 8 8 8 8 8 8	7 8 9 10 11 12 13 14 15 16	-27.288 -19.511 -0.653 -7.66 -20.033 -1.939 -10.558 22.476 -41.834 -18.261	111.789 90.565 17.411 44.603 91.303 21.331 53.648 -72.978 169.235 77.792	-0.133 -9.698 -8.65 -0.322 -4.184 -6.392 -0.1 -2.95 6.405 -16.98 -6.57	-56.316 -56.316 -46.408 -8.911 -23.171 -45.812 -10.626 -26.826 36.102 -86.12 -39.25	-7.992 -13.293 -8.932 0.322 -3.299 -9.118 -0.458 -4.699 11.336 -20.15 -8.584	-0.138 2.938 1.846 2.089 3.236 1.028 0.888 1.203 2.442 1.077

Design	Project:- Roof design	Location:- Bengaluru	Date:- 26-12-2019 Rev :- 00 Design By:- Santosh
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8	18	-42.486	170.157	-14.159	-85.376	-20.383	2.816
8	19	-19.869	82.692	-6.293	-41.393	-9.559	0.055
8	20	-30.642	123.089	-9.855	-61.643	-14.86	-0.12
8	21	8.385	-28.25	0.395	13.318	3.917	-0.045
8	22	-0.765	16.091	-1.763	-8.763	0.068	1.95
8	23	8.664	-20.486	2.401	9.985	4.695	1.404
8	24	5.161	-6.89	0.47	2.855	2.885	1.526
8	25	-1.026	16.46	-0.634	-8.465	-0.025	2.099
8	26	8.021	-18.526	2.512	9.128	4.305	0.995
8	27	3.712	-2.367	1.087	1.028	2.185	0.925
	MAX	30.861	170.157	6.799	49.421	15.252	3.236
	MIN	-42.486	-101.227	-16.98	-86.12	-20.383	-0.138

9	1	-0.667	2.23	-6.108	0.949	0.249	0.009
9	2	2.064	-7.509	15.396	-1.464	-0.424	-0.02
9	3	0.918	-3.108	6.426	-0.606	-0.143	-0.042
9	4	1.392	-4.772	9.867	-0.944	-0.236	-0.049
9	5	4.908	-17.568	28.806	-1.34	-0.417	0.006
9	6	1.2	-3.46	7.096	-0.663	-0.077	-0.119
9	7	1.811	-5.384	11.022	-1.043	-0.15	-0.153
9	8	0.99	-4.026	8.378	-0.812	-0.284	0.023
9	9	0.073	-0.505	1.202	-0.126	-0.059	0.005
9	10	0.452	-1.836	3.955	-0.396	-0.133	-0.001
9	11	3.265	-12.073	19.106	-0.713	-0.278	0.043
9	12	0.299	-0.787	1.739	-0.172	-0.006	-0.056
9	13	0.787	-2.326	4.879	-0.475	-0.065	-0.084
9	14	-0.747	2.354	-5.516	0.699	0.159	0.029
9	15	2.032	-7.46	15.633	-1.564	-0.46	-0.012
9	16	0.886	-3.059	6.663	-0.706	-0.178	-0.034
9	17	1.36	-4.722	10.104	-1.044	-0.272	-0.042
9	18	4.876	-17.519	29.043	-1.44	-0.453	0.014
9	19	1.168	-3.411	7.333	-0.763	-0.113	-0.111
9	20	1.779	-5.334	11.259	-1.143	-0.186	-0.145
9	21	0.079	-0.123	-0.593	0.25	0.09	-0.02
9	22	0.196	-1.072	1.983	-0.127	-0.079	0.023
9	23	-0.262	0.689	-1.605	0.217	0.034	0.014
9	24	-0.073	0.023	-0.229	0.082	-0.003	0.011
9	25	1.334	-5.095	7.347	-0.077	-0.076	0.033
9	26	-0.149	0.548	-1.337	0.194	0.061	-0.017
9	27	0.095	-0.221	0.233	0.042	0.031	-0.031



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	MAX	4.908	2.354	29.043	0.949	0.249	0.043
	MIN	-0.747	-17.568	-6.108	-1.564	-0.46	-0.153
-							
10	1	-21.213	99.506	58.854	-0.289	0.007	0.09
10	2	29.184	-135.984	-77.676	-0.071	0.18	0.312
10	3	11.892	-55.395	-31.065	-0.026	0.099	0.167
10	4	18.511	-86.286	-48.927	-0.071	0.113	0.207
10	5	28.656	-133.524	-76.26	-0.089	0.174	0.306
10	6	13.25	-61.866	-34.801	-0.026	0.056	0.081
10	7	21.033	-98.34	-55.869	-0.015	0.057	0.068
10	8	16.226	-75.34	-42.922	-0.07	0.191	0.317
10	9	2.393	-10.868	-5.633	-0.034	0.126	0.2
10	10	7.688	-35.581	-19.922	-0.07	0.137	0.233
10	11	15.804	-73.372	-41.789	-0.084	0.186	0.312
10	12	3.479	-16.045	-8.622	-0.034	0.091	0.132
10	13	9.706	-45.224	-25.476	-0.025	0.092	0.121
10	14	-15.057	70.658	41.439	-0.153	0.033	0.087
10	15	31.646	-147.523	-84.642	-0.016	0.19	0.311
10	16	14.354	-66.934	-38.031	0.029	0.109	0.165
10	17	20.974	-97.825	-55.893	-0.016	0.123	0.206
10	18	31.118	-145.063	-83.226	-0.034	0.184	0.305
10	19	15.712	-73.405	-41.768	0.029	0.066	0.08
10	20	23.495	-109.879	-62.835	0.04	0.067	0.066
10	21	-6.156	28.848	17.415	-0.137	-0.026	0.003
10	22	2.09	-9.407	-4.885	-0.096	0.109	0.193
10	23	-4.826	22.829	13.759	-0.078	0.076	0.135
10	24	-2.179	10.472	6.614	-0.096	0.082	0.151
10	25	1.879	-8.423	-4.319	-0.103	0.106	0.191
10	26	-4.283	20.24	12.265	-0.078	0.059	0.101
10	27	-1.17	5.651	3.838	-0.074	0.059	0.095
	MAX	31.646	99.506	58.854	0.04	0.191	0.317
	MIN	-21.213	-147.523	-84.642	-0.289	-0.026	0.003
						1	
11	1	23.286	-102.609	6.688	50.006	11.719	0.939
11	2	-29.587	157.074	-16.407	-79.974	-14.61	2.376
11	3	-11.71	65.187	-6.326	-33.131	-5.731	1.149
11	4	-18.594	100.455	-10.757	-51.353	-9.3	1.401
11	5	-30.193	158.776	-13.438	-79.643	-14.555	2.499
11	6	-13.374	72.565	-6.334	-36.604	-6.776	0.159



11	7	-21.785	113.944	-9.989	-57.33	-11.061	-0.06
11	8	-15.092	89.57	-8.42	-45.625	-7.084	2.702
11	9	-0.791	16.061	-0.355	-8.15	0.019	1.721
11	10	-6.298	44.275	-3.9	-22.728	-2.836	1.922
11	11	-15.577	90.932	-6.046	-45.36	-7.039	2.801
11	12	-2.122	21.964	-0.362	-10.93	-0.816	0.929
11	13	-8.85	55.067	-3.286	-27.51	-4.244	0.754
11	14	17.004	-73.86	6.285	36.474	8.738	0.97
11	15	-32.1	168.574	-16.568	-85.387	-15.803	2.389
11	16	-14.223	76.687	-6.487	-38.543	-6.924	1.162
11	17	-21.107	111.955	-10.918	-56.765	-10.493	1.414
11	18	-32.706	170.276	-13.6	-85.055	-15.747	2.512
11	19	-15.887	84.065	-6.496	-42.017	-7.968	0.172
11	20	-24.297	125.444	-10.15	-62.743	-12.254	-0.047
11	21	6.282	-28.749	0.403	13.531	2.982	-0.032
11	22	-0.745	15.241	-1.696	-8.223	-0.047	1.739
11	23	6.406	-21.514	2.336	10.514	3.505	1.249
11	24	3.653	-7.406	0.564	3.226	2.077	1.349
11	25	-0.987	15.922	-0.509	-8.09	-0.025	1.789
11	26	5.741	-18.562	2.333	9.125	3.087	0.853
11	27	2.377	-2.011	0.871	0.835	1.373	0.765
					r	r	
	MAX	23.286	170.276	6.688	50.006	11.719	2.801
	MIN	-32.706	-102.609	-16.568	-85.387	-15.803	-0.06
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12	1	-0.578	2.287	-6.119	0.959	0.168	0.029
12	2	1.593	-7.614	15.276	-1.455	-0.331	-0.012
12	3	0.696	-3.15	6.346	-0.591	-0.12	-0.026
12	4	1.083	-4.876	9.835	-0.934	-0.186	-0.038
12	5	3.663	-17.679	28.475	-1.335	-0.339	0.021
12	6	1.015	-3.807	7.484	-0.668	-0.054	-0.103
12	7	1.542	-5.891	11.592	-1.054	-0.1	-0.142
12	8	0.748	-4.088	8.322	-0.808	-0.232	0.028
12	9	0.03	-0.517	1.178	-0.116	-0.062	0.017
12	10	0.34	-1.898	3.97	-0.391	-0.115	0.007
12	11	2.404	-12.14	18.881	-0.712	-0.238	0.054
12	12	0.286	-1.043	2.088	-0.178	-0.01	-0.046
12	13	0.707	-2.71	5.375	-0.487	-0.047	-0.077
12	14	-0.618	2.395	-5.496	0.702	0.105	0.038
12	15	1.577	-7.571	15.525	-1.558	-0.357	-0.008
12	16	0.68	-3.107	6.595	-0.694	-0.145	-0.022

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12	17	1.067	-4.833	10.085	-1.037	-0.211	-0.034
12	18	3.647	-17.636	28.723	-1.438	-0.364	0.025
12	19	0.999	-3.764	7.733	-0.77	-0.079	-0.1
12	20	1.526	-5.847	11.841	-1.157	-0.126	-0.139
12	21	0.041	-0.108	-0.623	0.257	0.063	-0.009
12	22	0.127	-1.086	1.963	-0.123	-0.074	0.029
12	23	-0.232	0.7	-1.609	0.223	0.011	0.023
12	24	-0.077	0.009	-0.214	0.085	-0.016	0.019
12	25	0.955	-5.112	7.242	-0.075	-0.077	0.042
12	26	-0.104	0.437	-1.154	0.192	0.037	-0.008
12	27	0.106	-0.397	0.489	0.037	0.019	-0.023
	MAX	3.663	2.395	28.723	0.959	0.168	0.054
	MIN	-0.618	-17.679	-6.119	-1.558	-0.364	-0.142

13	1	-14.531	101.743	59.431	-0.285	0.008	0.05
13	2	20.196	-140.488	-79.29	-0.053	0.119	0.233
13	3	8.32	-57.856	-32.074	-0.008	0.066	0.128
13	4	12.952	-90.165	-50.523	-0.041	0.072	0.146
13	5	19.742	-137.34	-77.502	-0.081	0.114	0.222
13	6	9.594	-66.931	-37.254	-0.017	0.018	0.048
13	7	15.153	-105.901	-59.494	-0.005	0.003	0.023
13	8	11.243	-77.938	-43.873	-0.047	0.127	0.228
13	9	1.742	-11.832	-6.101	-0.011	0.085	0.144
13	10	5.448	-37.679	-20.86	-0.037	0.09	0.158
13	11	10.879	-75.419	-42.443	-0.07	0.124	0.22
13	12	2.761	-19.092	-10.244	-0.018	0.047	0.08
13	13	7.208	-50.268	-28.037	-0.008	0.035	0.06
13	14	-10.337	72.405	41.94	-0.146	0.024	0.051
13	15	21.874	-152.224	-86.287	0.003	0.125	0.233
13	16	9.998	-69.592	-39.071	0.048	0.073	0.128
13	17	14.63	-101.9	-57.52	0.015	0.079	0.146
13	18	21.419	-149.075	-84.499	-0.025	0.121	0.223
13	19	11.272	-78.667	-44.251	0.039	0.025	0.049
13	20	16.831	-117.637	-66.491	0.051	0.01	0.023
13	21	-4.194	29.339	17.492	-0.14	-0.016	-0.002
13	22	1.487	-10.007	-5.161	-0.082	0.073	0.134
13	23	-3.263	23.046	13.726	-0.064	0.052	0.092
13	24	-1.411	10.123	6.346	-0.077	0.055	0.1
13	25	1.305	-8.747	-4.445	-0.093	0.071	0.13
13	26	-2.754	19.416	11.654	-0.067	0.033	0.061



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13	27	-0.53	3.828	2.758	-0.062	0.027	0.05
	MAX	21.874	101.743	59.431	0.051	0.127	0.233
	MIN	-14.531	-152.224	-86.287	-0.285	-0.016	-0.002
14	1	15.885	-105.046	6.724	51.249	8.149	0.653
14	2	-20.835	161.345	-16.677	-82.113	-10.587	1.863
14	3	-8.541	67.485	-6.334	-34.2	-4.345	0.939
14	4	-13.416	104.152	-10.681	-53.055	-6.915	1.054
14	5	-21.156	162.575	-13.872	-81.579	-10.364	1.867
14	6	-10.11	78.012	-7.19	-39.431	-5.451	-0.072
14	7	-16.34	122.144	-11.283	-61.599	-8.797	-0.429
14	8	-10.716	91.776	-8.531	-46.678	-5.209	2.051
14	9	-0.881	16.688	-0.257	-8.347	-0.216	1.312
14	10	-4.781	46.022	-3.734	-23.431	-2.272	1.404
14	11	-10.973	92.76	-6.287	-46.25	-5.03	2.054
14	12	-2.136	25.11	-0.941	-12.532	-1.1	0.503
14	13	-7.12	60.415	-4.216	-30.266	-3.778	0.217
14	14	11.663	-75.835	6.369	37.507	6.112	0.677
14	15	-22.524	173.029	-16.819	-87.61	-11.402	1.873
14	16	-10.23	79.169	-6.477	-39.697	-5.16	0.949
14	17	-15.105	115.837	-10.824	-58.552	-7.73	1.064
14	18	-22.845	174.259	-14.014	-87.076	-11.178	1.877
14	19	-11.799	89.696	-7.332	-44.927	-6.266	-0.062
14	20	-18.028	133.828	-11.425	-67.096	-9.612	-0.419
14	21	4.222	-29.211	0.356	13.742	2.037	-0.024
14	22	-0.693	15.554	-1.718	-8.336	-0.16	1.296
14	23	4.225	-21.99	2.419	10.829	2.337	0.926
14	24	2.275	-7.323	0.68	3.287	1.309	0.973
14	25	-0.821	16.046	-0.596	-8.122	-0.07	1.298
14	26	3.597	-17.779	2.077	8.737	1.895	0.522
14	27	1.105	-0.127	0.44	-0.13	0.556	0.379
	MAX	15.885	174.259	6.724	51.249	8.149	2.054
	MIN	-22.845	-105.046	-16.819	-87.61	-11.402	-0.429
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15	1	-0.411	2.242	-6.056	0.979	0.105	0.027
15	2	1.092	-7.647	15.307	-1.505	-0.234	-0.012
15	3	0.472	-3.168	6.369	-0.613	-0.089	-0.018
15	4	0.753	-4.91	9.878	-0.969	-0.129	-0.031
15	5	2.505	-18.102	28.851	-1.38	-0.243	0.02



15	6	0.808	-4.214	8.108	-0.717	-0.02	-0.099
15	7	1.233	-6.505	12.536	-1.131	-0.039	-0.14
15	8	0.502	-4.067	8.302	-0.84	-0.168	0.019
15	9	0.006	-0.484	1.151	-0.127	-0.052	0.014
15	10	0.23	-1.877	3.958	-0.412	-0.084	0.004
15	11	1.632	-12.431	19.136	-0.74	-0.175	0.044
15	12	0.275	-1.32	2.542	-0.21	0.004	-0.05
15	13	0.614	-3.154	6.084	-0.541	-0.012	-0.083
15	14	-0.438	2.403	-5.493	0.717	0.065	0.031
15	15	1.081	-7.583	15.533	-1.61	-0.25	-0.01
15	16	0.462	-3.104	6.594	-0.719	-0.105	-0.016
15	17	0.742	-4.845	10.103	-1.074	-0.145	-0.03
15	18	2.494	-18.038	29.076	-1.485	-0.259	0.021
15	19	0.798	-4.149	8.333	-0.822	-0.036	-0.097
15	20	1.222	-6.441	12.761	-1.236	-0.055	-0.138
15	21	0.027	-0.161	-0.563	0.262	0.041	-0.004
15	22	0.076	-1.072	1.954	-0.133	-0.058	0.022
15	23	-0.172	0.719	-1.622	0.223	0	0.02
15	24	-0.06	0.023	-0.218	0.081	-0.016	0.014
15	25	0.641	-5.254	7.371	-0.083	-0.062	0.035
15	26	-0.038	0.301	-0.926	0.182	0.028	-0.013
15	27	0.132	-0.616	0.845	0.016	0.02	-0.029
	MAX	2.505	2.403	29.076	0.979	0.105	0.044
	MIN	-0.438	-18.102	-6.056	-1.61	-0.259	-0.14
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16	1	-7.42	103.506	59.988	-0.286	0.003	0.026
16	2	10.407	-144.237	-80.805	-0.033	0.06	0.114
16	3	4.316	-59.795	-32.916	0.009	0.034	0.062
16	4	6.699	-92.979	-51.721	-0.02	0.032	0.054
16	5	10.153	-140.716	-78.822	-0.069	0.057	0.111
16	6	5.198	-72.462	-40.105	-0.033	-0.016	-0.024
16	7	8.155	-114.057	-63.675	-0.03	-0.045	-0.078
16	8	5.8	-80.114	-44.77	-0.028	0.065	0.112
16	9	0.926	-12.56	-6.458	0.006	0.044	0.07
16	10	2.833	-39.108	-21.503	-0.017	0.042	0.064
16	11	5.597	-77.298	-43.183	-0.056	0.062	0.109
16	12	1.632	-22.694	-12.21	-0.028	0.004	0.001
16	13	3.998	-55.97	-31.066	-0.025	-0.019	-0.042
16	14	-5.289	73.8	42.416	-0.144	0.012	0.026
16	15	11.26	-156.119	-87.834	0.024	0.064	0.114

Design	Project:- Roof design	Location:- Bengaluru	Date:- 26-12-2019 Rev :- 00 Design By:- Santosh
Corp			Design By:- Santosh

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16	16	5 168	-71 677	-20 0/5	0.066	0.038	0.062
10	10	7 552	-104 861	-59.945	0.000	0.038	0.002
10	17	11.006	-104.801	-98.75	-0.012	0.033	0.034
10	10	6.05	-132.333	-85.851	-0.012	-0.013	-0.024
10	20	9,008	-04.544	-47.133	0.024	-0.013	-0.024
10	20	9.008 2.122	-123.939	-70.704	0.027	-0.041	-0.078
10	21	-2.132	-10 537	_5 /10	-0.142	-0.003	0.066
16	22	-1 652	23.24	13 737	-0.071	0.037	0.005
16	23	-0.699	9 966	6 215	-0.066	0.027	0.043
16	24	0.693	-9 129	-4 625	-0.000	0.020	0.042
16	25	-1 3	18 173	10 861	-0.071	0.007	0.005
16	20	-0 116	1 535	1 433	-0.07	-0.005	-0.011
10	27	0.110	1.555	1.433	0.07	0.005	0.011
	ΜΑΧ	11.26	103,506	59,988	0.066	0.065	0.114
	MIN	-7.42	-156,119	-87,834	-0.286	-0.045	-0.078
					0.200	0.0.0	
17	1	8.12	-106.926	6.7	52.211	4.104	0.312
17	2	-10.52	165.12	-16.768	-84.006	-5.25	0.786
17	3	-4.236	69.434	-6.3	-35.129	-2.099	0.375
17	4	-6.789	106.991	-10.638	-54.42	-3.435	0.267
17	5	-10.678	166.116	-14.058	-83.332	-5.215	0.828
17	6	-4.451	84.257	-8.358	-42.843	-2.491	-0.312
17	7	-8.708	131.604	-11.391	-66.628	-4.693	-0.945
17	8	-5.386	93.833	-8.544	-47.668	-2.563	0.898
17	9	-0.359	17.284	-0.169	-8.566	-0.042	0.569
17	10	-2.401	47.329	-3.64	-23.999	-1.111	0.482
17	11	-5.513	94.63	-6.376	-47.129	-2.536	0.931
17	12	-0.53	29.142	-1.816	-14.737	-0.356	0.019
17	13	-3.936	67.02	-4.242	-33.766	-2.118	-0.487
17	14	5.953	-77.378	6.394	38.316	3.075	0.324
17	15	-11.386	176.939	-16.891	-89.564	-5.662	0.791
17	16	-5.102	81.253	-6.422	-40.686	-2.51	0.38
17	17	-7.655	118.81	-10.76	-59.978	-3.847	0.272
17	18	-11.545	177.935	-14.18	-88.89	-5.627	0.833
17	19	-5.317	96.076	-8.48	-48.401	-2.903	-0.307
17	20	-9.574	143.423	-11.513	-72.186	-5.105	-0.94
17	21	2.166	-29.549	0.306	13.894	1.029	-0.012
17	22	-0.311	15.965	-1.714	-8.507	-0.052	0.578
17	23	2.202	-22.309	2.473	11.044	1.209	0.414
17	24	1.181	-7.286	0.738	3.327	0.674	0.371
17	25	-0.375	16.364	-0.63	-8.238	-0.038	0.595

		Projec	Project:-		tion:-	Date:- 26-12-2019		
	Design	Roof	design	Ben	galuru	Rev:-00	· Santach	
	Corp						Design by Santosn	
17	26	2.116	-16.38	1.65	7.958	1.052	0.139	
17	27	0.413	2.559	0.437	-1.556	0.171	-0.114	
	I							
	MAX	8.12	177.935	6.7	52.211	4.104	0.931	
	MIN	-11.545	-106.926	-16.891	-89.564	-5.662	-0.945	
1		I						
18	1	-0.188	2.22	-6.021	0.993	0.06	0.009	
18	2	0.542	-7.699	15.381	-1.543	-0.117	-0.004	
18	3	0.237	-3.188	6.399	-0.63	-0.042	-0.009	
18	4	0.396	-4.944	9.922	-0.993	-0.054	-0.026	
18	5	1.291	-18.432	29.184	-1.418	-0.119	0.006	
18	6	0.508	-4.566	8.705	-0.775	0.022	-0.087	
18	7	0.846	-8.298	15.08	-1.211	0.028	-0.123	
18	8	0.25	-4.067	8.318	-0.865	-0.082	0.008	
18	9	0.006	-0.457	1.133	-0.134	-0.022	0.005	
18	10	0.133	-1.862	3.952	-0.425	-0.031	-0.008	
18	11	0.85	-12.653	19.361	-0.764	-0.083	0.017	
18	12	0.223	-1.56	2.977	-0.251	0.03	-0.058	
18	13	0.493	-4.546	8.077	-0.599	0.035	-0.086	
18	14	-0.208	2.418	-5.502	0.728	0.038	0.012	
18	15	0.533	-7.62	15.589	-1.65	-0.126	-0.003	
18	16	0.229	-3.108	6.607	-0.736	-0.051	-0.008	
18	17	0.388	-4.865	10.13	-1.099	-0.063	-0.024	
18	18	1.283	-18.353	29.392	-1.524	-0.127	0.007	
18	19	0.5	-4.487	8.912	-0.882	0.013	-0.086	
18	20	0.838	-8.219	15.287	-1.317	0.019	-0.122	
18	21	0.021	-0.198	-0.519	0.266	0.022	-0.003	
18	22	0.041	-1.066	1.958	-0.142	-0.026	0.009	
18	23	-0.08	0.739	-1.634	0.224	0.004	0.007	
18	24	-0.017	0.036	-0.225	0.079	-0.001	0.001	
18	25	0.341	-5.359	7.48	-0.091	-0.026	0.013	
18	26	0.028	0.187	-0.712	0.166	0.03	-0.024	
18	27	0.163	-1.306	1.838	-0.008	0.032	-0.038	
		I						
	MAX	1.291	2.418	29.392	0.993	0.06	0.017	
	MIN	-0.208	-18.432	-6.021	-1.65	-0.127	-0.123	
	<u> </u>				-			
19	1	-0.111	103.992	60.112	-0.289	0	0	
19	2	0.157	-145.178	-81.121	-0.021	0.002	0.006	
19	3	0.066	-60.252	-33.084	0.017	0	0.003	
19	4	0.09	-93.636	-51.952	-0.01	-0.012	-0.026	



19	5	0.153	-141.594	-79.108	-0.058	0.002	0.004
19	6	0.052	-75.813	-41.887	-0.022	-0.057	-0.082
19	7	0.055	-118.682	-66.115	-0.007	-0.099	-0.161
19	8	0.088	-80.663	-44.959	-0.018	0.001	0.005
19	9	0.014	-12.722	-6.529	0.012	0	0.002
19	10	0.034	-39.43	-21.624	-0.01	-0.01	-0.02
19	11	0.084	-77.796	-43.349	-0.048	0.001	0.004
19	12	0.004	-25.171	-13.572	-0.019	-0.046	-0.066
19	13	0.006	-59.466	-32.954	-0.007	-0.079	-0.128
19	14	-0.08	74.171	42.518	-0.146	0	0
19	15	0.17	-157.106	-88.16	0.037	0.002	0.006
19	16	0.079	-72.181	-40.122	0.074	0	0.003
19	17	0.103	-105.565	-58.991	0.047	-0.012	-0.026
19	18	0.166	-153.523	-86.146	-0.001	0.002	0.004
19	19	0.065	-87.742	-48.925	0.035	-0.057	-0.082
19	20	0.068	-130.61	-73.153	0.05	-0.099	-0.161
19	21	-0.032	29.822	17.595	-0.144	0	0
19	22	0.012	-10.663	-5.473	-0.067	0.001	0.002
19	23	-0.025	23.307	13.742	-0.052	0	0.001
19	24	-0.015	9.953	6.195	-0.063	-0.005	-0.01
19	25	0.01	-9.23	-4.667	-0.082	0.001	0.002
19	26	-0.03	17.083	10.221	-0.068	-0.023	-0.033
19	27	-0.029	-0.065	0.53	-0.062	-0.04	-0.064
	MAX	0.17	103.992	60.112	0.074	0.002	0.006
	MIN	-0.111	-157.106	-88.16	-0.289	-0.099	-0.161
20	1	0.129	-107.475	6.669	52.468	0.073	0
20	2	-0.114	166.013	-16.71	-84.395	-0.076	0.002
20	3	-0.043	69.851	-6.256	-35.3	-0.033	-0.004
20	4	-0.179	107.61	-10.58	-54.684	-0.153	-0.285
20	5	-0.12	166.965	-14.016	-83.701	-0.075	0
20	6	0.841	87.54	-8.697	-44.584	-0.396	-0.902
20	7	-4.128	138.275	-11.858	-69.477	-1.368	-2.618
20	8	-0.038	94.297	-8.501	-47.854	-0.029	0.006
20	9	0.018	17.368	-0.138	-8.578	0.006	0.001
20	10	-0.09	47.575	-3.596	-24.085	-0.09	-0.223

-6.346

-2.09

-4.619

6.377

-47.299

-16.006

-35.92

38.523

0.005

-0.716

-2.089

0.003

-0.028

-0.284

-1.062

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-77.808

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Design	Location:- Bengaluru	Date:- 26-12-2019 Rev :- 00 Design By:- Santosh
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20	15	-0.127	177.879	-16.827	-89.973	-0.083	0.003
20	16	-0.056	81.717	-6.373	-40.878	-0.04	-0.003
20	17	-0.191	119.477	-10.696	-60.262	-0.16	-0.284
20	18	-0.133	178.832	-14.133	-89.28	-0.082	0.001
20	19	0.829	99.407	-8.814	-50.163	-0.403	-0.9
20	20	-4.141	150.141	-11.975	-75.055	-1.375	-2.616
20	21	0.032	-29.667	0.292	13.945	0.016	-0.003
20	22	0.02	16.025	-1.7	-8.518	0.008	0.004
20	23	0.048	-22.439	2.482	11.12	0.026	0.002
20	24	-0.006	-7.336	0.752	3.367	-0.022	-0.11
20	25	0.017	16.406	-0.622	-8.24	0.009	0.004
20	26	0.402	-15.364	1.505	7.406	-0.119	-0.357
20	27	-1.586	4.93	0.241	-2.551	-0.508	-1.043
	MAX	0.841	178.832	6.669	52.468	0.073	0.006
	MIN	-4.141	-107.475	-16.827	-89.973	-1.375	-2.618
21	1	-0.003	2.229	-6.028	0.998	0.002	0
21	2	0.02	-7.736	15.416	-1.551	0.003	-0.006
21	3	0.011	-3.204	6.414	-0.633	0.003	-0.003
21	4	0.054	-4.97	9.944	-0.998	0.021	-0.021
21	5	0.028	-18.511	29.24	-1.425	0.002	-0.004
21	6	0.321	-4.076	8.151	-0.81	0.117	-0.119
21	7	-0.072	-11.734	19.591	-1.214	0.043	-0.033
21	8	0.013	-4.084	8.335	-0.87	0.004	-0.005
21	9	0.006	-0.458	1.134	-0.136	0.004	-0.002
21	10	0.041	-1.871	3.958	-0.427	0.018	-0.017
21	11	0.02	-12.704	19.394	-0.769	0.002	-0.004
21	12	0.254	-1.156	2.524	-0.277	0.095	-0.095
21	13	-0.06	-7.283	11.676	-0.6	0.036	-0.026
21	14	-0.003	2.43	-5.512	0.73	0.002	0
21	15	0.02	-7.655	15.622	-1.658	0.003	-0.006
21	16	0.011	-3.124	6.62	-0.74	0.003	-0.003
21	17	0.054	-4.889	10.15	-1.104	0.021	-0.021
21	18	0.028	-18.431	29.446	-1.532	0.002	-0.004
21	19	0.321	-3.995	8.357	-0.917	0.117	-0.119
21	20	-0.072	-11.654	19.798	-1.32	0.043	-0.033
21	21	0	-0.201	-0.516	0.267	0	0
21	22	0.005	-1.07	1.963	-0.143	0.002	-0.002
21	23	0.002	0.743	-1.638	0.224	0.002	-0.001
21	24	0.019	0.037	-0.226	0.079	0.01	-0.008



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21	25	0.009	-5.38	7.492	-0.092	0.002	-0.002
21	26	0.126	0.394	-0.943	0.154	0.048	-0.047
21	27	-0.031	-2.669	3.633	-0.008	0.019	-0.013
					ſ	1	
	MAX	0.321	2.43	29.446	0.998	0.117	0
	MIN	-0.072	-18.511	-6.028	-1.658	0	-0.119
r	I				ſ	1	
22	1	7.222	103.766	60.126	-0.291	-0.002	-0.03
22	2	-10.146	-144.893	-81.162	-0.024	-0.06	-0.097
22	3	-4.21	-60.115	-33.09	0.014	-0.033	-0.052
22	4	-6.555	-93.473	-51.99	-0.013	-0.057	-0.099
22	5	-9.897	-141.353	-79.167	-0.06	-0.057	-0.095
22	6	-5.53	-78.523	-43.526	-0.019	-0.093	-0.157
22	7	-8.644	-122.354	-68.356	0.002	-0.152	-0.259
22	8	-5.656	-80.508	-44.983	-0.022	-0.064	-0.1
22	9	-0.907	-12.686	-6.526	0.008	-0.042	-0.064
22	10	-2.783	-39.372	-21.646	-0.013	-0.061	-0.101
22	11	-5.456	-77.676	-43.387	-0.05	-0.061	-0.097
22	12	-1.963	-27.413	-14.874	-0.018	-0.09	-0.148
22	13	-4.454	-62.477	-34.739	-0.001	-0.137	-0.229
22	14	5.149	74.012	42.53	-0.147	-0.011	-0.028
22	15	-10.975	-156.794	-88.201	0.034	-0.064	-0.097
22	16	-5.04	-72.017	-40.129	0.071	-0.037	-0.052
22	17	-7.384	-105.374	-59.029	0.044	-0.061	-0.098
22	18	-10.726	-153.254	-86.206	-0.002	-0.061	-0.094
22	19	-6.36	-90.425	-50.564	0.038	-0.097	-0.157
22	20	-9.474	-134.255	-75.395	0.059	-0.155	-0.259
22	21	2.073	29.754	17.597	-0.144	0.009	-0.002
22	22	-0.768	-10.649	-5.48	-0.07	-0.036	-0.061
22	23	1.606	23.261	13.749	-0.055	-0.025	-0.043
22	24	0.668	9.919	6.189	-0.065	-0.035	-0.062
22	25	-0.668	-9.233	-4.682	-0.084	-0.035	-0.06
22	26	1.078	15.898	9.575	-0.068	-0.049	-0.085
22	27	-0.167	-1.634	-0.358	-0.059	-0.073	-0.126
	MAX	7.222	103.766	60.126	0.071	0.009	-0.002
	MIN	-10.975	-156.794	-88.201	-0.291	-0.155	-0.259
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23	1	-7.889	-107.194	6.661	52.32	-3.95	-0.308
23	2	10.337	165.801	-16.692	-84.291	5.069	-0.765
23	3	4.161	69.757	-6.257	-35.259	2.015	-0.37



Design

23	4	6.465	107.514	-10.556	-54.634	3.099	-0.822
23	5	10.479	166.782	-13.984	-83.607	5.039	-0.813
23	6	6.317	90.271	-9.048	-46.084	2.808	-1.209
23	7	8.888	144.172	-12.331	-71.98	3.885	-2.324
23	8	5.338	94.235	-8.488	-47.832	2.489	-0.87
23	9	0.397	17.4	-0.139	-8.606	0.046	-0.554
23	10	2.24	47.605	-3.578	-24.107	0.913	-0.916
23	11	5.452	95.02	-6.322	-47.285	2.465	-0.908
23	12	2.122	33.811	-2.372	-17.267	0.68	-1.225
23	13	4.178	76.932	-4.999	-37.984	1.542	-2.117
23	14	-5.777	-77.601	6.372	38.41	-2.953	-0.315
23	15	11.181	177.638	-16.808	-89.855	5.467	-0.768
23	16	5.006	81.595	-6.372	-40.823	2.413	-0.373
23	17	7.31	119.351	-10.671	-60.198	3.497	-0.825
23	18	11.324	178.619	-14.1	-89.171	5.437	-0.816
23	19	7.161	102.109	-9.164	-51.648	3.206	-1.212
23	20	9.732	156.01	-12.447	-77.544	4.283	-2.327
23	21	-2.112	-29.594	0.289	13.91	-0.996	0.007
23	22	0.358	16.077	-1.695	-8.552	0.063	-0.561
23	23	-2.112	-22.34	2.479	11.061	-1.159	-0.403
23	24	-1.19	-7.238	0.76	3.311	-0.725	-0.584
23	25	0.415	16.469	-0.612	-8.278	0.051	-0.58
23	26	-1.25	-14.135	1.363	6.731	-0.841	-0.739
23	27	-0.221	7.426	0.049	-3.628	-0.41	-1.184
	MAX	11.324	178.619	6.661	52.32	5.467	0.007
	MIN	-7.889	-107.194	-16.808	-89.855	-3.95	-2.327
24	1	0.182	2.219	-6.024	0.994	-0.057	-0.009
24	2	-0.506	-7.713	15.412	-1.546	0.122	-0.006
24	3	-0.218	-3.192	6.411	-0.632	0.047	0.003
24	4	-0.288	-4.956	9.939	-0.993	0.096	-0.018
24	5	-1.235	-18.468	29.243	-1.421	0.122	-0.015
24	6	-0.057	-3.543	7.565	-0.84	0.141	-0.078
24	7	-0.756	-15.089	24.071	-1.209	0.224	-0.129
24	8	-0.228	-4.074	8.334	-0.866	0.085	-0.017
24	9	0.002	-0.457	1.133	-0.134	0.025	-0.01
24	10	-0.054	-1.868	3.955	-0.424	0.065	-0.026
24	11	-0.811	-12.678	19.398	-0.766	0.085	-0.024
24	12	0.131	-0.738	2.056	-0.301	0.101	-0.074
24	13	-0.428	-9.974	15.26	-0.596	0.167	-0.115



24	14	0.201	2.42	-5.51	0.729	-0.036	-0.012
24	15	-0.498	-7.633	15.618	-1.653	0.13	-0.007
24	16	-0.21	-3.112	6.617	-0.738	0.055	0.002
24	17	-0.28	-4.876	10.145	-1.099	0.104	-0.019
24	18	-1.227	-18.388	29.448	-1.527	0.13	-0.016
24	19	-0.049	-3.463	7.77	-0.946	0.149	-0.079
24	20	-0.748	-15.008	24.276	-1.315	0.232	-0.13
24	21	-0.02	-0.201	-0.515	0.266	-0.021	0.003
24	22	-0.034	-1.069	1.963	-0.142	0.028	-0.013
24	23	0.082	0.739	-1.637	0.224	-0.002	-0.01
24	24	0.053	0.034	-0.226	0.08	0.018	-0.018
24	25	-0.325	-5.371	7.495	-0.091	0.028	-0.017
24	26	0.146	0.599	-1.176	0.141	0.036	-0.042
24	27	-0.134	-4.019	5.426	-0.007	0.069	-0.062
					r		
	MAX	0.201	2.42	29.448	0.994	0.232	0.003
	MIN	-1.235	-18.468	-6.024	-1.653	-0.057	-0.13
r	1						
25	1	14.519	102.986	60.118	-0.294	-0.003	-0.06
25	2	-20.393	-143.754	-81.132	-0.038	-0.122	-0.198
25	3	-8.436	-59.456	-32.973	0.001	-0.068	-0.109
25	4	-13.191	-92.926	-52.077	-0.018	-0.105	-0.169
25	5	-19.932	-140.516	-79.293	-0.068	-0.117	-0.191
25	6	-11.602	-81.557	-45.604	-0.058	-0.132	-0.222
25	7	-18.062	-126.782	-71.433	-0.054	-0.207	-0.347
25	8	-11.369	-79.871	-44.968	-0.037	-0.128	-0.204
25	9	-1.804	-12.432	-6.44	-0.006	-0.085	-0.133
25	10	-5.608	-39.209	-21.724	-0.022	-0.115	-0.181
25	11	-11	-77.28	-43.496	-0.061	-0.125	-0.198
25	12	-4.337	-30.113	-16.546	-0.054	-0.137	-0.223
25	13	-9.504	-66.293	-37.208	-0.05	-0.197	-0.323
25	14	10.35	73.451	42.521	-0.152	-0.021	-0.058
25	15	-22.06	-155.568	-88.171	0.02	-0.129	-0.197
25	16	-10.103	-71.27	-40.012	0.058	-0.075	-0.109
25	17	-14.858	-104.741	-59.116	0.039	-0.112	-0.169
25	18	-21.599	-152.329	-86.332	-0.01	-0.124	-0.19
25	19	-13.27	-93.37	-52.644	-0.001	-0.139	-0.221
25	20	-19.729	-138.596	-78.472	0.003	-0.214	-0.346
25	21	4.168	29.535	17.598	-0.142	0.018	-0.002
25	22	-1.544	-10.555	-5.476	-0.079	-0.073	-0.125
25	23	3.238	23.164	13.788	-0.064	-0.051	-0.09

Design Root design Bengaluru Design By:- Santos	Design C o r p	Project:- Roof design	Location:- Bengaluru	Date:- 26-12-2019 Rev :- 00 Design By:- Santosh
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25	24	1.336	9.776	6.146	-0.071	-0.066	-0.114
25	25	-1.36	-9.26	-4.74	-0.091	-0.071	-0.122
25	26	1.972	14.324	8.735	-0.088	-0.077	-0.135
25	27	-0.612	-3.766	-1.596	-0.086	-0.107	-0.185
				I			
	MAX	14.519	102.986	60.118	0.058	0.018	-0.002
	MIN	-22.06	-155.568	-88.171	-0.294	-0.214	-0.347
26	1	-15.879	-106.273	6.649	51.843	-7.948	-0.623
26	2	20.697	164.867	-16.667	-83.852	10.151	-1.523
26	3	8.301	69.213	-6.3	-35.035	4.044	-0.732
26	4	13.065	107.138	-10.47	-54.435	6.284	-1.349
26	5	21.019	166.095	-13.88	-83.259	10.066	-1.617
26	6	11.211	94.212	-10.311	-48.417	5.146	-2.108
26	7	18.24	150.146	-12.603	-75.336	8.147	-3.405
26	8	10.654	93.869	-8.477	-47.694	4.968	-1.742
26	9	0.737	17.346	-0.184	-8.641	0.083	-1.11
26	10	4.548	47.686	-3.52	-24.161	1.874	-1.603
26	11	10.912	94.852	-6.247	-47.22	4.901	-1.818
26	12	3.065	37.345	-3.392	-19.346	0.965	-2.21
26	13	8.688	82.092	-5.226	-40.882	3.365	-3.248
26	14	-11.629	-76.902	6.36	38.038	-5.944	-0.639
26	15	22.397	176.615	-16.782	-89.373	10.952	-1.529
26	16	10.001	80.962	-6.416	-40.557	4.846	-0.739
26	17	14.765	118.886	-10.586	-59.957	7.085	-1.355
26	18	22.719	177.844	-13.995	-88.781	10.868	-1.624
26	19	12.911	105.961	-10.427	-53.939	5.948	-2.114
26	20	19.94	161.894	-12.719	-80.858	8.948	-3.412
26	21	-4.249	-29.371	0.289	13.805	-2.004	0.016
26	22	0.675	16.174	-1.694	-8.632	0.106	-1.127
26	23	-4.283	-22.088	2.452	10.895	-2.336	-0.811
26	24	-2.378	-6.918	0.784	3.135	-1.441	-1.057
26	25	0.804	16.665	-0.58	-8.395	0.073	-1.165
26	26	-3.119	-12.088	0.848	5.542	-1.895	-1.361
26	27	-0.308	10.285	-0.069	-5.225	-0.695	-1.88
	MAX	22.719	177.844	6.649	51.843	10.952	0.016
	MIN	-15.879	-106.273	-16.782	-89.373	-7.948	-3.412

27	1	0.363	2.201	-6.027	0.988	-0.117	-0.018
27	2	-1.032	-7.648	15.398	-1.535	0.238	-0.003



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27	3	-0.448	-3.158	6.396	-0.627	0.089	0.012
27	4	-0.632	-4.913	9.929	-0.984	0.167	-0.012
27	5	-2.497	-18.327	29.228	-1.407	0.238	-0.023
27	6	-0.33	-3.823	8.115	-0.874	0.217	-0.076
27	7	-1.979	-16.742	26.594	-1.248	0.35	-0.148
27	8	-0.47	-4.046	8.327	-0.857	0.167	-0.026
27	9	-0.004	-0.454	1.126	-0.131	0.047	-0.014
27	10	-0.15	-1.858	3.952	-0.416	0.109	-0.034
27	11	-1.643	-12.589	19.391	-0.755	0.167	-0.042
27	12	0.091	-0.986	2.501	-0.329	0.15	-0.085
27	13	-1.228	-11.321	17.284	-0.628	0.256	-0.143
27	14	0.404	2.395	-5.508	0.726	-0.073	-0.024
27	15	-1.016	-7.57	15.605	-1.64	0.256	-0.005
27	16	-0.432	-3.08	6.604	-0.732	0.106	0.01
27	17	-0.615	-4.835	10.136	-1.089	0.184	-0.014
27	18	-2.481	-18.249	29.435	-1.512	0.256	-0.025
27	19	-0.314	-3.746	8.323	-0.979	0.235	-0.079
27	20	-1.962	-16.664	26.801	-1.353	0.367	-0.151
27	21	-0.041	-0.195	-0.519	0.262	-0.043	0.006
27	22	-0.074	-1.065	1.96	-0.138	0.054	-0.023
27	23	0.16	0.731	-1.64	0.225	-0.006	-0.017
27	24	0.086	0.029	-0.227	0.082	0.025	-0.026
27	25	-0.66	-5.336	7.492	-0.087	0.054	-0.031
27	26	0.207	0.465	-0.953	0.126	0.046	-0.052
27	27	-0.452	-4.702	6.439	-0.023	0.098	-0.081
					r		
	MAX	0.404	2.395	29.435	0.988	0.367	0.012
	MIN	-2.497	-18.327	-6.027	-1.64	-0.117	-0.151
					1		
28	1	21.733	101.707	60.117	-0.299	-0.005	-0.093
28	2	-30.537	-141.993	-81.159	-0.065	-0.182	-0.306
28	3	-12.546	-58.324	-32.757	-0.021	-0.101	-0.163
28	4	-19.89	-92.452	-52.471	-0.026	-0.153	-0.245
28	5	-29.982	-139.409	-79.671	-0.083	-0.177	-0.3
28	6	-17.978	-83.428	-47.283	-0.083	-0.17	-0.307
28	7	-27.939	-129.527	-73.951	-0.087	-0.259	-0.465
28	8	-17.024	-78.889	-44.986	-0.065	-0.192	-0.314
28	9	-2.632	-11.954	-6.264	-0.03	-0.127	-0.2
28	10	-8.507	-39.257	-22.036	-0.034	-0.169	-0.265
28	11	-16.58	-76.822	-43.795	-0.079	-0.188	-0.31
28	12	-6.977	-32.038	-17.885	-0.079	-0.182	-0.316



28	13	-14.946	-68.916	-39.22	-0.083	-0.254	-0.442
28	14	15.495	72.544	42.522	-0.157	-0.032	-0.09
28	15	-33.032	-153.658	-88.197	-0.008	-0.192	-0.305
28	16	-15.041	-69.99	-39.795	0.035	-0.111	-0.162
28	17	-22.385	-104.118	-59.509	0.031	-0.164	-0.243
28	18	-32.477	-151.074	-86.709	-0.026	-0.188	-0.299
28	19	-20.473	-95.094	-54.321	-0.026	-0.18	-0.306
28	20	-30.434	-141.192	-80.989	-0.031	-0.27	-0.464
28	21	6.238	29.163	17.595	-0.141	0.027	-0.003
28	22	-2.314	-10.427	-5.484	-0.095	-0.109	-0.193
28	23	4.882	23.041	13.877	-0.078	-0.076	-0.136
28	24	1.945	9.389	5.991	-0.08	-0.097	-0.169
28	25	-2.092	-9.393	-4.889	-0.103	-0.107	-0.191
28	26	2.71	12.999	8.066	-0.103	-0.104	-0.194
28	27	-1.275	-5.44	-2.601	-0.104	-0.14	-0.257
	MAX	21.733	101.707	60.117	0.035	0.027	-0.003
	MIN	-33.032	-153.658	-88.197	-0.299	-0.27	-0.465
					1	1	
29	1	-23.792	-104.676	6.664	51.03	-11.901	-0.929
29	2	30.891	163.689	-16.663	-83.313	15.147	-2.234
29	3	12.27	68.484	-6.401	-34.763	5.951	-1.058
29	4	19.703	107.172	-10.266	-54.381	9.476	-1.831
29	5	31.523	165.474	-13.708	-82.919	15.15	-2.401
29	6	17.518	97.142	-11.081	-50.049	8.37	-2.568
29	7	28.665	154.249	-13.753	-77.669	13.356	-4.176
29	8	15.863	93.526	-8.474	-47.594	7.397	-2.578
29	9	0.966	17.362	-0.264	-8.754	0.04	-1.637
29	10	6.912	48.312	-3.356	-24.449	2.86	-2.256
29	11	16.368	94.954	-6.11	-47.279	7.399	-2.712
29	12	5.165	40.288	-4.008	-20.983	1.975	-2.845
29	13	14.082	85.974	-6.146	-43.079	5.964	-4.132
29	14	-17.427	-75.729	6.367	37.425	-8.901	-0.959
29	15	33.437	175.268	-16.782	-88.755	16.347	-2.246
29	16	14.816	80.063	-6.519	-40.205	7.151	-1.069
29	17	22.248	118.751	-10.385	-59.823	10.675	-1.843
29	18	34.068	177.053	-13.827	-88.36	16.35	-2.414
29	19	20.064	108.72	-11.199	-55.491	9.57	-2.58
29	20	31.211	165.828	-13.872	-83.11	14.556	-4.188
29	21	-6.365	-28.947	0.297	13.605	-3	0.03
29	22	0.961	16.471	-1.69	-8.827	0.138	-1.672
Design	Project:- Roof design	Location:- Bengaluru	Date:- 26-12-2019 Rev :- 00 Design By:- Santosh				
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29	23	-6.488	-21.611	2.415	10.593	-3.541	-1.202
29	24	-3,515	-6,136	0.869	2.746	-2,131	-1.511
29	25	1.213	17.185	-0.508	-8.669	0.139	-1.739
29	26	-4.388	-10.148	0.543	4.478	-2.573	-1.806
29	27	0.07	12.695	-0.526	-6.569	-0.578	-2.449
	MAX	34.068	177.053	6.664	51.03	16.35	0.03
	MIN	-23.792	-104.676	-16.782	-88.755	-11.901	-4.188
30	1	0.537	2.169	-6.027	0.98	-0.177	-0.022
30	2	-1.575	-7.59	15.451	-1.516	0.347	0.008
30	3	-0.685	-3.124	6.411	-0.621	0.124	0.026
30	4	-0.992	-4.891	9.99	-0.977	0.232	0
30	5	-3.771	-18.147	29.293	-1.39	0.348	-0.021
30	6	-0.704	-4.195	8.79	-0.895	0.279	-0.062
30	7	-3.27	-17.156	27.573	-1.273	0.454	-0.146
30	8	-0.732	-4.034	8.37	-0.842	0.239	-0.029
30	9	-0.02	-0.462	1.138	-0.126	0.061	-0.014
30	10	-0.265	-1.876	4.001	-0.41	0.148	-0.035
30	11	-2.489	-12.48	19.444	-0.742	0.24	-0.052
30	12	-0.035	-1.319	3.041	-0.346	0.185	-0.084
30	13	-2.088	-11.687	18.067	-0.648	0.325	-0.151
30	14	0.598	2.358	-5.508	0.722	-0.113	-0.033
30	15	-1.55	-7.514	15.659	-1.62	0.372	0.003
30	16	-0.661	-3.049	6.619	-0.724	0.15	0.021
30	17	-0.967	-4.816	10.198	-1.08	0.258	-0.004
30	18	-3.746	-18.071	29.501	-1.494	0.374	-0.025
30	19	-0.679	-4.12	8.998	-0.999	0.305	-0.066
30	20	-3.245	-17.08	27.781	-1.377	0.48	-0.15
30	21	-0.062	-0.189	-0.519	0.258	-0.065	0.011
30	22	-0.127	-1.074	1.982	-0.133	0.074	-0.028
30	23	0.229	0.712	-1.634	0.226	-0.014	-0.02
30	24	0.107	0.005	-0.203	0.083	0.029	-0.031
30	25	-1.005	-5.297	7.519	-0.082	0.075	-0.039
30	26	0.222	0.284	-0.683	0.116	0.047	-0.055
30	27	-0.805	-4.9	6.83	-0.035	0.118	-0.089
	MAX	0.598	2.358	29.501	0.98	0.48	0.026
	MIN	-3.771	-18.147	-6.027	-1.62	-0.177	-0.151
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31	2	-40.383	-138.917	-80.854	-0.131	-0.228	-0.455



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31	3	-16.704	-57.457	-32.864	-0.05	-0.129	-0.234
31	4	-26.582	-91.422	-52.839	-0.059	-0.193	-0.351
31	5	-39.456	-135.717	-78.978	-0.153	-0.216	-0.458
31	6	-24.329	-83.554	-48.259	-0.161	-0.191	-0.421
31	7	-37.774	-129.642	-75.422	-0.201	-0.285	-0.621
31	8	-22.489	-77.081	-44.766	-0.122	-0.247	-0.452
31	9	-3.546	-11.914	-6.373	-0.058	-0.168	-0.276
31	10	-11.448	-39.085	-22.354	-0.065	-0.22	-0.37
31	11	-21.748	-74.521	-43.265	-0.14	-0.238	-0.455
31	12	-9.646	-32.791	-18.69	-0.146	-0.217	-0.426
31	13	-20.402	-69.661	-40.42	-0.179	-0.293	-0.586
31	14	20.539	71.176	42.471	-0.159	-0.048	-0.113
31	15	-43.69	-150.361	-87.884	-0.076	-0.241	-0.454
31	16	-20.011	-68.902	-39.893	0.005	-0.142	-0.233
31	17	-29.889	-102.866	-59.869	-0.004	-0.207	-0.35
31	18	-42.763	-147.161	-86.008	-0.098	-0.229	-0.457
31	19	-27.636	-94.999	-55.289	-0.106	-0.204	-0.421
31	20	-41.082	-141.086	-82.451	-0.146	-0.298	-0.62
31	21	8.268	28.611	17.574	-0.137	0.033	-0.002
31	22	-3.029	-10.07	-5.395	-0.125	-0.143	-0.271
31	23	6.443	22.514	13.802	-0.092	-0.103	-0.183
31	24	2.492	8.928	5.812	-0.096	-0.129	-0.23
31	25	-2.658	-8.79	-4.644	-0.134	-0.138	-0.272
31	26	3.393	12.075	7.643	-0.137	-0.128	-0.258
31	27	-1.985	-6.36	-3.221	-0.153	-0.166	-0.338
1	0	0	0	0	0	0	0
	MAX	20.539	71.176	42.471	0.005	0.033	0
	MIN	-43.69	-150.361	-87.884	-0.201	-0.298	-0.621
							
0	0	0	0	0	0	0	0
32	1	-31.575	-102.414	6.791	49.923	-15.894	-1.222
32	2	40.647	161.282	-17.045	-82.367	20.22	-2.956
32	3	16.197	68.022	-6.501	-34.626	7.929	-1.383
32	4	26.184	106.712	-10.283	-54.199	12.777	-2.337
32	5	41.322	162.296	-14.234	-81.666	20.238	-3.207
32	6	23.73	98.351	-11.904	-51.045	11.759	-3.079
32	7	38.93	155.786	-14.995	-79.042	18.789	-4.997
32	8	20.772	92.519	-8.731	-47.32	9.871	-3.425
32	9	1.212	17.911	-0.296	-9.127	0.038	-2.166
32	10	9.202	48.863	-3.322	-24.786	3.917	-2.929



32	11	21.312	93.33	-6.482	-46.759	9.886	-3.625			
32	12	7.238	42.174	-4.619	-22.262	3.102	-3.523			
32	13	19.398	88.122	-7.092	-44.66	8.726	-5.057			
32	14	-23.128	-74.023	6.461	36.57	-11.888	-1.273			
32	15	44.026	172.638	-17.177	-87.708	21.823	-2.977			
32	16	19.576	79.378	-6.633	-39.967	9.532	-1.403			
32	17	29.563	118.068	-10.415	-59.541	14.38	-2.357			
32	18	44.701	173.652	-14.366	-87.007	21.841	-3.227			
32	19	27.109	109.707	-12.036	-56.386	13.361	-3.1			
32	20	42.308	167.142	-15.127	-84.384	20.392	-5.017			
32	21	-8.446	-28.39	0.33	13.353	-4.007	0.051			
32	22	1.135	16.65	-1.781	-9.032	0.181	-2.222			
32	23	-8.645	-20.654	2.436	10.064	-4.736	-1.592			
32	24	-4.651	-5.178	0.923	2.235	-2.797	-1.974			
32	25	1.405	17.056	-0.657	-8.752	0.188	-2.322			
32	26	-5.632	-8.522	0.275	3.497	-3.204	-2.271			
	MAX	44.701	173.652	6.791	49.923	21.841	0.051			
	MIN	-31.575	-102.414	-17.177	-87.708	-15.894	-5.057			
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33	1	0.708	2.136	-6.051	0.966	-0.24	-0.027			
33	2	-2.125	-7.43	15.445	-1.498	0.442	0.033			
33	3	-0.933	-3.06	6.429	-0.621	0.156	0.047			
33	4	-1.363	-4.811	10.036	-0.97	0.291	0.022			
33	5	-5.042	-17.811	29.274	-1.367	0.445	-0.009			
33	6	-1.132	-4.477	9.392	-0.912	0.337	-0.036			
33	7	-4.644	-17.453	28.531	-1.289	0.558	-0.132			
33	8	-1.002	-3.954	8.363	-0.829	0.301	-0.019			
33	9	-0.048	-0.458	1.15	-0.127	0.072	-0.008			
33	10	-0.392	-1.859	4.036	-0.407	0.18	-0.028			
33	11	-3.335	-12.259	19.426	-0.724	0.304	-0.053			
33	12	-0.208	-1.592	3.52	-0.36	0.217	-0.074			
33	13	-3.017	-11.972	18.832	-0.661	0.394	-0.151			
33	14	0.791	2.312	-5.522	0.714	-0.153	-0.042			
33	15	-2.092	-7.359	15.657	-1.599	0.477	0.027			
33	16	-0.9	-2.99	6.641	-0.722	0.191	0.041			
33	17	-1.331	-4.74	10.248	-1.071	0.326	0.016			
33	18	-5.009	-17.741	29.486	-1.467	0.48	-0.015			
33	19	-1.099	-4.407	9.603	-1.013	0.372	-0.042			
33	20	-4.611	-17.382	28.743	-1.389	0.593	-0.138			
33	21	-0.082	-0.176	-0.53	0.252	-0.087	0.015			

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33	22	-0.185	-1.052	1.973	-0.129	0.089	-0.026
33	23	0.292	0.695	-1.634	0.222	-0.025	-0.021
33	24	0.12	-0.005	-0.191	0.082	0.029	-0.031
33	25	-1.351	-5.205	7.504	-0.076	0.091	-0.043
33	26	0.212	0.128	-0.449	0.106	0.047	-0.054
33	27	-1.192	-5.062	7.207	-0.045	0.136	-0.092
	MAX	0.791	2.312	29.486	0.966	0.593	0.047
	MIN	-5.042	-17.811	-6.051	-1.599	-0.24	-0.151

34	1	34.464	93.878	57.91	-0.237	-0.067	-0.065
34	2	-46.392	-125.327	-74.674	-0.295	-0.207	-0.774
34	3	-19.212	-51.872	-30.34	-0.129	-0.124	-0.402
34	4	-30.813	-83.206	-49.22	-0.169	-0.183	-0.591
34	5	-44.891	-121.263	-72.236	-0.321	-0.195	-0.757
34	6	-28.026	-75.583	-44.683	-0.283	-0.172	-0.643
34	7	-43.737	-117.915	-70.248	-0.381	-0.253	-0.935
34	8	-25.548	-68.717	-40.843	-0.239	-0.268	-0.697
34	9	-3.804	-9.953	-5.376	-0.106	-0.202	-0.4
34	10	-13.085	-35.021	-20.479	-0.138	-0.248	-0.551
34	11	-24.347	-65.466	-38.892	-0.259	-0.258	-0.684
34	12	-10.855	-28.922	-16.85	-0.229	-0.24	-0.593
34	13	-23.424	-62.788	-37.302	-0.307	-0.305	-0.826
34	14	24.46	66.654	40.765	-0.12	-0.097	-0.081
34	15	-50.393	-136.216	-81.533	-0.249	-0.219	-0.781
34	16	-23.213	-62.761	-37.199	-0.082	-0.137	-0.409
34	17	-34.814	-94.096	-56.078	-0.123	-0.195	-0.598
34	18	-48.892	-132.152	-79.093	-0.274	-0.207	-0.764
34	19	-32.027	-86.473	-51.542	-0.237	-0.185	-0.65
34	20	-47.738	-128.804	-77.106	-0.334	-0.265	-0.941
34	21	10.003	27.223	17.145	-0.117	0.03	0.016
34	22	-2.99	-7.697	-4.115	-0.167	-0.173	-0.381
34	23	7.882	21.685	13.618	-0.101	-0.14	-0.232
34	24	3.242	9.151	6.067	-0.117	-0.163	-0.308
34	25	-2.389	-6.071	-3.14	-0.178	-0.168	-0.374
34	26	4.357	12.2	7.881	-0.163	-0.159	-0.329
34	27	-1.928	-4.732	-2.345	-0.202	-0.191	-0.445
	MAX	34.464	93.878	57.91	-0.082	0.03	0.016
	MIN	-50.393	-136.216	-81.533	-0.381	-0.305	-0.941



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35	1	-37.923	-96.54	7.638	47.201	-19.941	-1.489
35	2	45.891	145.945	-18.774	-75.384	24.791	-4.434
35	3	18.521	61.644	-7.248	-31.705	10.05	-2.142
35	4	29.985	97.372	-11.337	-49.9	16.065	-3.415
35	5	46.396	145.864	-16.116	-74.37	24.448	-4.623
35	6	27.014	89.466	-13.088	-47.055	14.769	-4.138
35	7	44.607	142.554	-16.76	-73.215	23.407	-6.438
35	8	22.522	82.732	-9.883	-42.983	11.812	-4.909
35	9	0.625	15.29	-0.662	-8.04	0.019	-3.076
35	10	9.797	43.873	-3.934	-22.596	4.831	-4.094
35	11	22.926	82.667	-7.757	-42.172	11.538	-5.06
35	12	7.42	37.548	-5.334	-20.32	3.794	-4.673
35	13	21.494	80.018	-8.272	-41.248	10.705	-6.512
35	14	-27.831	-69.535	7.029	34.428	-14.983	-1.596
35	15	49.928	156.747	-19.018	-80.493	26.774	-4.477
35	16	22.557	72.446	-7.492	-36.814	12.033	-2.185
35	17	34.022	108.174	-11.581	-55.009	18.048	-3.458
35	18	50.433	156.666	-16.36	-79.479	26.431	-4.666
35	19	31.05	100.268	-13.331	-52.164	16.752	-4.181
35	20	48.644	153.356	-17.003	-78.324	25.39	-6.481
35	21	-10.092	-27.005	0.609	12.773	-4.957	0.106
35	22	0.128	13.552	-2.13	-7.72	-0.088	-3.093
35	23	-10.82	-20.169	2.48	9.751	-5.984	-2.176
35	24	-6.234	-5.878	0.845	2.473	-3.578	-2.686
35	25	0.331	13.519	-1.067	-7.315	-0.224	-3.169
35	26	-7.423	-9.04	0.145	3.611	-4.096	-2.975
35	27	-0.385	12.195	-1.324	-6.853	-0.641	-3.895
	MAX	50.433	156.747	7.638	47.201	26.774	0.106
	MIN	-37.923	-96.54	-19.018	-80.493	-19.941	-6.512
36	1	0.903	2.052	-5.99	0.938	-0.288	-0.039
36	2	-2.556	-6.72	14.481	-1.395	0.507	0.082
36	3	-1.136	-2.769	6.054	-0.582	0.178	0.078
36	4	-1.673	-4.393	9.492	-0.908	0.331	0.062
36	5	-6.057	-16.677	27.999	-1.252	0.518	0.016
36	6	-1.439	-4.139	8.948	-0.85	0.375	0.003
36	7	-5.733	-16.601	27.694	-1.189	0.632	-0.105
36	8	-1.178	-3.494	7.669	-0.752	0.346	0.006
36	9	-0.042	-0.334	0.928	-0.102	0.083	0.002
36	10	-0.472	-1.633	3.678	-0.362	0.205	-0.011



36	11	-3.979	-11.46	18.484	-0.638	0.354	-0.047
36	12	-0.284	-1.429	3.242	-0.317	0.24	-0.058
36	13	-3.72	-11.399	18.24	-0.588	0.445	-0.144
36	14	0.993	2.202	-5.442	0.696	-0.181	-0.057
36	15	-2.52	-6.66	14.7	-1.492	0.55	0.075
36	16	-1.1	-2.709	6.273	-0.679	0.221	0.071
36	17	-1.637	-4.333	9.711	-1.004	0.374	0.054
36	18	-6.021	-16.617	28.218	-1.349	0.56	0.009
36	19	-1.403	-4.079	9.167	-0.947	0.418	-0.004
36	20	-5.697	-16.541	27.913	-1.286	0.674	-0.112
36	21	-0.09	-0.15	-0.548	0.241	-0.106	0.018
36	22	-0.192	-0.866	1.658	-0.098	0.1	-0.02
36	23	0.376	0.714	-1.713	0.227	-0.031	-0.022
36	24	0.161	0.064	-0.338	0.097	0.03	-0.028
36	25	-1.592	-4.849	7.065	-0.041	0.104	-0.046
36	26	0.255	0.166	-0.556	0.12	0.047	-0.052
36	27	-1.463	-4.819	6.943	-0.016	0.15	-0.095
	MAX	0.993	2.202	28.218	0.938	0.674	0.082
	MIN	-6.057	-16.677	-5.99	-1.492	-0.288	-0.144
37	1	29.505	66.063	42.389	-0.266	-0.084	0
37	2	-27.156	-60.074	-36.234	0.033	-0.361	-1.048
37	3	-8.878	-19.546	-11.181	0.018	-0.199	-0.552
37	4	-16.467	-36.365	-21.566	0.035	-0.285	-0.801
37	5	-26.562	-58.769	-35.432	0.02	-0.358	-1.018
37	6	-14.666	-32.309	-19.098	-0.054	-0.282	-0.84
37	7	-24.966	-55.063	-33.177	-0.061	-0.405	-1.204
37	8	-14 628	-32 192	-19 225	-0.056	-0 378	-0 904

57	Z	-27.150	-00.074	-30.234	0.055	-0.561	-1.048
37	3	-8.878	-19.546	-11.181	0.018	-0.199	-0.552
37	4	-16.467	-36.365	-21.566	0.035	-0.285	-0.801
37	5	-26.562	-58.769	-35.432	0.02	-0.358	-1.018
37	6	-14.666	-32.309	-19.098	-0.054	-0.282	-0.84
37	7	-24.966	-55.063	-33.177	-0.061	-0.405	-1.204
37	8	-14.628	-32.192	-19.225	-0.056	-0.378	-0.904
37	9	-0.006	0.229	0.817	-0.068	-0.248	-0.506
37	10	-6.077	-13.225	-7.49	-0.055	-0.317	-0.706
37	11	-14.153	-31.148	-18.583	-0.067	-0.376	-0.88
37	12	-4.636	-9.98	-5.516	-0.126	-0.314	-0.737
37	13	-12.876	-28.184	-16.78	-0.132	-0.413	-1.028
37	14	19.188	42.948	27.296	-0.185	-0.097	-0.041
37	15	-31.283	-69.32	-42.271	0.065	-0.367	-1.065
37	16	-13.005	-28.792	-17.218	0.05	-0.205	-0.568
37	17	-20.594	-45.611	-27.603	0.067	-0.29	-0.817
37	18	-30.689	-68.014	-41.469	0.052	-0.364	-1.035
37	19	-18.792	-41.555	-25.135	-0.022	-0.287	-0.856
37	20	-29.093	-64.309	-39.214	-0.029	-0.41	-1.221

	Project:-	Location:-	Date:- 26-12-2019
Design	Roof design	Bengaluru	Rev :- 00 Design By:- Santosh

37	21	10.317	23.115	15.093	-0.081	0.013	0.041
37	22	0.361	1.083	1.306	-0.102	-0.228	-0.468
37	23	7.672	17.294	11.327	-0.108	-0.163	-0.269
37	24	4.637	10.567	7.173	-0.101	-0.197	-0.369
37	25	0.599	1.605	1.627	-0.107	-0.227	-0.456
37	26	5.357	12.189	8.16	-0.137	-0.196	-0.385
37	27	1.237	3.087	2.528	-0.14	-0.245	-0.53
	MAX	29.505	66.063	42.389	0.067	0.013	0.041
	MIN	-31.283	-69.32	-42.271	-0.266	-0.413	-1.221

38	1	-40.697	-63.397	5.566	28.752	-24.228	-3.079		
38	2	9.157	81.86	-3.934	-38.988	6.431	-10.793		
38	3	-0.144	29.696	-0.244	-13.893	0.603	-6.144		
38	4	3.422	51.261	-1.485	-24.156	2.814	-8.414		
38	5	16.245	79.219	-2.503	-38.154	7.56	-10.031		
38	6	1.135	46.878	-2.68	-22.771	1.679	-9.179		
38	7	13.667	74.996	-3.444	-36.675	6.316	-11.847		
38	8	-8.458	52.826	-1.178	-25.754	-4.71	-10.738		
38	9	-15.899	11.095	1.774	-5.678	-9.372	-7.019		
38	10	-13.046	28.348	0.781	-13.889	-7.603	-8.834		
38	11	-2.788	50.714	-0.034	-25.087	-3.806	-10.128		
38	12	-14.875	24.841	-0.175	-12.781	-8.512	-9.446		
38	13	-4.85	47.335	-0.786	-23.904	-4.801	-11.581		
38	14	-30.213	-39.612	4.014	17.773	-18.273	-2.854		
38	15	13.351	91.374	-4.556	-43.379	8.813	-10.703		
38	16	4.049	39.21	-0.865	-18.284	2.985	-6.054		
38	17	7.615	60.775	-2.106	-28.547	5.196	-8.324		
38	18	20.438	88.734	-3.124	-42.545	9.942	-9.941		
38	19	5.329	56.392	-3.301	-27.163	4.061	-9.089		
38	20	17.86	84.51	-4.065	-41.066	8.698	-11.757		
38	21	-10.483	-23.785	1.553	10.978	-5.955	-0.225		
38	22	-16.314	10.568	1.016	-5.768	-9.664	-6.511		
38	23	-20.035	-10.297	2.492	4.27	-11.995	-4.651		
38	24	-18.608	-1.671	1.996	0.165	-11.111	-5.559		
38	25	-13.479	9.512	1.589	-5.434	-9.212	-6.206		
38	26	-19.523	-3.424	1.518	0.719	-11.565	-5.865		
38	27	-14.51	7.823	1.213	-4.843	-9.71	-6.932		
	MAX	20.438	91.374	5.566	28.752	9.942	-0.225		
	MIN	-40.697	-63.397	-4.556	-43.379	-24.228	-11.847		



Design

39	1	1.942	2.145	-5.621	0.714	-0.021	-0.25		
39	2	-1.629	-3.084	6.914	-0.594	0.336	0.109		
39	3	-0.468	-0.901	2.159	-0.178	0.146	0.054		
39	4	-0.885	-1.779	4.043	-0.336	0.242	0.058		
39	5	-2.899	-7.868	13.187	-0.451	0.516	-0.126		
39	6	-0.705	-1.71	3.801	-0.294	0.29	-0.002		
39	7	-2.576	-7.797	12.849	-0.378	0.621	-0.245		
39	8	-0.522	-1.757	3.715	-0.269	0.324	-0.046		
39	9	0.407	-0.011	-0.089	0.064	0.172	-0.09		
39	10	0.073	-0.713	1.418	-0.062	0.248	-0.086		
39	11	-1.538	-5.584	8.734	-0.155	0.468	-0.234		
39	12	0.217	-0.658	1.225	-0.029	0.287	-0.134		
39	13	-1.279	-5.527	8.464	-0.096	0.552	-0.329		
39	14	1.459	1.516	-3.945	0.486	0.024	-0.208		
39	15	-1.822	-3.335	7.584	-0.685	0.354	0.126		
39	16	-0.661	-1.153	2.829	-0.27	0.164	0.071		
39	17	-1.078	-2.03	4.713	-0.427	0.259	0.075		
39	18	-3.093	-8.119	13.857	-0.543	0.534	-0.109		
39	19	-0.898	-1.961	4.471	-0.385	0.308	0.015		
39	20	-2.769	-8.048	13.519	-0.469	0.639	-0.228		
39	21	0.483	0.628	-1.675	0.228	-0.045	-0.042		
39	22	0.323	-0.272	0.28	0.06	0.172	-0.106		
39	23	0.787	0.601	-1.622	0.226	0.095	-0.128		
39	24	0.62	0.25	-0.869	0.163	0.134	-0.127		
39	25	-0.185	-2.185	2.789	0.117	0.244	-0.2		
39	26	0.692	0.278	-0.965	0.18	0.153	-0.151		
39	27	-0.056	-2.157	2.654	0.146	0.286	-0.248		
	MAX	1.942	2.145	13.857	0.714	0.639	0.126		
	MIN	-3.093	-8.119	-5.621	-0.685	-0.045	-0.329		