COMMUNITY SPORTS AND RECREATION CENTER

DHARAN, EASTERN NEPAL

BY:

PRASHMA SHRESTHA

750131

A thesis submitted in partial fulfillment of the requirements for the Degree of Bachelor in Architecture

Purbanchal University
KHWOPA ENGINEERING COLLEGE
DEPARTMENT OF ARCHITECTURE
Libali, Bhaktapur, Nepal

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An Undertaking of Bhaktapur Municipality
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CERTIFICATE

This is to certify that the thesis entitled **COMMUNITY SPORTS AND RECREATION CENTER** at ***Dharan, Eastern Nepal***, submitted to the Department of Architecture of Khwopa Engineering College by **Ms. Prashma Shrestha** of Class Roll No. 31/ B.Arch./075 has been declared successful for the partial fulfillment of the academic requirement towards the completion of the degree of Bachelor of Architecture of Purbanchal University.

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ABSTRACT

In recent years, the city of Dharan has experienced significant urban development and population growth, emphasizing the need for communal spaces that promote physical activity, health, and community engagement. This thesis proposes the design and development of a Community Sports and Recreation Center in Dharan, aimed at fostering a sense of community, promoting a healthy lifestyle, and providing diverse recreational opportunities.

The proposed sports complex will include state-of-the-art facilities for various sports and recreational activities, accommodating the needs of both professional athletes and the local community. Special attention will be given to incorporating sustainable practices, such as energy-efficient systems, water harvesting, and the use of locally-sourced materials, to minimize the environmental impact of the project. In addition to the physical infrastructure, the thesis will explore the social and cultural implications of the sports complex on the community. Public engagement and participatory design methods will be employed to ensure that the final design is inclusive and reflective of the aspirations of the local population.

Through this thesis, the aim is to contribute to the discourse on sustainable architecture, cultural preservation, and community development. The sports complex in Dharan will not only serve as a hub for athletic activities but also stand as a testament to the harmonious coexistence of modernity, tradition, and nature in the built environment.

DECLARATION

I hereby declare that this dissertation has not been previously accepted in substance for any degree & is not being replicated in any manner. I state that this dissertation is the result of my own findings of thorough independent research work, except where stated. I hereby give consent for my dissertation, if accepted to be available for copying & understand that any reference to or quotation from my thesis will receive an acknowledgement.

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DECLARATION

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Firstly, I would like to acknowledge my thesis supervisor Ar. Rikesh Shrestha sir for providing his precious guidance & support during mitigation of design problems with a meaningful solution throughout the process & correcting me during decision making and my thesis coordinator Ar. Rashish Lal Shrestha for his perceptive advice, direction & inspiration. Meanwhile, I would also like to thank all the teachers from the Department of Architecture of Khwopa Engineering College who suggested & corrected me during the process.

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TABLE OF CONTENTS

List of Figures

CHAPTER 01.

INTRODUCTION
Community Sports Hub in Dharan, Eastern Nepal

1.1.PROJECT INTRODUCTION

Community is a term that is used very often in architecture but rarely defined. Cambridge dictionary defines community as “the people living in one particular area or people who are considered as a unit because of their common interests, social group, or nationality”. We can understand community as a group of individuals sharing similar religious, environmental and political views. Community also refers to “Togetherness”. However, a community is more than just a physical gathering of people; it also represents intangible moments of unity and belonging. Community sport is defined as organized physical activities that are often based on local regions and aim to enhance individual and social well-being. It focuses on the integration of diverse people of the community, encouraging unity and teamwork regardless of skill level or background. A wide range of activities such as team sports like football, badminton, and basketball, as well as individual sports like running, cycling and swimming can be included in community sports. However, the sports included should fulfill the need, interest and preferences of the designated community.

Community Sports Hub:

A community sports hub is a purpose-built facility or complex that integrates a range of sport amenities and services to support diverse sporting activities and promote community engagement in the city of Dharan. It serves as a central hub where individuals of all ages and abilities can participate in recreational, competitive, and social sports activities. The design focuses on sustainability, inclusivity, and accessibility with the aim of creating a welcoming environment that encourages social interaction, physical activity, and overall well-being within the community of Dharan. The project includes indoor and outdoor spaces such as courts, fields, tracks, pools, and gyms, equipped with modern amenities and equipment. Additionally, it incorporates meeting spaces, and cafeterias to facilitate community events.

1.2.BACKGROUND

Global Context:

In the Global context, Community Sports Hub has become one of the key elements for the urban development. In the UK, the mid-1970s and early 1980s were a boom time for public leisure services. The community sports hub concept, which integrates health, leisure, sport, and education elements, is being promoted by Sport England as an example of best practices. We can find the best examples of Community Sports Hub in the countries like Singapore, Australia, Brazil, China, Scotland, Canada, Germany, and many more. In such developed countries, Community Sports Hub can be seen as a major tool for community development and has very positive impacts to the people of the community.

*Figure 1**Error! No text of specified style in document.** 1 Singapore Sports Hub, Singapore*

Figure1.2 Pimpama Sports Hub, Australia

National Context:

In the context of Nepal, the concept of Community Sports Hub is not new but it is surely concentrated in the Valley. There are sports infrastructures such as Dasharath Rangashala, Tribhuvan University International Cricket Ground, ANFA football ground and International Sports Complex, that have been hosting national and international level games. Similarly, there are small scale sports and recreational centers that address the need of sports services of the community, but unfortunately, they are not accessible to everyone in the society. Physical activity and sport facilities should not be a privilege but the right of every human being.

Figure1.3 Dasharath Rangashala, Kathmandu

Figure1.4 Tribhuvan University International Cricket Ground

Regional Context:

Dharan has been a sort of sporting hub of Eastern Nepal. From football to basketball and from Karate to adventure sports like paragliding and rafting, Dharan always steals limelight in sporting sector. Dharan also has a good reputation in sports, and is known for its extraordinary athletes and conduction of reputed sports events regularly such as Dharan Run, and Buddha Subba Gold Cup Football Tournament. Dharan, as a growing urban center, lacks comprehensive sports and recreational facilities that cater to the needs of its diverse population. A Sports Hub would address this gap by offering a multipurpose space for various sports, fitness activities, and community events.

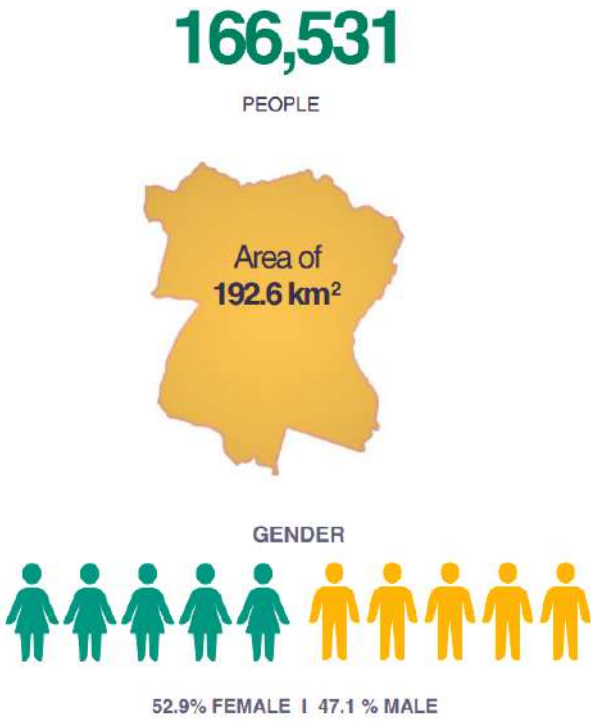
In recent years, Dharan Municipality have built two open gym parks in Dharan for the community. One in B.P.K.I.H.S, Dental Road, Dharan-19 and another in Phusre, Dharan-13. The open gym park, near the B.P.K.I.H.S was visited during the evening time (4p.m.- 6p.m.), for the observation and study purpose. During the visit, the participation of people of different age groups was observed from young kids to adults to elderly. However, one of the big concerns of the park is safety of the users. Since it is an open public place, people were seen smoking nearby the area. Smoking should be prohibited in such spaces to ensure a healthy environment for the users.

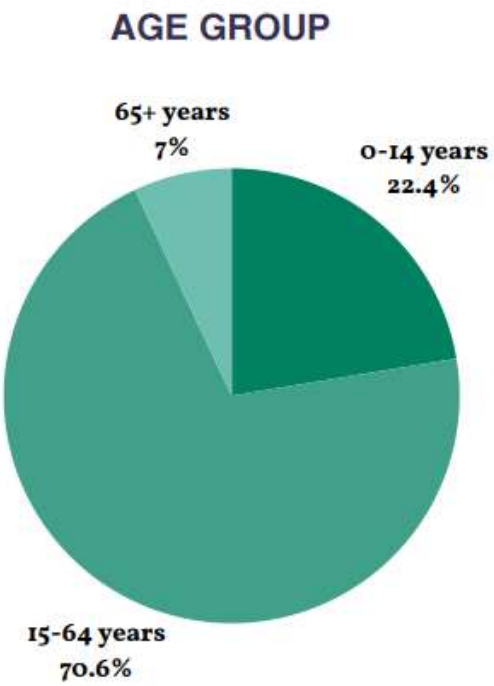
Figure1.5Initiatives of Dharan Municipality: Designing open gym parks on street side for the urban planning development.

1.3.PROJECT JUSTIFICATION

The selection of a Community Sports Hub stems from a profound belief in the transformative power of physical activity and sports. Recognizing the positive impact of such facilities on community well-being, the goal is to create a dynamic space that not only promotes health and fitness but also fosters social connections and a sense of belonging. While personal experience may not be a direct influence, a passion for promoting a healthy and active lifestyle, coupled with an understanding of the vital role community spaces play, motivates the pursuit of this topic. The desire to contribute to the betterment of communities through thoughtful design is a driving force. There are different supporting factors for the justification of the project. They are explained as below:

Demographics: According to census 2011, the total population of Dharan sub-metropolitan city is 166531 in which 52.9 % is female and 49.1% is male. On the basis of age-group, 0-14 years take up 22.4%, 15-64 years take up 70.6%, and 65 + years take up 7%. The preferred sports among the people of Dharan are Football, Basketball, Badminton, Karate and swimming in general.





Secondary Research: Based on the research paper, 'Knowledge and Perception of Physical Activities and Dietary Habits Among Adolescents of Dharan', conducted by the doctors of B.P.K.I.H.S. in 2017, the key findings and implications are as follows:

Key Findings:

- 72.1% Adolescents observe regular physical activity/exercise by their parents for maintaining good health.
- 88.3% Respondents believe that physical activity reduces stress.
- 57% Respondents believe that a balanced meal is important and are practicing healthy dietary habits.

Implications:

- Incorporate Family-friendly Facilities inclusive of young people.
- Design Spaces that promote relaxation, mindfulness, and stress reduction.
- Incorporate Health-Focused Café to promote healthy dietary habits.

BPKIHS, is a Nepalese autonomous health sciences university, that serves the health education needs of the eastern region of Nepal. The Institute comprises four colleges: The Faculty of Medicine, the College of Dental Surgery, the College of Nursing and the School of Public Health and Community Medicine.

The British Gurkha Army, stationed in Dharan, known as "Laure", upholds a rich tradition of loyalty and service. Since one of the selection rounds is held in British Camp of Dharan, recruits from different parts of Eastern region travel to Dharan for intensive trainings to be qualified as a potential British Army.

Dharan Run *Samuha*, founded by Mr. Santosh Rai in 2011, not-for-profit organization, organizes weekly run events for fund raising purpose. Every year, a 10 Km. run event is successfully carried out with active participation of people from Dharan as well as other part of the country.

Raju Kaji Shakya, a Nepalese football manager, Former footballer who captained the Nepal National Football Team, and served as Head Coach of Nepal national football team is from Dharan.

Active participation of the youth of Dharan in sports can be seen in the National Newspaper of Nepal after the construction of a basketball court in 2017.

Education Institutions play a vital role in the project as the students are the prime users. There are over 50 Primary and Higher Education Institute in Dharan.

The relevance to Nepal lies in addressing the growing need for inclusive and accessible recreational spaces. Rapid urbanization and lifestyle changes demand facilities that cater to diverse age groups. By emphasizing inclusivity, the project aligns with Nepal's cultural values of community engagement and physical well-being. The present need in Nepal arises from urbanization trends leading to limited open spaces for recreational activities. Additionally, a rising concern for sedentary lifestyles and related health issues necessitates accessible sports facilities. The Community Sports Hub aims to bridge this gap by providing a year-round space for physical activity regardless of weather conditions. In summary, the project's justification is rooted in the conviction that a Community Sports Hub can be a catalyst for positive change, addressing current societal needs and contributing to the overall well-being of Dharan, Nepal.

1.4.DESIGN APPROACH

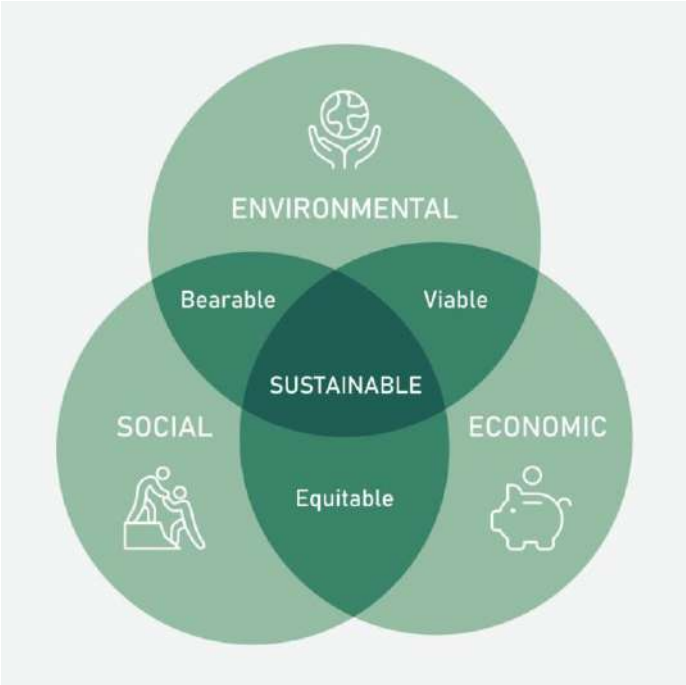
a. Sustainable Design:

Sustainability in architecture refers to the practice of designing and constructing buildings and built environments that minimize negative impacts on the environment, promote social equity and well-being, and ensure economic viability over the long term. It involves considering the interconnections between environmental, social, and economic factors to create spaces that meet the needs of present generations without compromising the ability of future generations to meet their own needs.

Figure1.6 Sustainable Methods

Sustainability is based on three fundamental pillars. The three pillars or key principles of sustainability are

- Environmental sustainability,
- Social sustainability and
- Economic sustainability.



The three pillars of sustainability are explained as below:

- **Environmental Sustainability:** This pillar focuses on minimizing the negative impact of human activities on the natural environment and ecosystems, as well as promoting practices that conserve resources and reduce pollution. Key considerations within environmental sustainability include:
  - Energy efficiency: Designing buildings to minimize energy consumption through passive design strategies, efficient HVAC systems, renewable energy sources, and energy-efficient appliances and lighting.
  - Resource conservation: Efficient use of materials such as Bamboo, water conservation measures, and promoting recycling and reuse of construction materials to reduce waste.
  - Biodiversity preservation: Incorporating green spaces, preserving existing vegetation, and implementing landscaping strategies that support local ecosystems and wildlife habitats.
  - Pollution reduction: Minimizing air and water pollution during construction and operation phases, using non-toxic materials, and implementing waste management strategies to reduce environmental pollution.
- **Social Sustainability:** This pillar focuses on creating built environments that support the well-being, health, and quality of life of individuals and communities, while also promoting equity and social cohesion. Key considerations within social sustainability include:
  - Accessibility and inclusivity: Designing buildings and spaces that are accessible to people of all ages, abilities, and socioeconomic backgrounds, and promoting universal design principles.
  - Community engagement: Involving stakeholders such as Sub-Metro city Government, Local sport clubs, community of Dharan, Sunsari Chamber of Commerce & Industry, etc.in the design process, fostering community participation, and creating spaces that encourage social interaction and cultural exchange.
  - Health and well-being: Designing buildings with good indoor air quality, natural daylighting, thermal comfort, and access to green spaces to support physical and mental health.

- **Economic Sustainability:** This pillar focuses on creating built environments that are financially viable over the long term, balancing economic considerations with social and environmental goals. Key considerations within economic sustainability include:
  - Public Private Partnership (PPP) Approach: As per Mr. Suraj Shrestha, the Planning and Engineering Division Chief of Dharan Sub-Metropolitan City, "the role of private sector is inevitable for development activities in the current society" PPP investment plans can be proposed such as:
    - ✓ Government-managed land development for private sector services, facility development and operation.
    - ✓ Ownership sharing at 80-20 ratio.
    - ✓ Lease of open public spaces for park or café development.
    - ✓ Incentives such as 10% tax exemption for private sector.
  - Resilience and adaptability: Designing buildings and infrastructure that are resilient to natural and man-made hazards, such as extreme weather events and economic downturns, and incorporating flexibility and adaptability to accommodate future changes in use or occupancy.
  - Local economic development: Supporting local economies through the use of locally sourced materials, local labor, and investments in community infrastructure and amenities that contribute to economic growth and prosperity.

By integrating these three pillars of sustainability into architectural design and planning processes, we can create built environments that are environmentally responsible, socially equitable, and economically viable, thereby contributing to the long-term health, resilience, and well-being of individuals, communities, and the planet.

b. Wellness Integration:

Wellness is the daily practice of healthy habits in order to achieve improved physical and mental health results. Understanding the importance of wellbeing requires an understanding of how it relates to health. World Health Organization (WHO) defines Health as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity(illness)." Similarly, WHO defines wellness as "the optimal state of health of individuals and groups", and wellness is expressed as 'a positive approach to living'.

Wellness is a multidimensional concept that encompasses:

- Physical: Maintaining a healthy body through exercise, nutrition, and sleep.
- Mental: Maintaining a healthy state of mind and connecting with the world through education, creativity, and problem-solving.
- Emotional: Being aware of, accepting and expressing our feelings, as well as understanding the feelings of others.
- Social: Connecting and Engaging with the people and the community in meaningful ways.
- Spiritual well-being: Searching for meaning and a higher purpose in human life.
- Environmental: Creating positive interactions between environmental health and human activities, actions, and well-being.

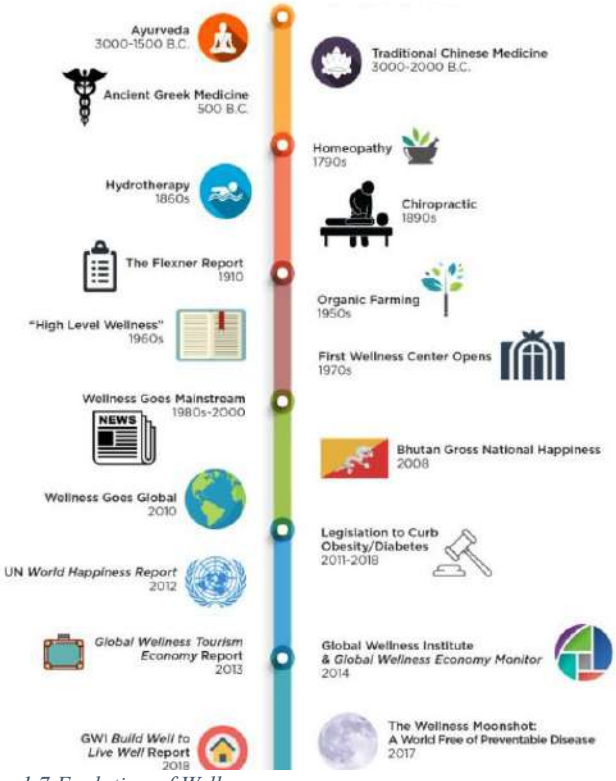


Figure 1.7 Evolution of Wellness

1.5.PROJECT OBJECTIVES

a. To create Inclusive Spatial Design:

Create an architectural design that prioritizes inclusivity, ensuring that the Community Sports Hub caters to a diverse range of users, including different age groups, abilities, and interests, fostering physical activity and sportsmanship.

Approach:

- **Adaptable Spaces:** Design a multipurpose court that can host various sport events, encouraging a diverse range of physical activities and promoting sportsmanship.
- **Universal Accessibility:** Incorporate ramps and accessible pathways to ensure that individuals of all abilities can participate in sports and wellness activities, fostering an inclusive environment.
- **Age-Appropriate Zones:** Develop designated areas for specific age groups, such as a youth sports area and a senior-friendly wellness zone, encouraging community members to engage in age-appropriate physical activities.

b. To promote Connectivity and Social Interaction:

Foster connections and social interactions through thoughtful architectural elements, promoting a sense of community well-being within the sports complex.

Approach:

- **Communal Spaces:** Integrate communal areas strategically, such as outdoor seating areas and gathering spaces, promoting social interaction and community well-being after sports activities.
- **Transparent Facades:** Use transparent materials in communal spaces to maintain visual connections and create a welcoming atmosphere, fostering a sense of community well-being.
- **Café/Rest Areas:** Design a café or rest areas as central meeting points where community members can socialize, share experiences, and contribute to overall community well-being.

c. To Integrate Holistic Well-being:

Prioritize the well-being of users by seamlessly integrating fitness facilities and wellness spaces into the architectural design, fostering physical activity, sportsmanship, and community well-being.

Approach:

- **Green Wellness Zones:** Integrate green spaces strategically, creating wellness zones with features like outdoor yoga decks and meditation areas, promoting overall well-being.
- **Fitness Hub:** Design a fitness hub as a central feature with interconnected spaces for gym facilities, group exercises, and wellness workshops, encouraging physical activity and fostering a sense of sportsmanship.
- **Natural Light and Ventilation:** Prioritize natural light and ventilation in wellness spaces, enhancing the indoor environment for physical activities and contributing to the overall well-being of community members.

By aligning architectural and design objectives with the project's overarching goals of fostering physical activity, sportsmanship, and community well-being, the Community Sports Hub becomes a holistic and inclusive environment that positively impacts the residents of Dharan.

1.6.SCOPE AND LIMITATION

Scope

a. Research Areas:

- Site analysis of the chosen location in Dharan, considering topography, climate, and local amenities.
- User behavior studies to understand community preferences and needs regarding sports and recreational activities.
- Investigation into sustainable architectural solutions for minimizing environmental impact.

b. Program/Space:

- Design versatile spaces accommodating various sports and recreational activities, including wellness zones and community engagement areas.
- Multi-Sport Courts, Indoor Swimming Pool, Wellness Zones, Communal Area, Cafe, Administration Block, Bathroom, Changing Room and Parking.

c. Deliverables:

- Architectural drawings, including site plans, floor plans, and elevations.
- Physical or digital models representing the proposed design.
- Comprehensive research report detailing site analysis, user behavior findings, and design rationale.

d. Stakeholders:

- Community members in Dharan.
- Local authorities and government bodies.
- Potential users and sports enthusiasts.

Limitations

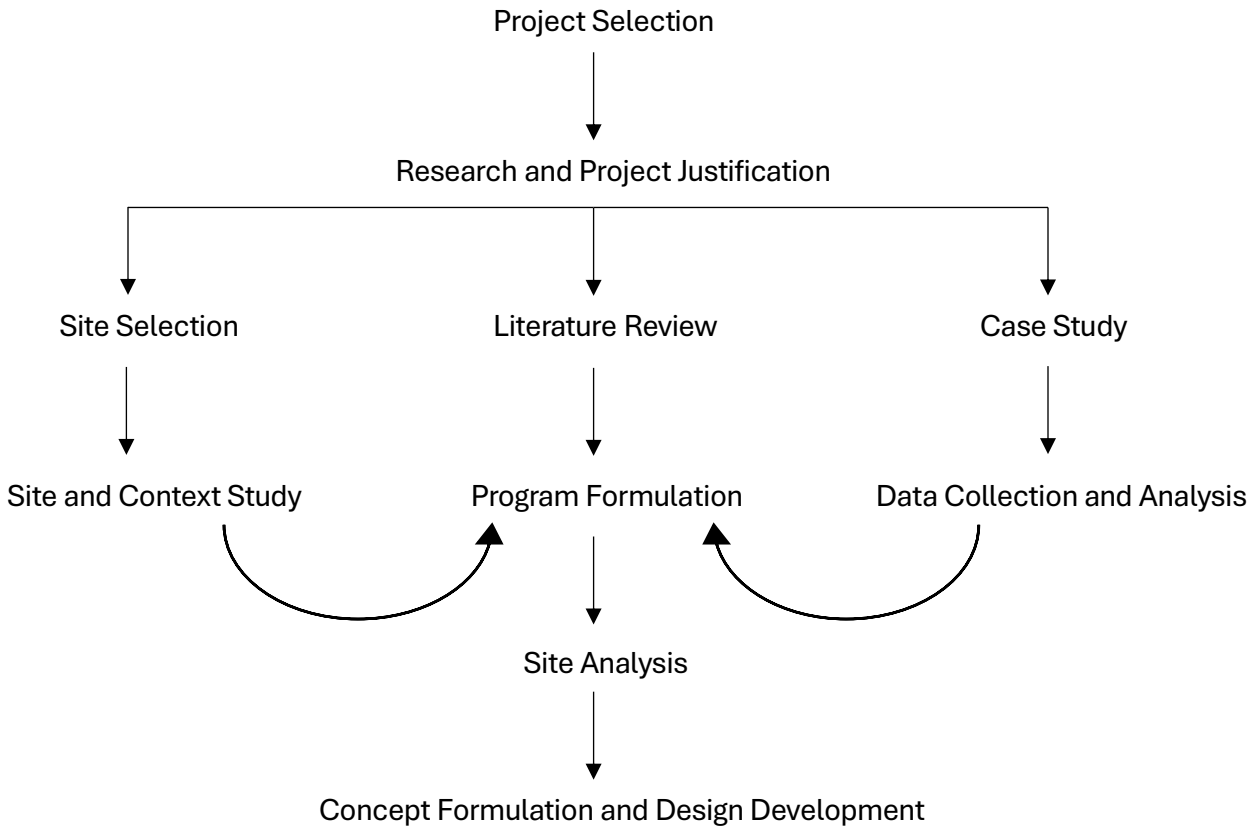
a. Site-Specific Constraints: Limited site size and potential zoning restrictions may influence the scale and layout of the sports complex.

b. Environmental Factors: Adapting the design to address local climate challenges, such as extreme temperatures or heavy rainfall.

c. Community Input: The level of community involvement and acceptance may influence the implementation of certain design elements and features.

d. Availability of Data: Data accessibility for research and analysis may be limited, impacting the depth of certain aspects of the project.

1.7.METHODOLOGY



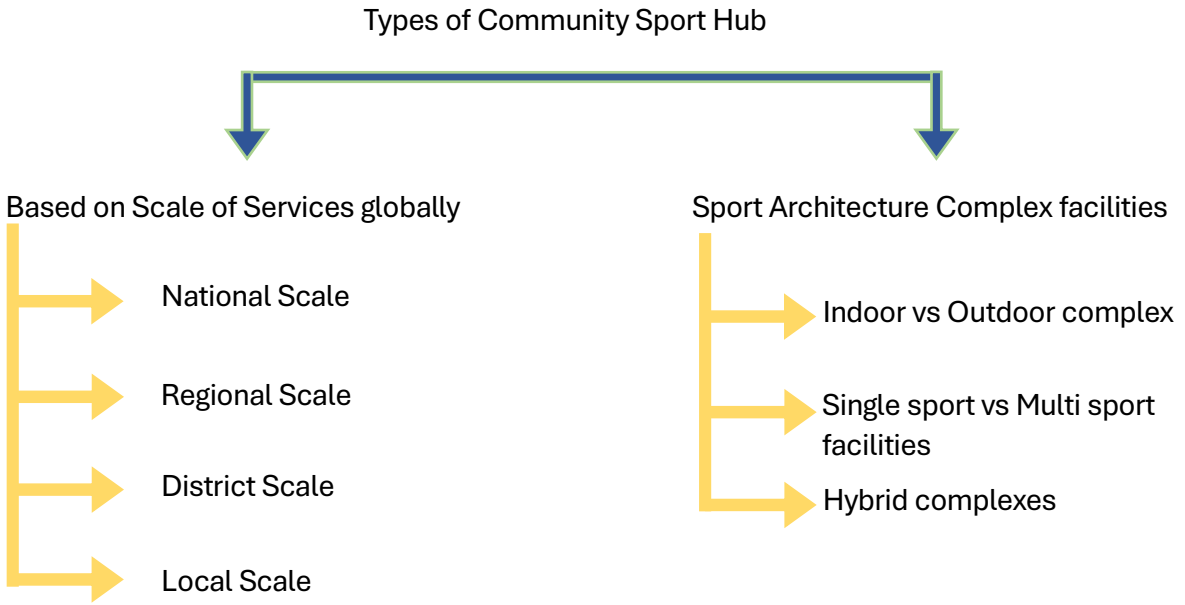
CHAPTER
02.

LITERATURE REVIEW
Community Sports Hub in Dharan, Eastern Nepal

A literature review refers to a comprehensive examination and analysis of existing academic works, research studies, design precedents, and relevant theoretical frameworks related to a specific topic or aspect of architectural design. It serves as a critical component of the design process, in gaining a thorough understanding of the historical, theoretical, and practical dimensions of the project's context. This chapter includes key understanding of types of Community Sports Hub, value of Community Sports Infrastructure, scenario of Dharan sports venue, community sports interest survey in Dharan, general planning requirement and dimensions and sustainable design materials as well. A series of standards, relevant references, books, articles, research papers are studied as well as a survey is conducted to explore the different facts for my thesis project. They are explained below:

2.1. TYPOLOGY OF COMMUNITY SPORTS HUB

Community Sports Hub can be categorized into two types on the basis of scale of services globally and facilities provided in the sports complex.



2.1.1. Based on Scale of services globally

The followings are the list of types of community sports hub on the basis of scale of services globally.

- **National scale:** These facilities accommodate or service activities including major competitions, training, and teaching with international standards.
- **Regional scale:** Serve one or several regions with a population of 200,000 - 350,000 residents.
- **District scale:** Serve residential neighborhoods with a population of 2,000 - 10,000 people & are provided in a housing complex as a complimentary facility.
- **Local scale:** Serves sports in a school, usually in the form of a hall, versatile space and is used for standard exercise only.

2.1.2. Based on Sports Complex Architecture and Facilities

- **Indoor vs Outdoor complex:** One of the primary concerns in sports complex design is whether the facility will be indoors or outdoors. Indoor complexes provide year-round use and protection from the elements, making them perfect for a variety of activities. Outdoor complexes, on the other hand, appreciate the natural environment and frequently cater to sports that require large fields.
- **Single sport vs Multi sport facility:** The decision between single-sport and multi-sport facilities is based on the community's requirements and preferences. Single-sport facilities are designed to accommodate certain activities and offer specialized infrastructure. Multi-sport facilities, on the other hand, cater to a wide range of interests, encouraging inclusivity and a greater feeling of community involvement.
- **Hybrid complexes:** In recent years, there has been a trend towards developing hybrid sports facilities that incorporate indoor and outdoor venues while also accommodating a variety of activities. This method ensures flexibility and adaptation, allowing the complex to evolve to meet the community's evolving demands.

2.2. VALUE OF COMMUNITY SPORTS INFRASTRUCTURE

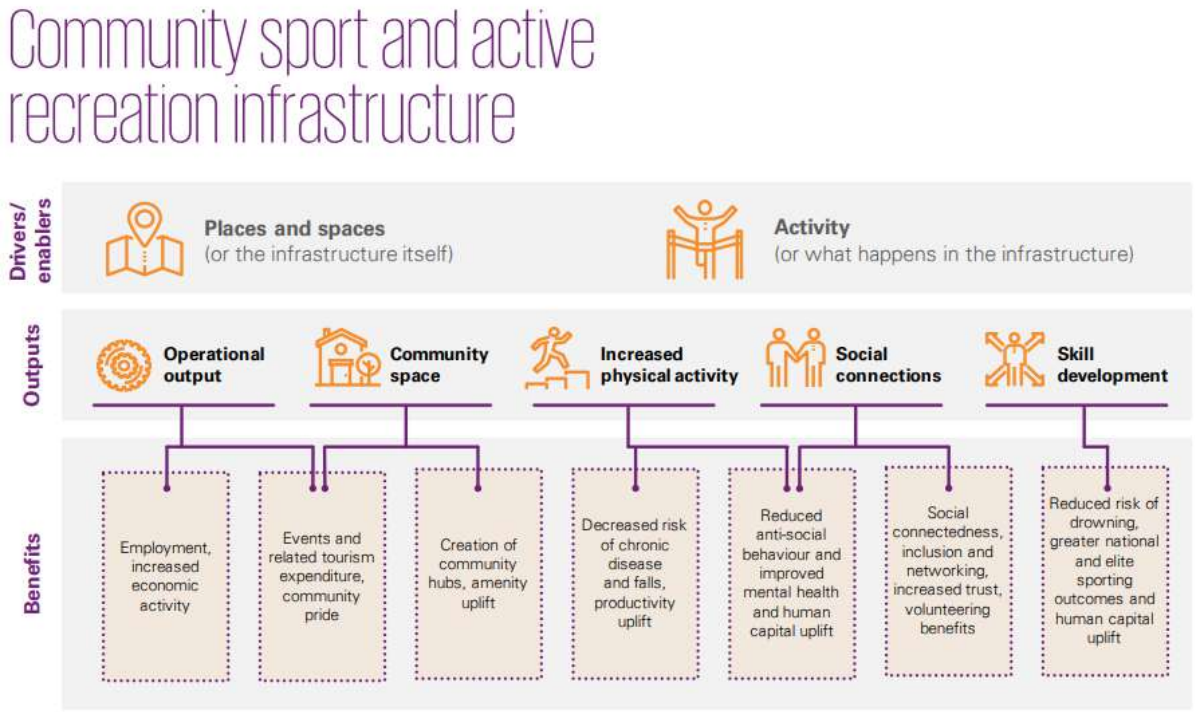
KMPG International Limited is a multinational professional services network and one of the big four accounting organizations. It is a global network of professionals who deliver meaningful results through a deep understanding of the issues and operations of the public sector.

A report on the study of Value of Community Sports Infrastructure in Victoria, Australia was published by KMPG in 2020. The report delves into the multifaceted benefits of community sport infrastructure, emphasizing its role beyond merely providing spaces for physical activity. It highlights that these facilities serve as essential hubs for social interaction, health promotion, and community cohesion. The research underscores the economic value generated by such infrastructure, both in terms of direct financial contributions and broader socio-economic advantages.

According to KMPG, 2020 study in Victoria, Australia the key findings include:

- **Social Cohesion:** Community sports hubs act as focal points for social interaction, fostering a sense of belonging and community cohesion. They offer spaces where people from diverse backgrounds come together, forging connections and building social networks.
- **Health and Well-being:** These facilities play a vital role in promoting physical activity and healthy lifestyles. They provide accessible spaces for exercise and recreational activities, contributing to improved public health outcomes and reduced healthcare costs.
- **Economic Impact:** The report highlights the economic benefits generated by community sport infrastructure. Beyond direct revenue streams, such as membership fees and facility rentals, these hubs stimulate local economies through increased tourism, job creation, and enhanced property values.
- **Youth Development:** Community sports hubs offer valuable opportunities for youth development, providing access to structured sports programs, mentorship, and leadership opportunities. They serve as platforms for skill development, personal growth, and community engagement among young people.

- **Inclusivity and Accessibility:** Ensuring inclusivity and accessibility is crucial for maximizing the impact of community sports hubs. The report emphasizes the importance of designing facilities that cater to diverse needs and interests, including provisions for people with disabilities and marginalized communities.



Overall, the study underscores the integral role of community sport infrastructure in fostering social, economic, and health-related benefits. It advocates for continued investment in these facilities as a means of promoting community well-being and prosperity.

Figure 2. 1Benefits of Community Sport and active recreation infrastructure, according to KMPG.

2.3.PRESENT SCENARIO OF SPORT VENUES IN DHARAN

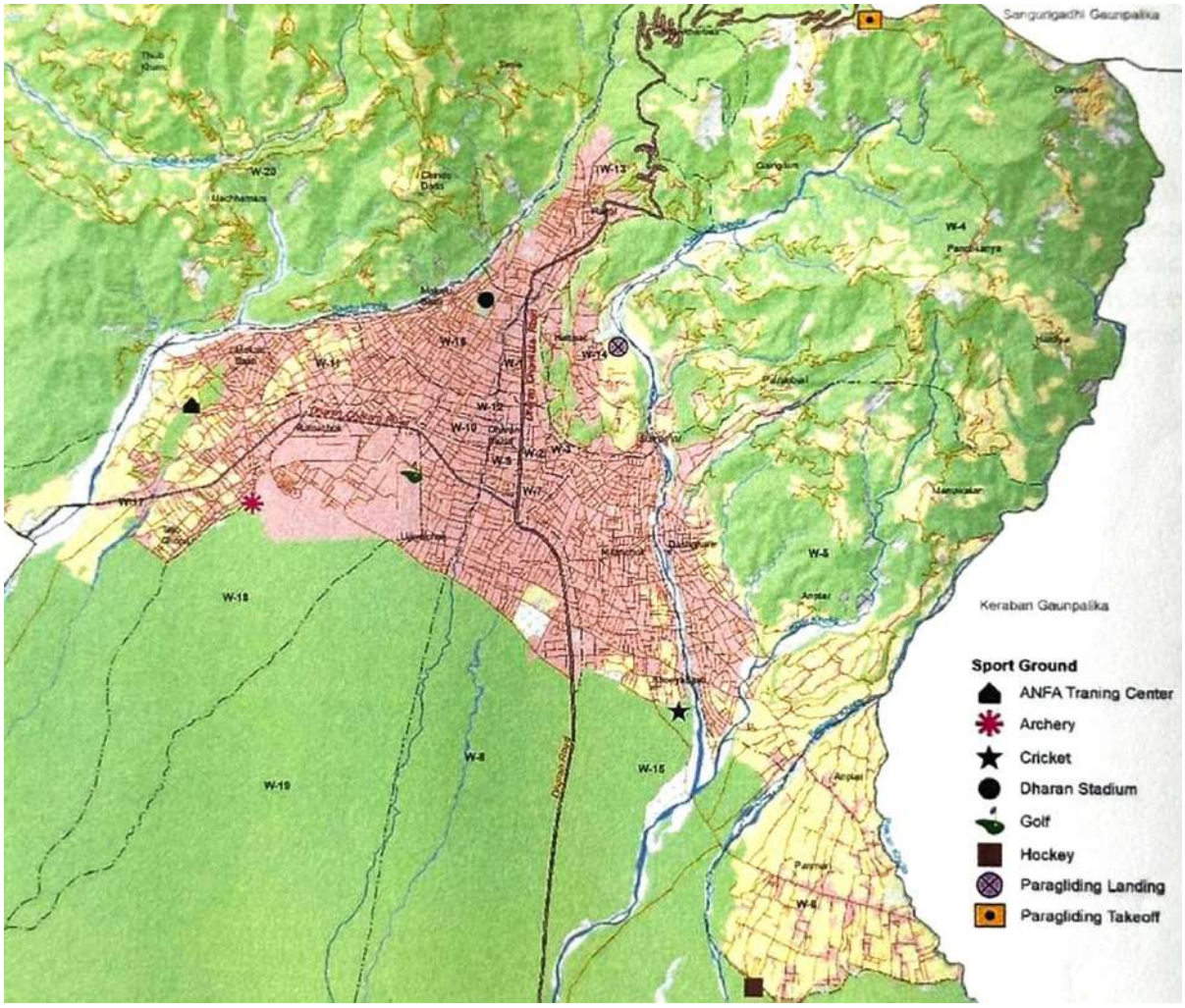


Figure 2. 2Map of Dharan, indicating the existing sport venues.

There are sports venues set aside for Football, Cricket, Golf, Archery, and Hockey in Dharan Sub-metropolitan city. Dharan Stadium, Golf Course, ANFA training ground, Cricket ground, Archery Arena and Hockey ground are the major sport venues. Among them, Archery Arena and Hockey ground are currently closed. Adventure sports like Paragliding and Zipline are also in operation from Bhedetar. National Sport Council takes the management responsibility of Dharan Stadium.

Dharan Stadium
Location: Jana path, Dharan-16
Total Area: 32,000 sq. m.

Figure 2. 3 Images of Dharan Stadium

ANFA Training Academy
Location: Dharan-17
Total Area: 11,300 sq. m.

Figure 2. 4 Images of ANFA Training Academy

Cricket Stadium
Location: Bhanu Marg,
Dharan-17
Total Area: 26798.88 sq. m.

Figure 2. 5Images of Cricket Stadium, Dharan

Golf Course
Location: B.P.K.I.H.S. complex, Dharan-17
Total Area: 186,726.4 sq. km

Figure 2. 6 Images of Golf course, Dharan

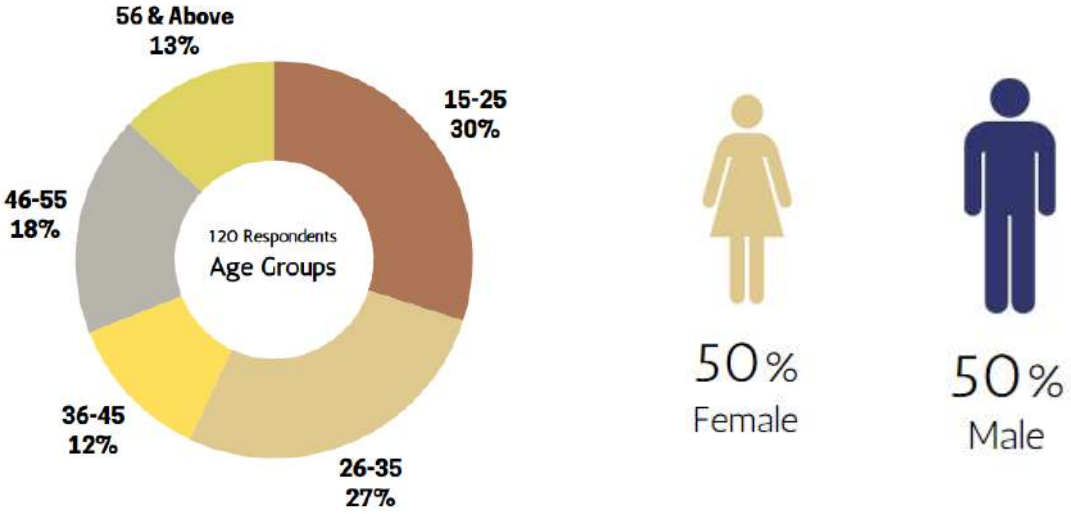
2.4. COMMUNITY SPORTS

2.4. SPORTS INTEREST SURVEY IN DHARAN

A survey was conducted in Dharan to understand residents' views on sports and physical activities. Using both online platforms & paper surveys between February 25 & 29 2024, respondents rated statements on sports importance, facility accessibility, engagement frequency, activity choice factors, and community sports interest, providing additional comments.

2.4.1. Demographic Overview:

There was a total of 120 respondents, among which 50% were female and 50% were male. Similarly, on the basis of age group, 30% were from 15-25 age group, 27% were from 26-35 age group, 12% were from 36-45 age group, 18% were from 46-55 age group and 13% were from 56 age and above.



2.4.2. Frequency of Engagement in Physical Activity:

Respondents were asked that how frequent do they engage in physical activity in general. To which the findings were as follows:

- 33% engage in sport and physical activities for 5 or more times a week.
- 38% engage in sport and physical activities for 3-4 times a week.
- 22% engage in sport and physical activities for 1-2 times a week.
- 7 % engage in sport and physical activities for less than once a week.

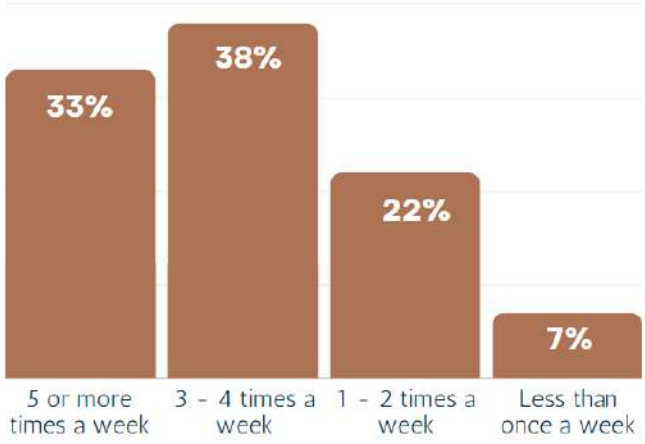


Figure 2. 7Percentage of respondents engaged in sport activities

2.4.3. Key Perceptual Findings

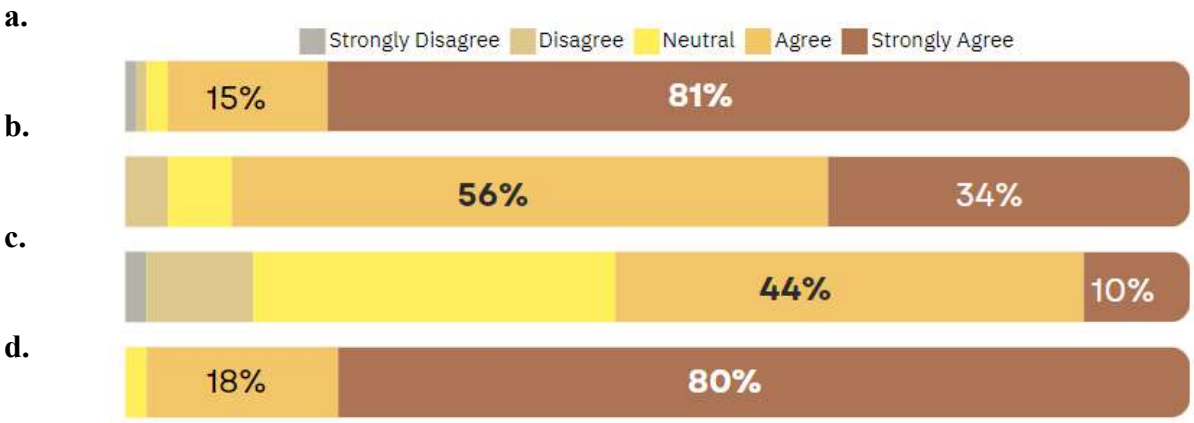
The respondents were asked to indicate their level of agreement with the following statements on a scale of 1 to 5, where 1 is strongly disagree and 5 is strongly agree:

a. Participating in sports & physical activity is important for overall health and well-being.

b. Well maintained sports facilities are easily accessible in Dharan.

c. There is enough awareness about the benefits of sports & physical activity in the community.

d. Community Sports initiatives can positively impact social cohesion & community spirit.



2.4.4 Sports preference by Age:

Maximum respondents preferred sport activities like Running/Jogging, Badminton and Swimming from all age group.

SPORTS/ AGE	15-25	26-35	36-45	46-55	56 Abv
FOOTBALL	✓	✓	✓		
BASKETBALL	✓				
SWIMMING	✓	✓	✓	✓	
RUNNING/ JOGGING	✓	✓	✓	✓	
GYM/ FITNESS	✓	✓	✓		
YOGA			✓	✓	✓
BADMINTON	✓	✓	✓	✓	
CRICKET	✓	✓	✓		
MARTIAL ARTS	✓				
CYCLING	✓	✓	✓		

Figure 2. 8 Sports preference by Age

2.4.5 Sports preference by Gender:

Sports activities like Basketball, Swimming, Running/Jogging, Gym and Fitness, Yoga, and Badminton were preferred by both genders.

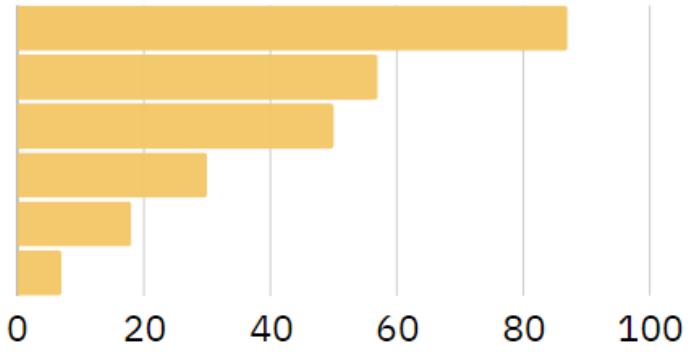
SPORTS/ GENDER	MALE	FEMALE
FOOTBALL	✓	
BASKETBALL	✓	✓
SWIMMING	✓	✓
RUNNING/ JOGGING	✓	✓
GYM/ FITNESS	✓	✓
YOGA	✓	✓
BADMINTON	✓	✓
CRICKET	✓	
MARTIAL ARTS	✓	
CYCLING	✓	

Figure 2. 9 Sports preference by Gender

2.4.6 Factors Influencing Sports Engagement

Upon asking the respondents, the factors that influence their choice of sports or physical activities, the following result was obtained:

- Health Benefits
- Personal Interest
- Availability of Facilities
- Social Aspect
- Accessibility
- Cultural Significance



2.4.7 Desired Facilities in Community Sports Hub

The respondents were asked, if a Community Sports Hub were to be established in Dharan, what facilities would they like to see. Their responses are listed below:

- Variety of Sports
- Multipurpose Hall
- Indoor Swimming Pool
- Open Playground/ Green Park/ Garden/ Meditation Space
- Clean Bathroom/ Changing Room
- Healthy Restaurant/ Cafe
- Training Coaches
- Recreational Activities (Archery, Wall Climbing)

2.4.8 Perceived Benefits of Community Sports Hub

The followings are the perceived benefits of Community Sports Hub in Dharan:

- Physical & Mental Well-being
- Increased Social Interaction & Unity
- Youth Development
- Community Pride/ Touristic Attraction
- Economic Benefits

2.4.9 Additional Comments/ Suggestions

The respondents were asked to share their thoughts and mention their additional comments and suggestion regarding the project. The following are the list of additional comments/suggestions:

- Well-maintained & Structured for Long Term
- Safe Playing Environment
- Center Area for Easy Access
- Unique Design can be an attraction
- Age & Gender friendly for increased participation of people

2.5. GENERAL PLANNING REQUIREMENT

2.5.1 Location

- In relation to the town planning, sports ground must fit well with local topography.
- Connection to existing community assets. Creating transportation linkages to other community resources such as schools and more will encourage participation at the new development.
- Creating a site that is safe, easy to use and navigate.

2.5.2 Orientation

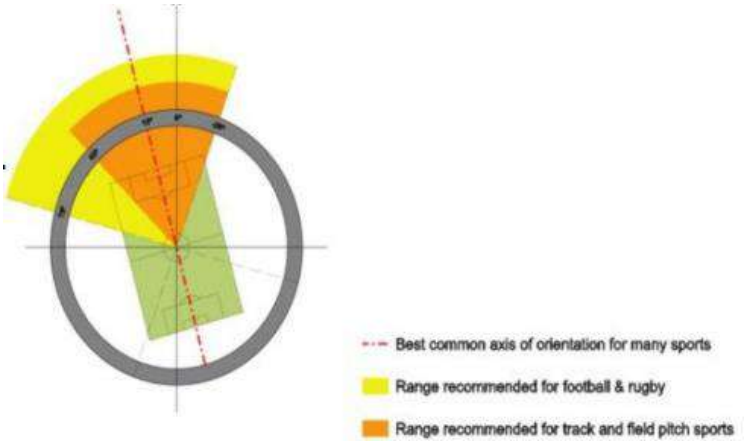


Figure 2. 10 Field play of orientation

Great care must be taken regarding the angle of the playing field in relation to the sun and the prevailing weather conditions. Playing field should be oriented North-West to South-East to protect from the direct glare to the players.

2.5.3 Zoning

The next priority is to plan the position of stadium on the site and to plan the interrelationship of its major parts and identifying the five zones which make up the safety plan. The size and location of these zones are critical to the performance of the stadium in an emergency, and they are:

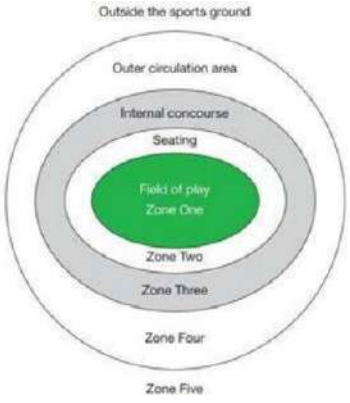


Figure 2. 11 Safety Zone

- Zone One: Outside the sports ground
- Zone one: The playing field.
- Zone two: The spectator seating and standing areas.
- Zone three: The internal concourses, restaurants, bars, etc.
- Zone four: The circulation area between the stadium structure and the perimeter fence.
- Zone five: The open space outside the perimeter fence

2.5.4 Space Requirement Study

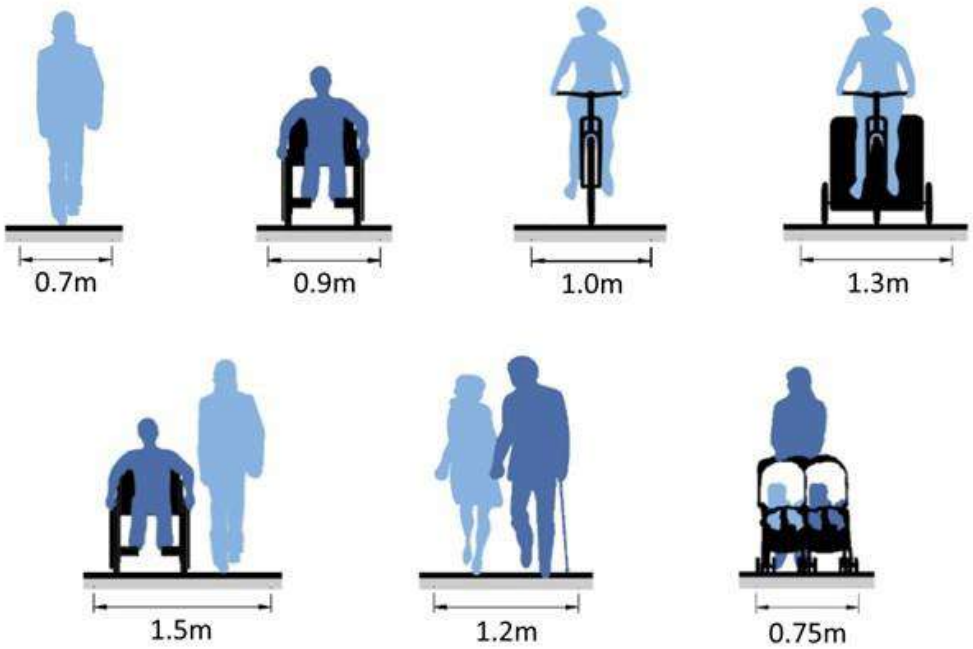


Figure 2. 12 Space requirement study

2.5.5 Seating safety and Viewing angles/ sightlines

The absolutely essential requirement is to maintain a clear seat way to allow the movement of spectators along the seat row. The minimum recommended dimension is 400mm and this may be reduced to 305mm where there are only 7 seats in a row served by a gangway on one side, or 14 seats where there is a gangway on both sides. The bigger the seat way the better and there are many factors to be considered. They are:

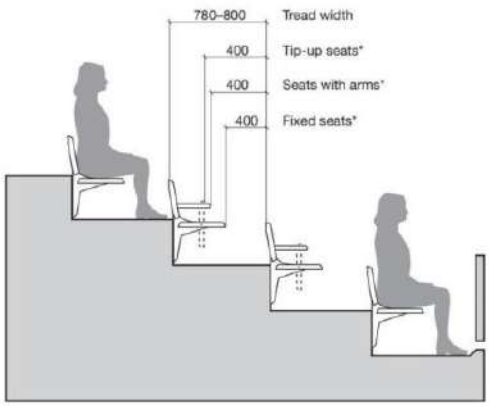


Figure 2. 13 Seating safety

- Police and stewards may be required to physically remove a spectator. The greater the likelihood of unruliness in the crowd, the more important a wide seaway becomes.
- First-aid personnel may be required to carry out a spectator who is unwell.
- Cleaners may have to move along the rows, often with large garbage sacks.
- Wider seat ways allow spectators to get out and buy from the concessions more easily.

With the advent of all - seater stadiums the standard of view to be achieved has become much more important, in that the spectator should not feel the need to stand at key stages in the game to get a satisfactory view of the action. This is established by means of the sight-line calculation, which would generate a typical profile for the seating tier.

The factors affecting the calculation of the riser height (N) for the seating tier are:

N= riser height

R = height between eye and the 'point of focus' (The point of focus is often the near touchline)

D = horizontal distance from the eye to point of

C = 'C value (standard of view)

T = depth of seating row

(The Guide to Safety at Sports Grounds, published by The Stationery Office, outlines minimum requirements for seat widths and seating row depths).

A worked example to calculate the required riser height for a given 'C' value is given below, using the expression: on the playing field focus Y.

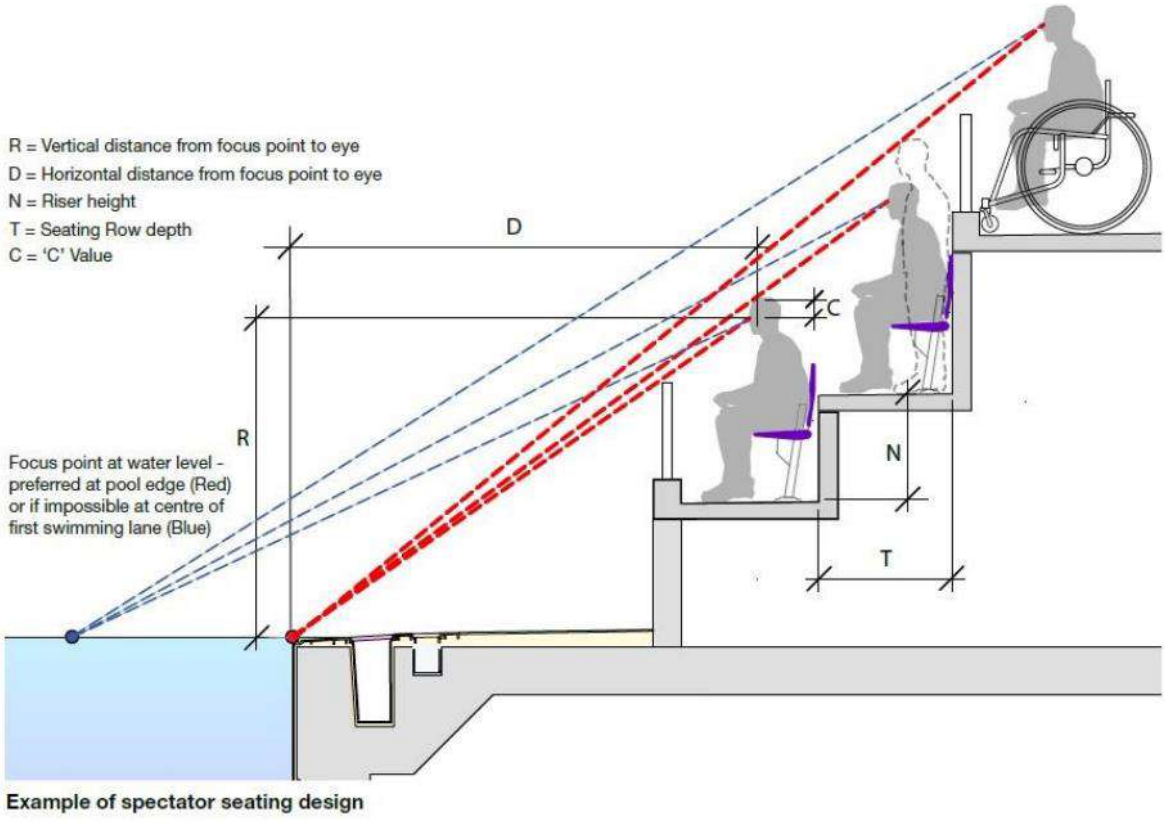


Figure 2. 14 Viewing angle standards

2.5.6 Parking

Parking lots and safe circulation is very important part of any public building like. The possible types of parking that can be given are Basement parking, surface parking and multi-story or parking towers. For this proper planning and design should be done for parking, safe circulation and safe entrance and exit. Here is the different planning for the parking and safe circulation.

- **Straight Parking:**

This type of parking is suitable two ways traffic and large no of vehicles can be accommodated in same length as compared to other types of parking. Parking bays are perpendicular to circulation road.

- **Angled Parking:**

This type of parking is suitable for one way traffic which has separate entrance/exit. It reduces the width of the parking lots as the vehicles are placed in angle. The parking bays are inclined in 30, 45, 60, 90 degrees.

- **Oblique Parking:**

This type of parking is suitable for two-way traffic and separate entrance/exit. It is also an inclined parking.

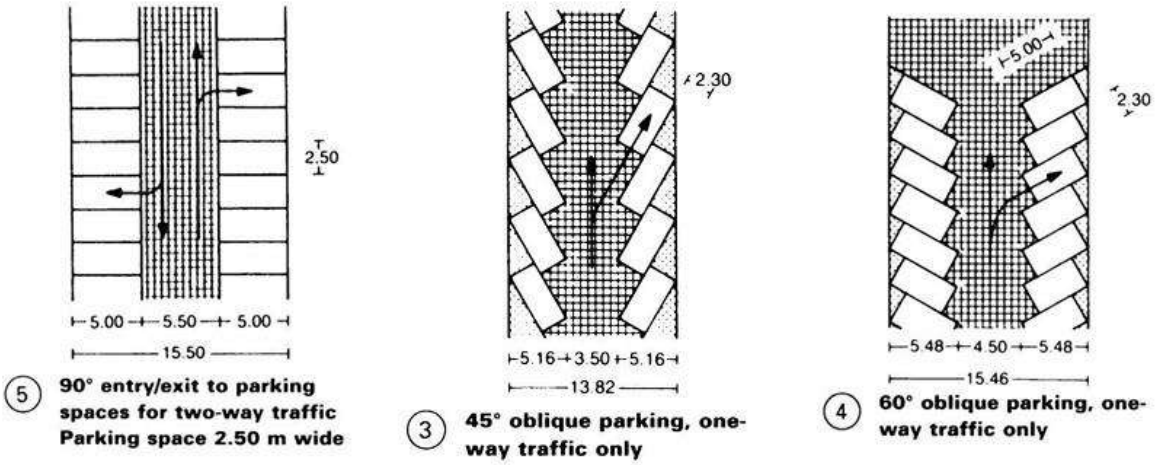


Figure 2. 15 Types of parking

Spectators with disabilities:

Recommendation of at least 6 per cent, but possibly more, of the total car parking capacity should be allocated to disabled people. In other countries local codes should be checked. In the absence of more specific requirements 1 per cent of car parking spaces may be an acceptable

ratio. In all cases these should be the spaces closest to the entrance gates, with easy access to ramped pedestrian routes.

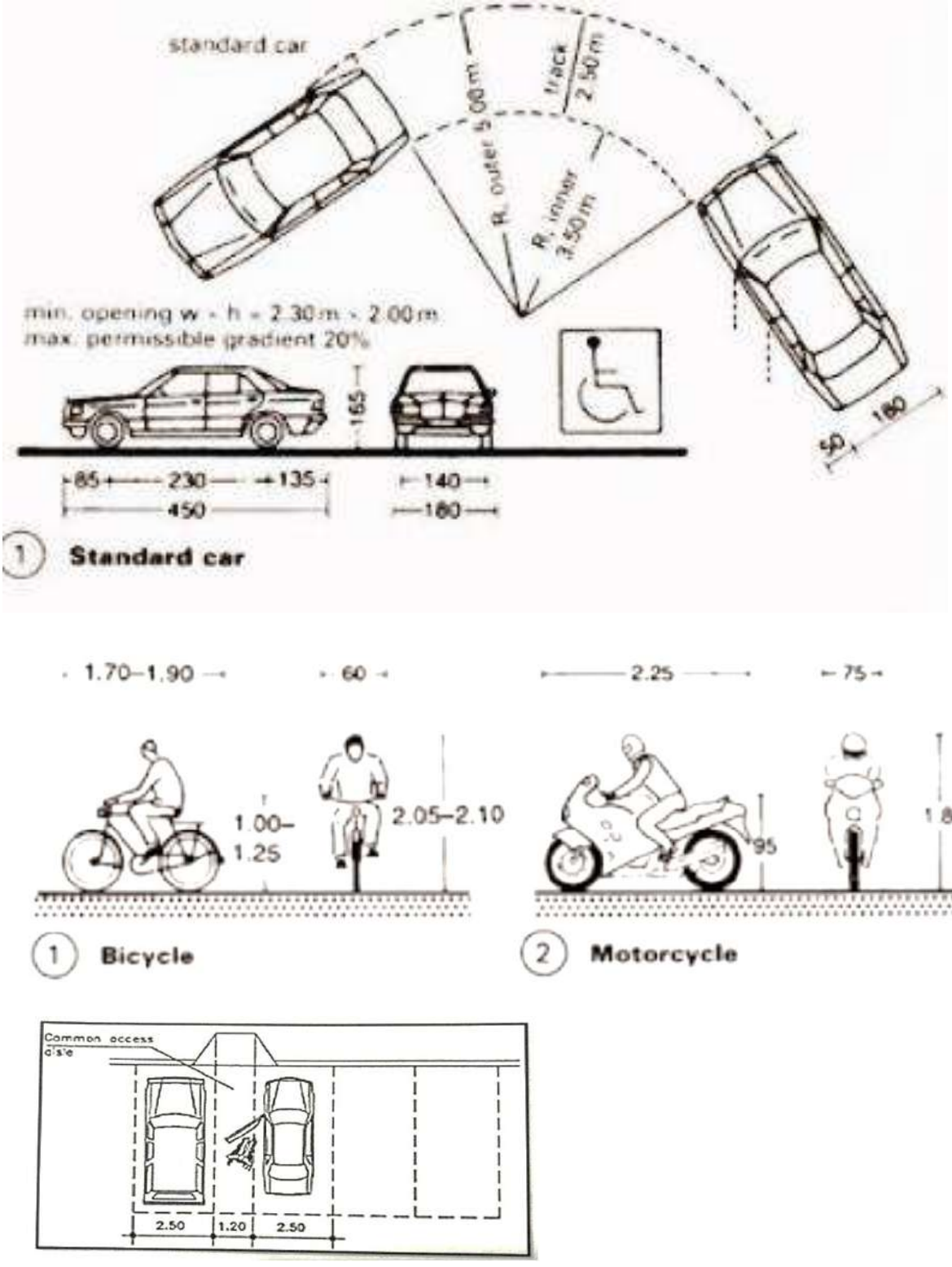


Figure 2. 16 Images showing parking standards

2.5.7 Planning for Disabled group of people

- **Ramps:**

An exterior location is preferred for ramps. Indoor ramps are not recommended because they take up a great deal of space. Ideally, the entrance to a ramp should be immediately adjacent to the stairs.

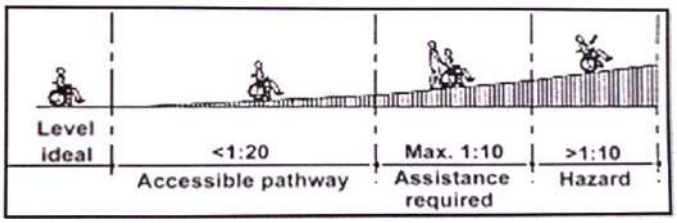


Figure 2. 17 Standard design for ramps

- **Elevators:**

The accessible elevator should serve all floors normally reached by the public. Key-operated elevators should be used only in private facilities or when an elevator is present. Wide elevator cabs are preferable to long ones.

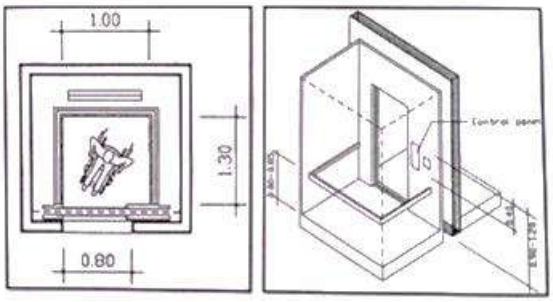


Figure 2. 18 Standard design for elevators

- **Corridors:**

Wide corridors are useful for wheelchair users, service equipment, high traffic areas etc. Changes in surface level of more than 13mm should be ramped. Floor surfaces should be non-slip and even. Carpets should be securely fastened.

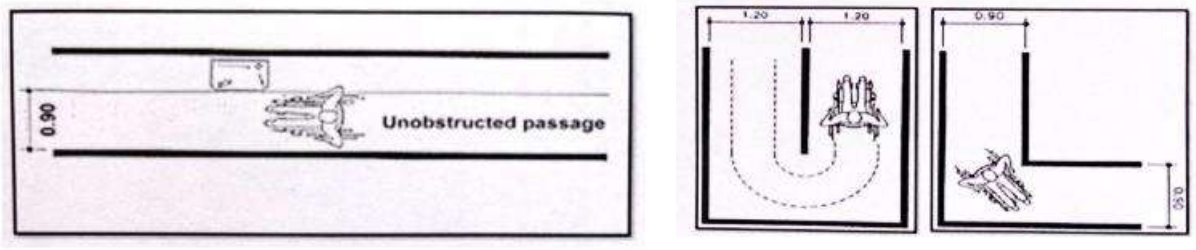


Figure 2. 19 Standard design for corridors

- **Rest room:**

Turning circles of 1.50 m diameter are recommended inside the rest room to allow for full turn maneuvering of a wheelchair

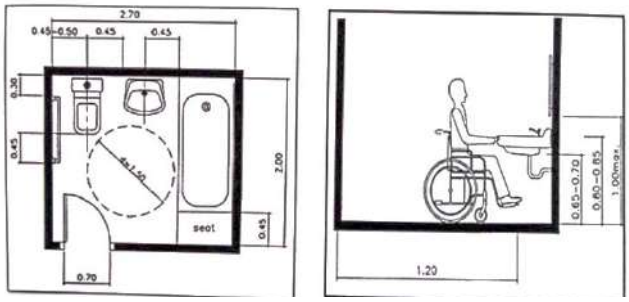


Figure 2. 20 Standard design for rest room

2.6. DIMENSIONS AND STANDARDS OF SPORT COURTS

The following are the list of games with area recommendation, area orientation and finish material:

1. Badminton: 5.2m X 13.4m (Single)

6m X 13.4m (Double) 1620 sq. ft, North – South, Concrete or bituminous materials

5. Basketball: 28m X 15m 640 sq. m, North – South, Wooden floor or concrete finish

2.6.1 Badminton court

Badminton is an outdoor/ indoor racquet game played by one or two players opposing an equivalent number across a net.

- **Court dimensions:** The court is a rectangle and can be used for both singles and doubles. The court size for singles is 13.4m × 5.18m (playing area = 69.41m2 including boundary lines) and 13.4m x6.1m (playing area = 81.74m2 including boundary lines). The lines are 40mm wide and colored white or yellow. It is desirable to have a wooden sprung floor together with approved non-slip court mats.
- **Space about court:** There is at least 2m clear space surrounding all the outer lines of the courts. There is also a minimum requirement of 2m between any two courts marked out side by side. The standard size is that of a double court, although a single court can be used where space is severely restricted.
- **Outside the court area:**

The appropriate measurements are:

Safety strip (sides) 1.25m

Safety strip (front and rear) 2.5m

Side-to-side distance between courts >=0.3m

End-to-end distance between courts >=1.3m

Between courts and walls >=1.5m

Spectators must always be accommodated behind the safety strip. For international competitions, the minimum hall height is 8m, with at least 6m over the back line of the court.

- **Flooring material:**
- The floor should be lightly sprung.
- Indoor: PVC flooring, wooden flooring.

- Outdoor: the rebound Ace synthetic material can be applied on asphalt or concrete base.

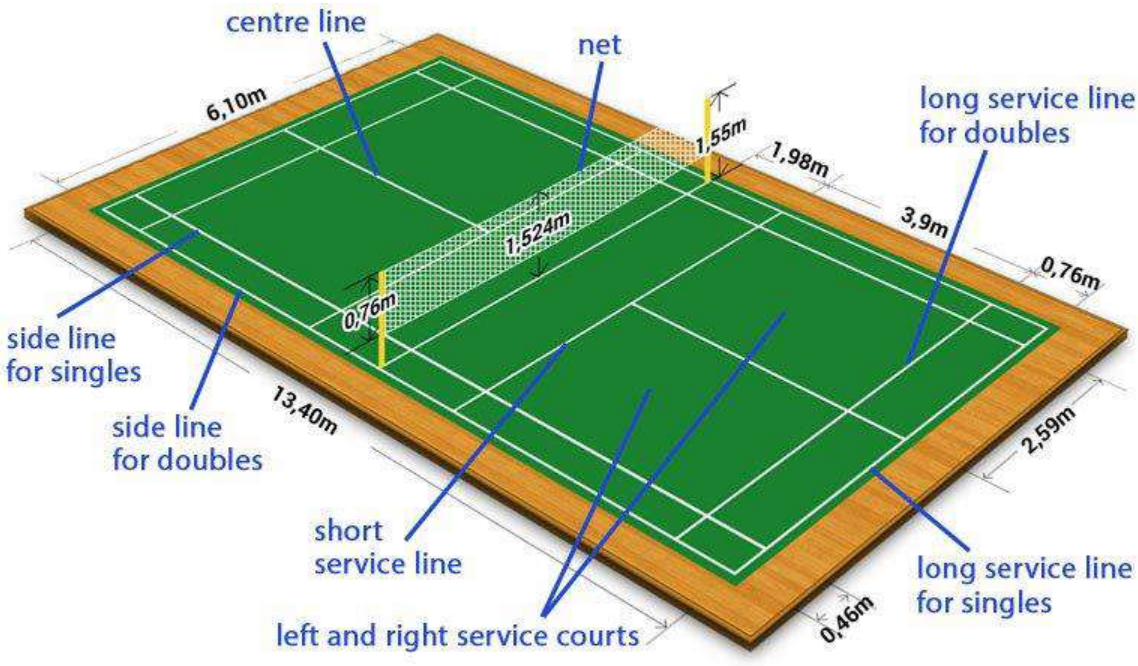


Figure 2. 21 Badminton Court Dimensions

2.6.2 Basketball Court

Basketball is played by two teams of five players each. The aim of each team is to score in the opponent's basket and to prevent the other team from scoring.

- **Court dimensions:** The playing court is a flat, hard surface free from obstructions with dimensions of 28m long by 15m wide, measured from the inside edge of the boundary line. A team's backcourt is the team's own basket, the inbounds part of the backboard and the part of the playing court limited by the end line behind the team's own basket side lines and center line. A team's frontcourt consists of the opponents' basket, the inbounds part of the backboard and part of the playing court limited by the end line behind the opponents' basket, side lines and inner edge of the center line nearest to the opponents' basket. The height of the ceiling or the lowest obstruction above the playing floor is at least 7m.

Flooring material:

In professional or organized basketball, especially when played indoors, it is usually made out of a wood, often maple, and highly polished. Outdoor surfaces are generally made from standard paving materials such as concrete, asphalt or outdoor suspended modular court.

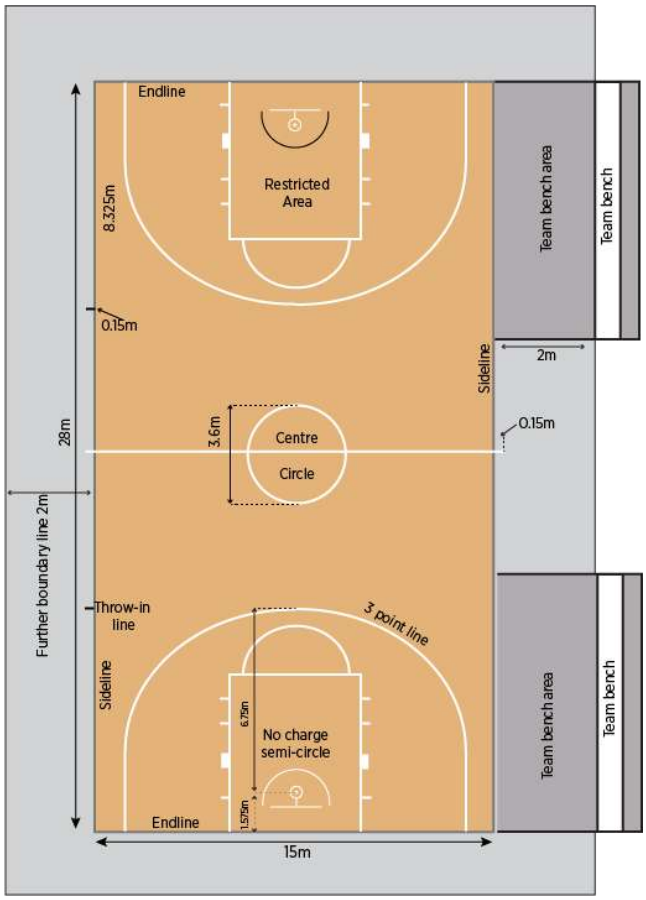


Figure 2. 22 Basketball Court Dimensions

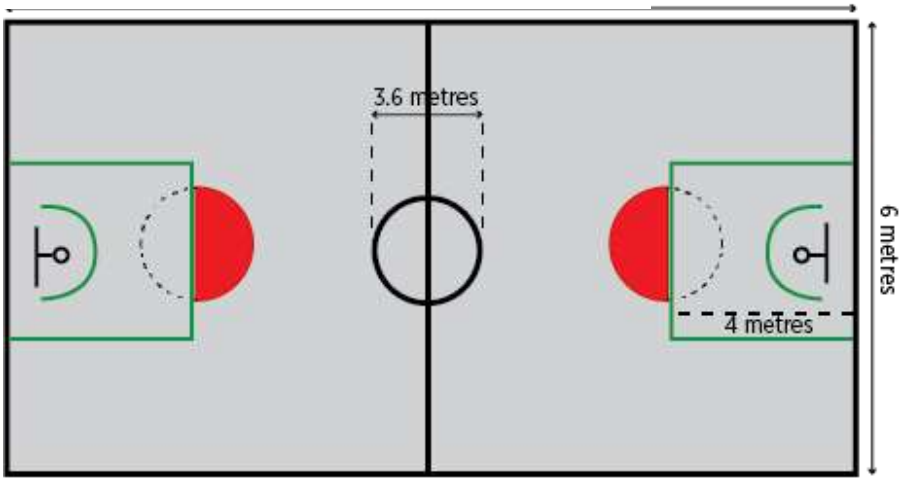


Figure 2. 23 Mini Basketball Court

2.6.3 Football Field

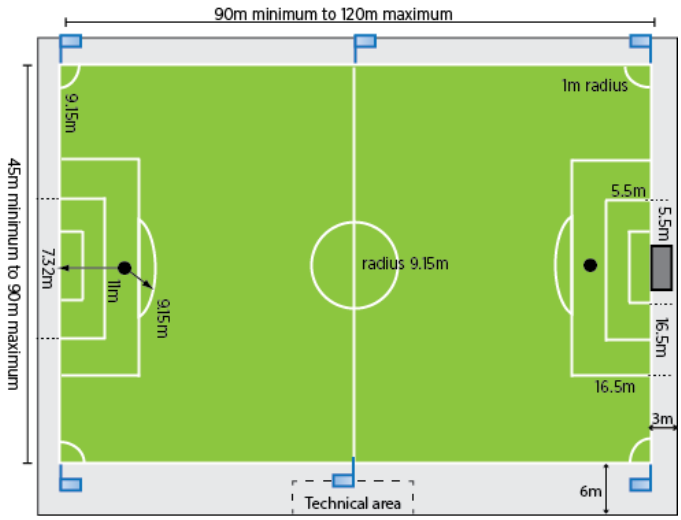


Figure 2. 25 Football field dimension

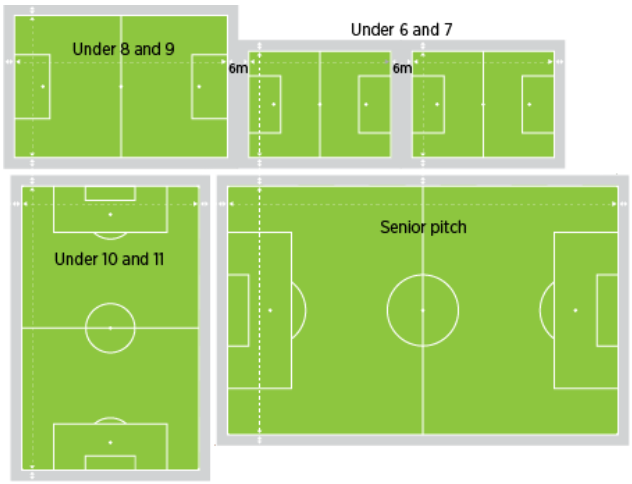


Figure 2. 24 Types of Mini Football Field

2.6.4 Jogging Track

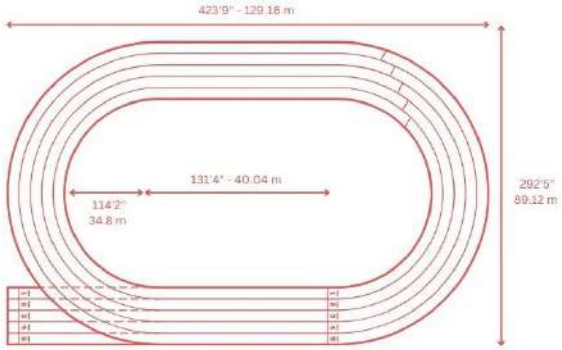


Figure 2. 26 Jogging track

2.6.5 Gym and Fitness

Type of Space	Machine footprint range		Circulation [1]
Resistance area	2m²/machine		1.75x machine footprint
Cardio vascular area	1.5m²/machine	2.0m²/machine	1.75 x machine footprint
Free weights area	2.5m²/machine	3.5m²/machine	2 x machine footprint
Stretch Area	2.0m²/person	2.5 m²/person	N/A
Spinning Room	1.0m²/machine	1.5m²/machine	1.25 x machine footprint

The image below shows the basic relationship between the main activity and support spaces of a health and fitness center. These may vary depending on the scale of accommodation to be provided.

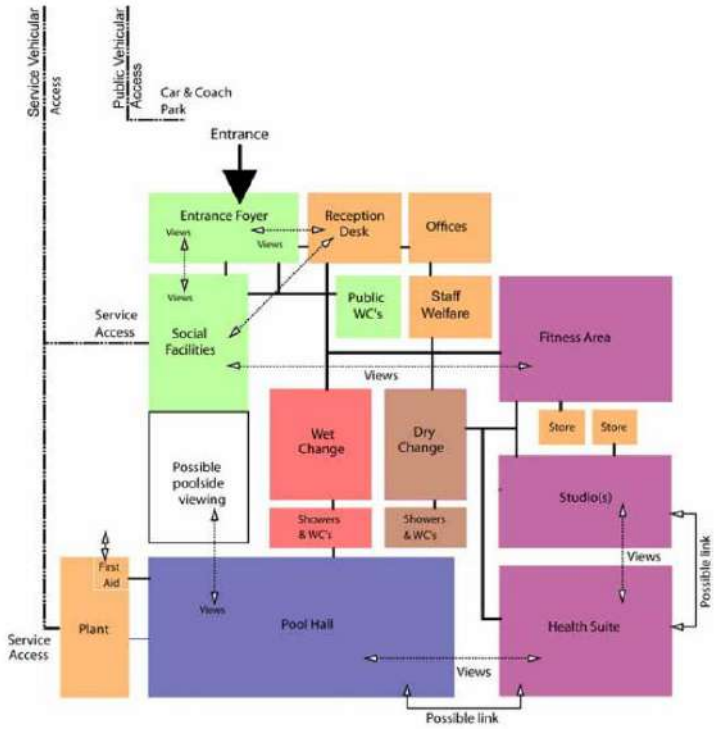


Figure 2. 27 Basic planning of a gym and supporting functions.

2.6.6 Indoor Swimming Pool

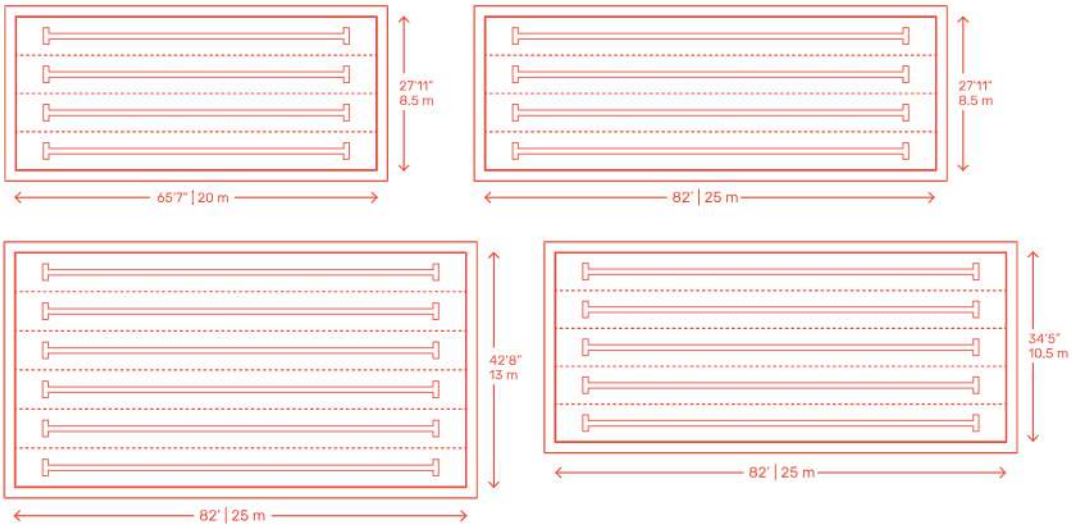


Figure 2. 28 Different types of Swimming Pool

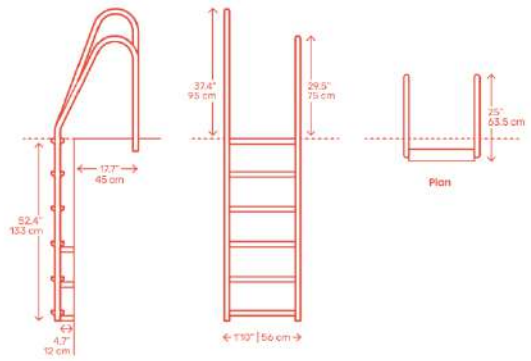


Figure 2. 30 Swimming pool handrail dimensions

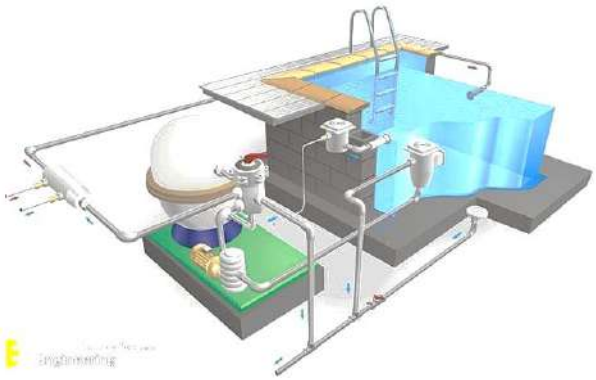


Figure 2. 29 Water Treatment system for Swimming Pool

2.6.7 Wall Climbing and Recreational Archery

In wall climbing, the clear height should be minimum 5 meter for adults and minimum 3 meter for kids to maintain safety.

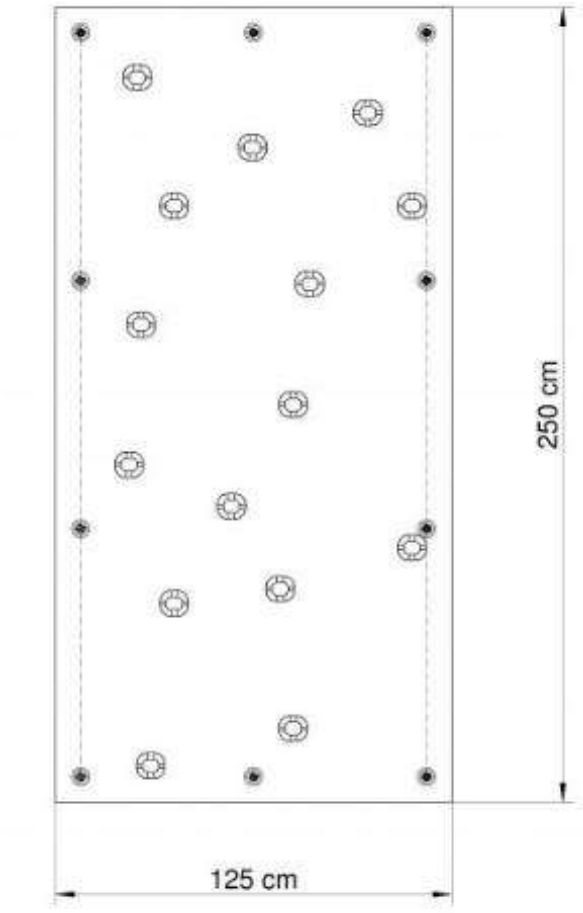


Figure 2. 31 Wall Climbimg dimension

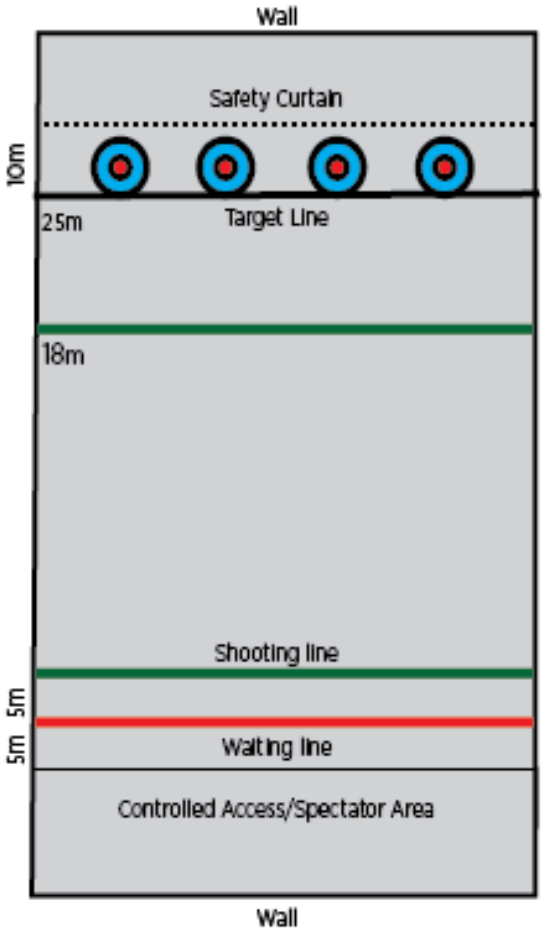
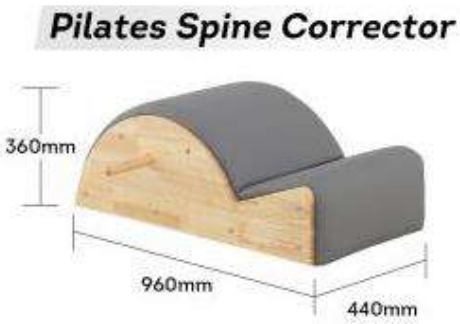
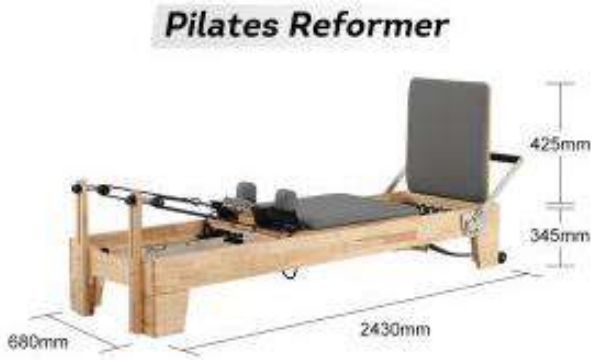


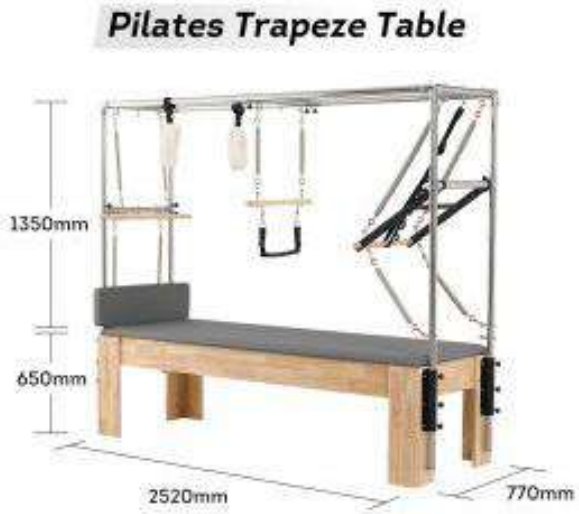
Figure 2. 32 Recreational Archery Dimension

2.6.8 Types of Pilates Equipment

Pilates equipment ranges from simple, portable items like resistance bands, Pilates mats, and the magic circle (also known as the Pilates ring) to big pieces of apparatus like the Pilates Reformer, Pilates Chair, and Cadillac.







2.7. BAMBOO AS A SUSTAINABLE BUILDING MATERIAL

Bamboo is a versatile, strong, renewable and environmentally friendly material. It is the fastest growing woody plant producing a mature fiber for use within three years. However, bamboo is subjected to attack by fungi and insects and untreated bamboo have a life expectancy of not more than five years. The basic and general physical properties of the bamboo are summarized below (Dunkelberg, Klaus, 2005).

Bamboo is a family of bambusoideae, and bamboo's growth character is divided into types: monopodia and symposia bamboo. Monopodia bamboo roots spread horizontally in shallow depths of soil where the new shoots are produced at a relatively long distance from the parents' plant. Symposia bamboo roots grow very close to parents' plant, forming a clump of many stems or canes (Anon., n.d.).

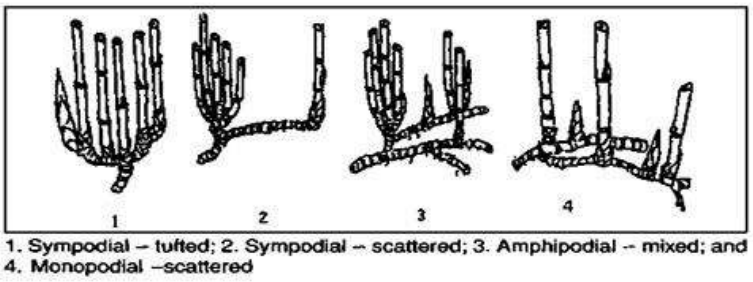


Figure 2. 34 Growth Character of Bamboo

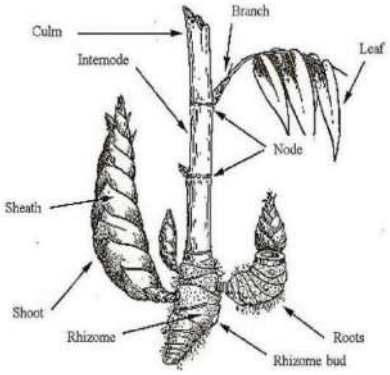


Figure 2. 33 Morphology of Bamboo

2.7.1 Parts of Bamboo

- Clump: A cluster of bamboo poles that are interconnected or belong to a single bamboo plant.
- Culm or stem: An individual bamboo pole; hollow cylinder or main stem above the ground.

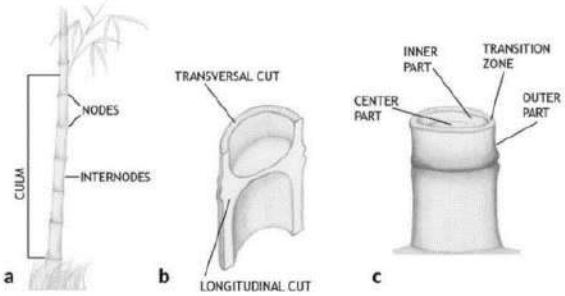


Figure 2. 35 Parts of Bamboo

- Inter-node: Portion of bamboo between two nodes. The inter nodal portion has linear fibers.
- Node: Projected or joining portion of two inter-nodes. This is the growth point of the vegetative axis. Nodes have a cross or interwoven fiber structure (horizontal and vertical).

- Shoot: New emerging culm
- Bud and Rhizome: Eyelike formation located on a culm node or rhizome node, underground portion of bamboo.
- Culm sheath: Protective layer on newly emerging culms. The layer drops off on maturity.

2.7.2 Properties of Bamboo

Bamboo rods are round, segmented, jointed, and hollow. Bamboo Culm consists of 50% parenchyma, 40% fiber, and 10% conducting tissue, which indicates that as a construction material, bamboo has a very strong fiber (Maharjan, 2022).

Tensile Strength:

Bamboo is able to resist more tension than compression. The fibers of bamboo run axially are of highly elastic vascular bundle that has a high tensile strength. The tensile strength of these fibers is higher than that of steel, but it's not possible to construct connections that can transfer this tensile strength. Slimmer tubes are superior in this aspect too. Tensile strength of bamboo (28KN/sq.in) is close to steel (23KN/sq.in).

Compressive Strength:

Compared to the bigger tubes, slimmer ones have got, in relation to their cross-section, a higher compressive strength value. The slimmer tubes possess better material properties due to the fact that bigger tubes have got a minor part of the outer skin, which is very resistant in tension. The portion of lignin inside the culms affects compressive strength, whereas the high portion of cellulose influences the buckling and the tensile strength as it represents the building substance of the bamboo fibers. The compressive strength of bamboo is at least twice of concrete.

Elastic Modulus: The accumulation of highly strong fibers in the outer parts of the tube wall also work positive in connection with the elastic modulus like it does for the tension, shear and bending strength. The higher the elastic modulus, the higher is the quality of the bamboo. Enormous elasticity makes it a very useful building material in areas with very high risks of earthquakes.

Anisotropic Properties: Bamboo is an anisotropic material. Properties in the longitudinal direction are completely different from those in the transversal direction. There are cellulose fibers in the longitudinal direction, which is strong and stiff and in the transverse direction there is lignin, which is soft and brittle.

Shrinkage: Bamboo shrinks more than wood when it loses water. The canes can tear apart at the nodes. Bamboo shrinks in a cross section of 10-16 % and a wall thickness of 15-17 %. Therefore, it is necessary to take necessary measures to prevent water loss when used as a building material.

Fire Resistance: The fire resistance is very good because of the high content of silicate acid. Filled up with water, it can stand a temperature of 400° C while the water cooks inside.

Besides the advantageous property of bamboo, bamboo is vulnerable to termites and fungal attacks. Therefore, it is preserved using borax boric acid solution through several techniques, such as immersion, gravitational or vertical soak diffusion, and injection using a compressor machine. Moreover, borax acid is capable to extend the life span of bamboo.

Apart from this, Bamboo shrinks by 10-16% in cross section and has a wall thickness of 15-17% that is more than wood when loses water.

- Measures are taken to prevent water loss when used as a building material.
- Prone to rapidly catch fire by the friction among the culms during wind (in the forest).
- Jointing- although many jointing techniques exist, their structural efficiency is low.
- Untreated bamboo structures can hardly survive with an expected life of a maximum of 5 years.

PROPERTIES	BAMBOO
Specific gravity	0.575 to 0.655
Average weight	0.625kg/m
Modulus of rupture	610 to 1600kg/cm2
Modulus of Elasticity	1.5 to 2.0 x105kg/cm2
Ultimate compressive stress	794 to 864kg/cm2
Safe working stress in compression	105kg/cm2
Safe working stress in tension	160 to 350kg/cm2
Safe working stress in shear	115 to 180kg/cm2
Bond stress	5.6kg/cm2

Figure 2. 36 Properties of Bamboo

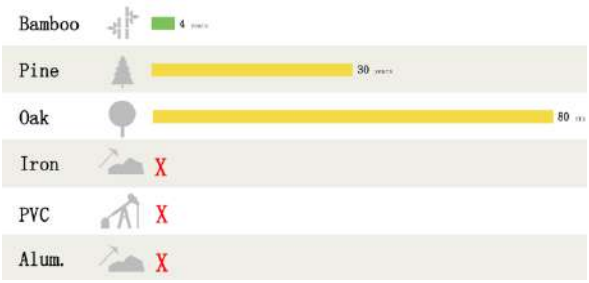


Figure 2. 37 Harvest age of renewable sources

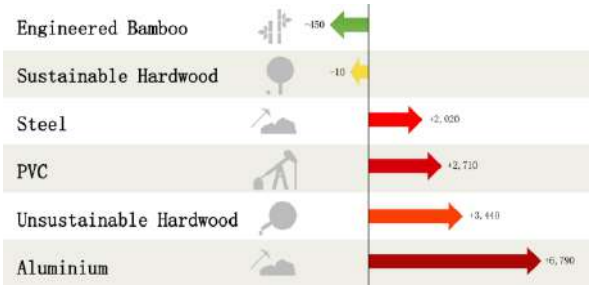


Figure 2. 38 CO2 emmision(Kg)- 1 ton of material

2.7.3 Distribution of Bamboo in Nepal

Bamboo has had a very historical and cultural association in Nepal, it is used in almost all aspects of life from construction, marriage, death to livelihood. The use of bamboo however, has been only subsistence, and the modern market for it is not well developed. With the growing bamboo demand in the world, abundant availability of the resources, vast traditional knowledgebase and cultural affinity of this material in Nepal, there is a tremendous potential for it to contribute to the people's livelihood (Adhikary, Nripal abari, n.d.). Bamboos are endemic to all the three major ecological zones of Nepal: Terai, Midhills and Mountains (Fig.2.3) (Karki, 1996). However, they are more concentrated and show larger diversity in the eastern half of the country, from the Annapurna to the Kanchenjunga ranges of the 'Himalayan Mountains (Ghimire, A, 2008).

Species abundance is directly related to the amount and distribution of rainfall, with areas that receive well distributed and greater rainfall, such as Pokhara and Illam regions, having the largest number of bamboo species. Nepal has both tropical bamboos found in South-East Asia and temperate bamboos found in Tibet and Bhutan.

Natural bamboo resources in Nepal have considerably dwindled during the last three decades. This is primarily owing to the large-scale destruction of the habitat of bamboos resulting from encroachment and release of forest land for agriculture, shifting cultivation, negligence in the management of natural bamboo stands, and the lack of an appropriate policy governing the resources. Total coverage: around 63,000 ha out of which 60% is estimated to be in the natural forests.

Figure 2. 39 Distribution of Bamboo in Nepal

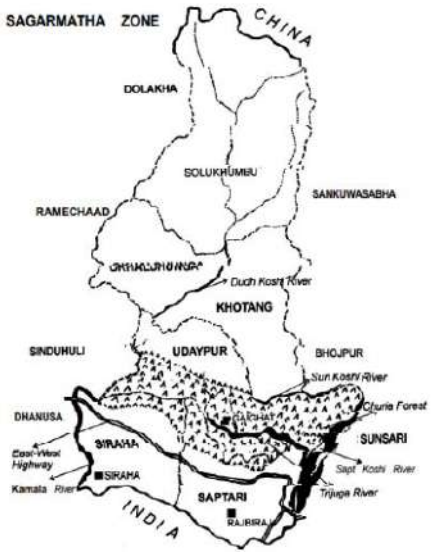


Figure 2. 40 Distribution of Bamboo in Eastern Development Region of Nepal

Local name	Scientific name
Ban/Tama/Khasre Bans	Bambusa nepalensis
Ghar/Chille Bans/Taru bans	Bambusa nutans subsp. nutans
Dhanu Bans	Bambusa balcooa
Gopi Bans	Cephalostachyum latifolium
Nigalo/Lebans	Ampelocalamus patellaris
Kath Bans	Dendrocalamus strictus var. wild
Kande Bans	Bambusa bambos
Kali Bans	-
Bangali Bans	
Phalame Bans	
Khakale Bans	
Jabarjoto/Jarbuto Bans	Thamnocalamus spathiflorus
Kaante/Kaand bans	Bambusa bambos
Munger Bans/Lathi Bans/ Lath Bans	Dendrocalamus strictus
Chav Bans	Bambusa tulda
Bhalu Bans	Dendrocalamus hookerii

Figure 2. 41Types of Bamboo mainly used for construction

2.7.4 Pre-Processing of Bamboo

Here the pre-processing of bamboo means the preparation of bamboo for its further utilizations as a material. It is the phase between the bamboo plant and the bamboo material. The difference of the utilizations of bamboos determines the processing of bamboo and also changes from one to another. For example, the bamboo sprouts are very popular foods in Asia and will be cut in

the beginning of the sprout growth in the spring: whereas the bamboo culms for building normally come from the 4-5 years old bamboo and should be cut in fall and winter (Yu, 2007). But generally, there are three phases which most of the utilizations have to take:

- The harvest,
- The transport and
- The preservation.

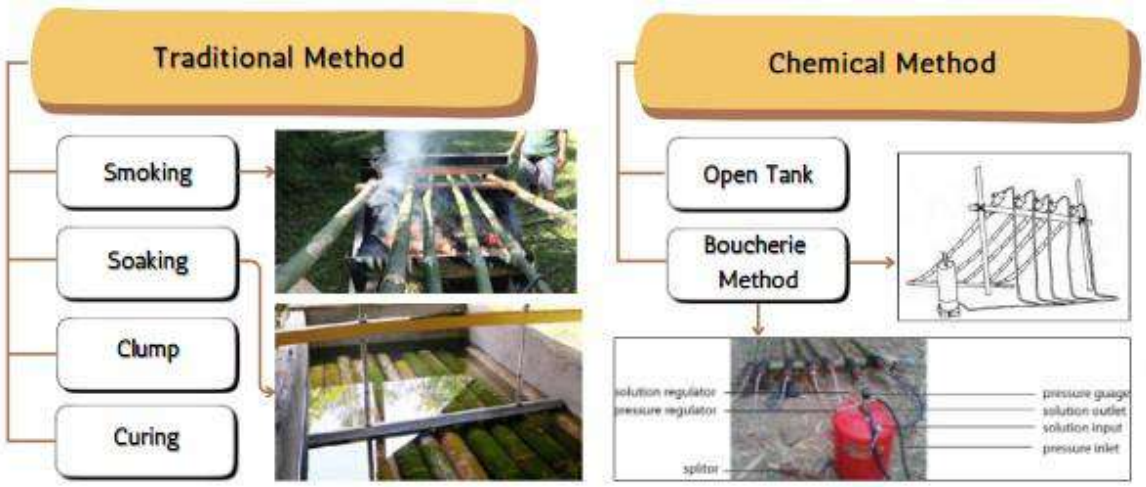
a. Harvesting of Bamboo:

The harvest is different from one to another according to which part of bamboo will be harvested and for what purpose the bamboo is used. The proper harvest time and methods will provide bamboo material with the best quality and at the same time prevent damaging the growth of the bamboo plant. For the sprout, the best time of harvest is the early spring when the bamboo shoots just grow out of the earth. But for the building materials or for tools, the 4-5 years old is generally regarded as the best age for bamboo culms harvest, because these bamboo culms are mature enough and have reached their highest value in strength. After this time the strength of culms decreases. The time for harvest should be in the dry season in order to keep the moisture content in the bamboo culm low. Otherwise, the culms will easily attack by fungi and rot, and also increase the transport costs (Janssen, 2000). The cut of bamboo culms in one season should be no more than 25% of the total culms in order to keep a stable productivity of the whole bamboo forest. The cutting position should be about 30 cm above the ground in order to not destroy the rhizome and it should be just above a node so that the water will not be collected there and cause the plant to rot (Austin, 1972).

b. Transportation of Bamboo:

Transportation happens normally between the place of harvest and the processing place. The factories or workshops are often placed near the bamboo forest in order to save transport costs. Because of the tube structure of the bamboo culms a long distant transport of raw bamboo culms are not profitable. In some places people traditionally have used river as the natural transport channel which is cheap and efficient. The river transportation has another advantage: It prevents bamboo from attacks by insects (baniya, 2017).

c. Treatment and Preservation of Bamboo



There are two methods of preservation. They are Traditional method and Chemical method.

Traditional Method

a. Water Treatment or Leaching Bamboo:

The starch content in the bamboo is the main cause of the attack by the insects like beetles, termites etc. Therefore, after harvesting the bamboo, it should be placed in water for about a month. In this process, considerable quantity of starch content will be reduced resulting in the increase of durability of the bamboo. Placing the green bamboo in stagnant water is the traditional method of treatment for bamboo in Nepal.

Figure 2. 43Leaching of Bamboo

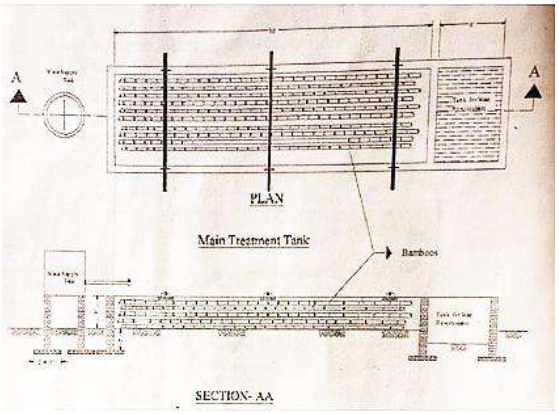


Figure 2. 42Main treatment tank for water treatment of Bamoo

Bamboo is stored in tanks with water, while adding chemicals. Stages that must be applied necessarily are as follows:

- Bamboo knots should be punctured, so water can easily penetrate into the bamboo canes.
- It is necessary to bind the bamboo together or to separate and store them in tanks or in running water.
- Storage of bamboo in the tank. It is necessary to change the water weekly; this will prevent the growth of bacteria that can cause unpleasant odor and discoloration of bamboo.
- It is necessary to use loadings for full immersion of bamboo in water.
- Bamboo should be immersed in water with times, after extraction, it is worth using further chemical treatment. Bamboo should be immersed for at least 3 - 4 weeks.
- Bamboo that has been leached for 3 months or more may become stained in the epidermis. This will reduce its physical and mechanical properties (schroder, 2012)

b. Smoke Treatment:

This is the general experience of the people that exposing of bamboo to smoke increases the durability of the bamboo. It is possible that toxic agents are produced which lead to poison the starch of the bamboo. Also due to the heating, the starch within the parenchyma cells may be destroyed. However, smoke in the room may have other negative effects including health hazard. Therefore, it is better to treat the bamboo in a smoke chamber and then use in the construction.

Figure 2. 44Smoke Treatment of Bamboo

Chemical Method:

In the chemical method, chemical preservatives like CCA (copper-chrome-arsenic composition) or cheaper ones like boric acid and borax are used to keep bamboo culms from being attacked by insects. For treatment of Bamboo total chemical should be used at 5% of total dissolve chemical. Example: For 14 Liter capacity of pump chemical to be used 700 Grams. For Structural Bamboo for pole, beam etc. Boric acid, Copper Sulphate and sodium or potassium dichromate to be used in proportion of 1, 5:3:4 i.e. for 14 liters of tank. For Non-Structural member like, wall lattice, Splits Boric acid and Borax to be used in 1:1.5: Proportion. I.e. for 14 liter of tank (u, 2022).

Figure 2. 45Curing of Bamboo with Borax and Boric Acid

The types of chemical processing methods (Janssen, 2000) (Janssen 1988) are as follows:

a. Open Tank Method

Bamboo culms will be soaked in a tank filled with chemical preservatives for about one week. Then the culms are left to dry for one week in a vertical position, protected from sunshine.

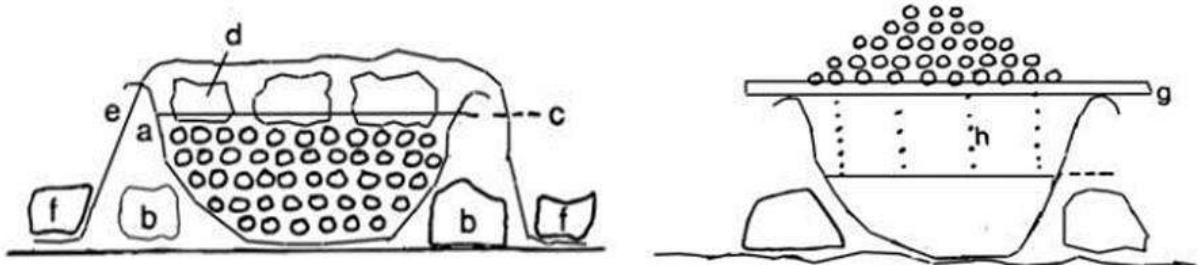


Figure 2. 46Open Tank Method

b. Boucherie Method

One side of the bamboo culms is enclosed with tubes which are connected to a drum with preservatives that is put on an about 10 meters high tower. Then the preservatives are pressed into the bamboo culms by the height pressure of the preservatives. We should fill up the Pump Cylinder up to 3/4 with Borax / Boric Acid Solution using a funnel. Then we should make a fresh cut on the bamboo with then Hardwood back saw about 10 cm away from the node.

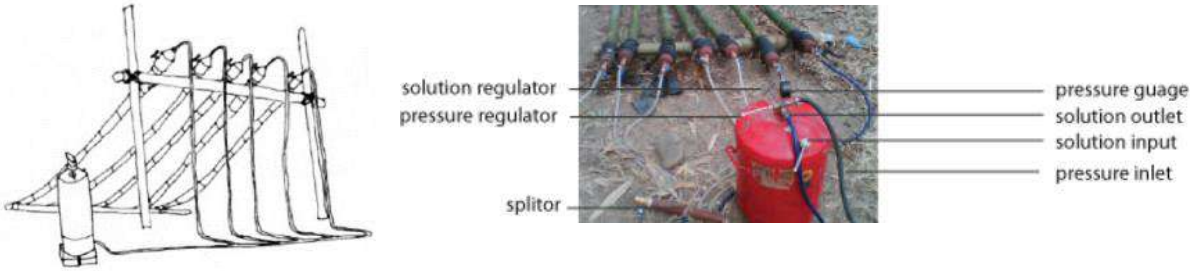


Figure 2. 47Boucherie Method

Drying of Bamboo

Seasoning of bamboo is accomplished either by air drying or kiln drying.

a. Air Drying

For a permanent construction, the culms need to be air dried at least two to four months prior to use. The method of air-drying takes from 6 to 12 weeks. This may depend on the humidity and thickness of the bamboo. During the drying process, the diameter of the bamboo can be reduced from 10% to 16%, and the wall thickness from 15% to 17%. After chemical treatment, all bamboo is laid and stored under a canopy or under a roof. Important factors when drying bamboo are listed below:

Figure 2. 48Drying of Bamboo in the air under the tent.

- First, you need to protect bamboo from direct contact with the ground, avoiding humidity, insects and infection with fungus.
- It is necessary to avoid changing the humidity. Round poles should not be exposed to direct sunlight for a long time. However, the bamboos, divided into lengths, can be dried in the open sun, o to remove infected clusters, infection of the entire storage area should not go

- There should be enough circulation of air in a room with bamboo.
- Vertical packing gives the bamboo to dry for a shorter period and is less defeated by a fungal attack.
- Horizontal laying is usually used for large batches of bamboo, they are laid on large sheets, and sheets can consist of plastic or glass, or use dividers. The lower bamboo batch can crack from the weight, for this, it is laid not in large layers and carefully checked.
- Every 15 days, bamboo should be turned in the longitudinal direction, for even drying

b. Kiln Oven Drying

The drying kiln method is suitable only for bamboo split, the process quickly dries out pieces of bamboo. However, this method is not suitable for whole bamboo, as high temperature gives cracks in the bamboo.

Figure 2. 49 Kiln oven drying method of Bamboo

2.7.5 Bamboo Connection and Joinery

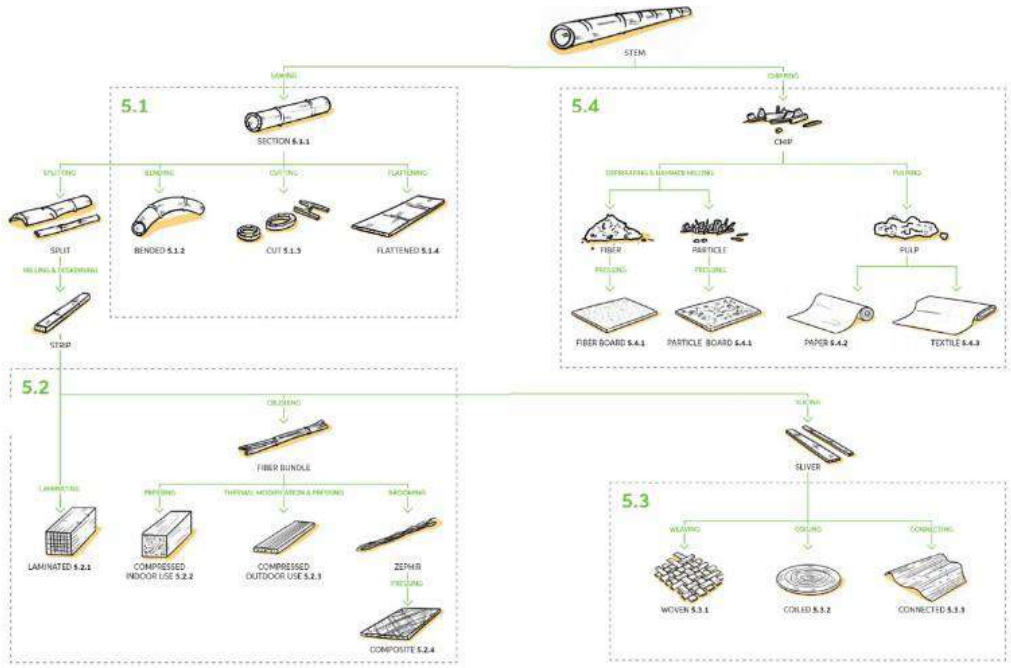


Figure 2. 50 Transformation paths of bamboo stem to many engineered bamboo materials.

Round and hollow section of bamboo pole is uncomfortable fact for the joinery and create many problems with modulation and prefabrication of elements. Though it is possible to change its shape. Due to bamboo flexibility, various shapes may be made by training the plant while it grows. Squared bamboo is created by compressing the growing stalk to the square form which provides flatter surface for the connection. Unfortunately, those methods are not common and requires more effort to achieve desired shape. The different types of Bamboo connection are explained below:

a. Wedge Connection

In a wedge connection, a wedge-shaped wooden piece is driven at the joint of two bamboo members. However, this connection requires additional reinforcement through the use of lashing or bolts.

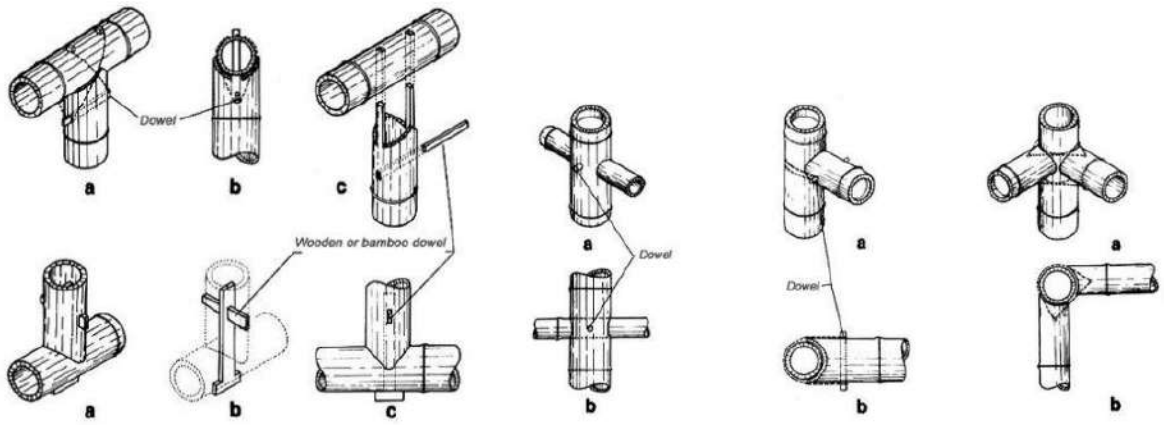


Figure 2. 51 Wedge Connection in bamboo

b. The 'Friction tight rope', or Lashing Connection

The 'friction tight rope' or lashing connection is widely used in traditional construction. These connections use natural materials like rattan, coconut fiber to join the bamboo culms together. Lashings, wraps, fraps, and clove-hitch are some knots used in these connections. To get tighter connections, we use green bamboo strips. These strips are watered before use and shrink while drying, resulting in a stronger connection.

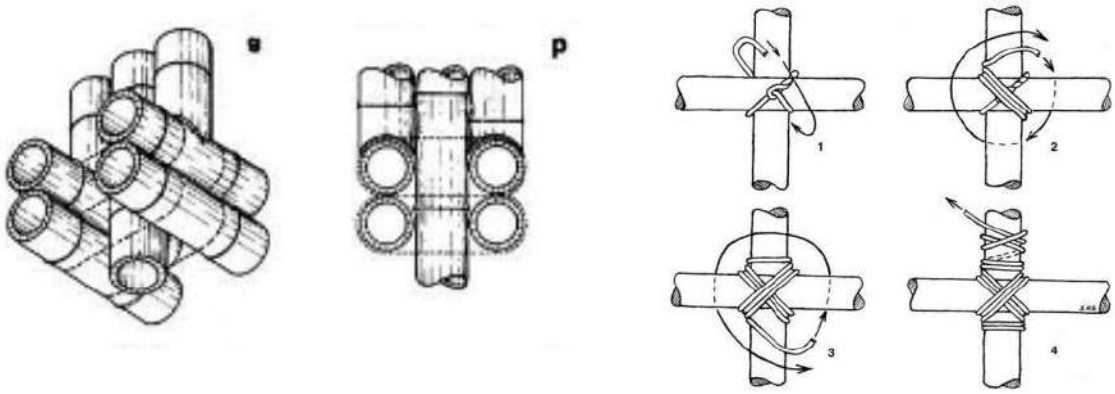


Figure 2. 52Horizontal and Vertical Lashing joint in Bamboo

c. The Plug-in Bolt Connection

The Plug-in bolt connection is not widely used and works on the similar principle of the tenon and mortise joint in wooden joineries. We must take care to avoid using the plug-in bolt connection close to the edge of the culm to prevent the splitting of the bamboo.

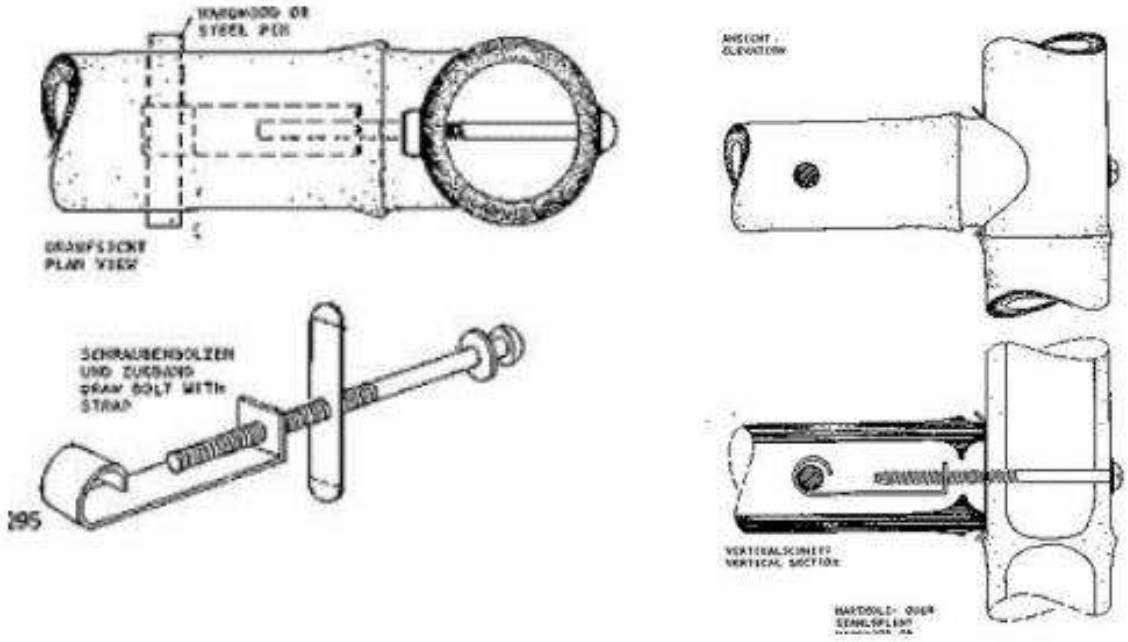


Figure 2. 53Use of Plug-in bolt connection in Bamboo

d. Induo-Anchor Technique

The Induo-Anchor technique is used for bamboos with larger diameters. The joint comprises an anchor, which is a spherical node usually made of cast-iron. The node is drilled and tapped at varying angles to create desired connections. We thread the bamboo culms into the nodes using conical end bolts.

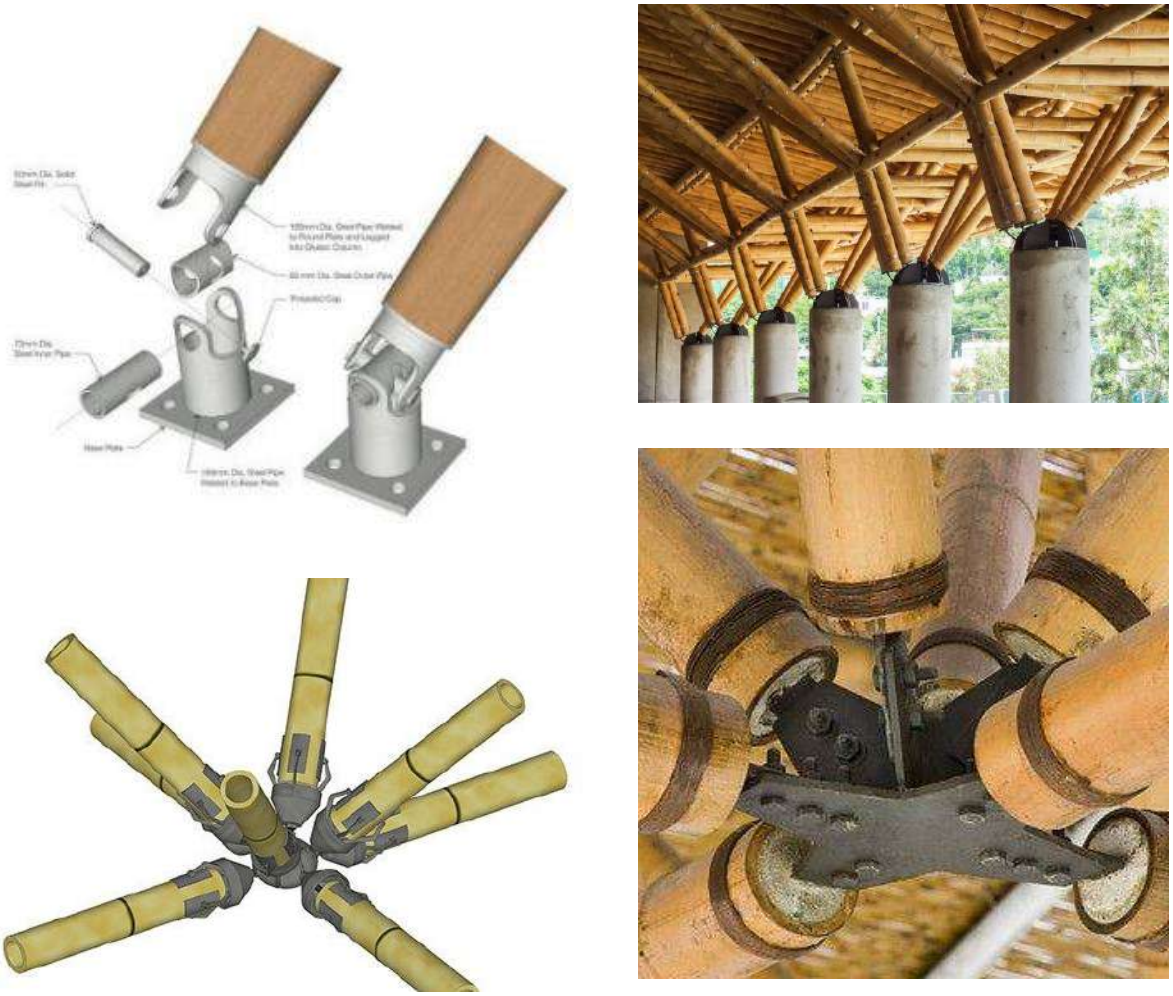


Figure 2. 54 Metal/Anchor joint technique in Bamboo

e. Special Construction Design

This type of bamboo connection is based on plug – in joint and friction tight rope joint. A special and durable design, very unique and easy to build. An effective and easy way of connecting does not require high skills of working with bamboo (Syidanova, 2018, p. 34).

Figure 2. 55 Special Construction Design

2.7.6 Building System and Components

a. Foundation

Bamboo's several regulations for foundation are as follows:

- Bamboo and soil should not come in contact there is a risk that bamboo can take root.
- The plinth in which the bamboo is installed should exceed 350 mm above the ground water or above the hot water line.
- Diameter of bamboo should not exceed 70 mm.
- If post it exceeds three permissible meters, then connecting beams should support the column (Syidanova, 2018, p. 41).

The various types of foundations constructed with bamboo are:

Bamboo in direct contact with the ground:

Bamboos are placed on either the ground surface or buried to the ground. Bamboo with nodes that are closely spaced having large diameters and thick sections are used to achieve the best strength and stability. In the absence of this, smaller sections of bamboos can be tied together

and preservatives applied to reduce the process of deterioration that usually occurs between 6 to 24 months (hunnarshala & CAN, 2019) (Koko, 2019, p. 32).

Bamboo on concrete footings or rocks:

The stiffest and largest sections of bamboos are used for bearings and placed on footings of either rock or preformed concrete without direct contact with the ground (Koko, 2019, p. 32).

Bamboo integrated into concrete footings:

The poles of bamboo are directly placed into concrete footing, which can take the form of a single post or strip footings (Koko, 2019, p. 32).

Composite bamboo/concrete columns:

A bamboo with a post that is integral and durable is achievable through the use of a concrete extension to the bamboo by using a plastic tube with the same diameter of the bamboo (Koko, 2019, p. 32).

Bamboo piles:

Bamboo piles are used to reduce settlements of building and stabilize soft soils. This is done through the use of bamboo poles that are split into sections and treated by filling them with coconut coir strands wrapped with jute and tied with wire. Sandy materials are used to cover the area after installation of the piles (Koko, 2019, p. 33).

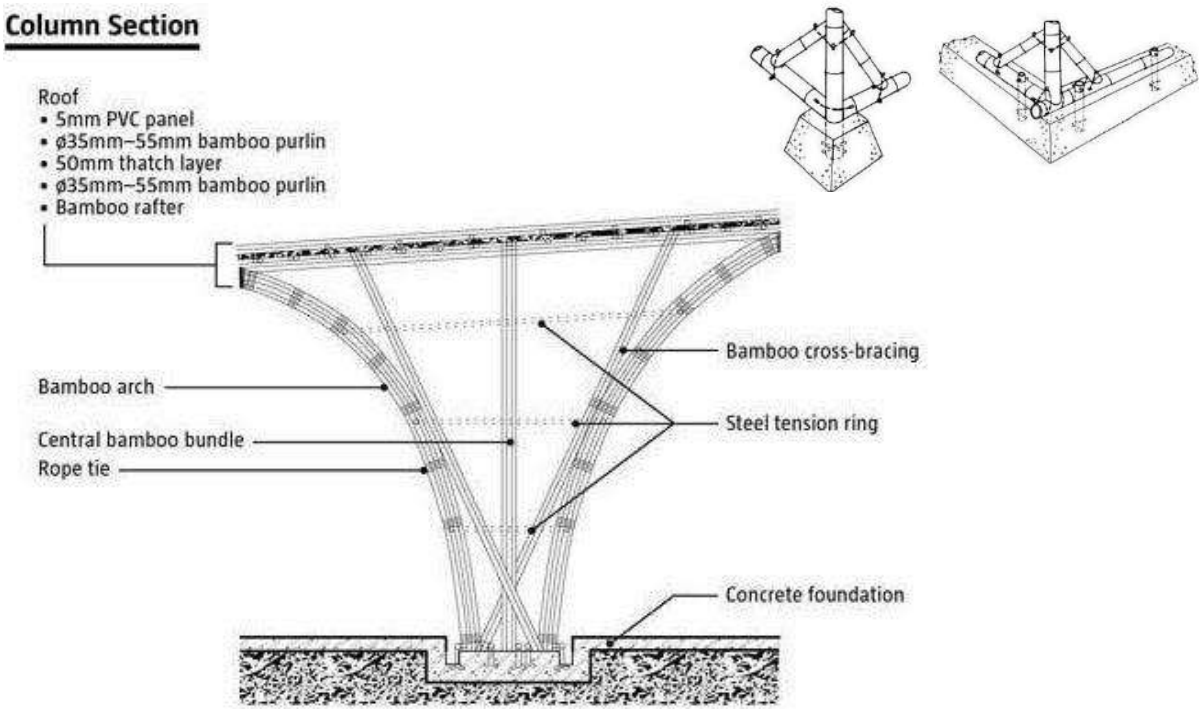


Figure 2. 56Bamboo piles on concrete base.

b. Plinth

Before using bamboo, it must be treated with tare or creosote, for additional protection. The depth of the pits to establish the bamboo should be 300 mm and a diameter of 100 mm, but if the diameter of the bamboo is greater than 100 mm, the pit size needs to change. After installing the culm in the pit, the spaces between the walls of bamboo and cement should be filled with sand (Krawczuk, 2013).

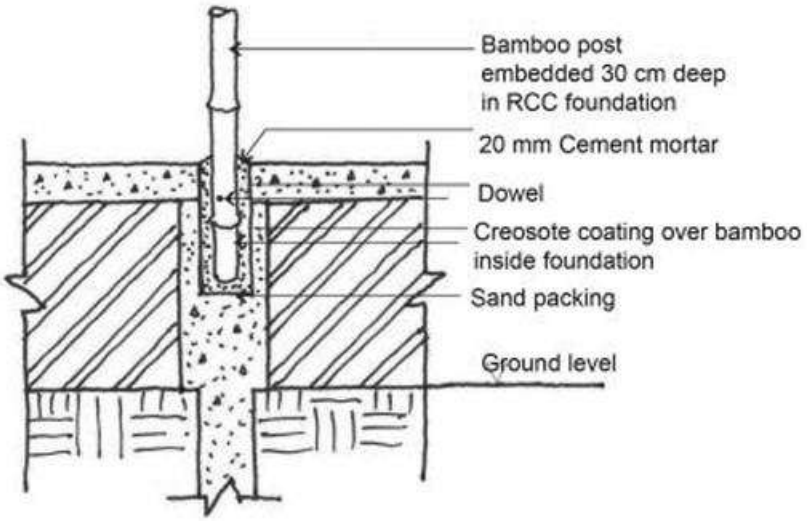


Figure 2. 57 Concrete foundation plinth for bamboo construction.

c. Foundation Plinth with Anchor Bolts

Bamboo and foundation are fixed with bolts and steel brackets and anchor bolts (Syidanova, 2018).

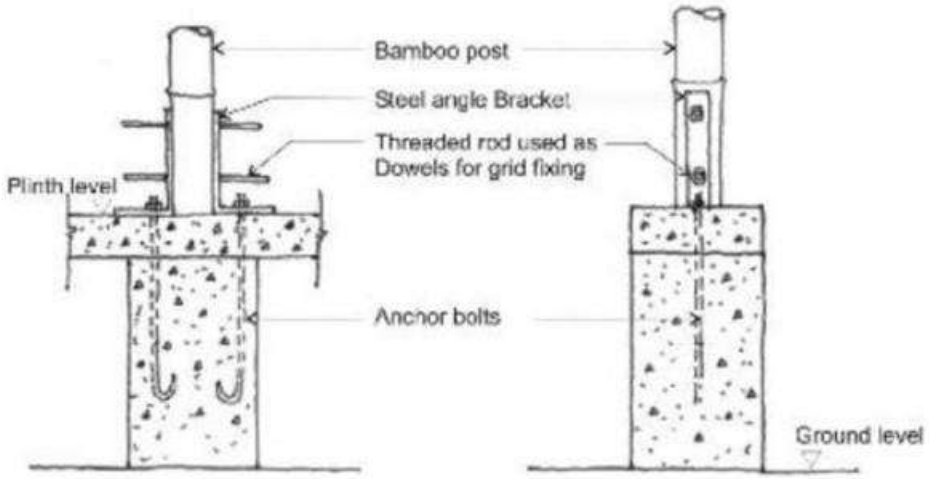


Figure 2. 58Fixing detail of bamboo to plinth using bolted connection.

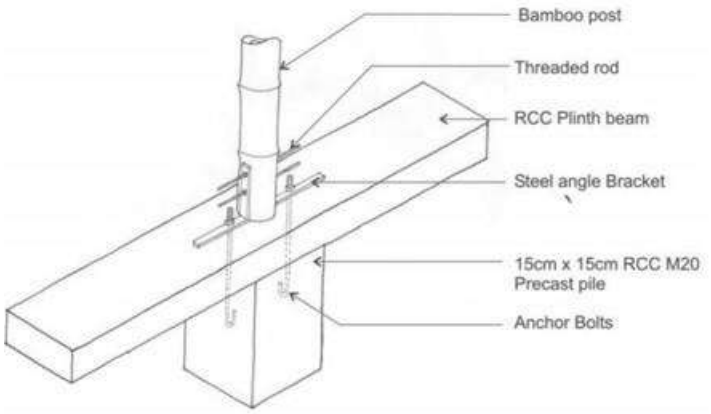


Figure 2. 59Fixing detail of bamboo to plinth using anchor bolts

d. Structural System

The structural system of Bamboo are as follows:

- **The Classic Post and Beam Method**

Figure 2. 60 The classic post and beam method in bamboo

- **Hyperbolic Paraboloids**

Figure 2. 61 Hyperbolic Paraboloids in bamboo

- **Hyperbolic Twisted Towers**

Figure 2. 62 Hyperbolic Twisted Towers

- **Spatial Grid Shells**

Figure 2. 63Spatial Grid Shell

e. Bamboo as a Roofing Material

Bamboo as building materials is easy to bend and lithe. Those characters are very suitable for organic shaped building construction. Bamboo is a low-cost building material available in wide parts of the world: it is lightweight, durable, flexible, and easily cultivated and processed. The need for better infrastructure is rising in demand as well. Schools, Hospitals, bridges etc. So much infrastructure demands a lot of brick and mortar which is short in supply. An effective and eco-friendly alternative could be bamboo. Bamboo is a grass that is extremely hard and durable all the right attributes required for a roof. Bamboo also grows quickly which means that there will be adequate supply. A bamboo roof needs support. Just like a concrete roof is supported by iron rods. A bamboo roof is supported by Bamboo Truss. The different types of roofing system for Bamboo buildings are as follows:

- **Thatch**

Figure 2. 64 Thatch roofing

- **Halved Bamboo**

Figure 2. 66 Halved Bamboo roofing

- **Terracotta Tiles**

Figure 2. 65Terracotta Tiles

- **Copper Shingles**

Figure 2. 67 Copper Shingles

- **Flattened Bamboo Shingles**

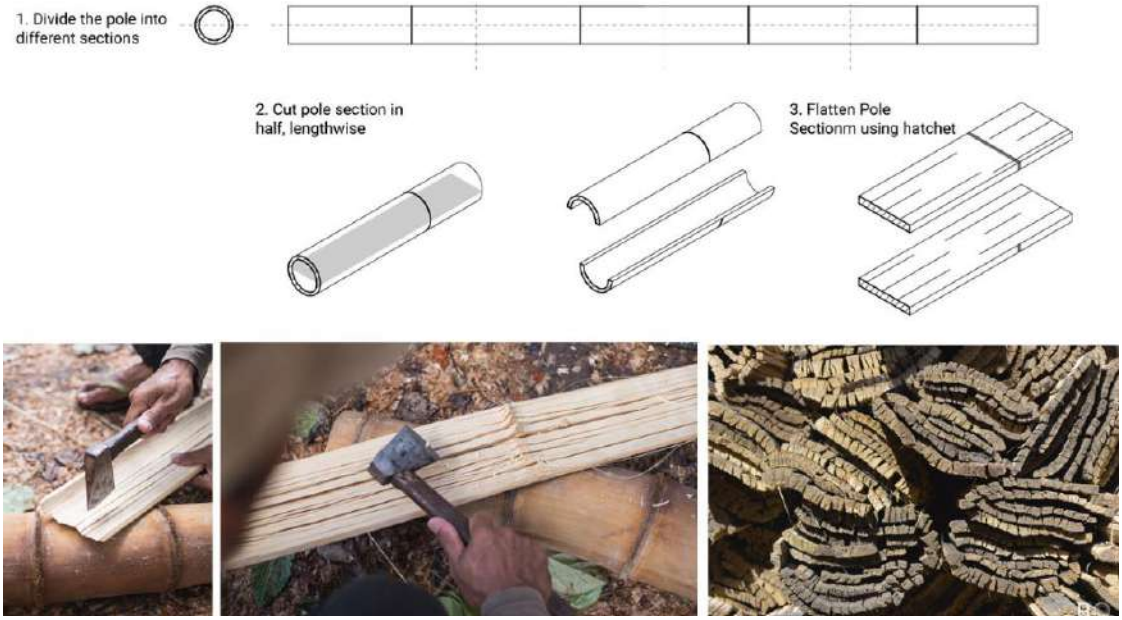


Figure 2. 68 Flattened Bamboo Shingles

CHAPTER 03.

CASE STUDY
Community Sports Hub in Dharan, Eastern Nepal

3.1. INTERNATIONAL CASE STUDY

3.1.1 Firstenberg Community Center

Project Details

Name: Firstenburg Community center

Location: Vancouver, Washington

Project Year: Completed-2007 A.D.

Architect: Opsis Architecture

Area: 7523.47 sq. m.

Figure 3.1.1. Top View of Firstenberg Community Center

The Firstenburg Community Center is a multi-use facility that combines recreational and community spaces with other public services. It embodies the character of the community, provides convenient access to services and brings together a diverse mix of users. Douglas fir trees, many of which were diseased, were harvested from the site and milled locally for 12,000 board feet of material used as wall paneling, screens, benches and bleacher seats.

Figure 3.1.2. Entrance Image of Firstenberg Community Center

- The recreation program includes swim and warm water leisure/therapy pools, a two-court gymnasium, fitness space, aerobics dance studios and multi-purpose activity spaces.
- The community spaces incorporate child watch, a teen lounge and game room, a senior lounge and resource room, and meeting rooms.
- The multi-use community rooms, which together seat up to 350, address the lack of meeting and gathering spaces in east Vancouver and provide a venue for City Council meetings, social dances, performances, neighborhood fairs and community forums.
- The Firstenburg Community Center is a two-level building massed to reduce the development footprint, preserve mature tree stands and enliven the facility by concentrating activity and social spaces.
- The building takes advantage of the park-like setting with large windows for daylighting and courtyards to allow interior functions to participate with the natural landscape.

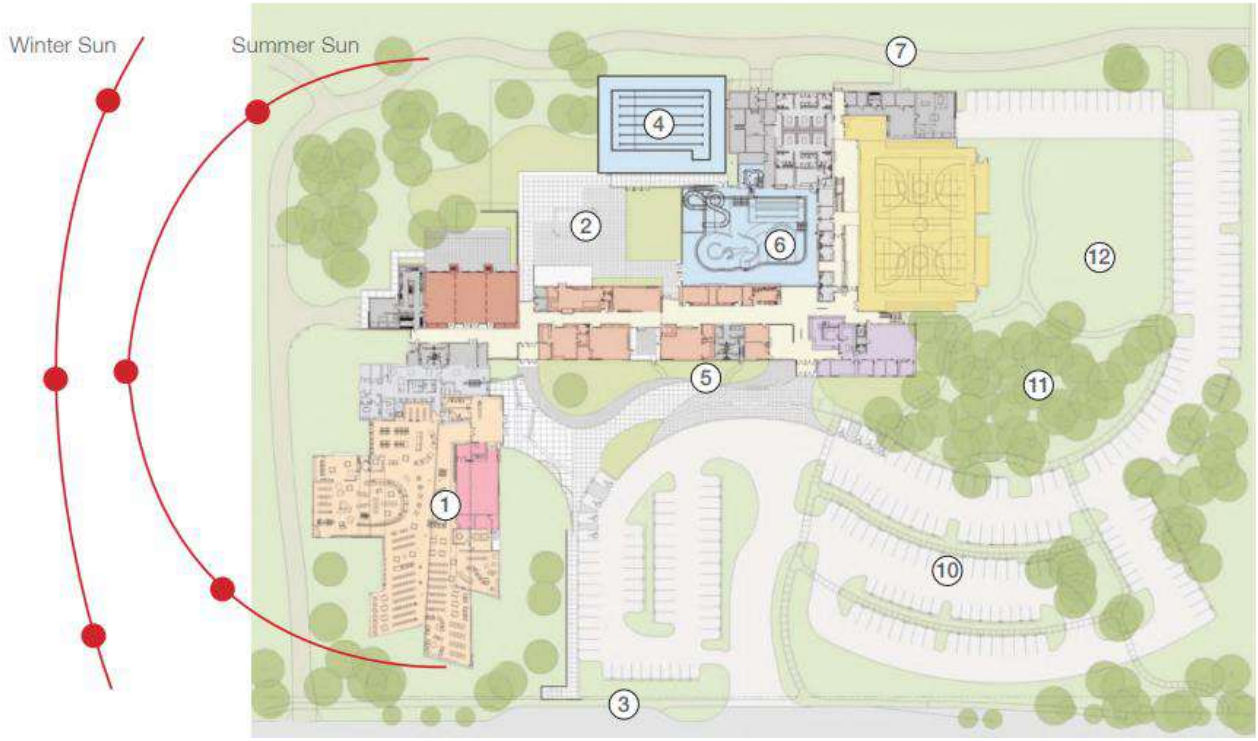
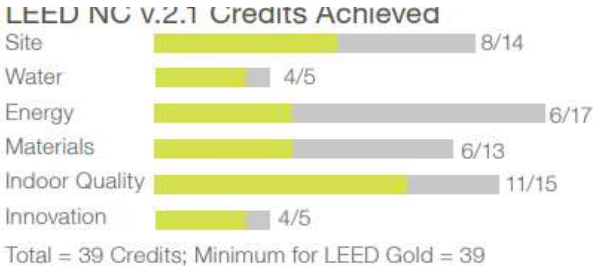


Figure 3.1.3. Master Plan of Firsternberg Community Center



- Use of alternative transportation is encouraged by building a bus stop and shelter, providing ample bike parking and designated carpool parking and creating pedestrian links to an adjacent park and future regional trail.
- The parking lot's organic shape maximizes the number of significant existing trees retained, while its use of porous concrete and drainage swales means that all of the stormwater is managed on site with no impact on the municipal system.

Figure 3.1.3 Ground Floor Plan

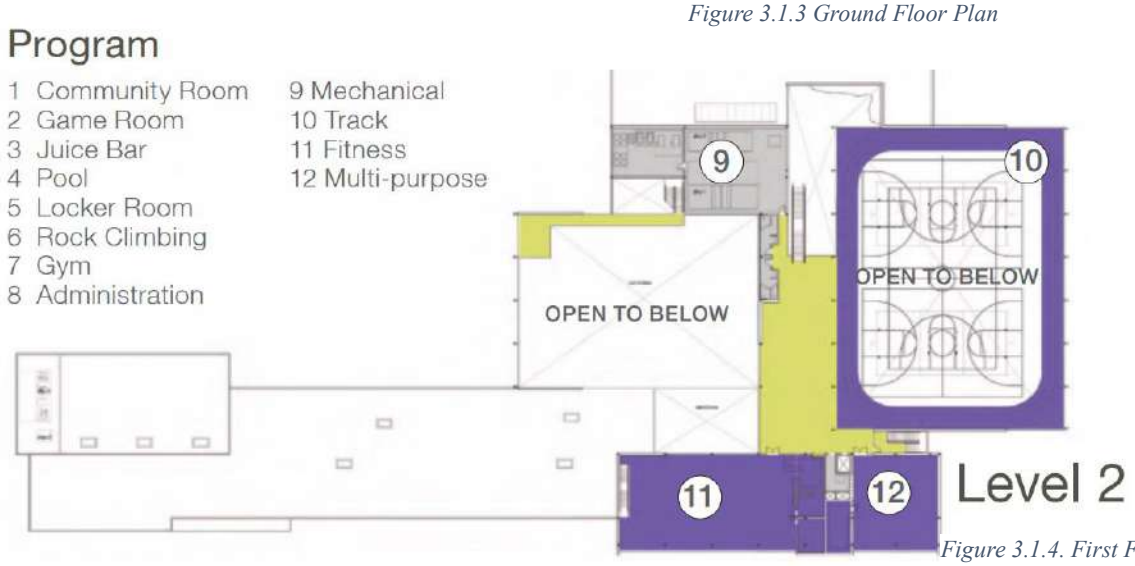
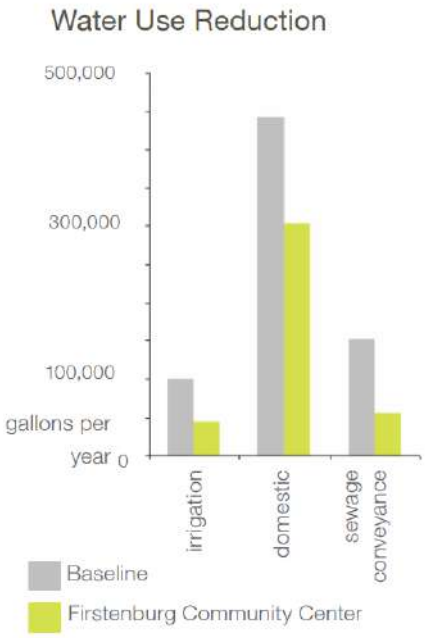


Figure 3.1.4. First Floor Plan



Water Cycle

- By carefully selecting drought tolerant native plants that can survive the region's dry summers and using high efficiency irrigation technology, water use for irrigation was reduced by over 50%.
- Water use inside the building was reduced by 31% over a baseline building, while water use for sewage conveyance was reduced by 63%.
- This is achieved through the use of waterless urinals and low flow fixtures, as well as by using graywater from the pool's filter backwash system to flush many of the building's toilets. Approximately 60,000 gallons of 'recycled' graywater are used annually.

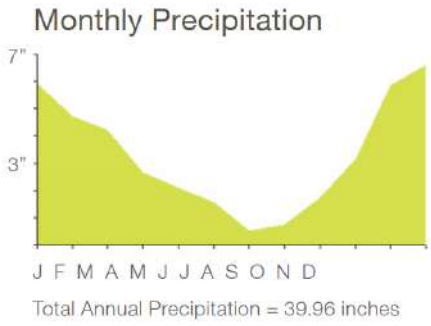


Figure 3.1.5. Swimming Pool Images

Energy Flow

- Sustainability goals identified at an early design charette highlighted maximization of transparency between spaces, using daylight throughout the entire building, reinforcing opportunities for passive cooling, creating strong connections to the site and providing a welcoming open display of recreation and community spaces.
- These forces resulted in a long thin building footprint that allows for exceptional daylight and cross ventilation, while creating a large protected south facing courtyard.
- Radiant concrete slab floors are heated or chilled to maintain comfortable temperatures throughout the year while using minimal energy. The mass of the concrete in the floor as well as in exposed thermally massive walls effectively stores heat or coolness to decrease the effect of exterior temperature swings.
- Other passive systems such as automated natural ventilation and solar shading devices that block heat gain from direct sun in the summer, but allow it during the winter work in tandem with the thermal mass and mechanical systems.

Materials and Construction

- Throughout this heavily-used facility, materials have been selected for their durability, beauty, and sustainability. A strong emphasis is placed on natural, non-toxic enduring materials that will be attractive for decades to come, while also eliminating material use altogether when possible.
- Douglas fir trees, many of which were diseased, were harvested from the site and milled locally for 12,000 board feet of material used as wall paneling, screens, benches and bleacher seats.
- The bamboo community room flooring and acoustical wall paneling made from perforated wheatboard are quick growing 'rapidly renewable' materials.
- Recycled materials such as the glass wall tiles used in the locker rooms and natatorium make up nearly 30% of all construction materials used.

Awards

Northwest Pacific Region AIA Merit Award 2008
Portland Chapter AIA Merit Award 2008
Portland Chapter AIA Sustainable Design Award 2006
ASHRAE Technology Award, 2007 First Place
Athletic Business Magazine Facility of Merit Award 2007
Washington Recreation and Park Association Spotlight Award 2007
Vancouver Community Pride Award 2006

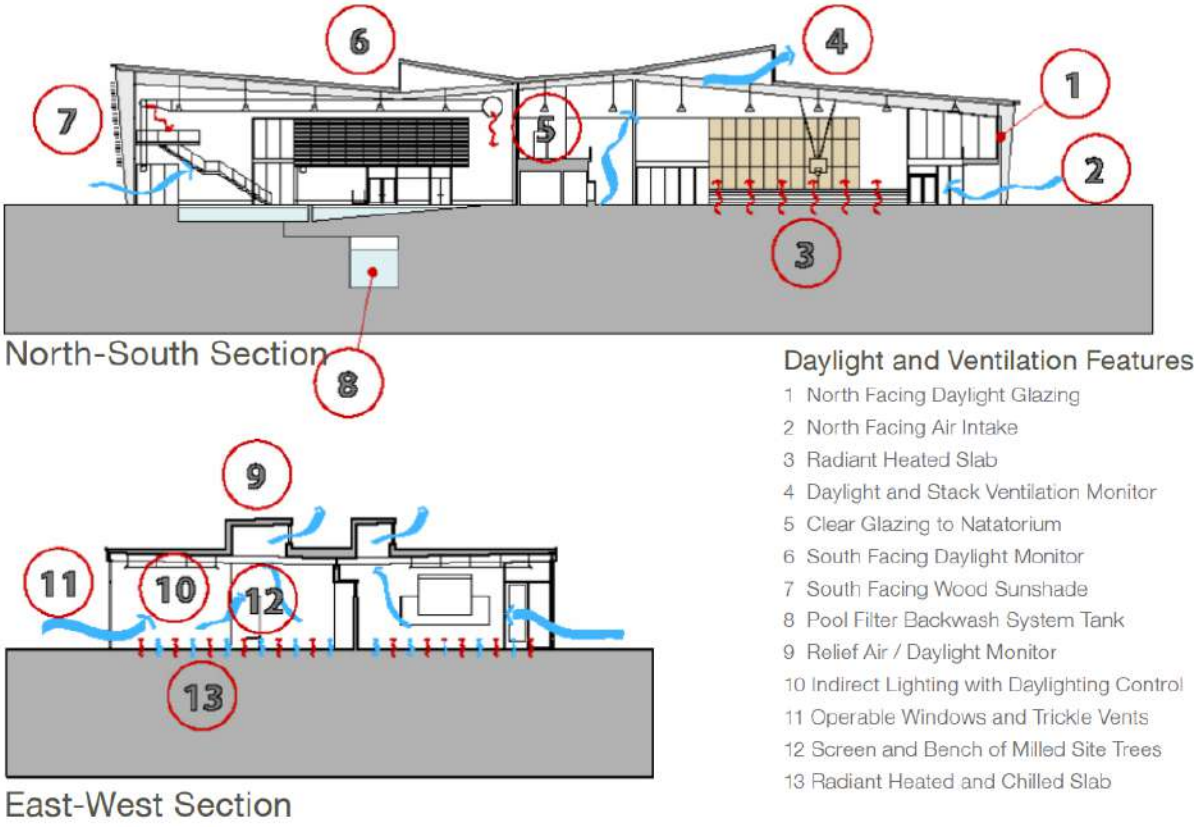
29%
Recycled Materials used for Construction

56%
Of Wood Base Building Products are Forest Stewardship Council Certified

41%
Regional Materials Manufactured within 500 Miles used for Construction

99.4%
Construction Waste was Recycled

Indoor Quality



- Ample daylighting, natural ventilation and non-toxic finishes help Firstenburg Community Center provide a healthy environment for the community's health and recreation activities.
- The design team used the Portland Daylighting Lab's artificial sky to model a variety of monitor and sunshade configuration possibilities, and a three dimensional model simulating air patterns and space temperatures was created in order to refine the natural ventilation systems.
- These efforts resulted in east-facing roof monitors with windows operated by sensor-activated actuators to provide deep penetration of daylight into the building and natural stack ventilation as well as north facing monitors at the gymnasium to provide natural stack ventilation and throw daylight deep into the building for balanced, glare-free natural light.
- Air quality is further improved by CO2 sensors and low level trickle vents that ensure sufficient ventilation while minimizing energy loads.

3.1.2 Sports Center in Leoberg

Project Details

Name: Sports Center in Leoberg

Location: Germany

Project Year: 2014 A.D.

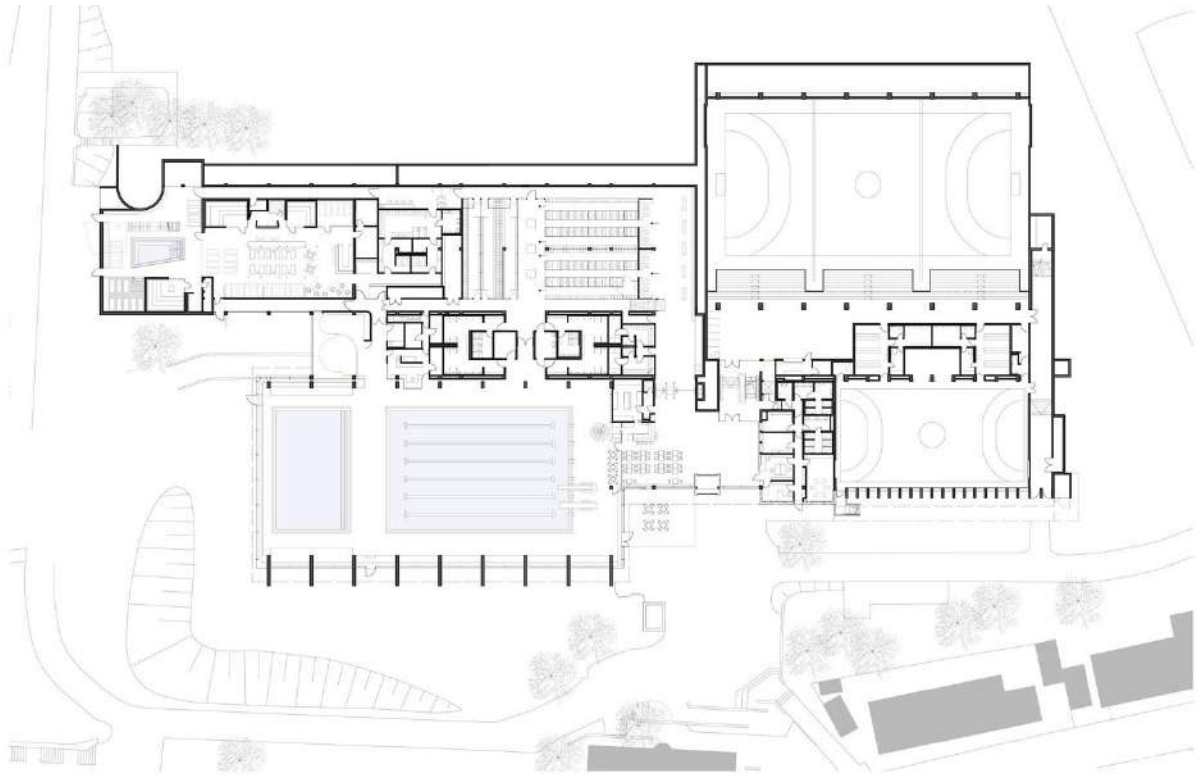
Architect: 4a Architekten

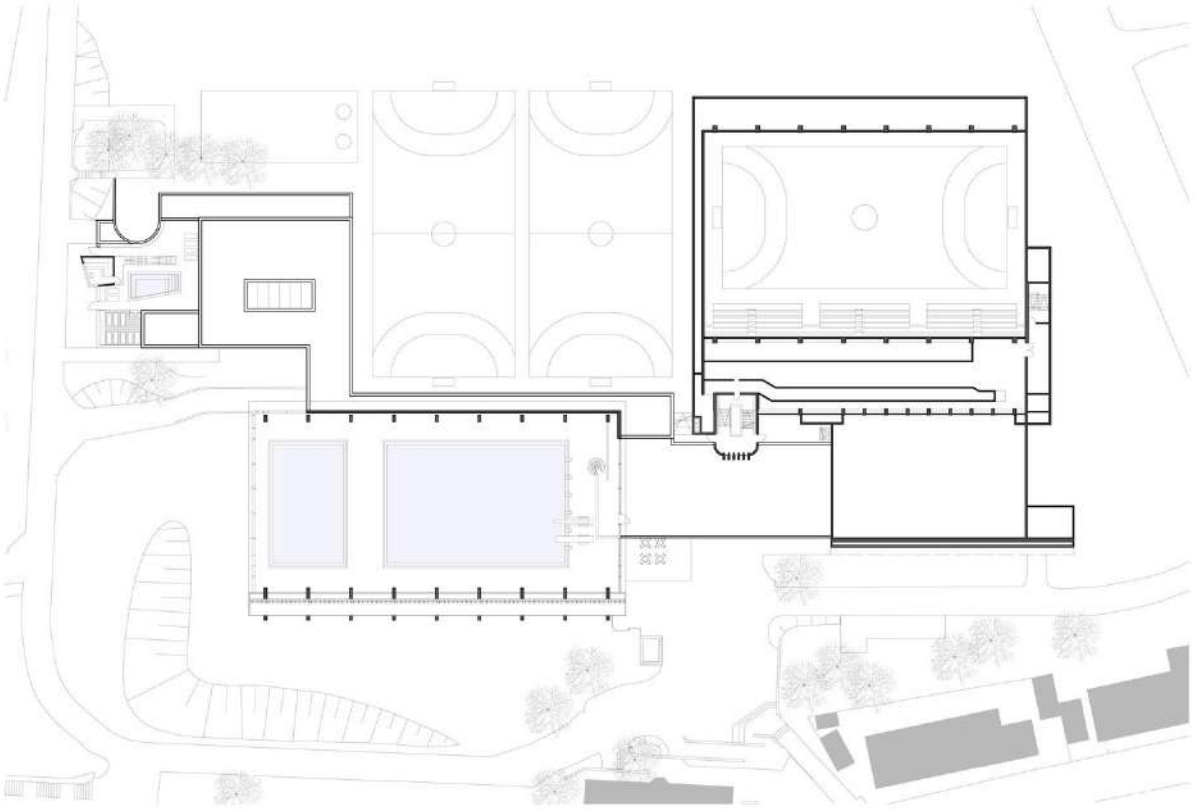
Area: 10,490 sq. m.

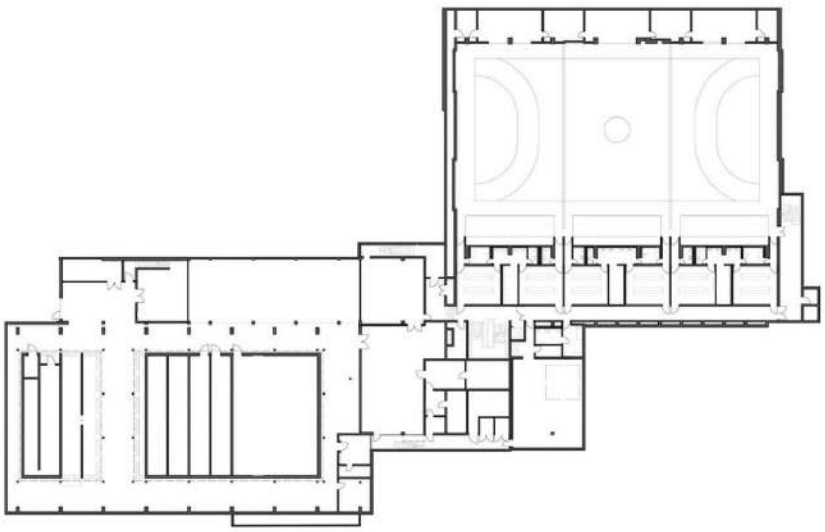
In a local referendum the people of Leonberg voted by a clear majority in favour of the redevelopment of the existing sports centre. This not only involved a new build but also to give the existing structure a new distinctive form. The aim of the redevelopment was to increase the appeal and feel-good factor of the baths and sports halls and to update the technical features of the building.

Design Features

- The triangular shape of the bathing hall continues to characterize the building complex. In order to optimize energy efficiency, all the glass facades in the building have been replaced – the external appearance of the sports centre therefore remains virtually unchanged.
- All the more surprising is the interior of the refurbished and remodeled building complex. The aim here was to optimize the sports centre with regard to its functional requirements and atmospheric effect using minor structural measures.
- In order to achieve this, the architects have created new floor plans and optimized the layout of routes in the foyer and adjoining rooms.
- The contemporary material and color design lends the interior an identity of its own and ensures that the whole building gives a pleasant sense of space.
- For the purposes of orientation, the architects have taken up the old color guidance system that characterizes the whole building with its color coding: blue guides visitors to the bathing hall while green leads them to the changing areas; orange shows the way to the large sports hall and yellow indicates the way to the gymnasium.







3.2. REGIONAL CASE STUDY

3.2.1 Panyaden Bamboo Sports Hall

Project Details

Name: Panyaden Bamboo Sports Hall

Location: Chiang Mai, Thailand

Project Year: 2017 A.D.

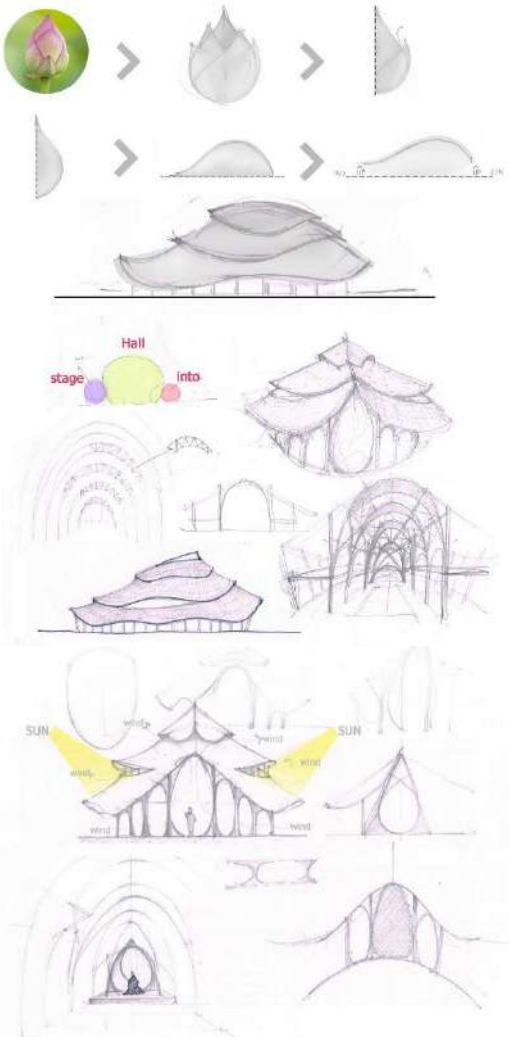
Architect: Chiang Mai Life Construction

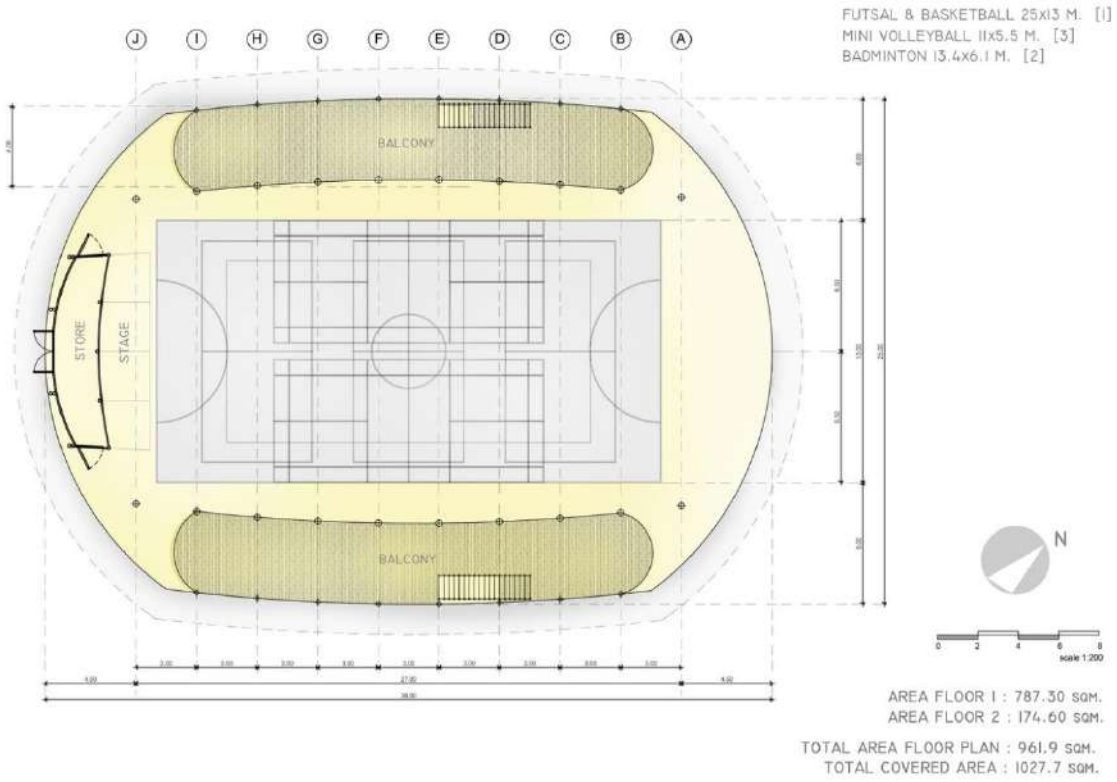
Area: 782 sq. m.

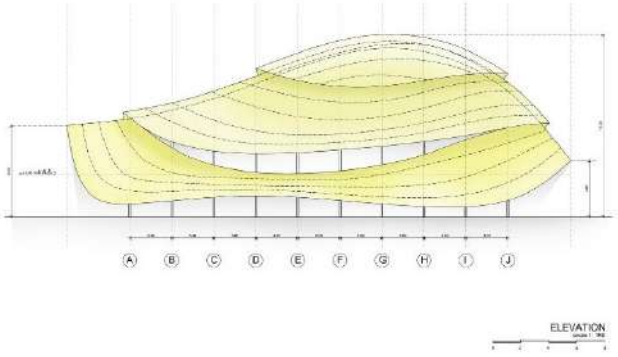
Chiangmai Life Architect's Bamboo Sports Hall for Panyaden International School combines modern organic design, 21st-century engineering, and a natural material – bamboo.

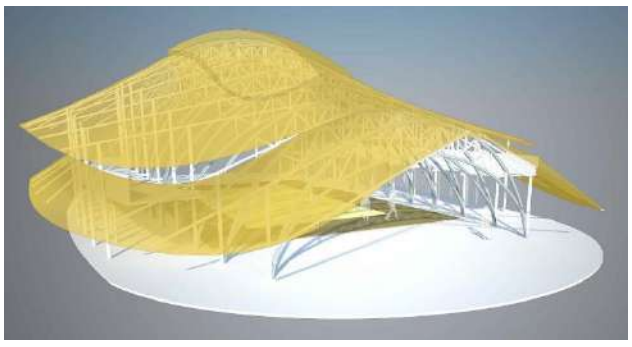
Design and Concept

- The design was based on the Lotus flower that embodies the Buddhist teachings which are at the heart of the school's vision.
- Holds the projected capacity of 300 students.
- Smoothly integrates with the previous earthen and bamboo buildings of the school as well as the natural hilly landscape of the area.
- The hall covers an area of 782 sqm and hosts futsal, basketball, volleyball, and badminton courts, as well as a stage that can be lifted automatically.




FUTSAL & BASKETBALL 25x13 M. [1]
MINI VOLLEYBALL 11x5.5 M. [3]
BADMINTON 13.4x6.1 M. [2]
J I H G F E D C B A
BALCONY
STORE
STAGE
BALCONY
N
AREA FLOOR 1 : 787.30 SQM.
AREA FLOOR 2 : 174.60 SQM.
TOTAL AREA FLOOR PLAN : 961.9 SQM.
TOTAL COVERED AREA : 1027.7 SQM.


A B C D E F G H I J
ELEVATION



Low Carbon Footprint

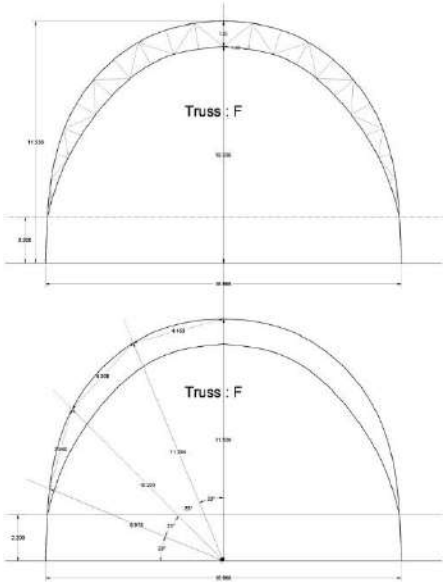
- Maintains the low carbon footprint and the “Green School” mission of Panyaden.
- Panyaden’s Sports Hall’s carbon footprint is zero.
- The bamboo used absorbed carbon to a much higher extent than the carbon emitted during treatment, transport, and construction.

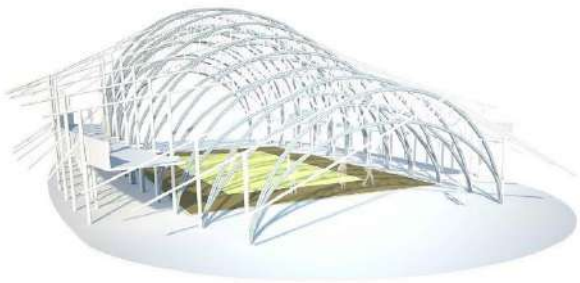
Bamboo Treatment

- The bamboo was all well selected for age and treated with borax salt.
- No toxic chemicals were involved in the treatment process.
- The life span of the bamboo hall is expected to be at least 50 years.

Structural Design

- Based on newly developed prefabricated bamboo trusses with a span of over 17 meters without steel reinforcements or connections.
- These trusses were prebuilt on-site and lifted into position with the help of a crane.





3.2.2 The Arc at Green School, Bali

Project Details

Name: The Arc

Location: Bali, Indonesia

Project Year: Completed-2021

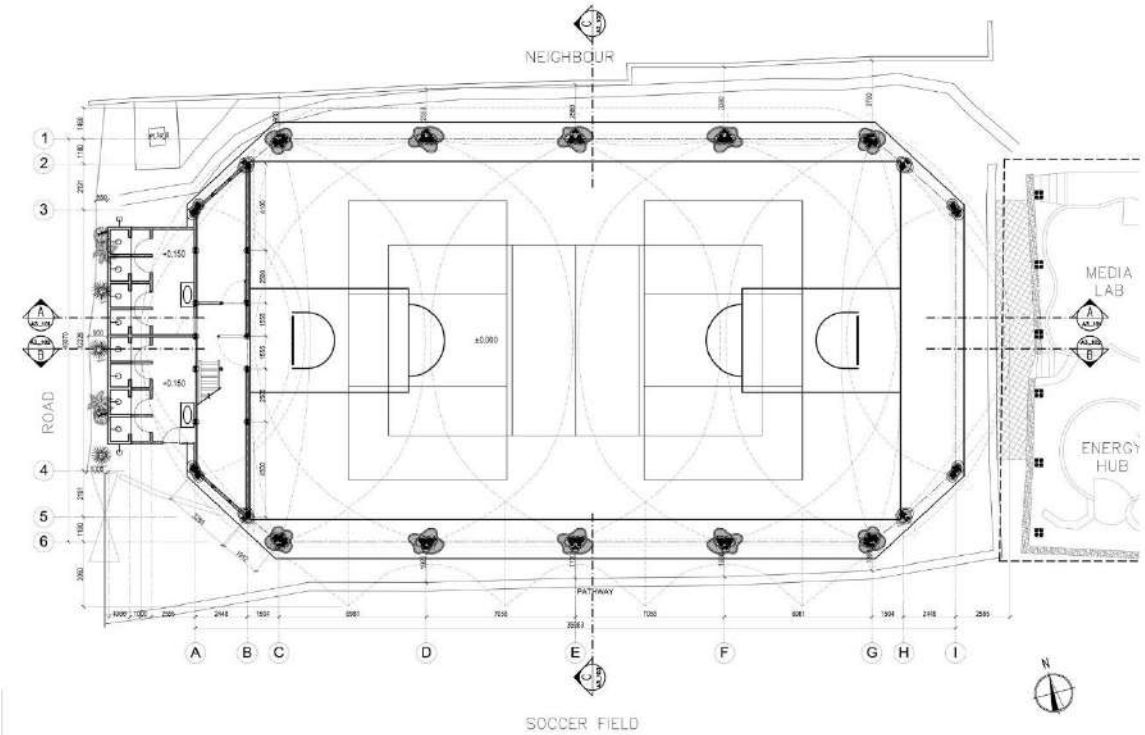
Architect: IBUKU,

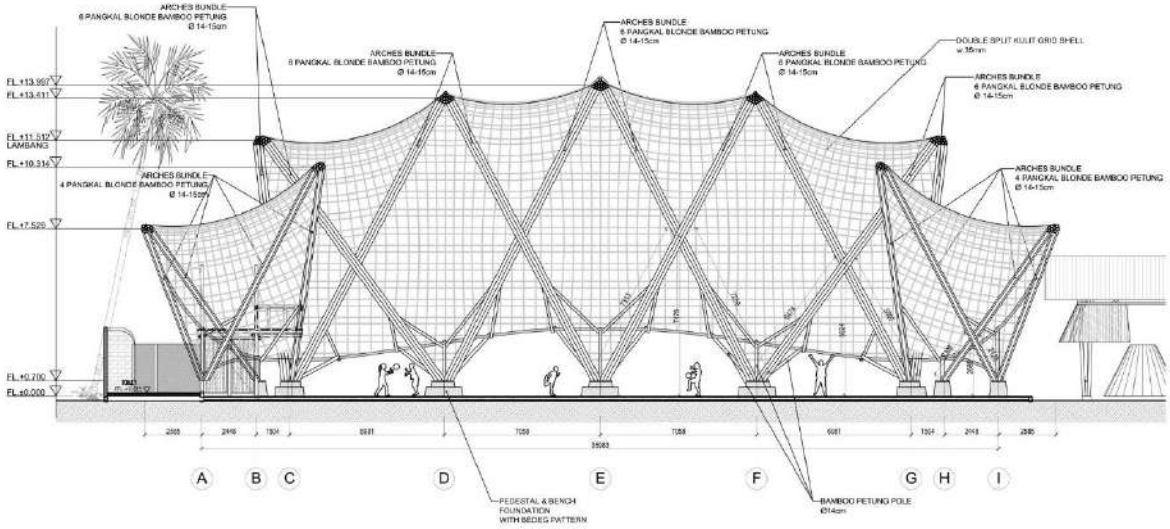
Area: 760 sq. m.

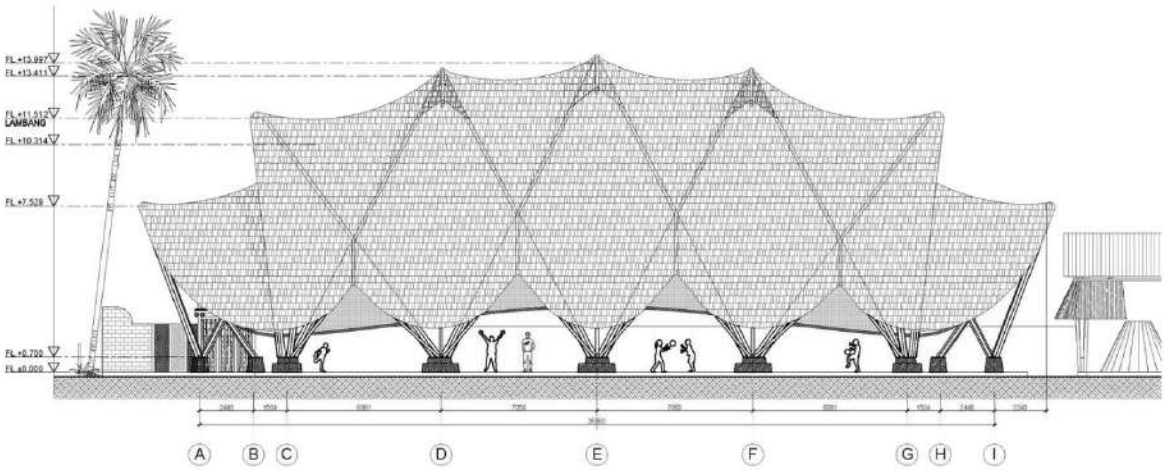
The Arc is a gymnasium for a school in Bali. “Green School” a private educational institution that promotes sustainability through learning in a natural environment. Featuring a complex double-curved roof made entirely from bamboo.

Design and Concept

- The building's organic form and structural system were inspired by natural systems, in particular the way our ribcages are held in place by the tension from an outer layer of muscle and skin.
- "Biologically, these highly tensile microscopic tendons transfer forces from bone to bone,"
- "In The Arc, bamboo splits transfer forces from arch to arch."
- Spaces around the base of the canopy allow breezes to flow through, providing natural ventilation.
- Vents at the roof's apex also allow warm air to escape.


NEIGHBOUR
ROAD
MEDIA LAB
ENERGY HUB
PATHWAY
SOCCER FIELD
1
2
3
4
5
6
A
B
C
D
E
F
G
H
I
N


ARCHES BUNDLE
6 PANGKAL BLONDE BAMBOO PETUNG
Ø 14-15cm
ARCHES BUNDLE
4 PANGKAL BLONDE BAMBOO PETUNG
Ø 14-15cm
DOUBLE SPLIT KULIT GRID SHELL
w.35cm
FL.+13.957
FL.+13.611
FL.+11.512
LAMBANG
FL.+10.316
FL.+7.525
FL.+0.700
FL.±0.000
A
B
C
D
E
F
G
H
I
PEDESTAL & BENCH
FOUNDATION
WITH BEDEG PATTERN
BAMBOO PETUNG POLE
Ø14cm


FL.+13.997
FL.+13.411
FL.+11.512
LAMBANG
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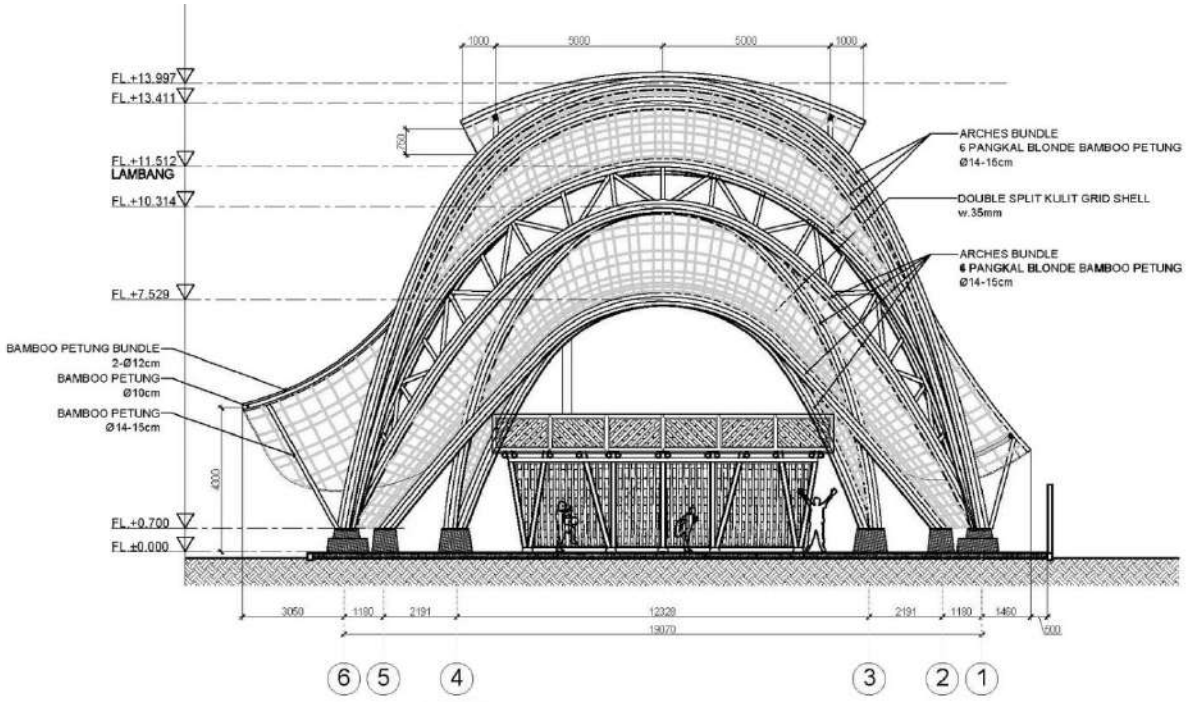
1000
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FL.+13.997
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LAMBANG
FL.+10.314
FL.+7.529
FL.+0.700
FL.±0.000
ARCHES BUNDLE
6 PANGKAL BLONDE BAMBOO PETUNG
Ø14-15cm
DOUBLE SPLIT KULIT GRID SHELL
w.35mm
ARCHES BUNDLE
6 PANGKAL BLONDE BAMBOO PETUNG
Ø14-15cm
BAMBOO PETUNG BUNDLE
2-Ø12cm
BAMBOO PETUNG
Ø10cm
BAMBOO PETUNG
Ø14-15cm
4000
3050
1180
2191
12329
2191
1180
1460
500
19070
6
5
4
3
2
1

Structural Design

- The lightweight structure features bamboo arches that support an organically shaped canopy.
- The 14-metre-high arches are connected by anticlastic grid shells that curve in two directions to create a robust, tensioned structure.
- The arches supporting the pavilion's roof span 19 meters and allow for a large floor area that is uninterrupted by supporting columns.

3.2.3 The Lumi Shala

Project Details

Name: The Lumi Shala

Location: Ubud, Indonesia

Project Year: Completed-2023 A.D.

Type: Hospitality, Wellness

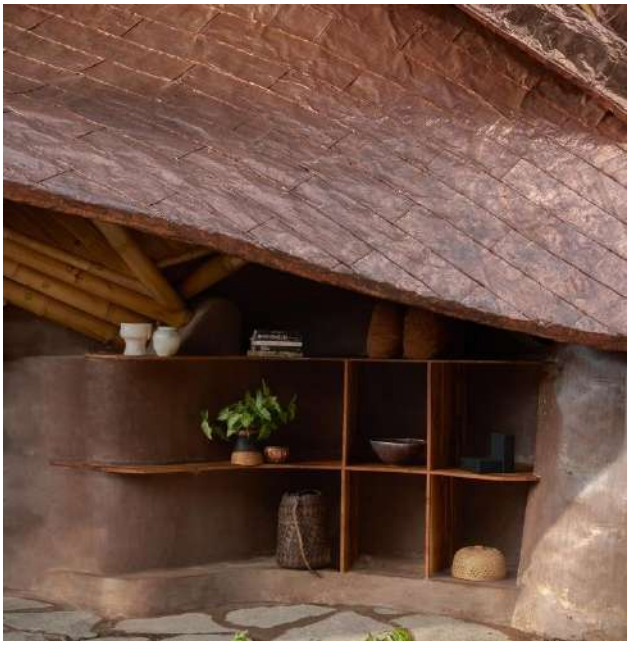
Architect: IBUKU,

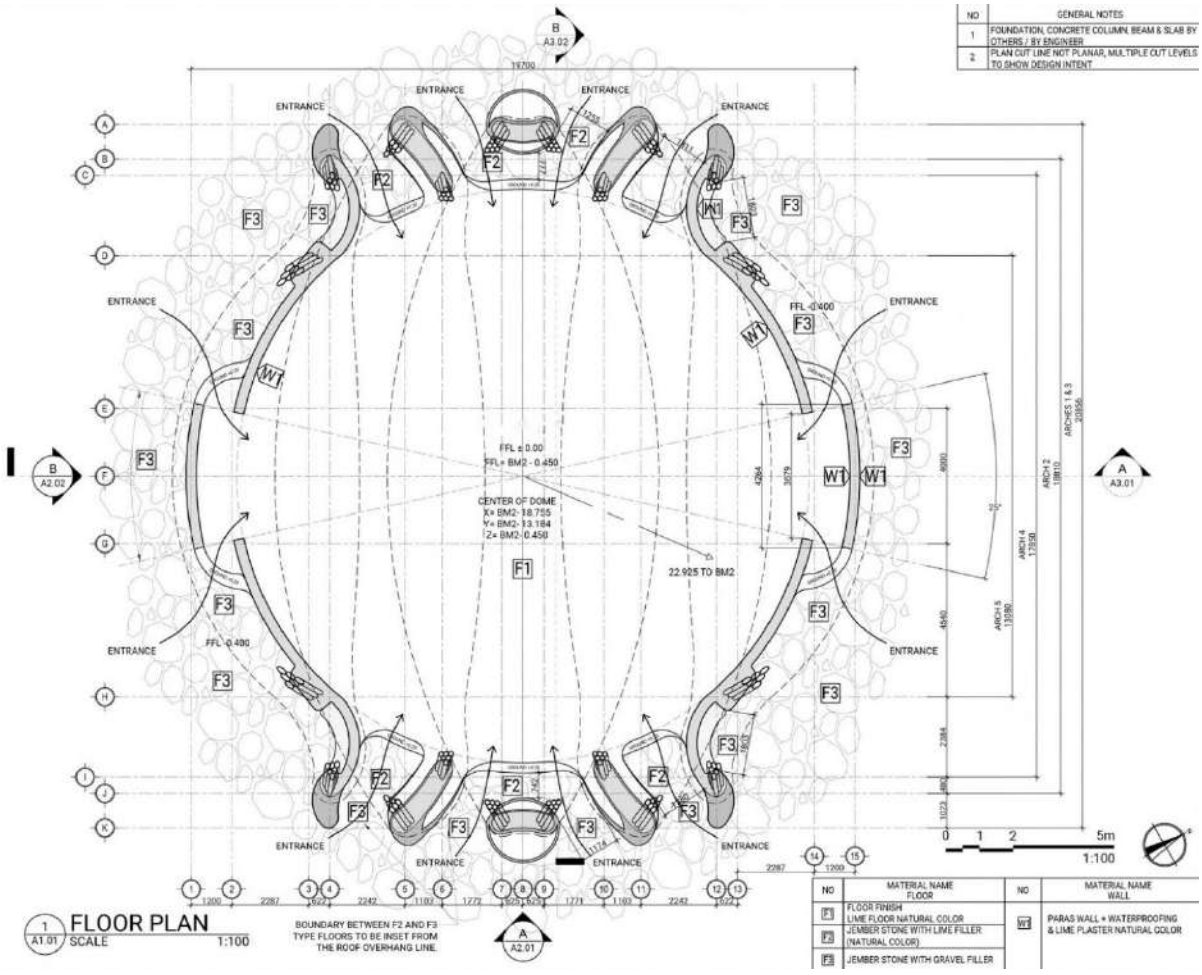
Area: 227 sq. m.

The Lumi Shala is a wellness space at the Alchemy Yoga Center in Bali. Featuring natural materials with artisanal and innovative systems, its form facilitates balance. Encircled by earthen walls that offer support for yoga practices, it has a comforting sense of enclosure.

Design Concept

- Bamboo arches soar overhead from mounded foundations, a balance that reflects the human form, grounding and extending.
- Five grid shell roof petals are arranged for gradients of natural light to wash across each convex interior, bringing focus inward while illuminating a space that best helps us embody the yoga practice.



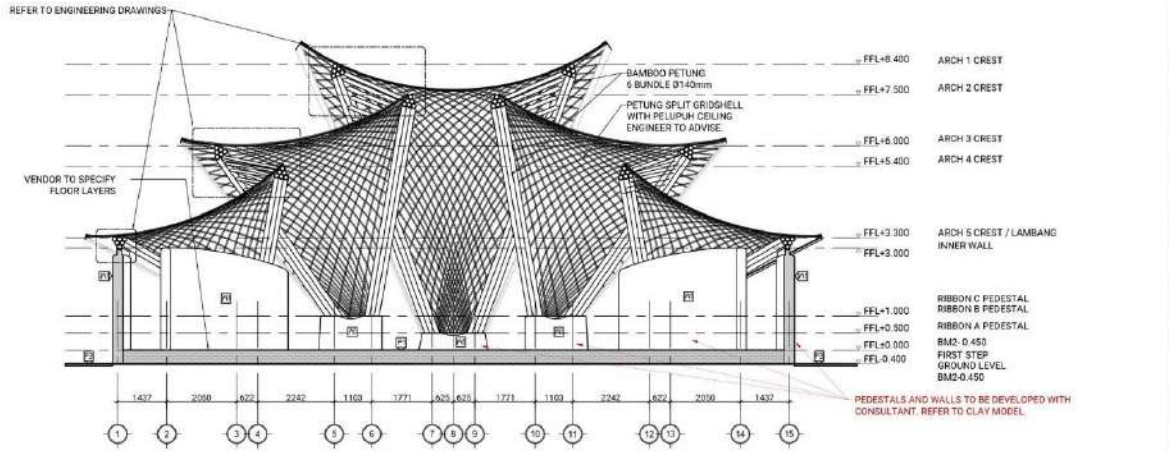


1 A1.01 **FLOOR PLAN** SCALE 1:100

NO	GENERAL NOTES
1	FOUNDATION, CONCRETE COLUMN, BEAM & SLAB BY OTHERS / BY ENGINEER
2	PLAN CUT LINE NOT PLANAR, MULTIPLE CUT LEVELS TO SHOW DESIGN INTENT

NO	MATERIAL NAME FLOOR
F1	FLOOR FINISH LIME FLOOR NATURAL COLOR
F2	JEMBER STONE WITH LIME FILLER (NATURAL COLOR)
F3	JEMBER STONE WITH GRAVEL FILLER

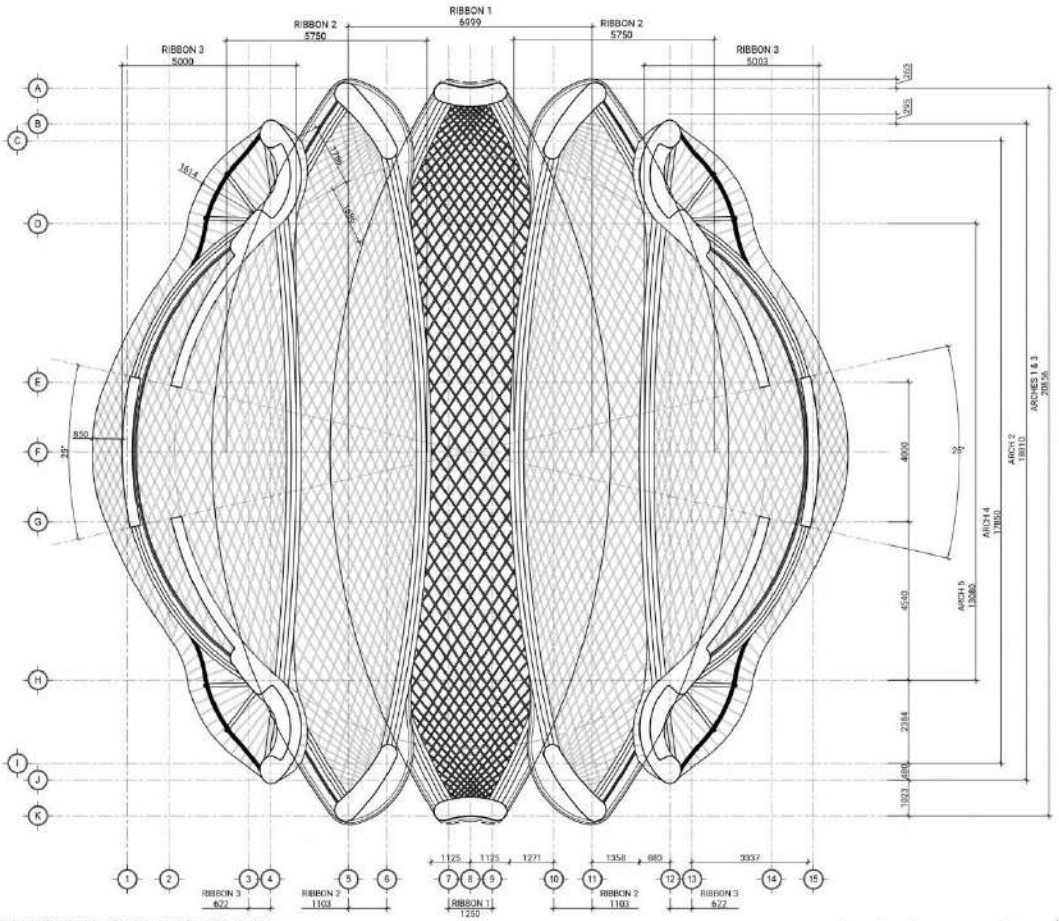
NO	MATERIAL NAME WALL
W1	PARAS WALL + WATERPROOFING & LIME PLASTER NATURAL COLOR



A A3.01 **SECTION A** SCALE 1:100

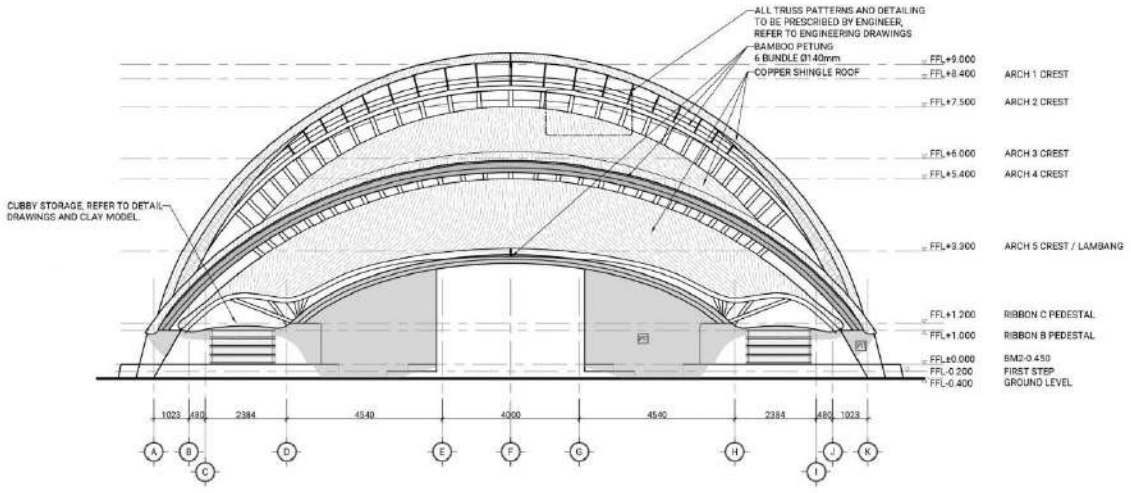
NO	MATERIAL NAME FLOOR
F1	FLOOR FINISH LIME FLOOR NATURAL COLOR
F3	FLOOR FINISH JEMBER STONE WITH GRAVEL INFILL

NO	MATERIAL NAME WALL
W1	PARAS WALL + WATERPROOFING & LIME PLASTER NATURAL COLOR



1 / A1.03 REFLECTED CEILING PLAN
SCALE 1:100

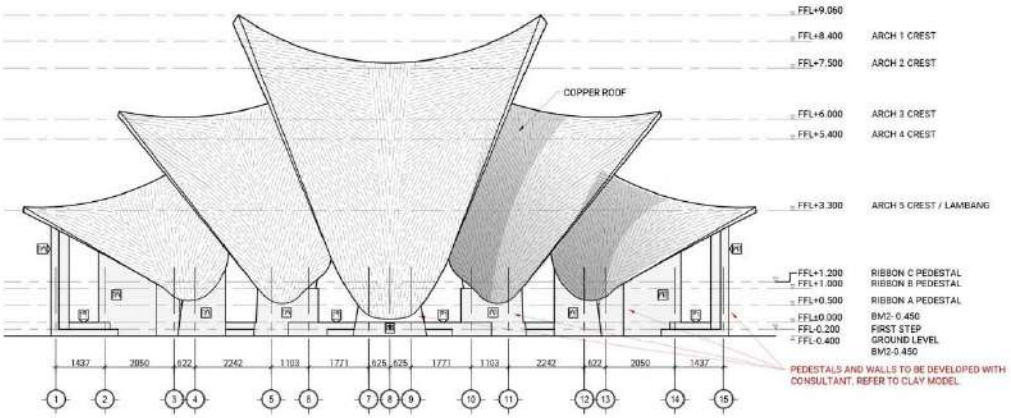
0 1 2 5m
1:100



0 1 2 5m
1:100

B / A2.02 ELEVATION B
SCALE 1:100

NO	MATERIAL NAME WALL
W1	PARAS WALL + WATERPROOFING & LIME PLASTER NATURAL COLOR



0 1 2 5m
1:100

A2.01 ELEVATION A
SCALE 1:100

NO	MATERIAL NAME FLOOR	NO	MATERIAL NAME WALL
F1	FLOOR FINISH LIME FLOOR NATURAL COLOR	W1	PARAS WALL + WATERPROOFING & LIME PLASTER NATURAL COLOR

Structural Design

- Arranged in a dynamic new orchestration to achieve clear spans of 21m.
- The Lumi Shala uses prescriptively curved and meticulously detailed bundled bamboo arches tied together with structural anticlastic grid shells.
- In the gaps between the five overlapping roof surfaces are deep trusses, artfully angled so as not to be seen from the interior, which gives way to a feeling of airy lightness.
- "The Copper Shingles reflect warm golden light onto the bellies of the blonde bamboo ceilings inside, inspiring feelings of lightness and freedom,"

3.2.4 Kura Kura Badminton Court

Project Details

Name: Kura Kura Badminton Courts

Location: Indonesia

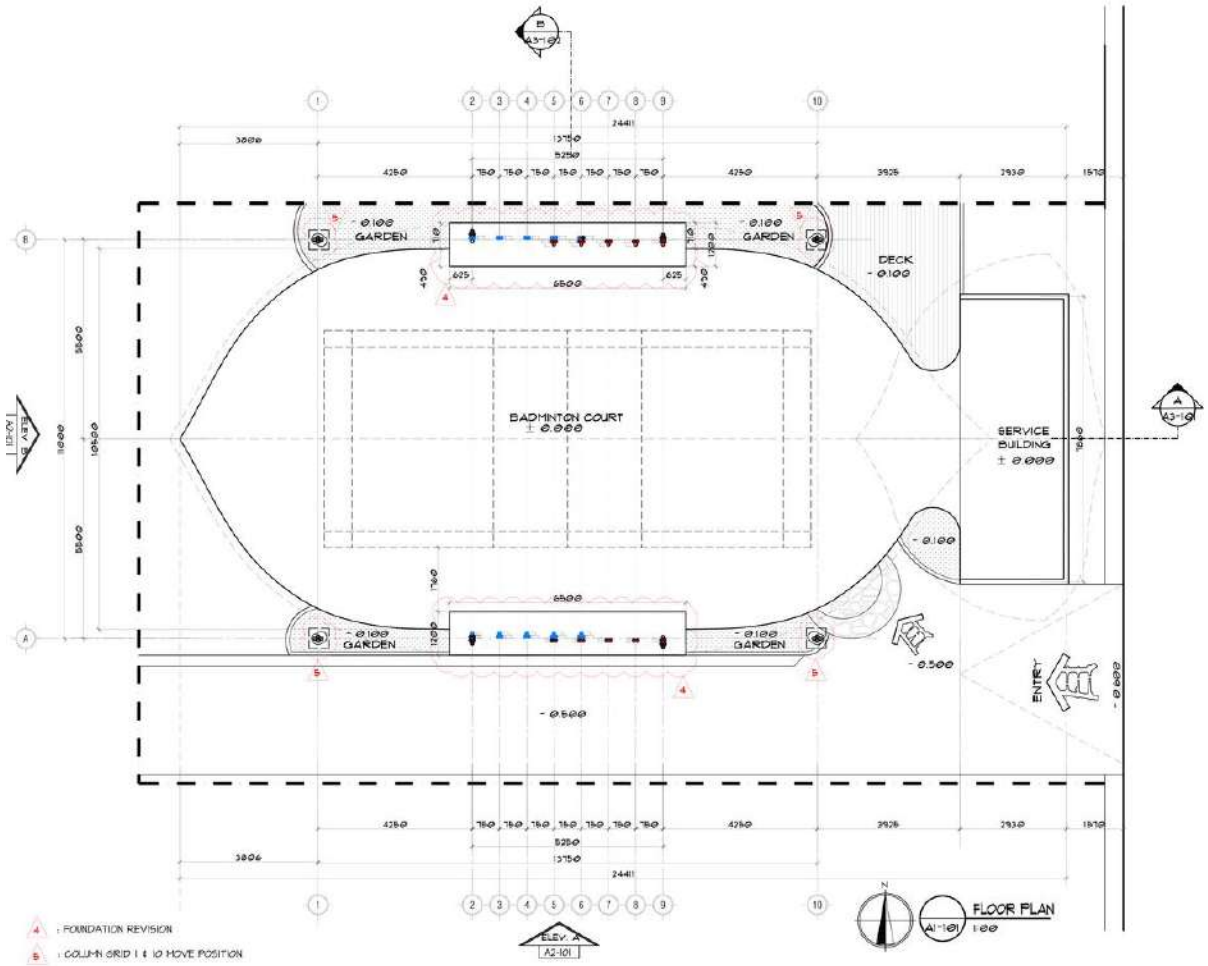
Project Year: 2016 A.D.

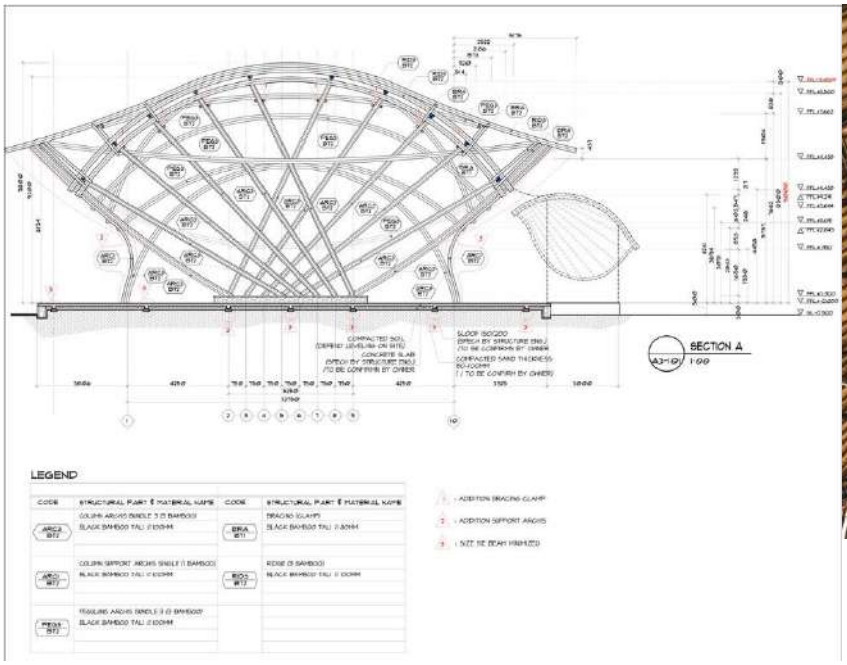
Type: Sports Architecture

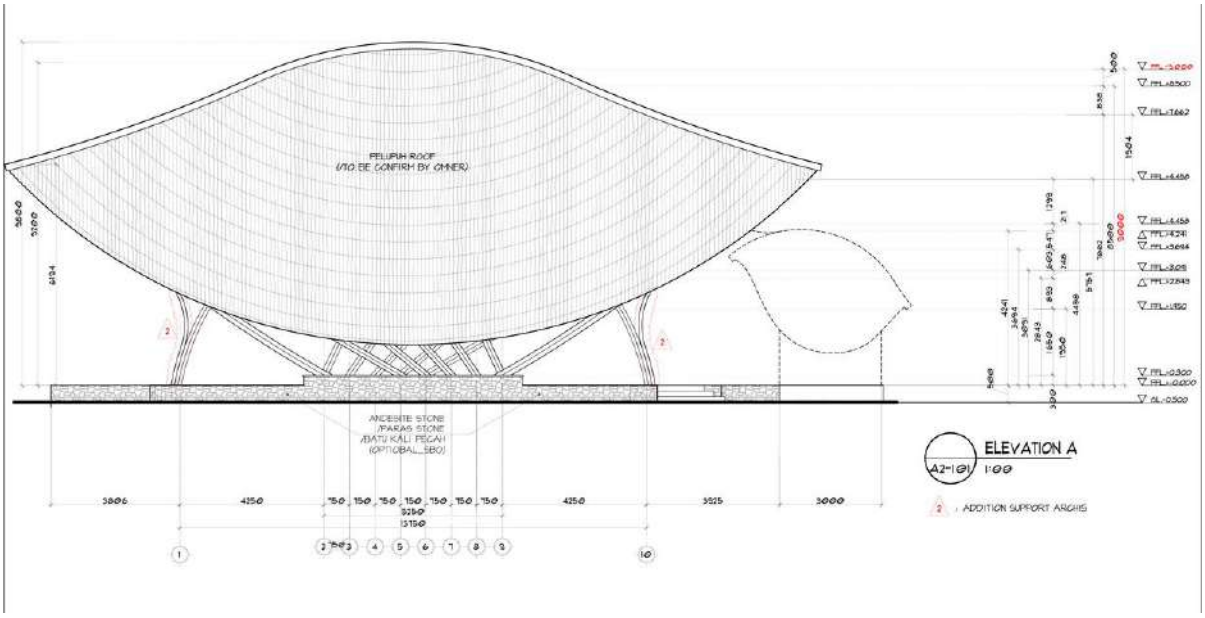
Architect: IBUKU,

Area: 300 sq. m.

- The initial concept to build Kura Kura started with Studio Jencquel as part of a larger real estate endeavor that they had developed (Rumah Hujan Estate).
- The studio had some spare land that was close to the street, and unused for "rooms". They saw the opportunity to build something that would also create a barrier or buffer between the street and the guest living areas of the property.
- The land was too small for a tennis court, so Maximillian Jencquel decided to create a badminton court. It is a national sport in Indonesia and all kids learn how to play it in school as there is a very competitive professional level in the country.
- Having never practices the sport himself, he started to research, and understand the constraints that are needed for a professional court.


BADMINTON COURT
± 0.000
SERVICE BUILDING
± 0.000
DECK
- 0.100
GARDEN
- 0.500
ENTRY
FLOOR PLAN
1:100
ELEV. A
A2-101
4 : FOUNDATION REVISION
5 : COLUMN GRID 1 & 10 MOVE POSITION


SECTION A
1:100
LEGEND



- Among them was the shape of the building in relation to the flight of the shuttle cock. The trajectory is parabolic and needs a minimum height clearance of 9m, which is quite high.
- Maximillian Jencquel didn't want a building that would stand out in the neighborhood like a tall box, so caressing the shape of the trajectory of the shuttle cock flight seemed to be the obvious choice. This meant the building would have bold curves.
- Though many materials can be considered for building such a shape, the obvious choice for budget, time, and geographical location, was to use bamboo.

3.2.5 Yoga and Spa

Project Details

Name: Yoga and Spa

Location: Ubud, Indonesia

Project Year: 2022 A.D.

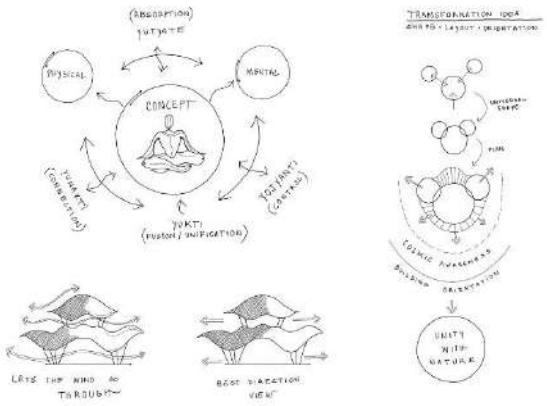
Type: Hospitality, Wellness

Architect: Pablo Luna Studio

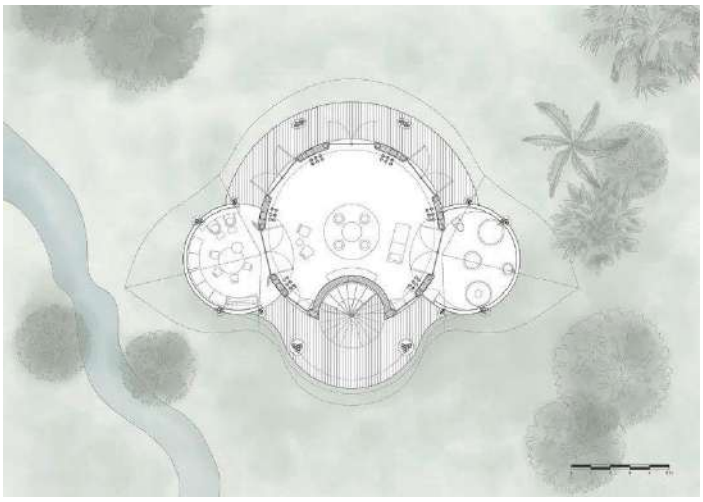
Area: 196 sq. m.

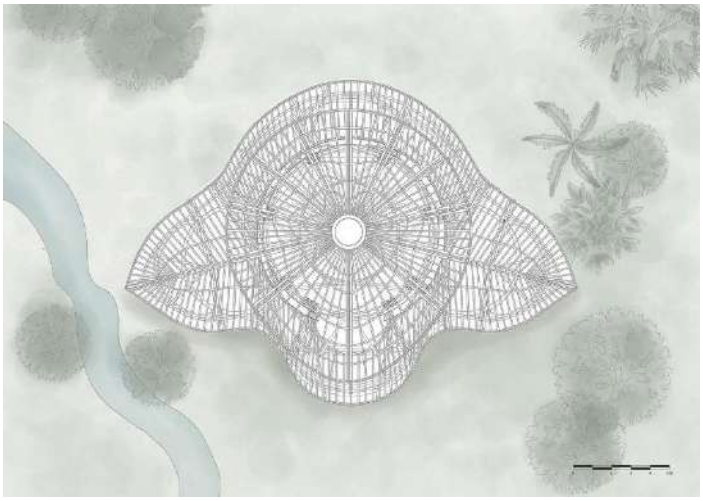
The Yoga & Spa is a space designed for a family as their sacred space, celebrating the interplay between physical, mental and spiritual practices. Inspired by the fluid movements of the surrounding flora and the practice of yoga, the architecture features expressive bamboo arched frames that gracefully embrace the captivating views.

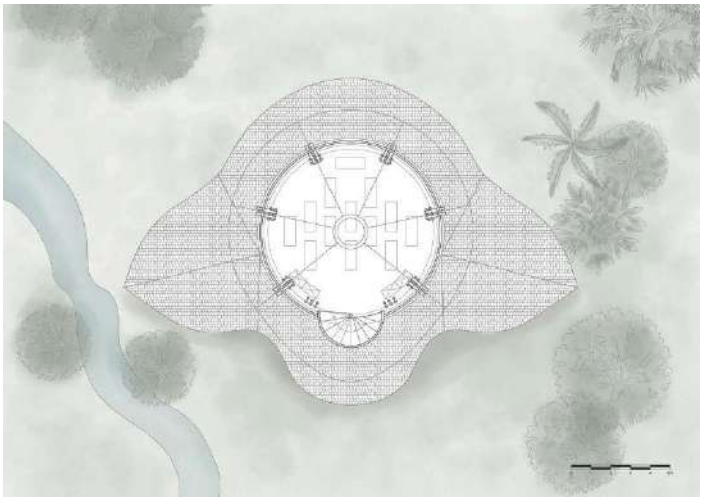
- Inspired by the movements of the flora at the site with expressive arches framing the views, this building motivates us to contemplate our surroundings from a new lens of love and compassion.
- A circle-shaped first floor surrounded by polished concrete walls, adorned with arched metal profile windows, and bamboo details.
- The central multifunctional area is used for massage sessions, dance classes, and art workshops, and invites relaxation and rejuvenation, with a window-framed view of the surroundings. Next to it, is the pottery area, an open space that offers a space dedicated to both creative work and teaching.

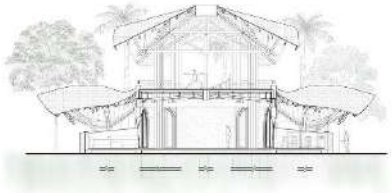


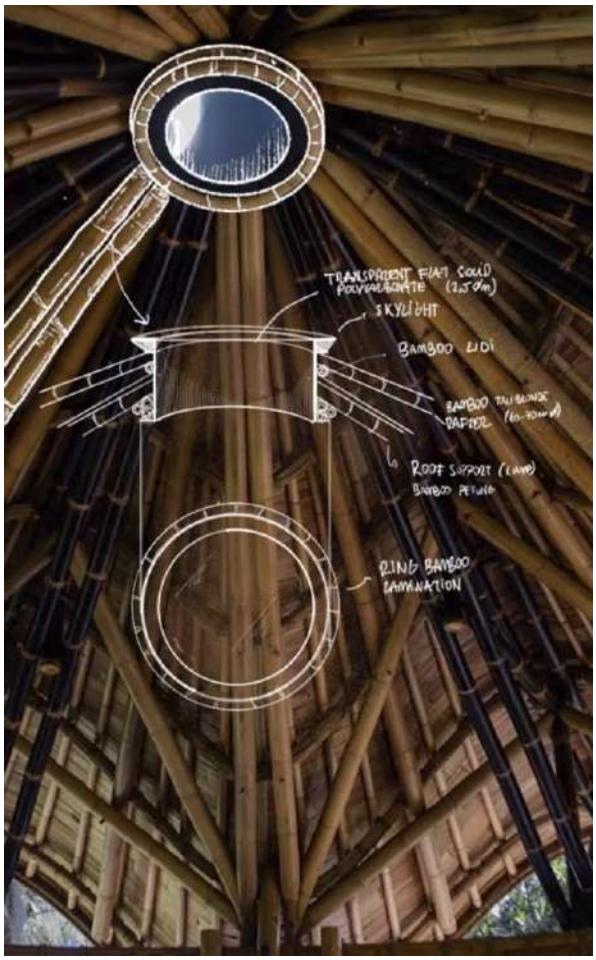
- Completing the second floor, a semi-open, polished concrete bathroom with bamboo structure and stone details offers a harmonious blend of practicality and aesthetics, ensuring moments of tranquility and comfort.
- An elegant spiral bamboo staircase connects to the second floor, where the Yoga Shala is located. Adopting an open-air concept, this area features striking bamboo arches that frame 360-degree panoramic views, fostering a deeper connection with the environment and nurturing a sense of compassion and appreciation.
- The Yoga Shala is enveloped by the natural beauty of bamboo. The ceiling stands out for its combination of black and yellow bamboo and a skylight in the center.



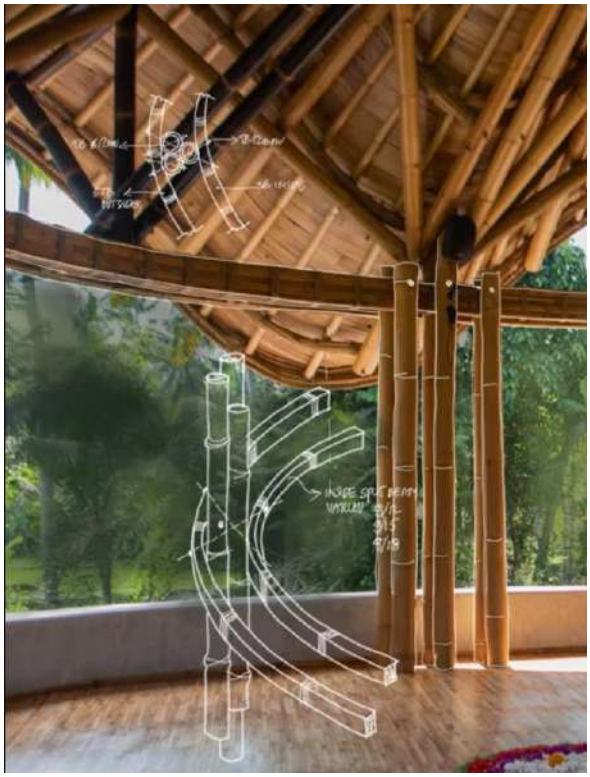







TRANSPARENT FLAT SOLID POLYCARBONATE (2.5 dm)
SKYLIGHT
BAMBOO LIDI
BAMBOO TALI BINDING RAFTER
ROOF SUPPORT (LAMA) BAMBOO PETUNG
RING BAMBOO LAMINATION


DOUBLE RIDGE PURLIN @ ø 12 cm
RAFTER TALI BAMBOO ø5~6
WIRED
DOUBLE ROOF PURLIN @ ø 12 cm (CLAMP)



3.3. NATIONAL CASE STUDY

3.3.1 National Sports Center

Project Details

Name: National Sports Center

Location: Chyasal, Lalitpur

Project Year: 2016 A.D.

Type: Sports Architecture

Architect: None

Area: 2925.200 sq. m.

National Sports Center Pvt. Ltd is located in Chyasal, Lalitpur. This sport center provides multiple sport facility in one complex. Their sport facilities and services are Futsal, Swimming, Swimming training, Aqua Zumba, Badminton, Gym, Sauna, and Steam bath. National Sports Center is a private institution, established in the year 2073 B.S., with the partnership of 6 members. *Raju Kaji Shakya* is one of the members. He is a Nepalese football manager, Former footballer who captained the Nepal National Football Team, and served as Head Coach of Nepal national football team and he is from Dharan as well.

Background

The background behind building the National Sports Center is quite interesting. Two of the members, *Surendra Shrestha* and *Dhurva K.C.* were already in the construction field. In their working experience, they had constructed swimming pool for a resort in Godavari. They were satisfied with the results and wanted to do something on their own. Initially they came up with an idea to open a swimming pool center for public. But they themselves being actively participating in sports activities and physical fitness, they felt the need of a place where people can freely play sports and encourage social interaction. Thus, they decided to include the other sports facilities along with swimming pool that the area of the site could possibly cover. Currently, the building is under renovation work. A new block with much bigger space for Gym, Sauna and Steam bath is being built. Due to high flow of people over the year, the existing gym area could not fulfill the required capacity.

Services

- Futsal
- Swimming Pool
- Badminton court
- Gym and Sauna
- Cafeteria
- His/ Her Changing Rooms





Services Detail

- **Futsal**

Number of futsal: 1

Area: 25m. x 15m.

Material: Futsal Artificial Grass

Prices:

Per hour (Sunday to Friday): Rs. 1,200

Per hour (Sunday to Friday-After 5p.m.): Rs. 1,400

Per hour (Saturday): Rs. 1,400

Per hour (Saturday-After 5p.m.): Rs. 1,600

- **Swimming Pool**

Area: 25m. x 13m.

Depths: 6 ft., 5 ft., 4 ft., 3 ft., 2.5 ft., 1.5 ft. (Highest to lowest)

Separate Changing rooms for boys and girls and Locker facility.

70,000 Liter water tank

Process of water treatment includes Chemical mixing, Vacuuming the dirt and Filtration.

Prices:

Monthly member: Rs. 4,500

Per day: Rs. 300

Per day under 10 years: Rs. 250

User Data

- Peak usage times and seasons:
  - Futsal: All around the year
  - Swimming: Baisakh to Bhadra
  - Gym: All around the year
- Demographics of users:
  - Futsal: Kids, adults and maximum age of 40-45 years come to play futsal
  - Swimming: Kids, adults and maximum age of 50-60 years come to play swimming.
  - Badminton: Adults and maximum age of 60-70 years come to play badminton.
  - Gym and Cardio: Mostly adults (20-40 years)
  - People come from Baneshwor, Koteshwor, Sankhamul, Patan, Sanepa area

- Frequency of events:
    - Schools and colleges host futsal competition twice or more monthly.

Financial and Operational Data

- Initial Construction: Approximately 3 Crores
- Yearly maintenance: Approximately 8-19 Lakhs
- Total number of staffs: 15-20

Operational Challenge

- To maintain safe swimming water. The swimming pool water treatment need skilled manpower from testing the water daily to the filtration treatment process to keep the passage clean all time.

Structure Detail

- It is a Steel structure with Trusses and CGI sheets.
- Brick cladding
- Stone Flooring in the passages

3.3.2 Jhunas Fitness and Wellness

Project Details

Name: Jhunas Fitness and Wellness

Location: Dental Road, Dharan-19

Project Year: 2020 A.D.

Type: Fitness and Wellness

Architect: None

Area: 618.8 sq. m.

Jhunas Fitness and Wellness is a small fitness hub in the Dental Road of Dharan, founded by Ms. Jhuna Rai. The owner herself designed this one-and half storey building both exterior and interior. The property is surrounded by greenery on all four sides, due to which the ambience of this place is very calming and peaceful.

Services:

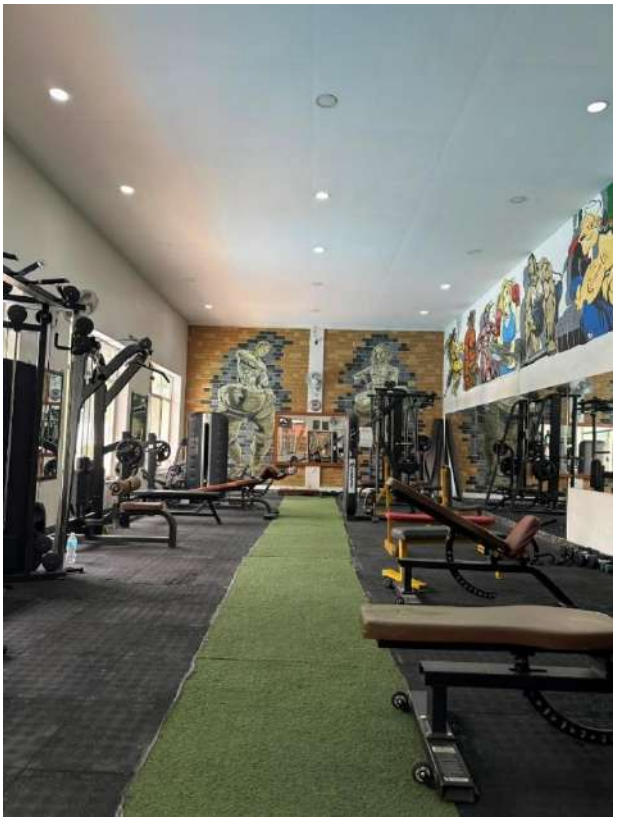
- Gym Hall
- Swimming Pool
- Spa and Sauna
- Juice Bar and cafe
- His/ Her Changing Rooms

User Data

- Peak usage times and seasons:
  - Wellness Spa and Sauna: All around the year
  - Swimming: Baisakh to Bhadra
  - Gym: All around the year
- Demographics of users
  - Spa and Sauna: Mainly women from 22 to 40 years old
  - Swimming: Kids, adults and maximum age of 50-60 years old
  - Gym and Cardio: Mostly adults (20-40 years)
  - People come from nearby area the most.
- Frequency of events
  - Women's Market is organized monthly.

Financial and Operational Data

- Initial Construction: Approximately 2 Crores
- Yearly maintenance: Approximately 1-2 Lakhs
- Total number of staffs: 6-8



3.4.Comparative Analysis

CASE STUDY	FIRSTENBURG COMMUNITY CENTER	PANYADEN BAMBOO SPORTS HALL	THE ARC AT GREEN SCHOOL	NATIONAL SPORTS CENTER	JHUNAS FITNESS AND WELLNESS
					
Climate	Semi-arid climate	Tropical	Tropical climate	Temperate climate	Temperate climate
Site Area	7523.47 sq. m.	782 sq. m.	760 sq. m.	2925.200 sq. m.	618.8 sq. m.
Facilities	Community center, Library and recreational	Multi-purpose Hall, Futsal, Badminton, Volleyball	Gymnasium	Futsal, Badminton, Swimming pool, Gym and Sauna	Swimming, Gym, Spa and Sauna
Structure	Wood and Steel	Bamboo Structure	Bamboo Structure	Steel Structure	Steel Structure and R.C.C
Property type	DIstrict Government	School Ownership	School Ownership	Partnership	Private
Number of floors	Two storey	Ground floor +1	Ground Floor	Two Storey	(G+1) with terrace at top
means of circulation in the building	Staircases and ramps	Bamboo Stair	No vertical staircase	Metal Staircase	Metal Staircase
Passage way	Multiple circulation passage	Multiple entrance and exits	Multiple entrance and exits	2m. passage	2m. passage
Used Building Materials	Wood facade and furnitures, Rubber mats	Bamboo and earth clay, Flattened Bamboo roofing	brick , structural steel	Stone block flooring, Steel Trusses, Brick Cladding	Stone Pavement, Rubber mat, Steel Roof truss, Brick wall, Gypsum false ceiling

C H A P T E R

04.

SITE ANALYSIS

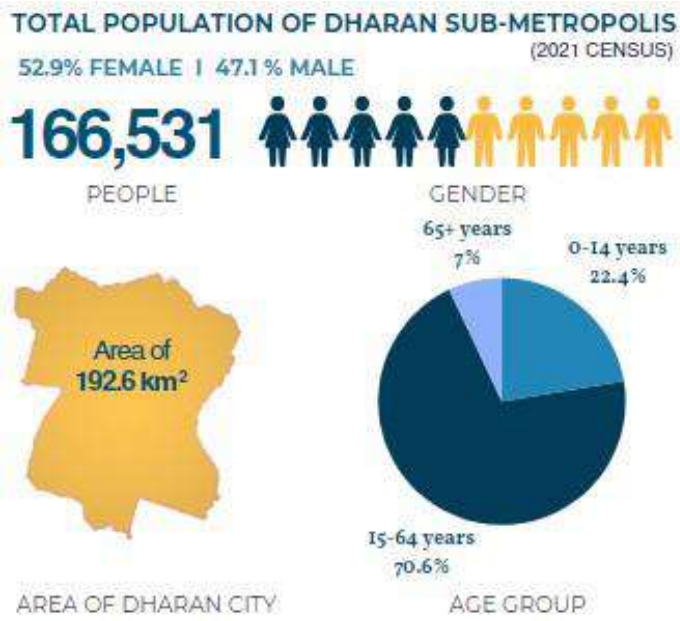
Community Sports Hub in Dharan, Eastern Nepal

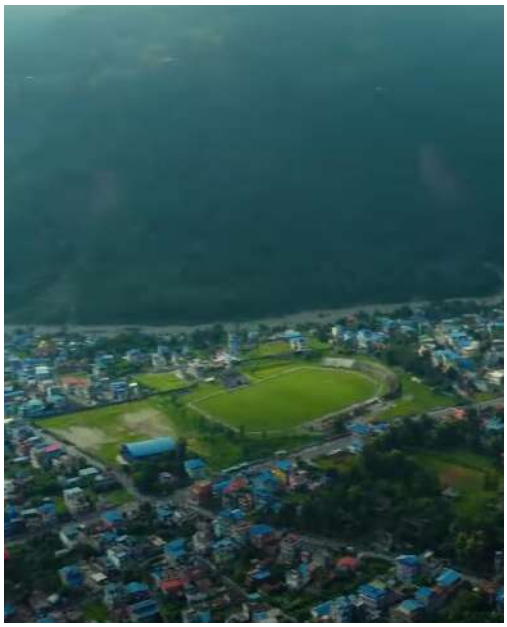
4.1. SITE INTRODUCTION

D H A R A N

Dharan is a sub metropolitan city located in Sunsari District of Koshi Province in the eastern part of Nepal, that holds cultural, historical, and economic significance.

- Kathmandu to Biratnagar 35 minutes flight and Biratnagar to Dharan 40 kms road distance
- Kathmandu via Sindhuli to Dharan 400 kms road distance
- Siliguri to Panitanki 25 kms, Panitanki via Kakarvitta to Dharan 110 kms. west.





Nestled in the foothills of the Himalayas, Dharan boasts a picturesque landscape with lush greenery and panoramic views. It is one of the cities of the Greater Birat Development Area which incorporates the cities of Biratnagar-Itahari-Gothgau-Biratchowk-Dharan, primarily located on the Koshi Highway in Eastern Nepal, with an estimated total urban agglomerated population of 804,300 people living in 159,332 households. It is the largest city in the province number one by Area.

PROPOSED SITE

Location: Jana Path, Dharan-16

Zone: Koshi

District: Sunsari

Province: 1

Site Area: 32000 sq.m.

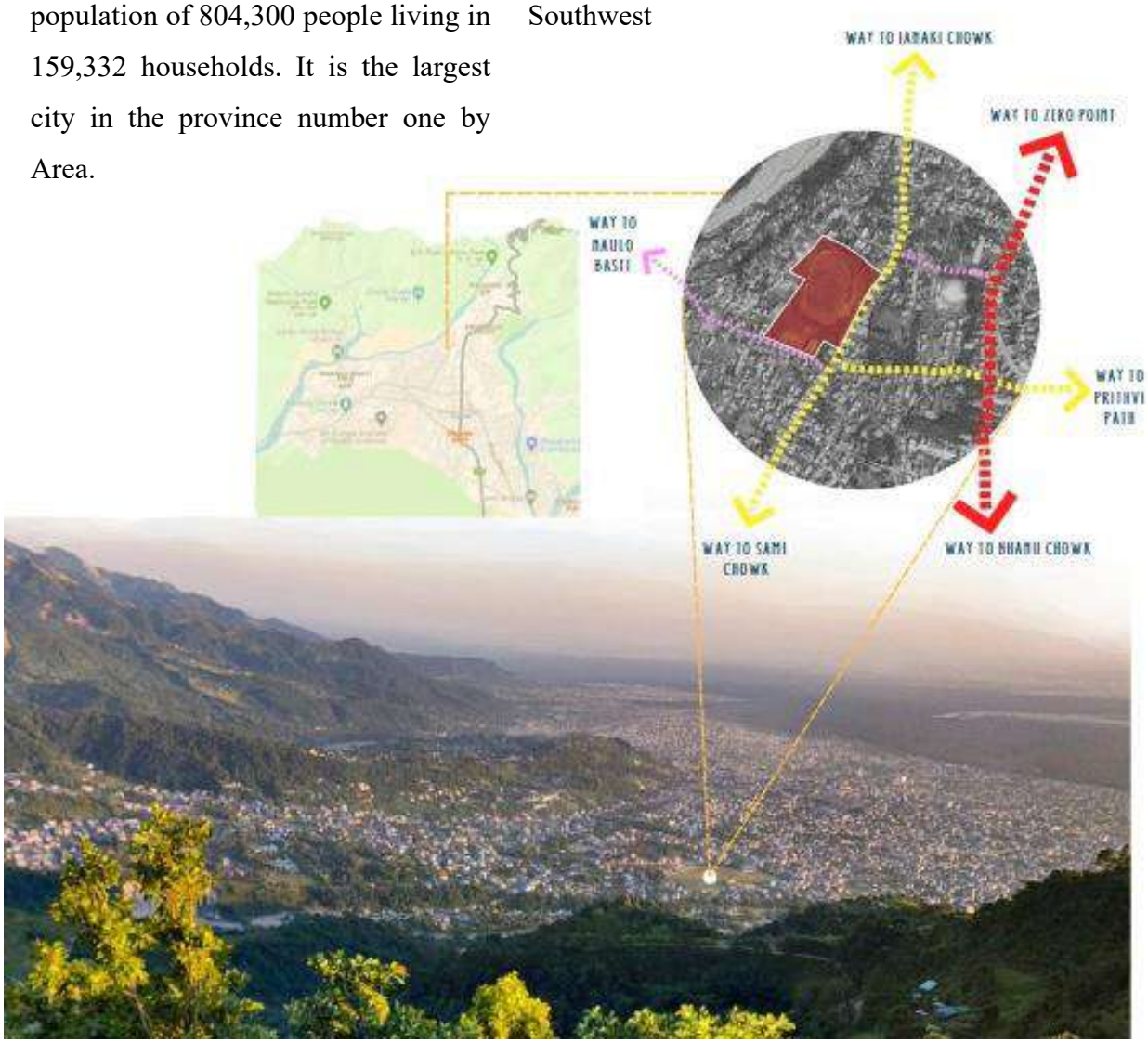
Longitude: 26°49’37.2” N

Latitude: 87°16’52.34” E

Topography: Flat

Nearest road network: Koshi Highway on the east

Access: Roads at Northwest, Southeast, and Southwest



4.2. SITE JUSTIFICATION

Community Sports Hub as a Central Hub in the city

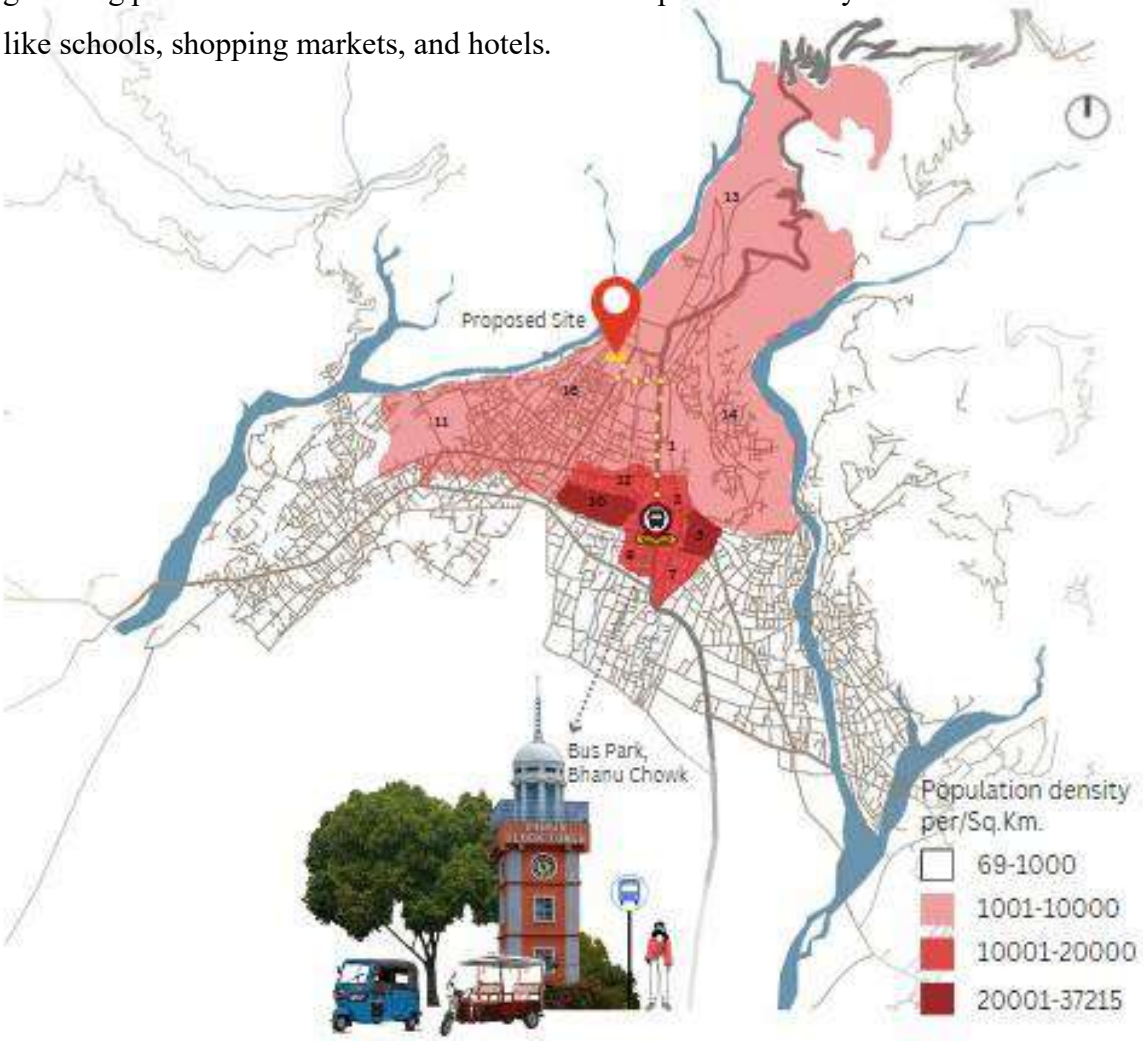
Justifying the location of the site as a Central Hub in the city involves considering various factors.

I **Accessibility:** The proposed site is easily accessible to a large portion of the city's population. The mode of public transportation in Dharan are Auto/Tempo and Safari.

- Via Koshi Highway: 2.1 km. (26 min. Walking)
- Via Prithvi Path: 2.5 km. (7 min. by vehicle)
- Via Putali Line: 2.8 km. (8 min. by vehicle)

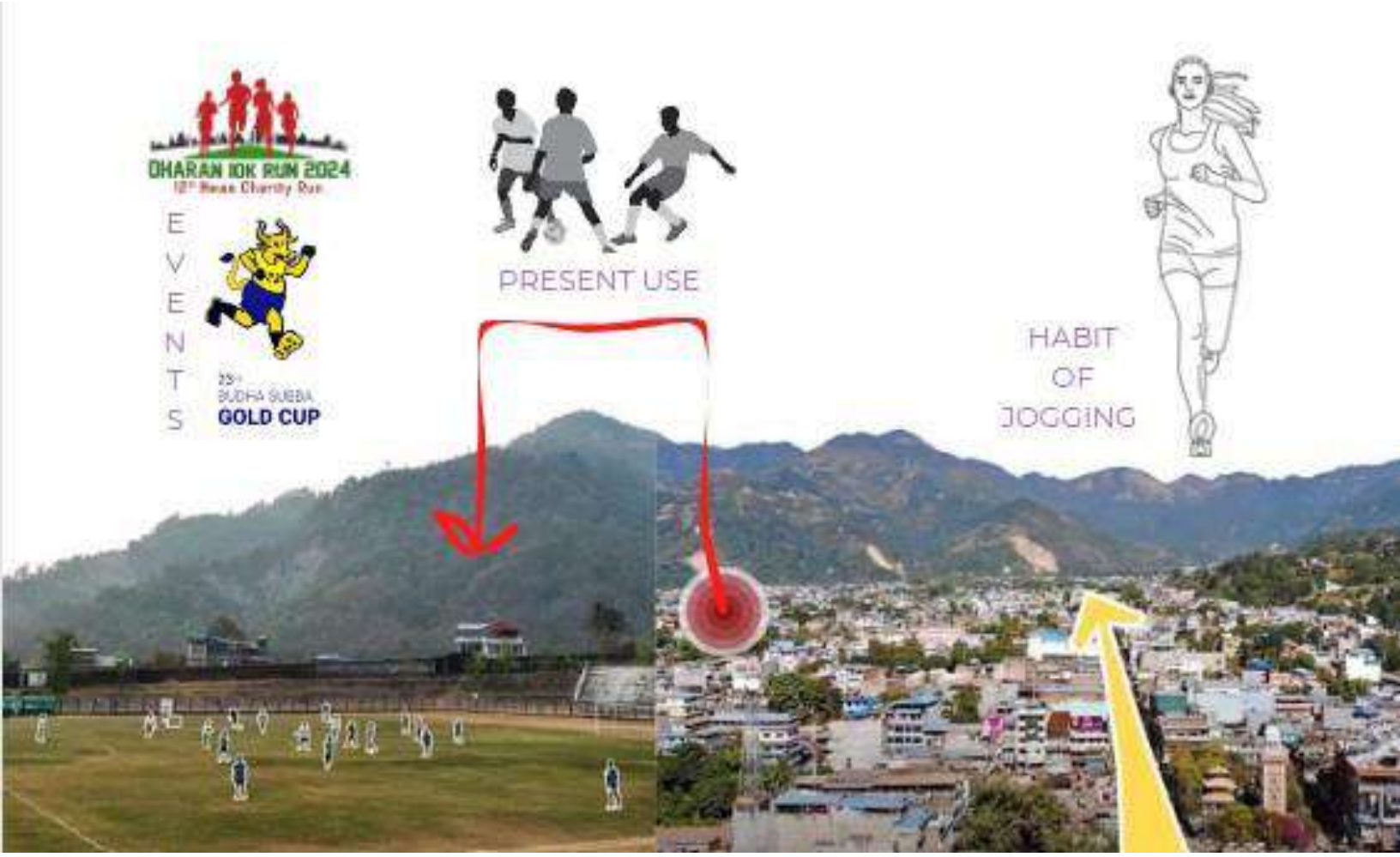
II **Population Density:** There is a significant concentration of potential users around the site, who can access the Sports Hub conveniently. There are 20 wards in Dharan. Among them, 10 wards near the site have higher population density.

III **Connectivity:** Connectivity to existing infrastructure enhances the site's appeal as a central gathering point. The site is well connected to other parts of the city with various amenities like schools, shopping markets, and hotels.



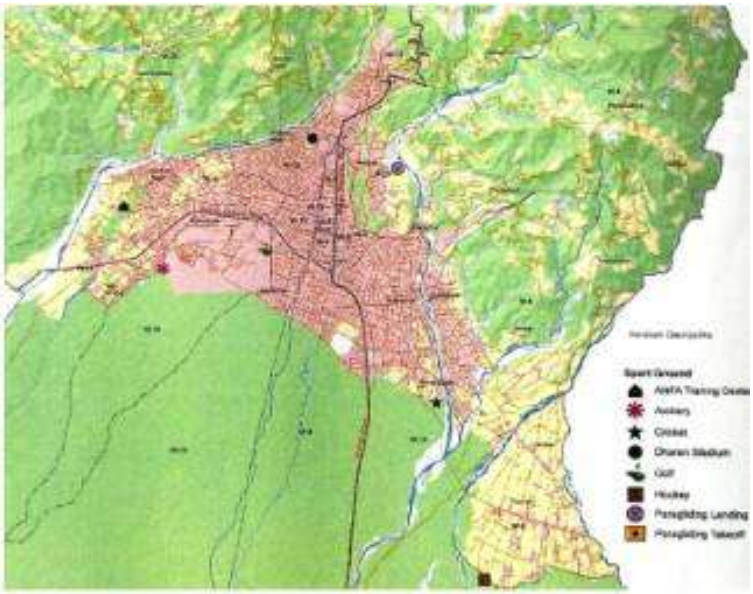
IV **Community Needs Assessment:** A survey was conducted with the residents to understand their needs and preferences regarding sports and recreational facilities. The key findings are:

- Interested in specific sports like football, badminton and swimming.
- Maximum respondents have the habit of going to morning/evening walks and actively participating in physical activity 3-4 times a week.
- Strongly agreed that, there is a need of multi-sport facility in the city, specially focused in indoor sport activities.
- Observed that people come to the site during morning and evening time for jogging as well as playing football.
- We can conclude that, the culture of participating in sport activities in the city level is very strong. Thus, the site is exactly located where there's a demonstrated demand for such amenities within the community.



V **Urban Regeneration Opportunities:** The proposed site present opportunities for urban regeneration. Community Sports Hub can contribute to the transformation of existing Dharan Stadium into a vibrant hub of activity and social interaction.

VI **Urban Planning Consideration:** An interview was taken in person with Mr. Suraj Shrestha, the Planning and Engineering Division Chief of Dharan Sub-Metropolitan City. As per Mr. Shrestha, "There are major sports venues inside the city, but there is a significant lack of smooth operation and maintenance. Since sports have been very prominent in the present context, the municipality is studying and trying to work on the development of sports sector in the city."



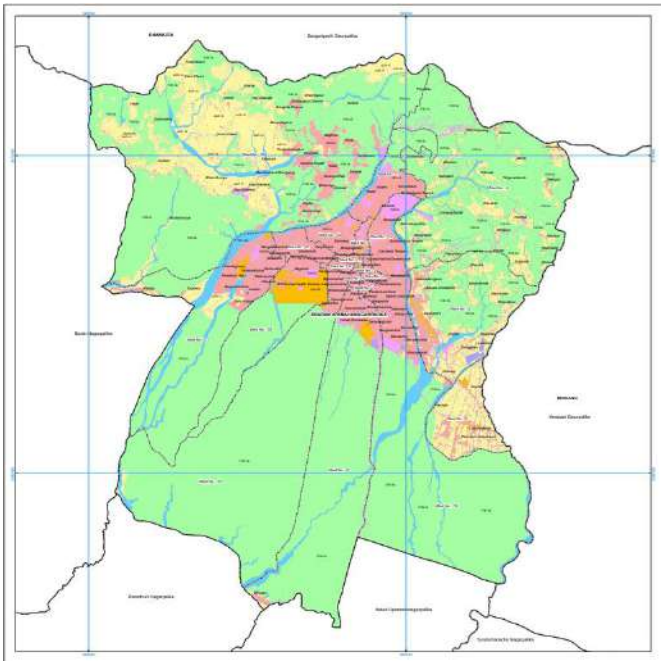
4.3. SITE ANALYSIS

4.3.1 Macro Analysis

Land Use and Bye-Laws

According to the bye-laws of Dharan Sub-Metropolitan City, the site area: Dharan Stadium lies in the public zone. The regulations for the project as per bye-laws are as follows:

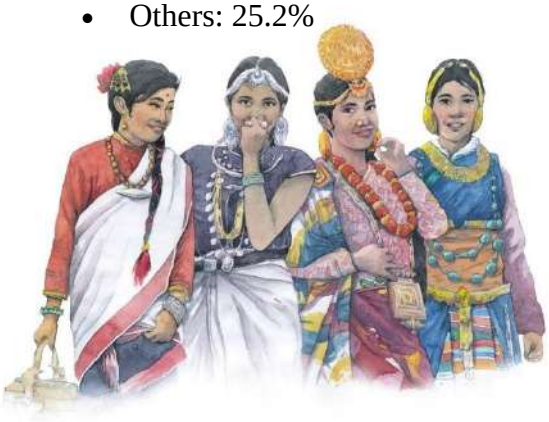
- F.A.R. (Floor Area Ratio): 3.5
- G.C.R. (Ground Coverage): 60%
- R.O.W. (Right of Way): 2m
- Set Back: 1.5m. (Ht.-10m.)
  3m. (Ht.: 10m.-17m.)
  5m. (Ht.: 17m. and above)



Caste and Ethnicities

According to 2011 Census:

- Rai: 20.7% (Largest)
- Limbu: 11.7% (Second Largest)
- Newar makes: 11.1%
- Chhetri: 10.7%
- Tamang: 7.3%
- Hill Brahmin: 7.1%
- Kami: 6.2%
- Others: 25.2%



Geographic Features

- Terrain: Plain
- Surface Geology: Thick colluvium deposit having boulder, gravel and fine material in some extends.
- Hydrology: Rainfall Station is Chatara. The average annual rainfall over the last ten years at Chatara Station, nearest to the municipality has been recorded as 159.29 mm.

Climatic Data

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature °C (°F)	14.2 °C (57.6) °F	16.9 °C (62.5) °F	21 °C (69.8) °F	24.2 °C (75.6) °F	25 °C (77) °F	25.4 °C (77.8) °F	25.2 °C (77.3) °F	25.3 °C (77.5) °F	24.6 °C (76.2) °F	22.4 °C (72.3) °F	18.9 °C (66.1) °F	15.6 °C (60.1) °F
Min. Temperature °C (°F)	8.2 °C (46.8) °F	10.5 °C (50.9) °F	13.5 °C (56.3) °F	17.5 °C (63.5) °F	20.7 °C (69.2) °F	22.9 °C (73.2) °F	23.2 °C (73.8) °F	23.1 °C (73.7) °F	21.9 °C (71.5) °F	17.9 °C (64.3) °F	13.4 °C (56.2) °F	9.8 °C (49.6) °F
Max. Temperature °C (°F)	19.3 °C (66.8) °F	21.8 °C (71.3) °F	26.6 °C (79.9) °F	29.4 °C (85) °F	28.9 °C (84) °F	28.3 °C (82.9) °F	27.5 °C (81.5) °F	27.8 °C (82) °F	27.3 °C (81.1) °F	26.2 °C (79.1) °F	23.5 °C (74.2) °F	20.5 °C (69) °F
Precipitation / Rainfall mm (in)	10 (0)	15 (0)	17 (0)	46 (1)	136 (5)	334 (13)	490 (19)	383 (15)	273 (10)	78 (3)	8 (0)	6 (0)
Humidity(%)	71%	64%	51%	53%	71%	83%	87%	86%	85%	79%	71%	71%
Rainy days (d)	1	2	3	7	14	20	21	21	18	7	1	1
avg. Sun hours (hours)	7.7	8.3	9.8	9.6	9.0	7.8	7.3	7.8	7.9	8.8	8.6	7.9

The hottest months:

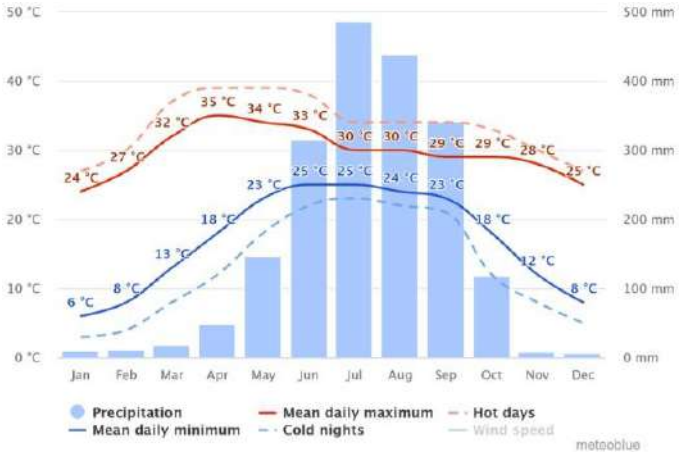
April.....29.4°C
May.....28.9°C
June.....28.3°C

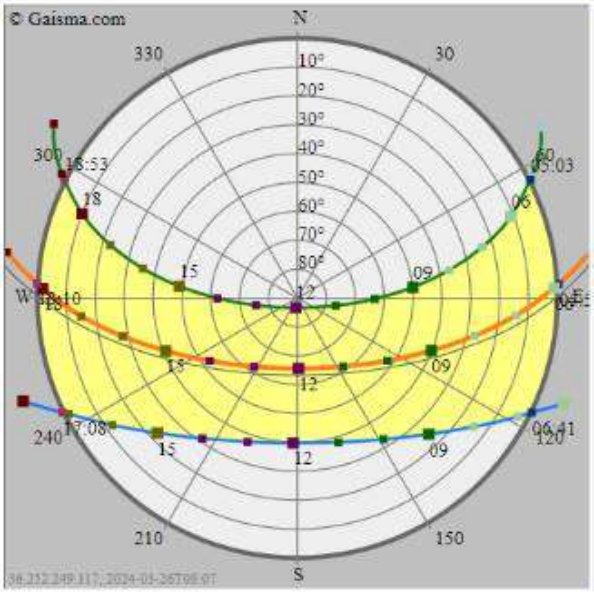
The coldest months:

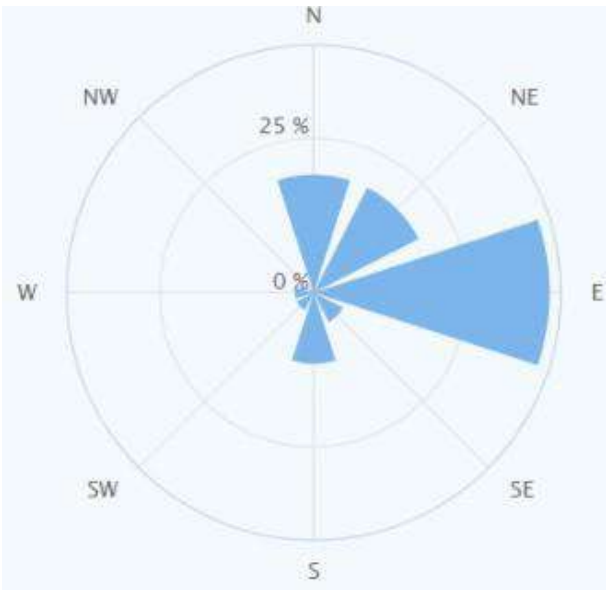
January.....8.2°C
February.....10.5°C
December.....9.8°C

Most precipitations:

June.....334mm.
July.....490mm.
August.....383mm.

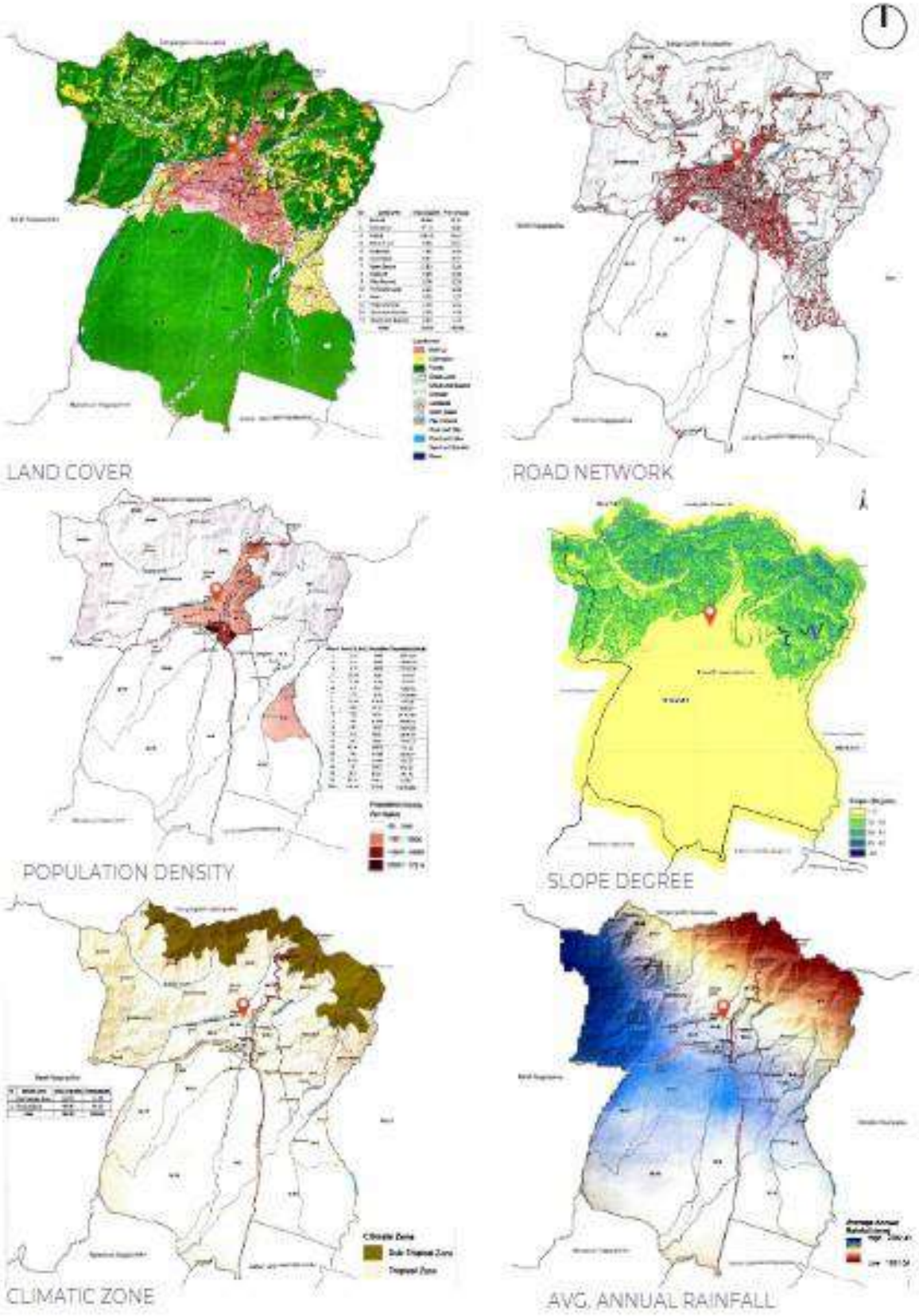


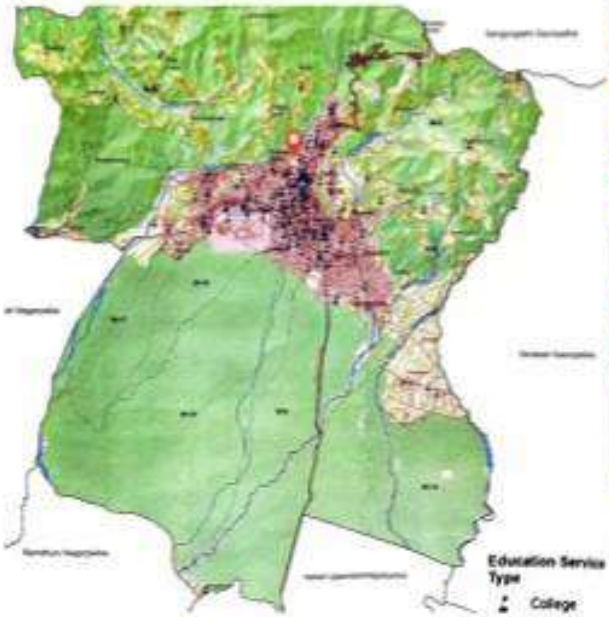




N ▼ Northern	NE ▲ Northeastern	E ◄ Eeastern	SE ► Southeastern	S ▲ Southern	SW ◄ Southwestern	W ► Western	NW ▲ Northwestern
19.1%	**19.1%**	**38.2%**	**5.3%**	**11.5%**	**3.1%**	**3.1%**	**0.8%**

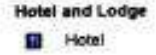
Important Maps





EDUCATIONAL SERVICE

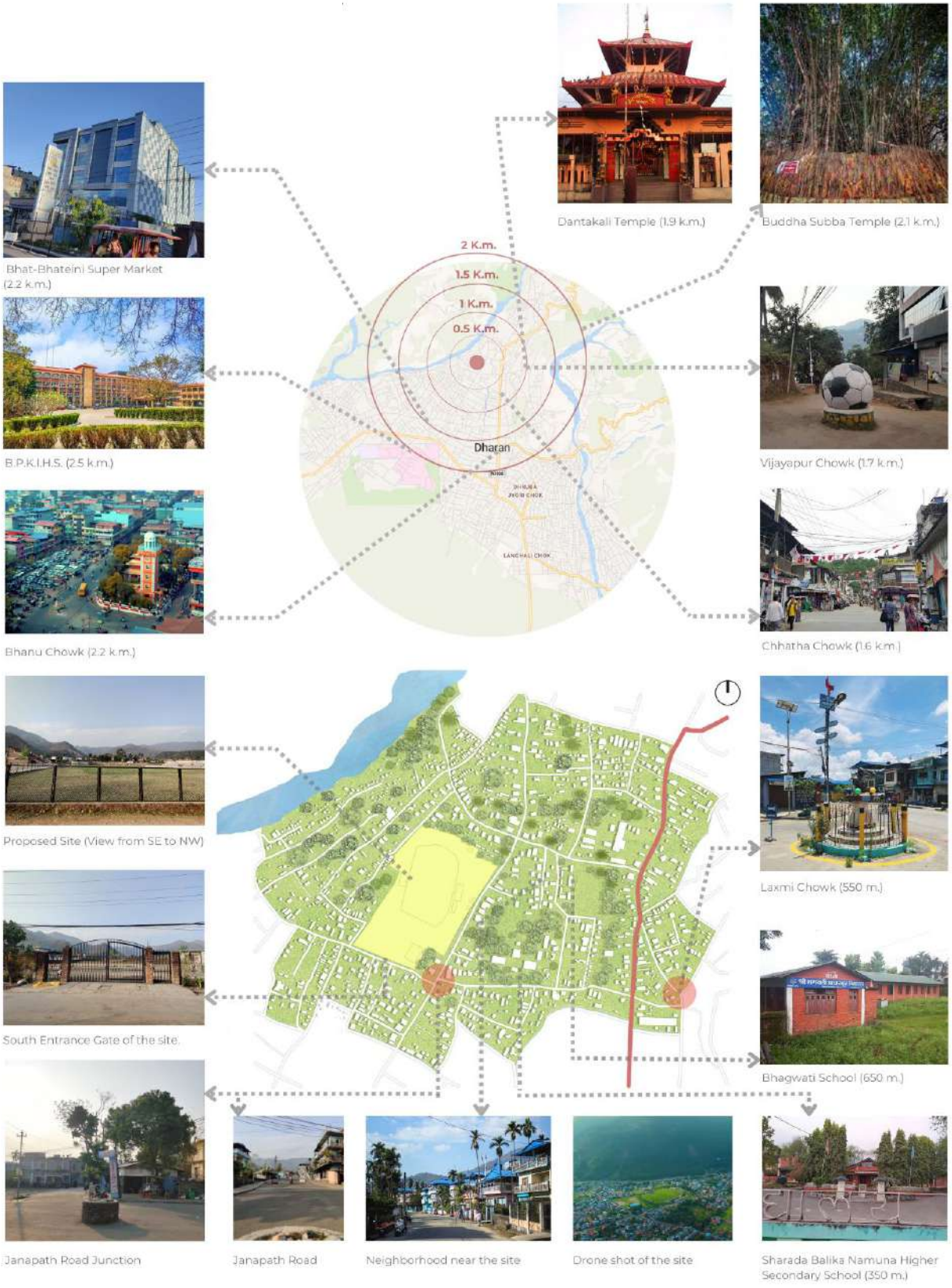
HEALTH SERVICE



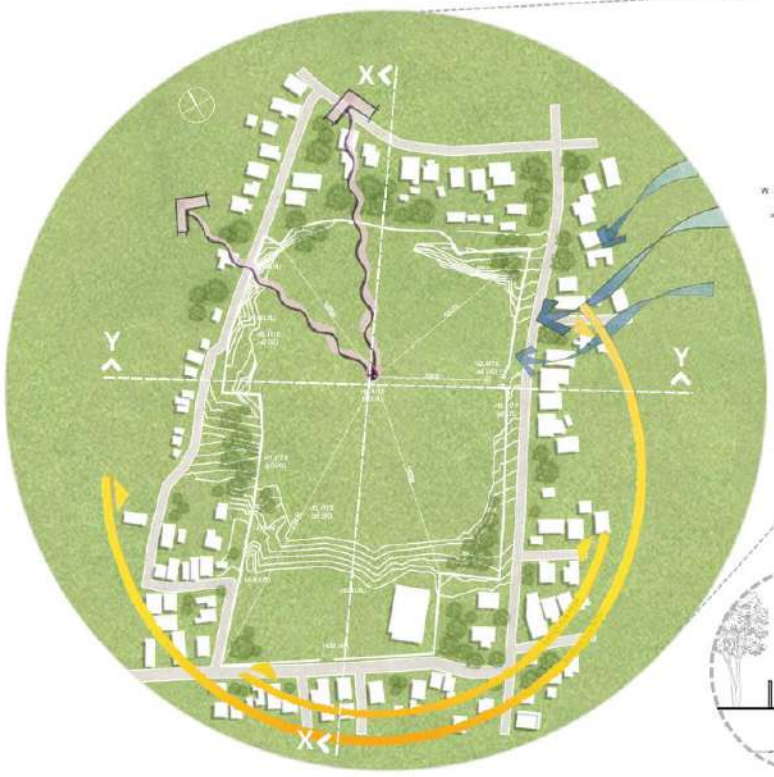
HOTEL SERVICE

FINANCIAL SERVICE

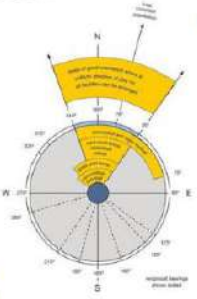
Landmarks, Nodes and Immediate Surrounding



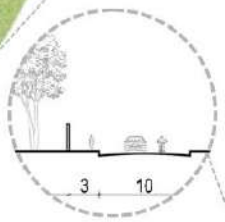
4.3.2 Micro Analysis



SITE PLAN



ORIENTATION



PROPOSED SITE

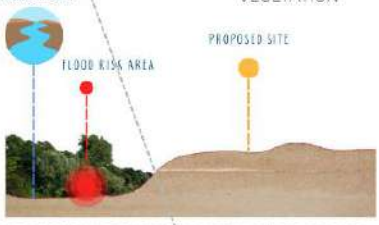
BUILDING MASS

MOBILITY

VEGETATION

SECTION AT YY

SECTION AT XX



SECTIONAL VIEW FROM SARDU RIVER TO SITE

VIEWS FROM THE SITE FROM NORTH TO EAST

6 METERS LEVEL DIFFERENCE

PRESENT USE: PEOPLE PLAYING IN THE GROUND

EXISTING BOUNDARY WALL (EAST VIEW)

EXISTING CONTOUR SLOPE IN THE SITE

CHAPTER 05.

PROGRAM FORMULATION
Community Sports Hub in Dharan, Eastern Nepal

5.1 Program Derivation

One of the key understandings from Literature Review and Case studies was that a strategically developed program is required in order to create a holistic model for Community Sports and Recreation Center. The process adopted for the program development therefore focuses on catering to the needs of the community, creating an enjoyable and comfortable environment for estimated 500 users.

5.2 Derivation Inferences

Activity based provision spaces

Desired Activity	**Space**
Free movement of users.	Main circulation axis as jogging track connecting activity zones, providing clear way finding.
Engage in physical activity and sports, based on different age groups.	Open gym parks, walking paths surrounded with landscape and safe children playground.
Yoga and Meditation	This activity requires a space that, reflects closeness to nature and capture the optimum views from the site.
Social Interaction, gathering and events.	Design of centrally located communal spaces in the form of cafe and shops, and multipurpose plazas to conduct markets and events.

5.3 Program Division on the basis of Function and Type

The programs based on function are shown in the table below:

Sports	**Recreation**	**Wellness**	**Communal Areas**
1. Football 2. Basketball 3. Badminton 4. Table-Tennis 5. Running Track	1. Swimming 2. Archery 3. Wall Climbing 4. Wall Bouldering 5. Open Gym parks 6. Kid's playground 7. Arcade games	1. Gym 2. Yoga 3. Sauna 4. Jacuzzi 5. Pilates	1. Plaza 2. Parking 3. Food Court 4. Retail Shop 5. Office 6. Healing garden and parks

The programs based on type are shown in the table below:

Outdoor	Indoor	Hybrid
1. Football 2. Running Track 3. Kid's Playground	1. Swimming 2. Archery 3. Wall Climbing and bouldering 4. Sauna and Jacuzzi 5. Gym	1. Basketball 2. Badminton 3. Table-Tennis 4. Yoga

5.4Program Formulation Table

5.4.1 Sport and Recreation Block

S.N.	Spaces	Number	Size (in m.)	Total Area (meter square)	Remarks
1	Reception	1	4.1 x 4.1	16.81 sq.m.	
2	Entrance Lobby	1	10.8 x 7.5	81 sq.m.	
3	Staff room		6.6 x 3.7	24.42 sq.m.	
4	Men's Locker and Changing	2 cubicles	5.5 x 5.2	28.6 sq.m.	1 cubicle (1.5x1) Locker (0.5x0.38)
5	Women's Locker and Changing	2 cubicles	5.5 x 5.2	28.6 sq.m.	1 cubicle (1.5x1) Locker (0.5x0.38)
6	Men's W/C	1 w/c, 3 urinals, 4 basins	5.5 x 5.2	28.6 sq.m.	1 cubicle (1.5x1)
7	Women's W/C	3 w/c, 3 basins	5.2 x 4.9	25.48 sq.m.	1 cubicle (1.5x1)

8	Accessible W/C	1	2.1 x 1.5	3.15 sq.m.	
9	Mechanical room	1	5.2 x 3.1	16.12 sq.m.	
10	Vending machine	1	4.9 x 3.1	15.19 sq.m.	
11	Medical room	1	7.8 x 7.7	60.06 sq.m.	
12	Arcade lounge	1	7.5 x 5.5	41.25 sq.m.	
13	Arcade game zone	1	24.2 x 5.1	123.42 sq.m.	
14	Game counter	1	4.1 x 4.1	16.81 sq.m.	
15	Store room	1	4.0 x 3.9	15.6 sq.m.	
16	Equipment room	1	8.1 x 3.6	29.16 sq.m.	
17	Basketball court	1	28 x 15	420 sq.m.	
18	Archery Hall	1	29 x 24	696 sq.m.	
19	Table-Tennis Hall	1	24 x 15.7	376.8 sq.m.	
20	Wall Climbing	1	19 x 8	152 sq.m.	
21	Wall Bouldering	1	24 x 6.5	156 sq.m.	

5.4.2 Aquatic and Fitness Block

Aquatic center

S.N.	Spaces	Number	Size (in m.)	Total Area (meter square)	Remarks
1	Entrance lobby	1	9.7 x 4.4	42.68 sq.m.	
2	Reception	1	3.9 x 3.5	13.65 sq.m.	
3	Staff room	1	5.0 x 4.5	22.5 sq.m.	
4	Swimming lounge	1	10.4 x 4.5	46.8 sq.m.	
5	Inclusive locker	1	5.7 x 4.5	25.65 sq.m.	
6	Women sanitary services	4 w/c, 5 shower, 5 changing, 5 basins	9.8 x 7.5	73.5 sq.m.	1 cubicle (1.5 x 1)

7	Men sanitary services	1 w/c, 3 urinals, 5 shower, 5 changing, 5 basins	10.4 x 7.5	78 sq.m.	1 cubicle (1.5 x 1)
8	Swimming staff room	1	5.5 x 2.7	14.85 sq.m.	
9	Shower heads	4	5.2 x 2.0	10.4 sq.m.	
10	Leisure pool	1		81.94 sq.m.	
11	Baby pool	1		37.44 sq.m.	
12	Lap pool	1	25 x 10.6	265 sq.m.	
13	Seating	4	6 x 0.5	12 sq.m.	
14	Water treatment room	1	7.5 x 4.0	30 sq.m.	
15	Chemical room	1	4.0 x 2.7	10.8 sq.m.	
16	HVAC room	1	9.2 x 7.7	70.84 sq.m.	

Yoga Studio

S.N.	**Spaces**	**Number**	**Size (in m.)**	**Total Area (meter square)**	**Remarks**
1	Reception	1	3.7 x 3.5	12.95 sq.m.	
2	Lounge	1	5.2 x 3.7	19.24 sq.m.	
3	Inclusive locker	1	3.5 x 2.0	7 sq.m.	
4	Men Sanitary services	1 w/c, 2 urinals, 2 changing, 3 basins	6.0 x 5.0	30 sq.m.	1 cubicle (1.5 x 1)

5	Women Sanitary services	3 w/c, 2 changing, 3 basins	6.0 x 5.0	30 sq.m.	1 cubicle (1.5 x 1)
6	Accessible W/C	1	2.1 x 1.5	3.15 sq.m.	
7	Staff W/C	1	2.1 x 1.5	3.15 sq.m.	
8	Store room	1	4.1 x 3.4	13.94 sq.m.	
9	Indoor Zen Garden	1	5.1 x 5.1	26.01 sq.m.	
10	Pilates studio	1	19.7 x 10.42	205.274 sq.m.	
11	Multi-activity studio	1	10.6 x 9.8	103.88 sq.m.	
12	Yoga hall	1	20.5 x 9.2	188.6 sq.m.	
13	Outdoor Yoga deck	1	10.8 x 9.6	6.48 sq.m.	

Sauna and Jacuzzi

S.N.	**Spaces**	**Number**	**Size (in m.)**	**Total Area (meter square)**	**Remarks**
1	Reception	1	3.5 x 3	10.5 sq.m.	
2	Lounge	1	4.6 x 3.6	16.56 sq.m.	
3	Store room	1	3.5 x 2.8	9.8 sq.m.	
4	Inclusive Locker	1	4.6 x 3.9	17.94 sq.m.	
5	Women’s Sauna	1	5 x 4.9	24.5 sq.m.	
6	Women’s Jacuzzi	1	4.5 x 4.4	19.8 sq.m.	
7	Women’s W/C	2 w/c, 3 basins, 2 shower, 3 changing, 6 locker rows	7.5 x 4.6	34.5 sq.m.	1 cubicle (1.5 x 1)
8	Men’s Sauna	1	5 x 5.3	26.5 sq.m.	
9	Men’s Jacuzzi	1	4.5 x 4.4	19.8 sq.m.	

10	Men's W/C	1 w/c, 2 urinals, 3 basins, 2 shower, 3 changing, 6 locker rows	7.5 x 4.6	34.5 sq.m.	1 cubicle (1.5 x 1)
11	Balcony seating	1	10.4 x 4.5	46.8 sq.m.	

Gym and Fitness

S.N.	Spaces	Number	Size (in m.)	Total Area (meter square)	Remarks
1	Reception	1	3.0 x 2.0	6 sq.m.	
2	Vending Machine	3 machines	6.5 x 3.6	23.4 sq.m.	
3	Men sanitary services	1 w/c, 3 urinals, 4 basins, 3 shower, 3 changing, 12 locker rows	9.8 x 5.3	51.94 sq.m.	1 cubicle (1.5 x 1)
4	Women sanitary services	3 w/c, 4 basins, 3 shower, 3 changing, 12 locker rows	10.4 x 5.3	55.12 sq.m.	1 cubicle (1.5 x 1)
5	Staff W/C	1	2.5 x 2	5 sq.m.	
6	Weight lifting	1	19.7 x 7.7	151.69 sq.m.	
7	Balcony	1	5.0 x 4.5	22.5 sq.m.	
8	CrossFit zone	1	16 x 6.0	96 sq.m.	
9	Warm up zone	1	9.2 x 4.7	43.24 sq.m.	

10	Cardio workout	1	30 x 5.5	165 sq.m.	
11	Equipment store room	1	9.2 x 7.5	69 sq.m.	
12	Rooftop running track	2 lanes	1 lane (1.22 m.)		
13	Rooftop badminton court	1	13.4 x 6.0	80.4 sq.m.	

5.4.3 Central Block

Administration

S.N.	Spaces	Number	Size (in m.)	Total Area (meter square)	Remarks
1	Reception	1	5.7 x 4.0	22.8 sq.m.	
2	Lounge	1	5.7 x 4.2	23.94 sq.m.	
3	Meeting room	1	5.7 x 3.8	21.66 sq.m.	
4	Managing Director office room	1	5.7 x 4.0	22.8 sq.m.	
5	Operation Head office room	1	6.8 x 3.8	25.84 sq.m.	
6	Security department head office	1	6.6 x 3.8	25.08 sq.m.	
7	Work Station	1	13.6 x 4.2	57.12 sq.m.	
8	Store room	1	3.8 x 2.7	10.26 sq.m.	
9	Pantry	1	4.7 x 4.0	18.8 sq.m.	
10	Staff W/C	1	3 x 1.8	5.4 sq.m.	
11	Multiactivity room	1	10.4 x 3.9	40.56 sq.m.	
12	Community meeting room	1	9.8 x 9.7	95.06 sq.m.	
13	Community store room	1	4.5 x 4	18 sq.m.	

14	Balcony	1	9.8 x 9.8	96.04 sq.m.	
15	Retail store	1	30 x 8.3	249 sq.m.	
16	Retail storage room	1	3.4 x 8.3	28.22 sq.m.	

Food Court

S.N.	Spaces	Number	Size (in m.)	Total Area (meter square)	Remarks
1	Indoor seating	1	30.3 x 20.4	618.12 sq.m.	
2	Outdoor seating	1	29.2 x 2.8	81.76 sq.m.	
3	Kitchen Stalls	3	6.5 x 5.1	33.15 sq.m.	
4	Dish washing area	1	6.6 x 2.8	18.48 sq.m.	
5	Preparation Area	1	6.6 x 2.7	17.82 sq.m.	
6	Dry storage	1	6.6 x 3.5	23.1 sq.m.	
7	Cold storage	1	6.6 x 2.0	13.2 sq.m.	
8	Staff W/C	1	3.2 x 2.4	7.68 sq.m.	
9	Janitor room (Male)	1	2.4 x 2.1	5.04 sq.m.	
10	Janitor room (Female)	1	2.4 x 1.9	4.56 sq.m.	
11	Men W/C	1 w/c, 2 urinals, 3 basins	5.5 x 5	27.5 sq.m.	1 cubicle (1.5 x 1)
12	Women W/C	3 w/c, 3 basins	5.5 x 4.4	24.2 sq.m.	1 cubicle (1.5 x 1)
13	Accessible W/C	1	1.9 x 1.5	2.85 sq.m.	

Services

S.N.	Spaces	Number	Size (in m.)	Total Area (meter square)	Remarks
1	Parking	Two wheelers (61), four	47.2 x 37.3	2227.84 sq.m.	

		wheelers (28), 4 buses			
2	Guard House	1	10.3 x 5.1	106.09 sq.m.	
3	Generator room	11	4.9 x 3.0	24.01 sq.m.	
4	Electrical Panel Hub	1	6.3 x 8.3	39.69 sq.m.	
5	Plumbing Panel Hub		6.5 x 8.3	42.25 sq.m.	
6	Store room	1	6.3 x 7.2	39.69 sq.m.	
7	Women sanitary services	12 w/c, 12 basins, 6 changing, 1 accessible,	15.5 x 9.7	240.25 sq.m.	1 cubicle (1.5 x 1)
8	Men sanitary services	6 w/c, 7 urinals, 12 basins, 6 changing, 1 accessible,	15.5 x 9.7	240.25 sq.m.	1 cubicle (1.5 x 1)

Sport Court size and Outdoor Spaces

S.N.	**Spaces**	**Number**	**Size (in m.)**	**Total Area (meter square)**	**Remarks**
1	Football Field	1	100 x 50	5000 sq.m.	
2	Basketball Court	2	28 x 15	420 sq.m.	
3	Badminton Court	4	13.4 x 6.0	80.4 sq.m.	
4	Table-Tennis	4	2.7 x 1.9	5.13 sq.m.	
5	Kid’s Playground	1	61 x 7.5	457.5 sq.m.	
6	Healing Garden	1	32x 29	928 sq.m.	

CHAPTER 06.

CONCEPT AND DESIGN DEVELOPMENT

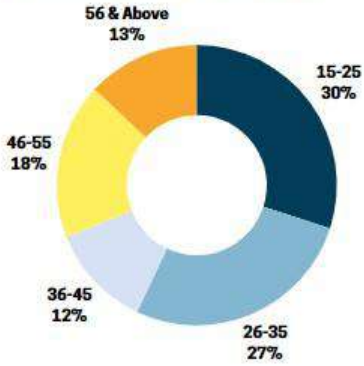
Community Sports Hub in Dharan, Eastern Nepal

INFERENCES FROM LITERATURE REVIEW

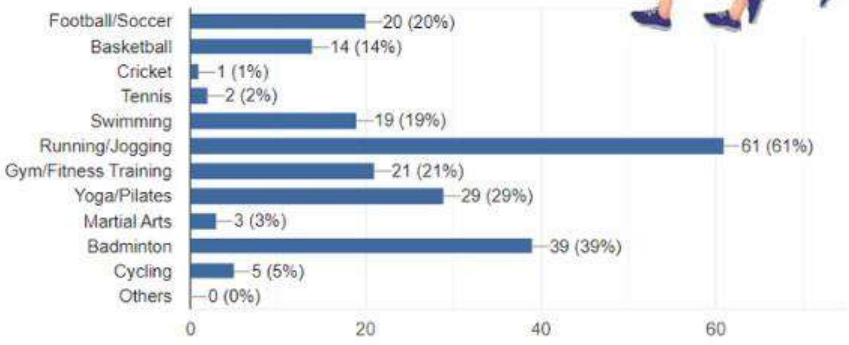
COMMUNITY SPORTS INTEREST SURVEY IN DHARAN, EASTERN NEPAL

61% PREFER RUNNING/JOGGING AMONG VARIOUS SPORT ACTIVITIES, WHICH MAKES WALKING AS THE COMMON ACTIVITY IN THE COMMUNITY.

Demographic Overview



Sports Prefereneces



SOCIAL EVENTS ASSOCIATED WITH WALKING AND RUNNING IN DHARAN

"Walk for Education" and "Dharan Run" are non-profit organizations, that actively organizes weekly run events and encourage the community of Dharan for a healthy life style and social work by means of sports, specifically running activities. Also, contributing towards community education.

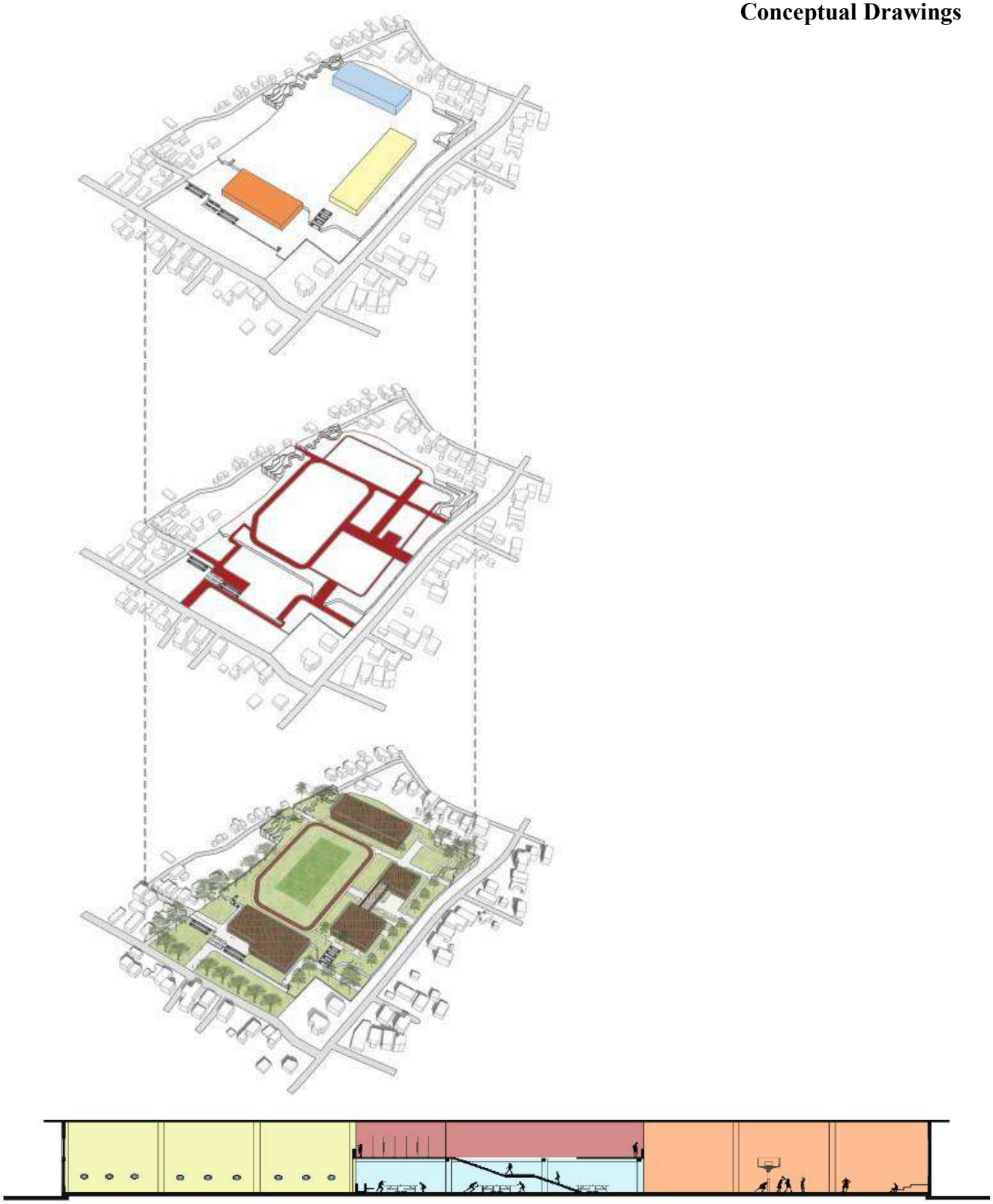
COMMON COMMUNITY ACTIVITY → WALKING → LOOP TRAIL → "THE WALKING LOOP: HARMONIZING COMMUNITY, HEALTH AND NATURE"

SUSTAINABILITY

Conceptual Zoning

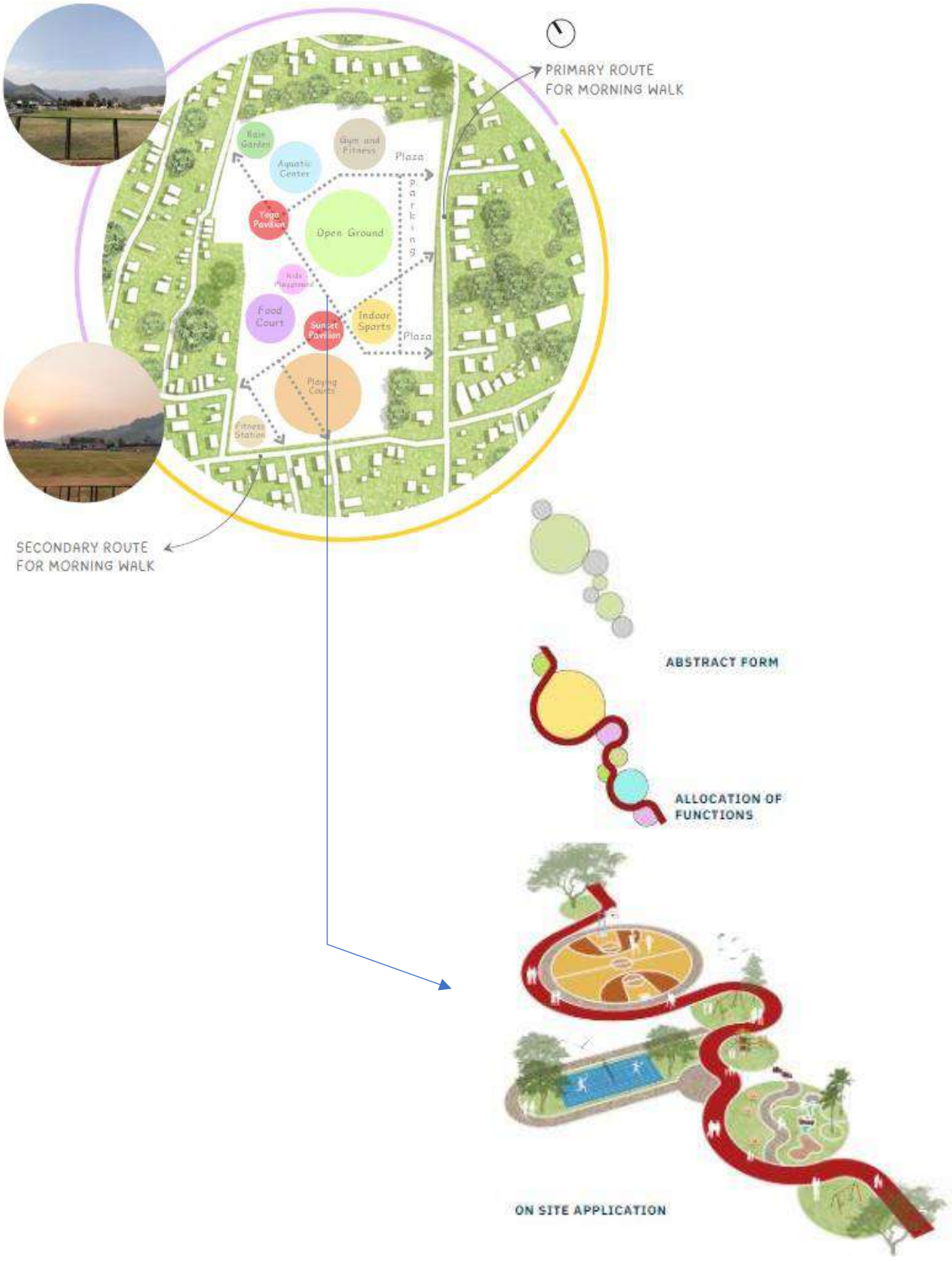
Final Conceptual Zoning

Conceptual Drawings

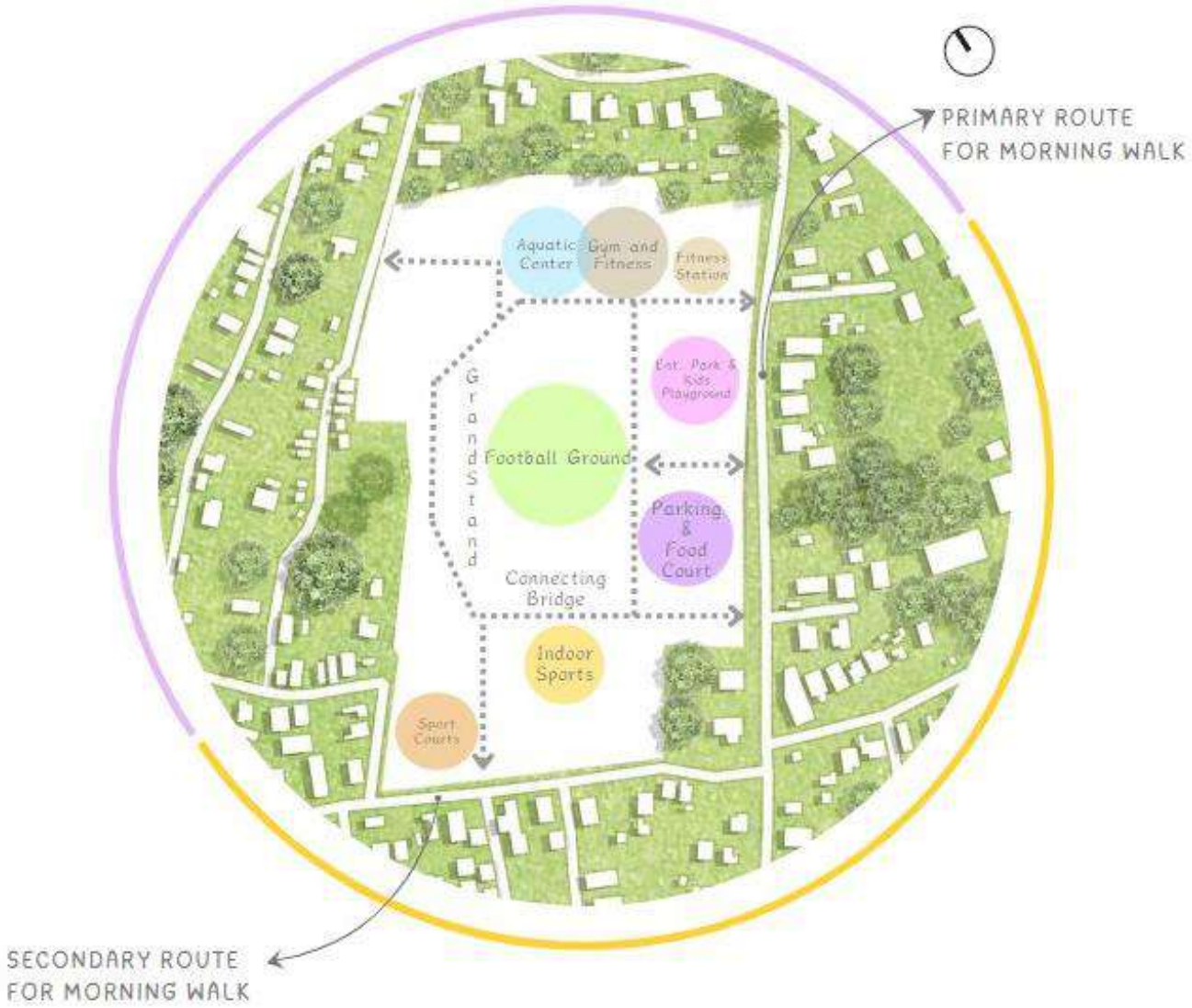


Phase I Design Development Planning

Phase II Design Development Planning



Phase III Design Development Planning



Design Brief

The design incorporates mainly three blocks. They are Aquatic and Fitness block at the top, Central Block at the center and Sports & Recreation block at the bottom. The running track is designed as a central loop that connects the different facilities, and other outdoor activities are placed according to the connection of the buildings.

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LEGENDS

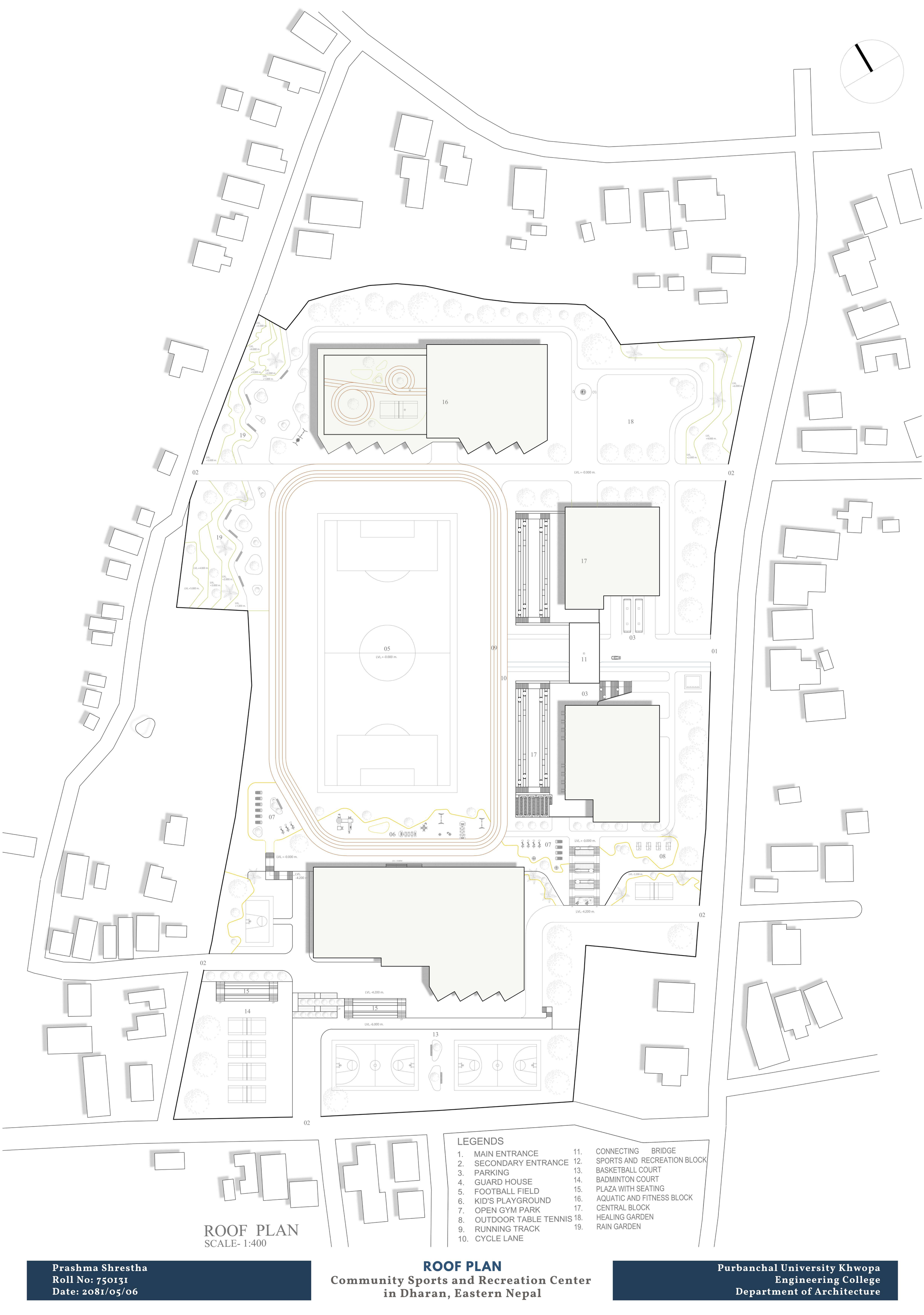
1. MAIN ENTRANCE
2. SECONDARY ENTRANCE
3. PARKING
4. GUARD HOUSE
5. FOOTBALL FIELD
6. KID'S PLAYGROUND
7. OPEN GYM PARK
8. OUTDOOR TABLE TENNIS
9. RUNNING TRACK
10. CYCLE LANE
11. CONNECTING BRIDGE
12. SPORTS AND RECREATION BLOCK
13. BASKETBALL COURT
14. BADMINTON COURT
15. PLAZA WITH SEATING
16. AQUATIC AND FITNESS BLOCK
17. CENTRAL BLOCK
18. HEALING GARDEN
19. RAIN GARDEN

Prashma Shrestha
Roll No: 750131
Date: 2081/05/06

MASTER PLAN

Community Sports and Recreation Center in Dharan, Eastern Nepal

Purbanchal University Khwopa
Engineering College
Department of Architecture



ROOF PLAN
SCALE- 1:400

LEGENDS

1. MAIN ENTRANCE
2. SECONDARY ENTRANCE
3. PARKING
4. GUARD HOUSE
5. FOOTBALL FIELD
6. KID'S PLAYGROUND
7. OPEN GYM PARK
8. OUTDOOR TABLE TENNIS
9. RUNNING TRACK
10. CYCLE LANE
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Prashma Shrestha
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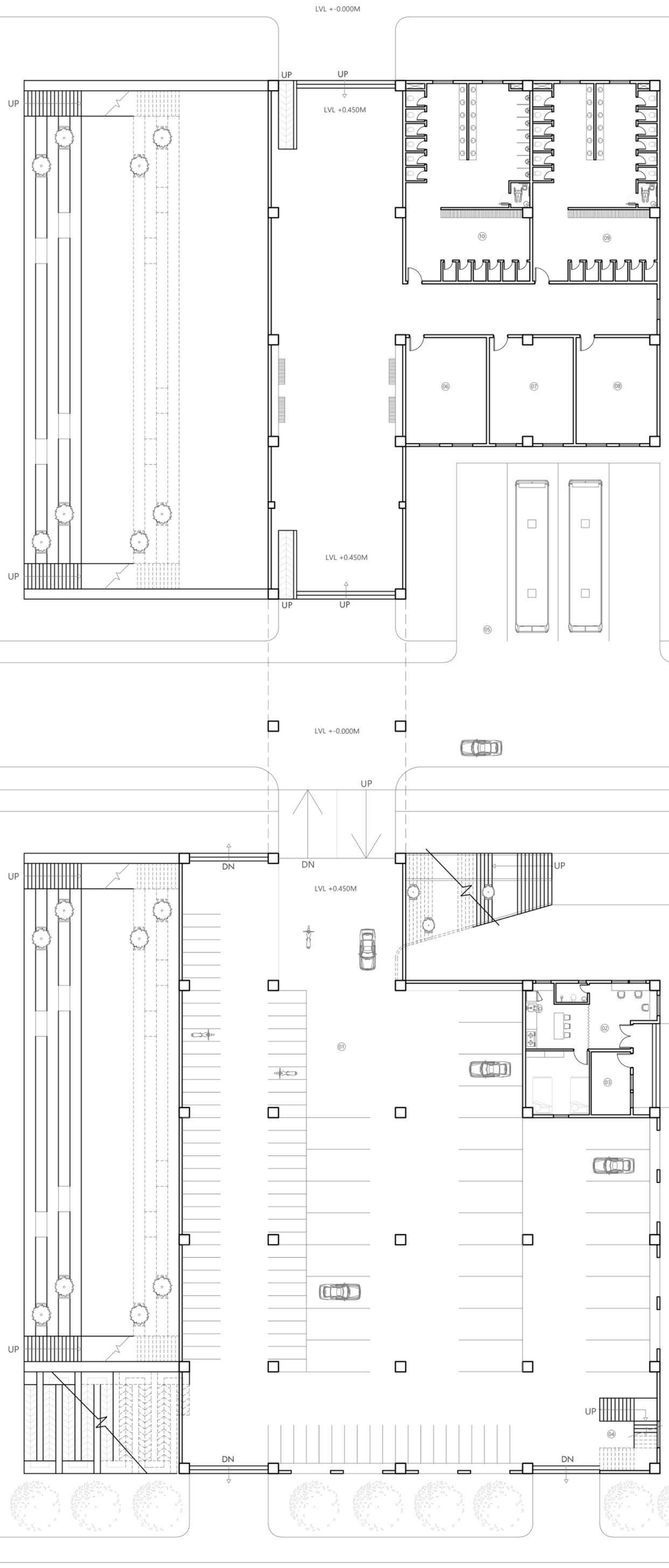
ROOF PLAN

Community Sports and Recreation Center in Dharan, Eastern Nepal

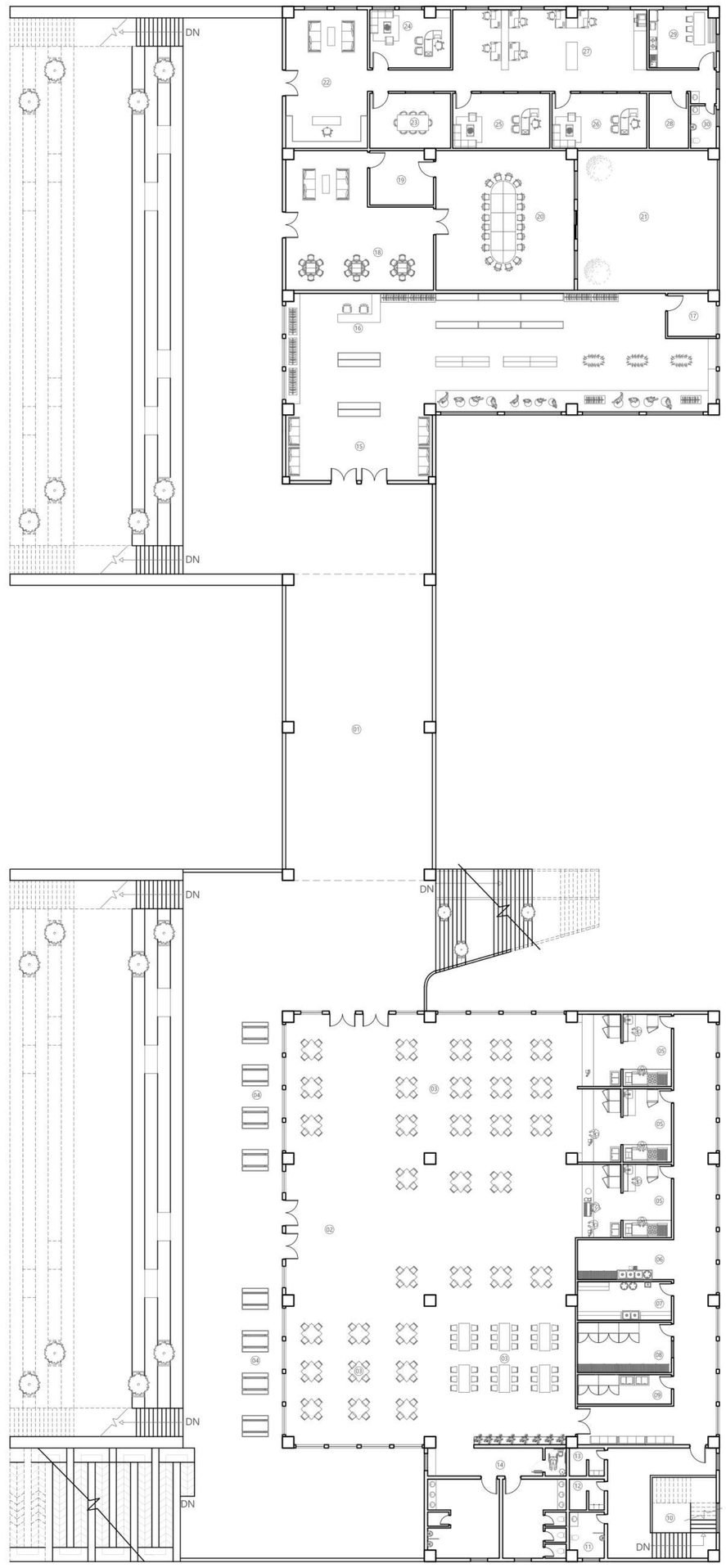
Purbanchal University Khwopa
Engineering College
Department of Architecture



CENTRAL BLOCK
GROUND FLOOR PLAN
SCALE- 1:400

LEGENDS

1. SEMI-COVERED PARKING
2. GUARD HOUSE
3. GENERATOR ROOM
4. SERVICE STAIRCASE
5. BUS PARKING
6. ELECTRICAL PANEL HUB
7. PLUMBING PANEL HUB
8. STORAGE ROOM
9. WOMEN'S SANITARY SERVICES
10. MEN'S SANITARY SERVICES

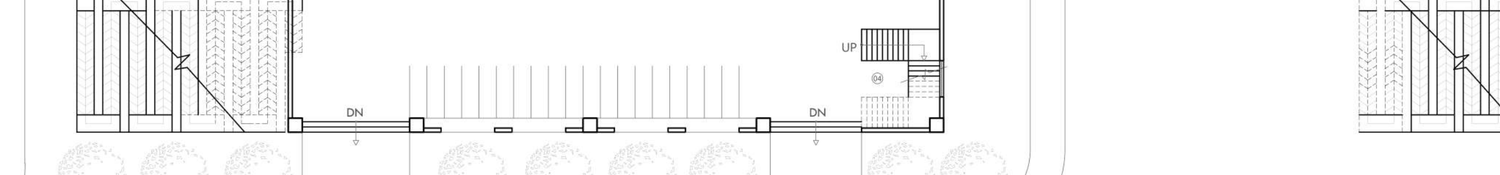


CENTRAL BLOCK
FIRST FLOOR PLAN
SCALE- 1:350

LEGENDS

1. CONNECTING BRIDGE
2. FOOD COURT ENTRANCE
3. INDOOR SEATING
4. OUTDOOR SEATING
5. KITCHEN STALLS
6. DISH WASHING AREA
7. PREPARATION AREA
8. DRY STORAGE
9. COLD STORAGE
10. SERVICE STORAGE
11. STAFF W/C
12. STAFF MEN CHANGING
13. STAFF WOMEN CHANGING
14. SANITARY SERVICES
15. RETAIL STORE
16. CASH COUNTER
17. RETAIL STORAGE ROOM
18. MULTI ACTIVITY ROOM
19. COMMUNITY STORE ROOM
20. COMMUNITY MEETING HALL
21. BALCONY
22. ADMINISTRATION RECEPTION AND LOL
23. MEETING ROOM
24. MANAGING DIRECTOR OFFICE
25. OPERATION HEAD OFFICE
26. SECURITY DEPARTMENT HEAD OFFICE
27. WORK STATION
28. OFFICE STORE ROOM
29. PANTRY
30. STAFF W/C

CENTRAL BLOCK
SECTION AT XX



CENTRAL BLOCK
SECTION AT YY

CENTRAL BLOCK FLOOR PLANS
Community Sports and Recreation center in Dharan, Eastern Nepal

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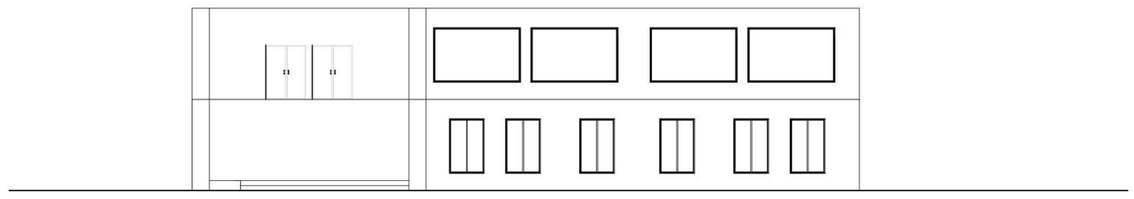
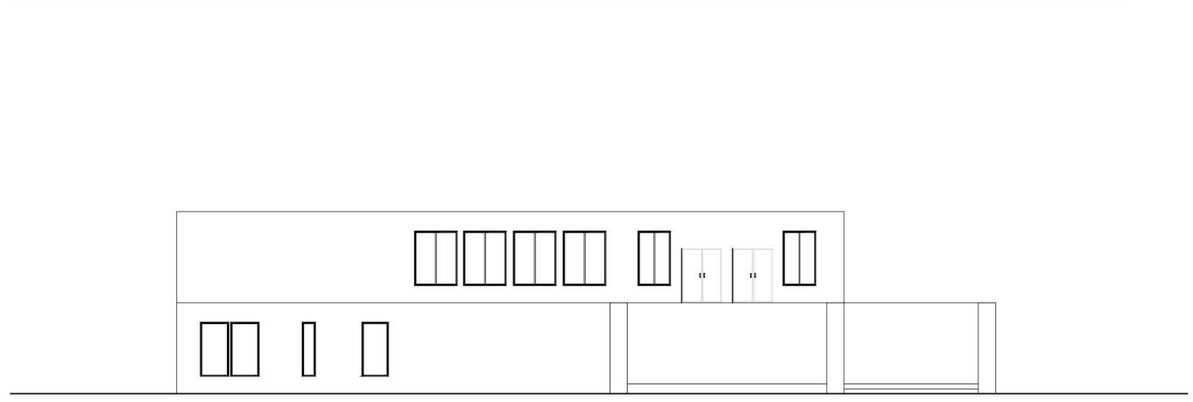
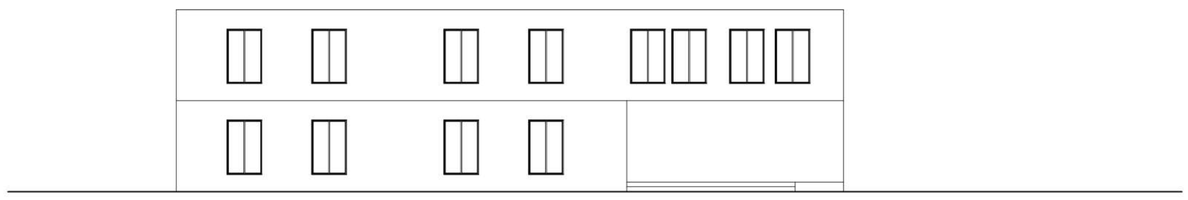
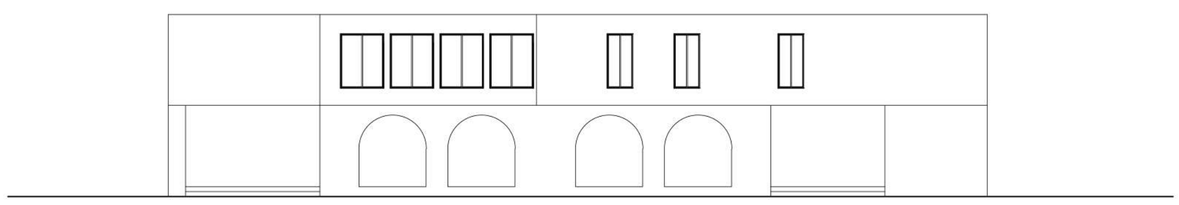
Date: 2081/05/06

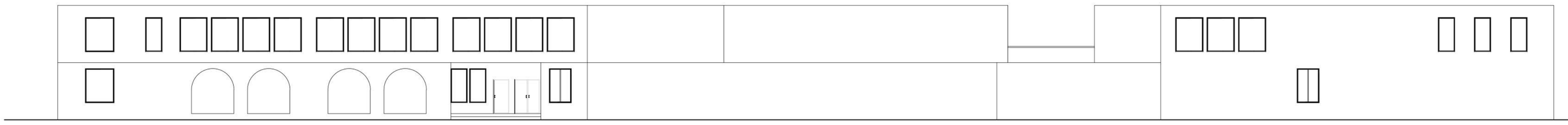
Purbanchal University
Khwopa Engineering College
Department of Architecture

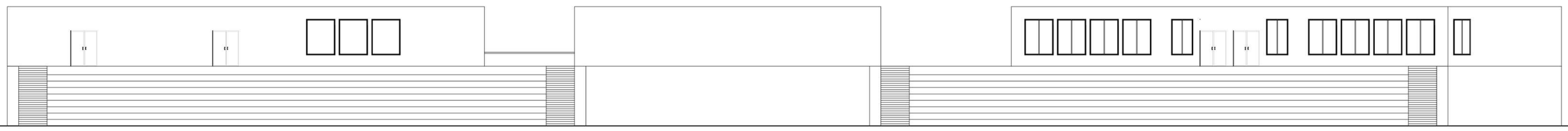












Prashma Shrestha
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SECTION AND ELEVATION

Community Sports and Recreation center
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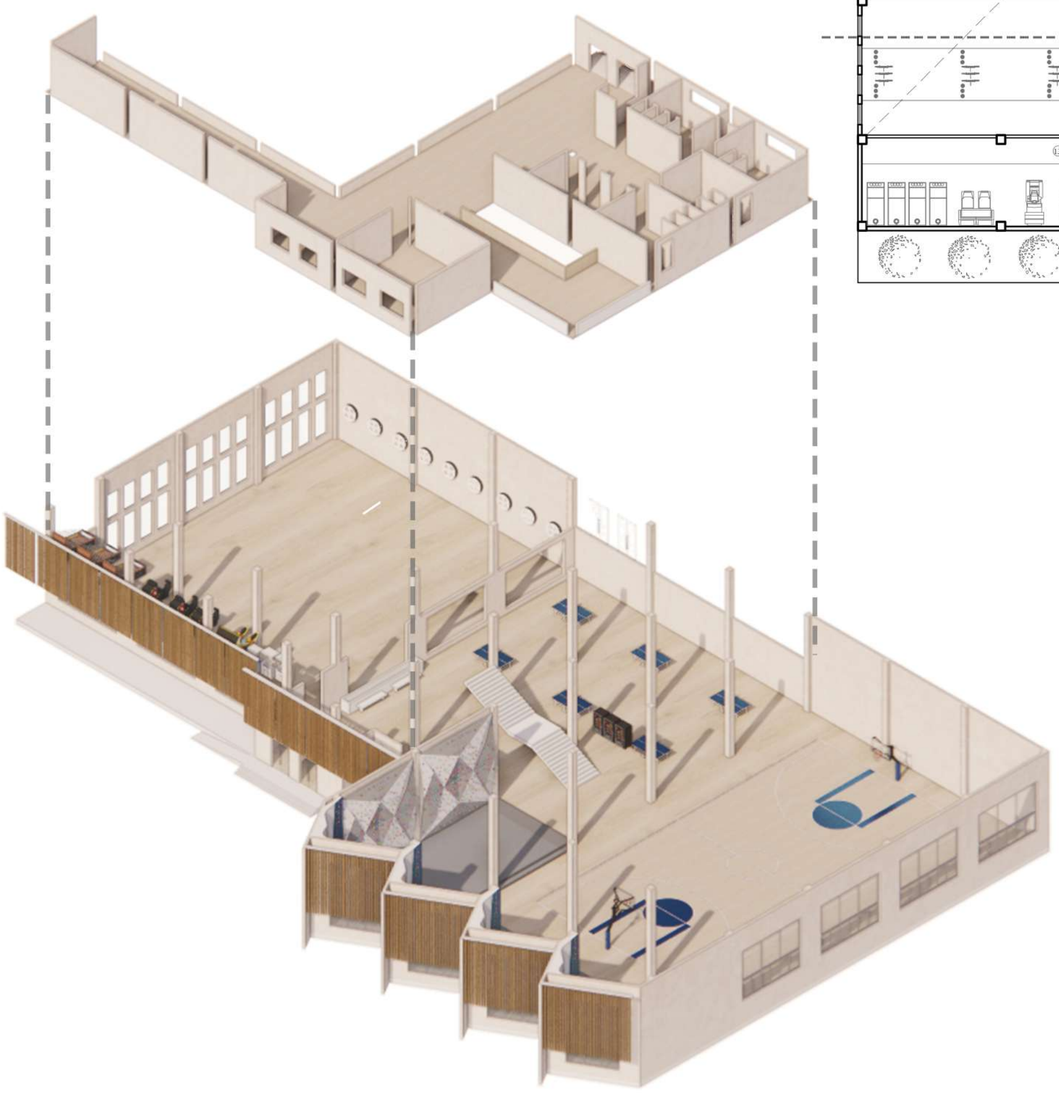
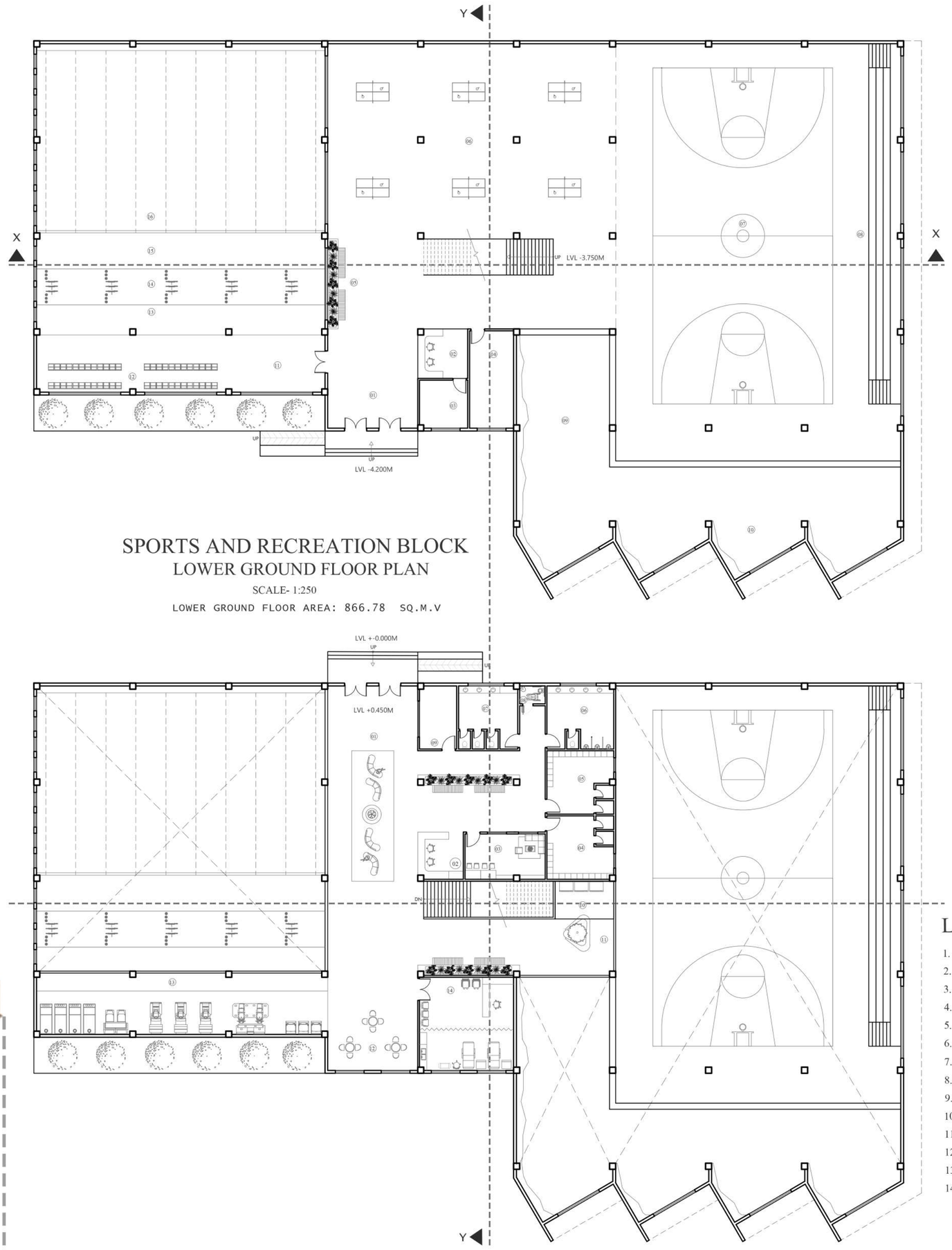
Purbanchal University
Khwopa Engineering College
Department of Architecture

FIG: INDOOR WALL CLIMBING

FIG:INDOOR BASKETBALL COURT





LEGENDS

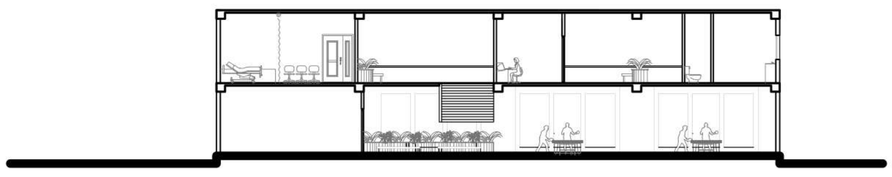
1. ENTRANCE FOYER
2. GAME COUNTER
3. STORE ROOM
4. EQUIPMENT ROOM
5. LOBBY
6. TABLE-TENNIS ZONE
7. BASKETBALL COURT
8. SEATING
9. WALL CLIMBING
10. WALL BOULDERING
11. ARCHERY LOBBBY
12. ARCHERY SEATING
13. WAITING ZONE
14. EQUIPMENT ZONE
15. SHOOTING ZONE
16. TARGET RANGE

SPORTS AND RECREATION BLOCK
LOWER GROUND FLOOR PLAN
SCALE- 1:250
LOWER GROUND FLOOR AREA: 866.78 SQ.M.V

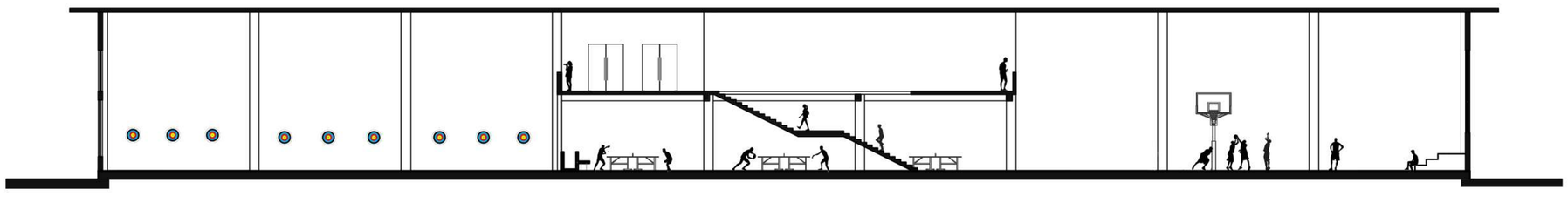
LEGENDS

1. ENTRANCE LOBBY
2. RECEPTION
3. STAFF ROOM
4. MENS' LOCKER AND CHANGE
5. WOMENS' LOCKER AND CHANGE
6. MENS' W/C
7. WOMENS' W/C
8. ACCESSIBLE W/C
9. MECHANICAL ROOM
10. VENDING MACHIN
11. BALCONY
12. ARCADE LOUNGE
13. ARCADE GAMING ZONE
14. MEDICAL ROOM

SPORTS AND RECREATION BLOCK
GROUND FLOOR PLAN
SCALE- 1:250
GROUND FLOOR AREA: 2663.779 SQ.M.



SECTION AT XX



SECTION AT YY

Prashma Shrestha
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SPORTS BLOCK FLOOR PLAN

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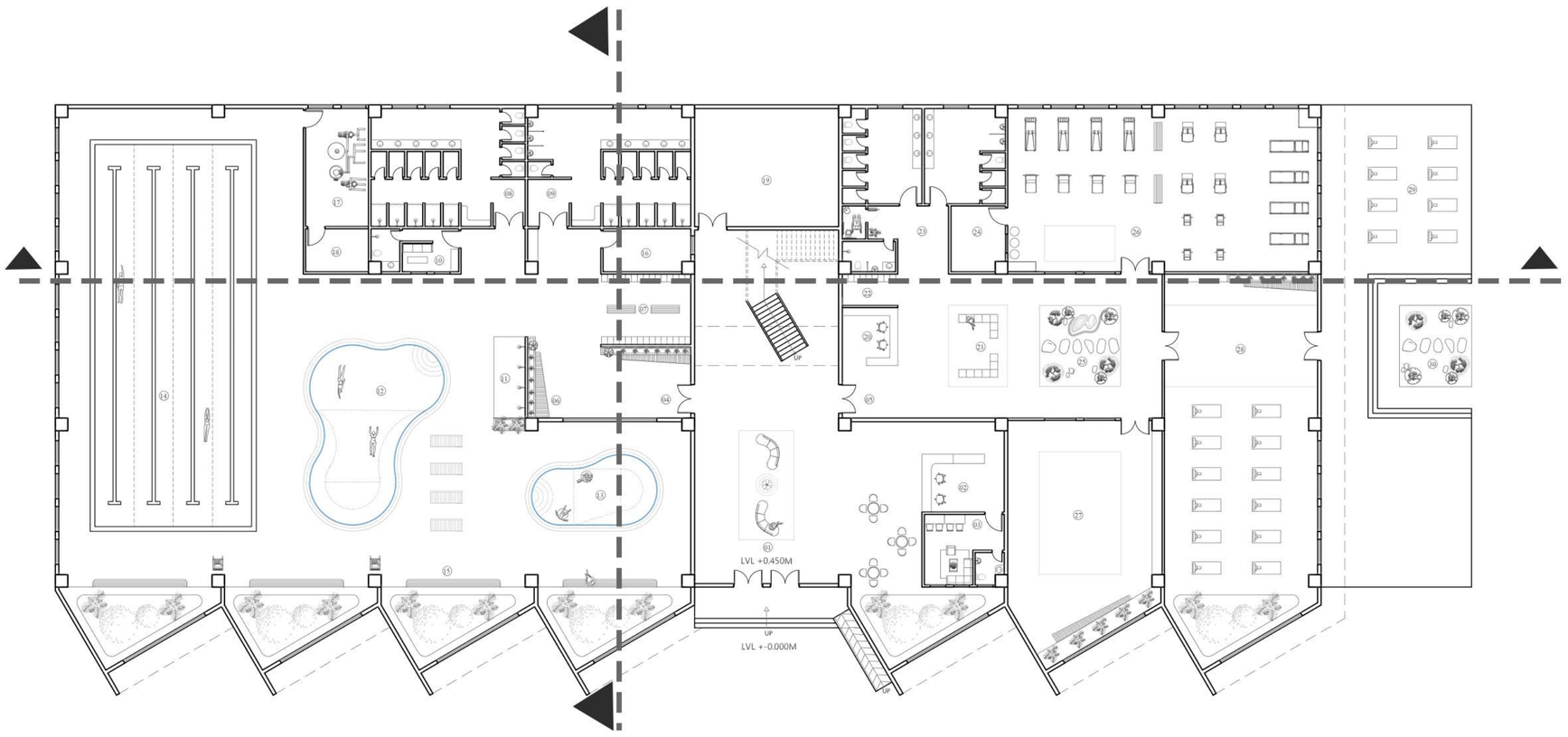
Purbanchal University
Khwopa Engineering College
Department of Architecture

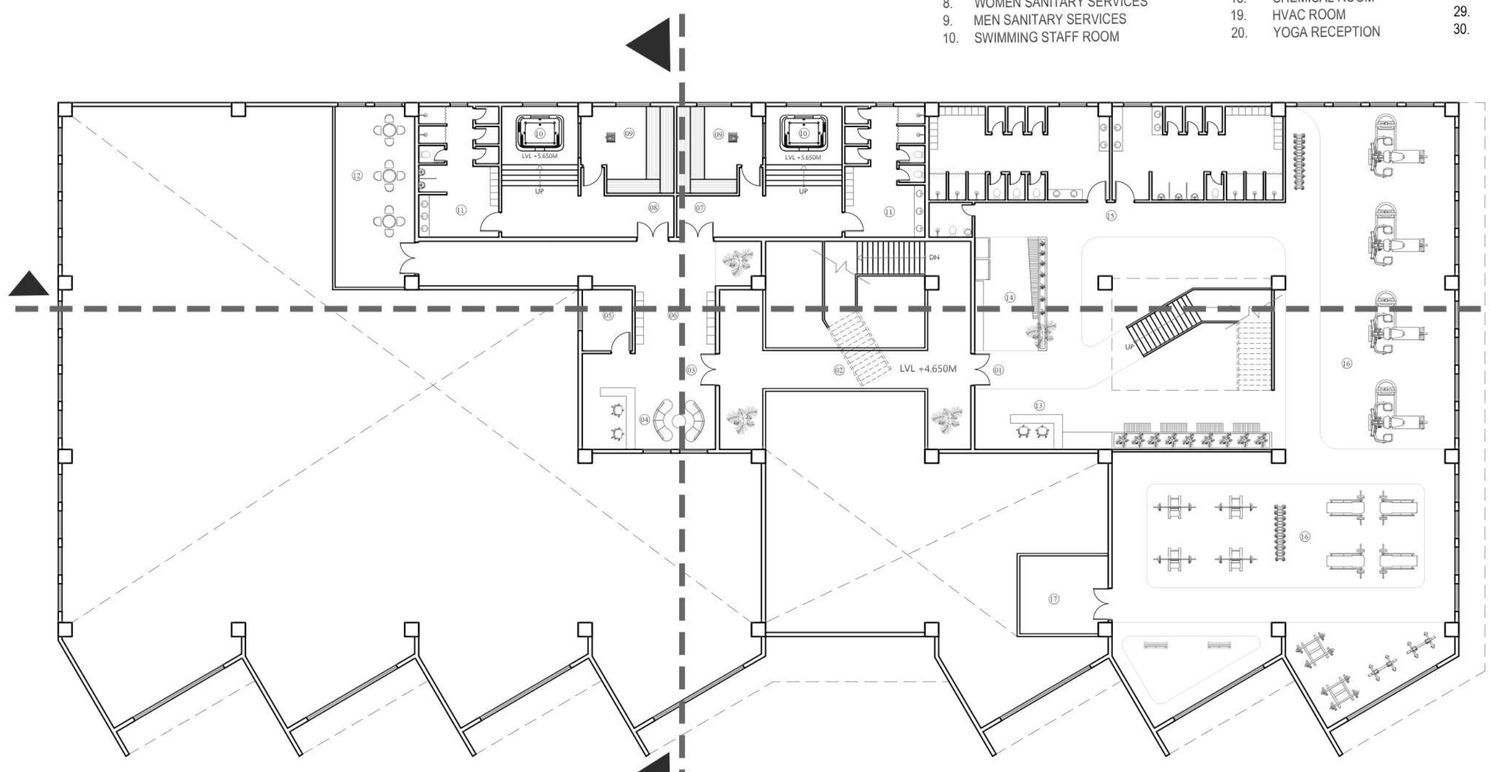


AQUATIC AND FITNESS BLOCK
GROUND FLOOR PLAN
SCALE- 1:250

FLOOR AREA: 2543.26 SQ.M.

LEGENDS

1. ENTRANCE LOBBY
2. RECEPTION
3. STAFF ROOM
4. AQUATIC CENTER ENTRANCE
5. YOGA STUDIO ENTRANCE
6. SWIMMING LOUNGE
7. INCLUSIVE LOCKER
8. WOMEN SANITARY SERVICES
9. MEN SANITARY SERVICES
10. SWIMMING STAFF ROOM
11. SHOWER HEADS
12. LEISURE POOL
13. BABY POOL
14. 25M. LAP POOL
15. SEATING
16. STORE ROOM
17. WATER TREATMENT ROOM
18. CHEMICAL ROOM
19. HVAC ROOM
20. YOGA RECEPTION
21. LOUNGE
22. INCLUSIVE LOCKER
23. SANITARY SERVICES
24. STORE ROOM
25. INDOOR ZEN GARDEN
26. PILATES STUDIO
27. MULTI-ACTIVITY STUDIO
28. YOGA HALL
29. OUTDOOR YOGA DECK
30. OUTDOOR ZEN GARDEN

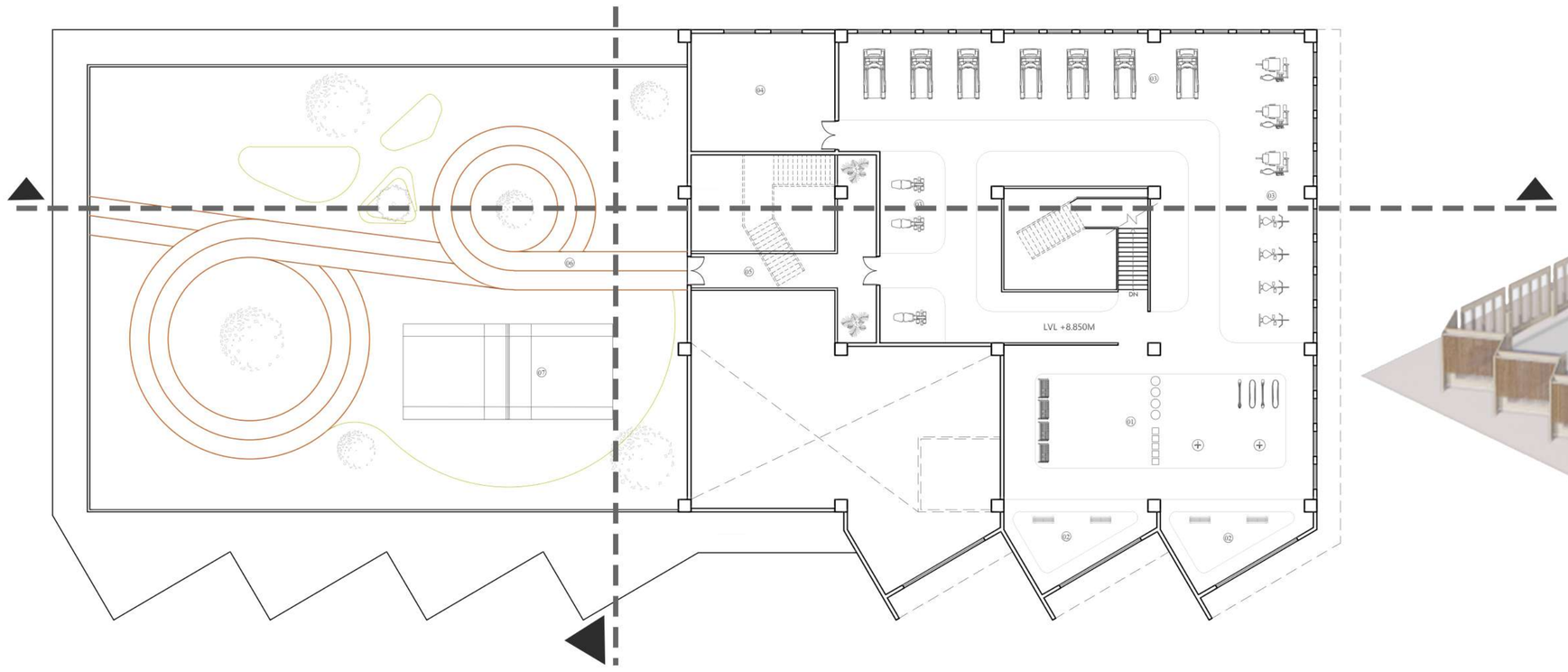


AQUATIC AND FITNESS BLOCK
FIRST FLOOR PLAN
SCALE- 1:250

FLOOR AREA: 1535.70 SQ.M.

LEGENDS

1. GYM ENTRANCE
2. CONNECTING BRIDGE
3. SPA ENTRANCE
4. SPA RECEPTION AND LOUNGE
5. STORE ROOM
6. INCLUSIVE LOCKER
7. WOMEN'S SAUNA AND JACUZZI
8. MEN'S SAUNA AND JACUZZI
9. SAUNA ROOM
10. JACUZZI TUB
11. SANITARY SERVICES
12. BALCONY SEATING
13. GYM RECEPTION
14. VENDING MACHINE
15. SANITARY SERVICES
16. WEIGHT LIFTING ZONE
17. BALCONY

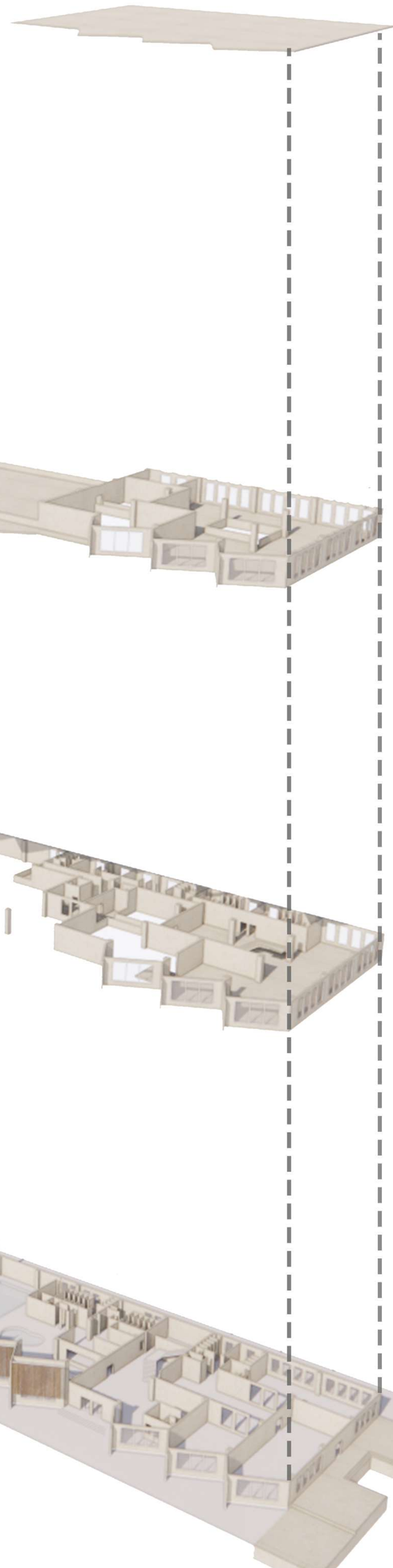


AQUATIC AND FITNESS BLOCK
SECOND FLOOR PLAN
SCALE- 1:250

FLOOR AREA: 1222.80 SQ.M.

LEGENDS

1. CROSSFIT ZONE
2. WARMUP ZONE
3. CARDIO WORKOUT ZONE
4. EQUIPMENT STORE ROOM
5. CONNECTING BRIDGE TO TERRACE
6. ROOFTOP RUNNING TRACK
7. ROOFTOP BADMINTON COURT



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AQUATIC AND FITNESS FLOOR PLAN
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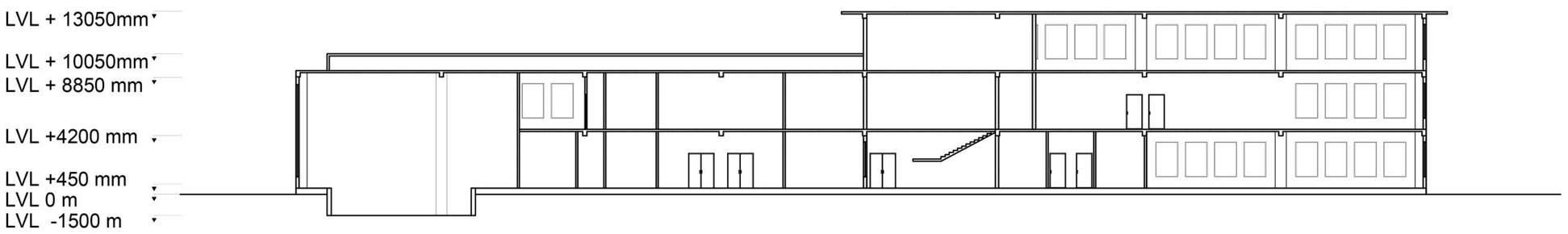
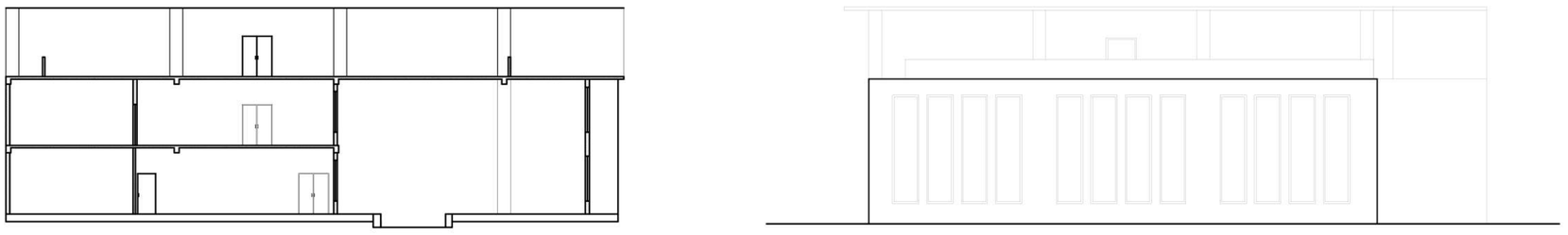


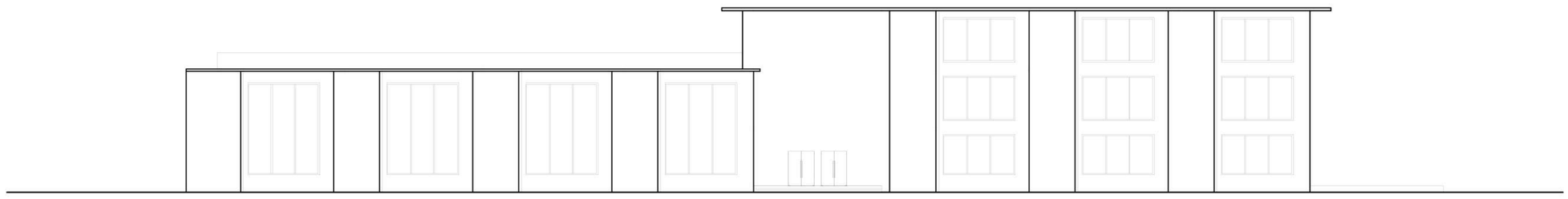
AQUATIC AND FITNESS BLOCK

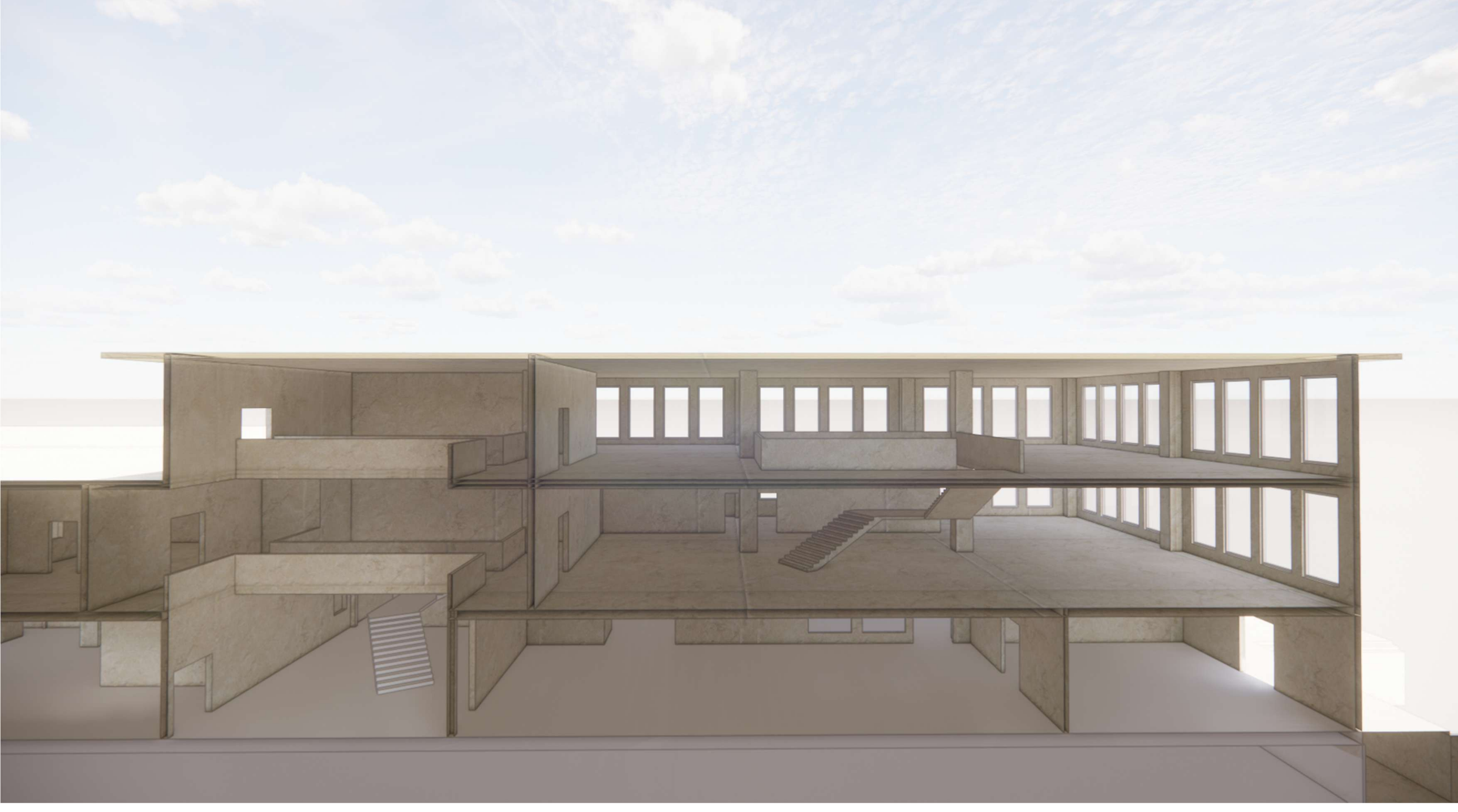
SECTION AT XX



AQUATIC AND FITNESS BLOCK

SECTION AT YY





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SECTION AND ELEVATION

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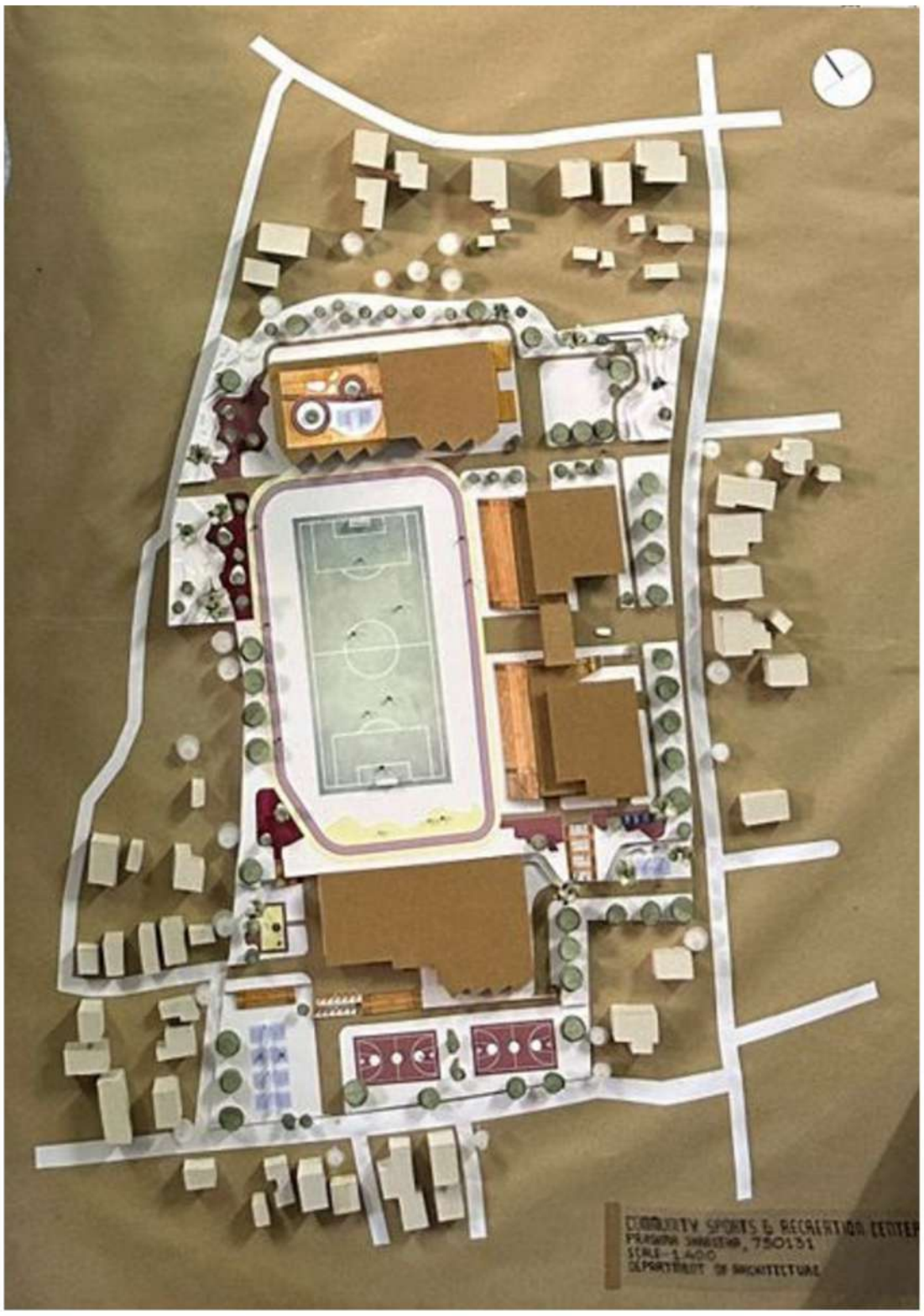

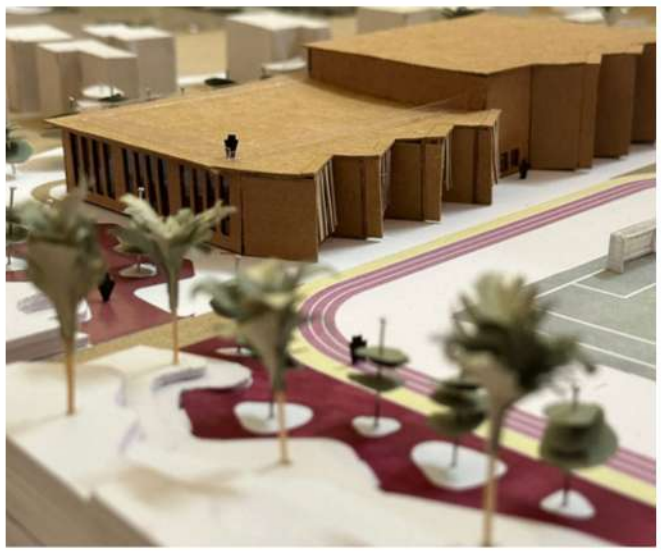

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FINAL 3D MODEL

Community Sports Hub
in Dharan, Eastern Nepal

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