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Theme: The effect of constraints and uncertainties on project time management. A Case Study of Djemorah swimming pool, Biskra.

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DEDICATION

*This dissertation is lovingly dedicated to my beloved **family**, whose love, patience, and endless encouragement have been the foundation of my strength and perseverance throughout this journey.*

*To my dear brother and greatest support, **Achraf Hocine**, for always being by my side with care, guidance, and unwavering belief in me.*
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Abstract:

This dissertation examines the impact of constraints and uncertainties on schedule management during the execution phase of construction projects, with an emphasis on their effect on meeting deadlines. Delays constitute a major issue, particularly in Algeria, where they have become endemic despite governmental efforts. This study seeks to identify the primary causes hindering the smooth progression of works and the repercussions of these dysfunctions on project advancement.

The methodology adopted combines field observations, a rigorous review of technical documents, and the joint application of the Line of Balance (LOB) method alongside Primavera software to ensure precise planning and monitoring. The study focuses on a detailed analysis of the community swimming pool project in Djemorah, Biskra, from inception to completion. The introduction of a baseline, recording of actual data, and variance analysis through time performance indicators provide a robust evaluation framework.

The findings reveal that deficiencies in coordination and management of human and material resources are the principal causes of repeated delays, despite proper plan preparation. The dissertation highlights the critical need to enhance digital monitoring tools and on-site supervision to better control the effects of constraints and uncertainties and to optimise schedule management in construction projects.

Keywords: Time Management, Constraints and Uncertainties, Schedule monitoring, Djemorah Swimming Pool, Line of Balance Method, Primavera Software.

Résumé:

Ce mémoire explore l'influence des contraintes et des aléas sur le management des délais durant la phase d'exécution des projets de construction, en mettant l'accent sur leur impact sur le respect des échéanciers. Si les retards constituent une problématique majeure, particulièrement en Algérie où ils sont devenus endémiques malgré les efforts gouvernementaux, cette étude se propose d'identifier les principales causes entravant le bon déroulement des travaux et les effets de ces dysfonctionnements sur l'avancement des projets.

La méthodologie adoptée combine une observation sur le terrain, l'examen rigoureux des documents techniques, et l'application conjointe de la méthode de la Ligne d'Équilibre (Line of Balance - LOB) ainsi que du logiciel Primavera pour assurer une planification et un suivi précis. L'étude se fonde sur une analyse détaillée du projet de construction de la piscine communautaire de Djemorah à Biskra, depuis son démarrage jusqu'à l'achèvement des travaux. L'introduction de la ligne de base, l'enregistrement des données réelles et l'analyse des écarts à travers des indicateurs de performance temporelle établissent un cadre rigoureux pour l'évaluation.

Les résultats obtenus montrent que des lacunes dans la coordination et dans la gestion des ressources humaines et matérielles sont à l'origine des retards répétés, et ce malgré une préparation adéquate des plans. Le mémoire met ainsi en lumière la nécessité cruciale de renforcer les outils numériques de suivi ainsi que la supervision sur site afin de mieux maîtriser les effets des contraintes et des aléas et optimiser le management des délais dans les projets de construction.

Mots-clés : Management des délais, contraintes et aléas, Contrôle des échéanciers, piscine de Djemorah, méthode de la Ligne d'Équilibre, logiciel Primavera.

الملخص:

تتناول هذه الرسالة تأثير القيود والعوائق على إدارة الاجال التعاقدية خلال مرحلة تنفيذ مشاريع البناء، مع التركيز على تأثيرها على الالتزام بالمواعيد النهائية. تُعد التأخيرات مشكلة رئيسية، خاصة في الجزائر، حيث أصبحت متفشية على الرغم من الجهود الحكومية. تهدف هذه الدراسة إلى تحديد الأسباب الرئيسية التي تعيق سير الأعمال بسلاسة والتأثيرات الناجمة عن هذه الاختلالات على تقدم المشروع.

تعتمد المنهجية المتبعة على الملاحظات الميدانية، والمراجعة الدقيقة للوثائق التقنية، وتطبيق مشترك لطريقة خط التوازن إلى جانب برنامج بريمافيرا لضمان التخطيط والمتابعة الدقيقة. تركز الدراسة على تحليل مفصل لمشروع مسبح جمورة في ولاية بسكرة، من مرحلة بداية الاشغال حتى الإستلام. إن إدخال الخط الأساسي، وتسجيل البيانات الفعلية، وتحليل الفروقات من خلال مؤشرات الأداء الزمني يوفر إطار تقييم قوي لسيرورة المشروع.

تكشف النتائج أن نقص التنسيق وإدارة الموارد البشرية والمادية هي الأسباب الرئيسية للتأخيرات المتكررة، على الرغم من إعداد الخطط بشكل مناسب، كما تبرز الحاجة الملحة لتعزيز أدوات المتابعة الرقمية والإشراف في الموقع للتحكم بشكل أفضل على آثار القيود والعوائق وتحسين إدارة الجداول الزمنية في مشاريع البناء.

الكلمات المفتاحية : إدارة الاجال، القيود والعوائق، مسبح جمورة، طريقة خط التوازن، برنامج بريمفيرا.

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INTRODUCTION

1. General Introduction:

In today's dynamic construction sector, effective project time management is a fundamental component of successful project delivery. It necessitates not only precise planning and scheduling but also a thorough understanding of the risks and variables that may cause disruptions. Among the most significant factors complicating project scheduling are constraints and uncertainties, which frequently arise unpredictably throughout a project's lifecycle. These challenges are particularly acute in public infrastructure projects, such as sports facilities, where timelines are sensitive, multiple stakeholders are involved, and delays can have substantial social, financial, and political ramifications.

This study explores the impact of constraints and uncertainties on time management within construction projects, focussing on the Djemorah swimming pool project in Biskra, Algeria, as a case study. This particular project is exemplary of public sports facilities affected by a range of internal and external challenges. The project, overseen by the Directorate of Youth and Sports—an entity central to the development of sports infrastructure nationally aligns with Algeria's broader policy objectives to promote physical activity, notably swimming, among young people, and to enhance access to sports amenities in both urban and rural areas.

Conceived as a vital resource for youth development, aquatic sports promotion, and local recreation, the Djemorah swimming pool project has faced numerous constraints, including restricted budgets, material procurement logistics, contractor mobilisation delays, and fluctuating administrative approvals. Concurrently, uncertainties such as weather interruptions, unforeseen site conditions, and alterations to design specifications have further contributed to schedule delays. These practical challenges make the project an insightful case through which to examine disruptions to time management strategies and potential improvements.

Constraints affecting construction are typically categorised as "hard constraints," including immovable deadlines, manpower limitations, and contractual commitments, and "soft constraints," such as evolving stakeholder requirements and regulatory changes. Both categories significantly impact project planning and implementation. Uncertainties add further complexity, arising from unpredictable events that may cause schedule deviations and heightened delay risks, such as environmental factors, economic shifts, and unanticipated technical issues.

Time management in the construction of sports facilities demands particular sensitivity due to public visibility, community expectations, and fixed event schedules. Delays in projects like the Djemorah swimming pool not only incur financial costs but also disappoint community aspirations and postpone the achievement of policy goals related to youth development and sports promotion. Understanding how constraints and uncertainties arise and affect project timetables is thus critical to successful delivery.

This dissertation aims to elucidate the interplay between project constraints, uncertainties, and time management by analysing empirical data and documentation from the Djemorah project. It assesses scheduling practices, risk management methodologies, and stakeholder coordination to identify the principal causes of delays and propose effective mitigation strategies. The findings contribute to improving project delivery performance in similar contexts.

In conclusion, the study offers valuable insights into the challenges facing public construction projects in Algeria, particularly those intended to foster youth and sports development. The Djemorah swimming pool serves as both a tangible case study and a symbolic representation of broader systemic issues affecting project schedules. The research endeavours to provide actionable recommendations

to enhance time control in future public infrastructure projects, ensuring timely completion and the fulfilment of intended social and developmental objectives.

2. Problem Statement:

Time management is a fundamental element for the success of a project and the achievement of its objectives within the scheduled timeframe. However, projects often face various constraints and challenges, such as financial, temporal, regulatory, or technical limitations, which can directly impact the planning, sequencing, and control of activities. These difficulties may lead to delays in execution, disruptions to project flow, or, in the worst case, failure to meet deadlines and deliver project outcomes as intended.

In the context of sports facilities projects in Algeria, time management is particularly marked by frequent schedule overruns and difficulties in maintaining timeline control throughout the project's lifecycle, especially during the implementation phase. These discrepancies between initial scheduling forecasts and actual progress highlight the limitations of current time management practices and raise concerns about their ability to ensure efficient coordination and timely delivery.

3. Problem Question:

Based on these observations and the ensuing reflections, it becomes essential to formulate a research question to clarify the underlying issue. The main research question is:

How do various constraints and uncertainties affect project time management, and what strategies can mitigate their impact to achieve improved control and mastery of project timelines?

4. Research objectives:

This study aims to better understand how constraints and uncertainties affect time management in construction projects. Taking into account the specificities of the local context, the goal is also to propose recommendations to optimise the scheduling and timeline control process. To achieve these objectives, the research is structured around three main areas:

- Identify and classify key constraints and barriers affecting time management in construction projects.
- Evaluate how these constraints and uncertainties affects current time management practices, including scheduling and stakeholder coordination.
- Propose evidence-based recommendations to enhance scheduling processes and improve control over project timelines.
- Contribute to academic and practical knowledge on project time management challenges via an in-depth case study of the Djemorah swimming pool project.

5. Research methodology:

To achieve the objectives of this research, a robust methodology combining quantitative and qualitative approaches has been employed, organised around two complementary components. The first component entails a thorough review of the literature pertaining to time management in construction projects, with a focus on the challenges posed by constraints and uncertainties. This review aims to establish a solid theoretical foundation, enhance understanding of scheduling difficulties, and outline prevailing practices.

The second component involves an empirical field study based on a case study of a sports facility project in Algeria. This enables an in-depth examination of time management practices and the influence of contextual factors in a real-world setting. A comprehensive approach is thus adopted, aiming to accurately describe the processes of time management in relation to constraints and uncertainties, to deepen insight into the current situation and identify key determinants of schedule control. To obtain relevant data, a structured interview was designed and disseminated to pertinent

stakeholders, facilitating the identification of contextual and organisational factors significantly impacting time management.

6. **Dissertation structure:**

The dissertation begins with an introduction that delineates the central issue: the impact of constraints and uncertainties on time management within sports facility projects. The research objectives are explicitly articulated, and an outline of the dissertation's organisation is provided.

The first chapter delivers an overview of the sector, detailing the unique characteristics of sports facility projects in Algeria, outlining the various phases of the project lifecycle, the roles of key stakeholders, and examining the principal challenges associated with time management.

The second chapter undertakes a detailed examination of a case study, analysing the project's urban and architectural context, its technical specifications, administrative procedures, and historical background. This chapter aids in comprehending how constraints and uncertainties influence time management.

The third chapter concentrates on managerial aspects of the case, appraising the effects of constraints on schedule control, investigating resource utilisation, addressing encountered challenges, and evaluating strategies employed to mitigate these issues. It concludes with recommendations aimed at improving time management practices.

Finally, the general conclusion summarises the main findings, underscores critical factors, discusses the study's limitations, and proposes directions for future research and enhancement.

FIRST CHAPTER: THEMATIC AND MANAGERIAL STUDY

Introduction:

The youth and sports sector plays a vital role in shaping urban and architectural development, as it provides spaces that foster recreation, learning, and social interaction. These facilities make a meaningful contribution to empowering young people while enhancing community well-being. Within this context, infrastructures such as sports complexes, youth centers, and swimming pools are regarded as essential assets that not only promote physical health but also reinforce social cohesion and help develop essential life skills.

This chapter presents a structured and coherent approach aimed at analysing project management within the youth and sports sector in Algeria. It begins with a general presentation of the sector, highlighting swimming pool projects as a key typology. The study then proceeds with the identification of the selected case study, followed by the definition and clarification of the main concepts. Particular attention is given to the presentation of national programmes related to youth and sports facilities, in order to situate the institutional and operational framework in which these projects are carried out. The chapter also examines the definition of a project, its essential characteristics, and the fundamental principles of project management as applied to this specific field. Subsequently, the analysis highlights the specific challenges of time management within the sector's projects, emphasising the constraints, risks, and performance factors that affect schedule compliance. Finally, the chapter presents the key tools, methods, and best practices that can optimise the planning and temporal monitoring of youth and sports projects in Algeria.

1. Presentation of the Youth and Sports sector:

A provincial directorate responsible for all matters related to youth and sports activities, as well as field monitoring of sectoral institutions, in addition to pedagogical supervision and administrative management. The youth and sports sector constitutes a central pillar of social and urban development, providing essential spaces for recreation, education, and community engagement. This section offers an overview of the sector's structure, objectives, and its significance within the broader context of national development policies.

The Youth and Sports sector holds responsibility for government strategies aimed at advancing youth development and promoting sports, both as vehicles for personal growth and as pillars of national well-being. Its mission centres on empowering youth, supporting community organisations, enhancing athletic performance, and fostering social cohesion through structured programmes, training, infrastructure development, and resource allocation.

A central goal is to encourage civic engagement and leadership among youth by providing supportive and stimulating environments. Through dedicated institutions, clubs, and associations, the sector seeks to nurture young talent, instill values of citizenship, and provide access to diverse leisure, educational, and cultural opportunities.

The sector also plays a pivotal role in the ongoing development and modernisation of sports activities. It has established a network of public facilities, regional youth centres, stadiums, and swimming pools, ensuring equitable access for youth across rural and urban communities. Further, the sector implements national strategies to recruit, develop, and support sports talent, with an emphasis on promoting a healthy, dynamic, and innovative culture.

To summarize, the youth and sports sector refers to the segment of society and public policy dedicated to promoting the physical, mental, and social development of young people through structured sports, recreation, and educational initiatives. This sector encompasses programs and systems intended for children, adolescents, and young adults, typically through facilities, organised activities, and dedicated governmental or non-governmental organisations. Its primary objectives include fostering positive youth development, encouraging healthy lifestyles, building community, and developing skills such as teamwork, leadership, and resilience.

1.1. Organisational Structure

The organisational structure of the Directorate of Youth and Sports is composed of four main departments, each encompassing several specialised offices. The Department of Physical and Sports Education includes the Office for the Development of Physical and Sports Education, the Office for the Identification and Training of Young and Sports Talents, and the Office for Sports Associations and Sports Events.

The Youth Activities Department is comprised of the Office of Youth Communication, Information, and Communication Systems; the Office of Social and Educational Programs and Youth Recreation; and the Office of Youth Projects and Promotion of Youth Associations. The Investments and Equipment Department oversees the Office of Sports, Social, and Educational Facilities and Equipment, the Office of Standardization and Maintenance, and the Office of Statistics, Programs, and Evaluation. Finally, the Training and Resource Management Department contains the Office of Personnel and Training, the Office of Budget and Monitoring of Grants and Assistance to Sports and Youth Associations and its Supervision, as well as the Office of General Resources.

Table 1. Organisational structure of the directorate of youth and sports
Source: (The directorate of youth and sports, 2024)

Department of Physical and Sports Education	Youth Activities Department	Investments and Equipment Department	Training and Resource Management Department
Office for the Development of Physical and Sports Education	Office of Youth Communication, Information, and Communication Systems	Office of Sports, Social, and Educational Facilities and Equipment	Office of Personnel and Training
Office for the Identification and Training of Young and Sports Talents	Office of Social and Educational Programs and Youth Recreation	Office of Standardization and Maintenance	Office of Budget and Monitoring of Grants and Assistance to Sports and Youth Associations, and its Supervision
Office for Sports Associations and Sports Events	Office of Youth Projects and Promotion of Youth Associations	Office of Statistics, Programs, and Evaluation	Office of General Resources

1.2. Concepts in relation with Youth and Sports:

Understanding the foundational concepts within the Youth and Sports sector is crucial for effectively designing and implementing programmes that support young people's development. Key terms such as :

- **Youth:** typically refers to individuals aged 15 to 24, though definitions may slightly vary by country and organisation. This stage is pivotal for personal development, where young people are targeted for initiatives focused on leadership, civic participation, life skills, education, and positive engagement through sports and recreational activities. Properly designed opportunities in this phase can foster confidence, resilience, and a sense of belonging within society.
- **Sports:** encompasses structured physical activities, often guided by rules and involving competition, teamwork, and goal-oriented outcomes. Sports contribute to the development of physical fitness, self-discipline, fair play, and enjoyment for participants. They can be individual or team-based, recreational or competitive, and serve as valuable tools for social inclusion and cultural exchange.
- **Sports Club/Association:** A sports club or association is an organised body providing regular and inclusive opportunities for young people to engage in specific athletic disciplines. Under the guidance of trained coaches or mentors, these clubs foster talent development, peer interaction, and community spirit. Clubs often serve as platforms for both recreational

participation and pathways to elite competition, strengthening the social fabric and promoting healthy lifestyles.

- **Ministry/Department of Youth and Sports:** The Ministry or Department of Youth and Sports is the central governmental authority responsible for shaping and implementing policies that govern youth and sports development at a national or regional level. Its responsibilities include planning and maintaining sports infrastructure, developing nationwide programs, distributing resources, overseeing community and elite sports, monitoring regulatory compliance, and advocating for social inclusion and equal access for all young people.

1.3. Swimming pools:

Swimming pools are vital facilities within Youth and Sports sector projects, serving as key infrastructure to encourage physical activity, social inclusion, and community well-being among young people. These projects involve the careful planning, design, and construction of swimming pools that adhere to safety, accessibility, and multi-use guidelines, supporting both recreational swimming and organised training or competitive events. Swimming pools within these projects also embed educational components such as swimming lessons and water safety training, essential for developing life skills in youth.

1.3.1. Swimming pools typologies:

Swimming pools can be categorised into various typologies, each tailored to specific needs and uses within the youth and sports environment:

- **Olympic Pools:** Measuring 50 metres in length, these are the largest pools used primarily for competitive swimming and international events. They meet stringent standards for dimensions, depth, and facilities to accommodate elite athletes and spectators.
- **Semi-Olympic Pools:** Typically 25 metres long, semi-Olympic pools are common in sports clubs, leisure centres, and gyms. They support both training and competitive events at regional or national levels.
- **Diving Pools:** Specifically designed for diving disciplines, these pools require significant depth and height clearance for platforms and springboards. They are often part of larger sports complexes and must comply with strict safety standards.
- **High-Diving Pools:** Similar to diving pools but designed for higher jumps, these pools cater to specialized high-diving competitions, requiring additional depth and safety features.
- **Indoor Pools:** Enclosed pools allowing year-round use regardless of climate, often equipped with heating, ventilation, and humidity control systems.
- **Outdoor Pools:** Exposure to natural environment and seasonal usage define these pools, popular in warm climates or summer seasons.

1.3.2. Different Swimming Pool Programs in Algeria:

In Algeria, swimming pools can be classified into several main types according to state programs and usage needs:

- **The Olympic pools (50 meters):** these pools are designed to meet international and national competition standards. A prominent example is the Olympic Pool in Sétif, located within the National School of Olympic Sports. This facility adheres strictly to international specifications and is regarded as one of Algeria’s most modern sports infrastructures.
- **The Semi-Olympic pools (25 meters)**: form the core of the government’s expansion strategy for sports facilities at a local level. For instance, the Wilaya of Algiers has initiated multiple projects under the "a pool in every municipality" strategy, aiming to increase youth access to quality aquatic facilities.
- **Neighborhood pools (Proximity pools):** these smaller pools primarily serve residential communities by providing convenient training and leisure spaces. In summer 2024, Algerian

authorities announced the availability of 368 swimming pools intended for young swimmers, many of which were neighbourhood pools, enhancing community-based aquatic activities.

- **Mobile pools:** an innovative initiative designed to bring swimming facilities to underserved regions lacking permanent pools. There were 163 mobile pools deployed during summer 2024 across 18 wilayas, enabling children and young people in remote areas to engage in swimming and water-based activities.

1.4. Swimming pools programming process in Algeria :

The programming process for swimming pools in Algeria is a structured procedure involving four key stages, as explained by an engineer at the Directorate of Youth and Sports in Biskra Province. The first step is identifying the need for a swimming pool in a particular region, which involves assessing factors such as the local population size and the availability of existing sports facilities. Following this, comprehensive studies are prepared, which include preliminary and detailed assessments of the location, required pool dimensions, and associated costs. The third step involves submitting the project for approval and financing, where it is reviewed by pertinent authorities such as the Ministry of Youth and Sports or the relevant Wilaya to secure budget allocation. Finally, after selecting an appropriate contractor, the construction phase begins, culminating in the delivery of the completed swimming pool for public use. This process ensures that projects are carefully designed and executed to meet community needs and align with governmental standards for youth and sports infrastructure development.

2. Identification of case study:

2.1. Semi-Olympic Pool:

A Semi-Olympic pool is typically 25 meters long and about 15 meters wide, making it half the length of a full Olympic pool. These pools are designed for professional training, local competitions, and recreational use, providing a versatile environment for swimmers of various skill levels. The depth of a semi-Olympic pool generally ranges from 1.2 to 2 meters, depending on its intended function, with a minimum recommended depth of 2 meters and an ideal depth of up to 3 meters to accommodate different aquatic activities safely. Featuring six lanes with lane widths of approximately 2.5 meters, these pools adhere to international standards, balancing professional requirements with practical size and cost considerations. The volume of water in a semi-Olympic pool ranges from a minimum of 2,500 cubic meters to around 3,570 cubic meters for a 3-meter depth. Semi-Olympic pools offer efficient solutions for community, school, and sports club facilities, combining professional swimming conditions with reduced construction and maintenance expenses compared to full Olympic pools.

2.2. Spatial and Functional Organisation of Semi Olympic pools:

The spatial and functional organisation of Semi-Olympic swimming pools is carefully planned to ensure optimal use, safety, and comfort for all users. Spatially, the main pool area includes clearly marked lanes designed for swimming activities. If used for competitions, spectator stands are incorporated to accommodate viewers. Essential supporting facilities such as locker rooms, showers, and sanitary areas are provided for swimmers' convenience and hygiene. Technical spaces, including water filtration systems, pump rooms, and storage areas, are integral to maintaining pool functionality and water quality. Functionally, the pool area is divided into distinct zones to streamline operations and user flow. The athletes' zone comprises changing rooms, warm-up areas, and direct access to the pool, ensuring athletes can prepare efficiently. The public and visitors' zone includes the entrance, ticketing point, and spectator seating, facilitating smooth visitor management. Lastly, the service and technical zone houses maintenance facilities, staff rooms, and mechanical systems, supporting pool upkeep and operational effectiveness. This separation of spaces within Semi-Olympic pools promotes proper circulation, upholds hygiene standards, and ensures safety, making the facility accessible and user-friendly for both athletes and the public.

2.3. Planning and Implementation of Semi Olympic Pool Projects:

Project programming of Semi Olympic pools encompasses comprehensive planning and implementation phases that ensure the successful delivery and operation of these facilities. The process begins with a thorough needs assessment, evaluating factors such as local population, potential users, and the presence of sports clubs to determine demand. Subsequently, the type of pool is defined, with the semi-Olympic pool often chosen for its suitability for training and competitions. Budget allocation and feasibility studies follow, assessing the financial viability and logistical requirements. The design phase involves detailed architectural and technical studies to specify pool dimensions, structural features, water treatment systems, and supporting amenities. Execution covers the construction and installation of necessary equipment, adhering to specified standards to meet safety, usability, and efficiency criteria. Finally, the operation and maintenance phase ensures ongoing functionality, safety, and user satisfaction through routine checks, cleaning, and system upkeep, securing the longevity and effectiveness of the semi-Olympic pool as a community and sports resource.

THE MANAGERIAL STUDY:

1. Project:

1.1. Definition:

A project is a unique and temporary process that involves a series of coordinated and controlled activities with clearly defined start and end points, undertaken to achieve specific goals while adhering to constraints of time, cost, and resources, often producing planned outcomes such as products, services, or benefits; its success is measured by how well these objectives are met within the agreed timeframe and budget, with standards like ISO 10006 characterising it as an organised sequence of activities complying with designated requirements and limits, the APM Body of Knowledge describing it as a one-time endeavour delivering deliverables or benefits under agreed acceptance criteria, and PMI defining it as a temporary effort creating unique results; furthermore, it is regarded as a complex and intangible concept that corresponds to a unique and innovative progression over time culminating in a tangible final deliverable, relying on human, material, and logistical resources, typically featuring uniqueness, singularity, and an element of uncertainty.

Moine (2012) defined a project as a complex and intangible work; it is an abstract concept. It corresponds to a unique and innovative result, a progression through time, a transformation leading to the final deliverable, which this time is something tangible either a material or immaterial final product. In summary, a project can be defined as the set of activities and actions undertaken to meet a defined need while facing constraints of time, cost, and quality. It depends on resources (human, material, and logistical), often has the character of uniqueness and singularity, and includes an element of uncertainty.

1.2. Key Characteristics of a Project:

Projects possess distinctive characteristics that differentiate them from routine operations and guide their management and execution effectively:

- **Temporary Nature:** Projects have a clearly defined beginning and end, concluding once the objectives are achieved. This temporality distinguishes projects from ongoing operational work.
- **Uniqueness:** Each project delivers a unique product, service, or result tailored to specific requirements, unlike repetitive tasks that occur in standard operations.
- **Defined Objectives and Goals:** Projects operate with clear objectives and goals that serve as benchmarks for success, guiding planning, execution, and evaluation phases.
- **Specific Scope and Requirements:** The scope precisely delineates what will be delivered and what will not, agreed upon at the outset and actively managed throughout the project lifecycle to prevent scope creep.
- **Resource Constraints:** Projects must carefully manage limited resources including time, budget, personnel, and materials to ensure successful delivery.

- **Cross-Functional Collaboration:** Projects typically involve diverse stakeholders and departments, requiring effective coordination and collaboration across multiple functions.
- **Inherent Risk and Uncertainty:** Projects often encounter novel challenges and complex environments, necessitating proactive risk identification, assessment, and management.
- **Phased Lifecycle:** Projects progress through distinct phases initiation, planning, execution, monitoring and controlling, and closure that provide structure and support systematic progress.
- **Deliverables and Milestones:** Specific outputs and milestones mark significant progress points and facilitate performance tracking.
- **Stakeholder Involvement:** Projects require continuous engagement and communication with customers, sponsors, and users to ensure their needs are met and expectations managed.

Figure 1. Characteristics of a Project (Source: Author, 2025, processed with Napkin).

1.3. The Life Cycle of the Project:

The project lifecycle is defined by the organisation responsible for delivering the project. It supports the initial preparation phase by establishing default stages and reflects the progressive development of the product or service throughout the project's duration. This framework structures the principal interactions between the sponsor and the project team. Its main purposes are to:

- Provide a foundation for project planning by dividing the work into distinct phases.
- Build upon established best practices during implementation and at phase transitions.
- Promote consistency across similar projects and enable effective oversight by management.

To implement the project lifecycle:

- Identify the project's nature and key characteristics at the outset.
- Determine whether a standard organisational lifecycle is appropriate, as is common in mature project management environments.
- Apply, adapt, or design a specific lifecycle by defining its phases, milestones, and indicative timeframes.
- Test understanding of the lifecycle with someone unfamiliar with the project, revising terminology where necessary for clarity.
- Validate the proposed lifecycle with the sponsor to confirm agreement on milestone approvals and decision points

1.4. The Project Iron Triangle:

The Iron Triangle, also known as the Triple Constraint Triangle, the Performance Triangle or the Golden Triangle, is "a representation of the most fundamental criteria for measuring project success, namely whether the project is delivered on time, within budget, and to a defined level of quality, performance, or scope" (Pinto, 2010). The Iron Triangle is a highly useful tool in project management, particularly during the planning phase, and it has become a standard measure for regularly assessing project performance. This triangle is often employed to illustrate the interdependence among the three main project variables (Bronte-Stewart, 2018).

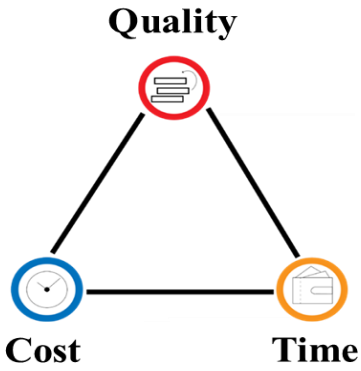

Figure 2. The iron triangle (Source: Author, 2025).

1.5.Project constraints:

Project constraints refer to the obligations and requirements to which a project is subject and by which its success is assessed.

According to the PRINCE2 methodology, six key variables must be managed throughout the project's life cycle: time, cost, scope, risk, benefits, and quality (Bronte-Stewart, 2018).

The PMBOK (2017) defines project success as the degree to which the project and its deliverables meet quality standards, adhere to schedule and budget, and achieve customer satisfaction. Similarly, the International Project Management Association (IPMA) emphasises that project success is closely tied to the effectiveness of project management, particularly the ability to deliver the project's product within its defined scope, schedule, cost, and quality parameters.

The PMI's further notes that project management generally involves identifying requirements, addressing the diverse needs and expectations of stakeholders throughout project execution, and balancing competing constraints such as time, cost, scope, resources, quality, and risk.

The APM Body of Knowledge highlights that success factors include sound management practices such as setting clear goals and objectives, maintaining a focus on business value, implementing appropriate governance structures, ensuring senior management commitment, and providing timely and transparent communication. The key areas to manage therefore include schedule, finance, scope, resources, quality, and risk.

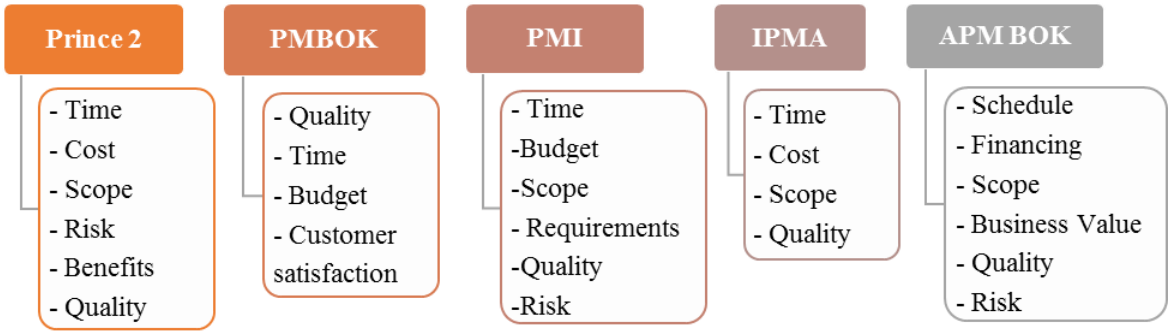

Figure 3. Project constraints (Source: Author, 2025).

1.6. Project life cycle:

The project lifecycle represents the sequence of phases through which a project progresses, from its initiation to its closure. It provides a structured framework that enables the project team to plan, execute, monitor, and complete the project in an organised manner. The typical project lifecycle comprises five main phases:

- **Initiation phase:** this is the first stage of the project lifecycle. Its purpose is to define the project's scope and objectives, analyse stakeholder needs, clarify the initial request, and assess

both the feasibility and the relevance of undertaking the project. The initiation phase often results in the development of a project charter or a feasibility report that formalises the decision to proceed.

- **Planning phase:** during this stage, the project is prepared and defined in detail. It involves identifying the specific activities required, scheduling tasks, allocating resources, and developing the strategy necessary to achieve the objectives. Key documents such as the project plan, resource plan, and risk management plan are typically produced at this stage to guide future implementation.
- **Execution phase:** this is the implementation phase, where the approved plans are put into action. Project tasks are undertaken using the allocated resources while adhering to the established cost, time, and quality parameters. Effective communication, coordination, and leadership are critical at this stage to ensure the team delivers the expected outputs.
- **Monitoring and control phase:** conducted concurrently with execution, this phase focuses on tracking project performance against the plan. Progress is measured regularly by comparing actual results with planned milestones to identify deviations. When necessary, corrective actions are taken to realign project activities with predetermined objectives, ensuring the project remains on track.
- **Closure phase:** the final stage of the project lifecycle involves delivering the final outputs to the client or stakeholder, releasing allocated resources, conducting a project review, and formally closing the project. This phase also includes documenting lessons learned to inform future projects.

Figure 4. Project life cycle (Source: Author, 2025, processed with Napkin).

2. Project management:

According to Thiétart (1986), management is the action, art, or method of directing an organisation, guiding it, planning its development, and exercising control over it across all areas of activity within the enterprise. In accordance with ISO 10006, project management encompasses the planning, organisation, monitoring, control, and reporting of all aspects of a project, as well as the motivation of the people involved to achieve the project's objectives.

The PMBOK Guide (2017) defines project management as the application of knowledge, skills, tools, and techniques to project activities in order to meet its requirements. It is carried out by appropriately applying and integrating the five groups of project management processes: initiation, planning, execution, monitoring and control, and closure.

2.1. The levels of project management:

Project management encompasses both project administration and project leadership:

- **Project administration**: project administration is a function whose primary objective is to provide project leadership with a set of analysed information in order to ensure the relevance and timeliness of its decisions. It represents the set of management tools and methods made available to project managers to facilitate project execution and to improve visibility over its progress (Richard, 2006).
- **Project leadership**: project leadership is a function within which decisions are made regarding the project's objectives, policies, financial aspects, and organisational structure.

2.2. Project management knowledge areas:

The project management knowledge areas, as defined in the PMBOK Guide by the Project Management Institute, consist of ten fundamental disciplines that project managers need to oversee to ensure successful project delivery. These knowledge areas are managed throughout the five project lifecycle phases: initiation, planning, execution, monitoring and controlling, and closing. The ten key knowledge areas are:

- **Project Integration Management:** Involves coordinating all elements of the project to ensure they work together as a cohesive whole, including developing the project charter and management plan, directing and managing project work, and controlling changes.
- **Project Scope Management:** Ensures the project includes all the necessary work and only that work, defining and controlling what is and is not included in the project.
- **Project Schedule Management:** Focuses on timely completion of the project by planning, estimating, and controlling the schedule.
- **Project Cost Management:** Concerned with budgeting, estimating, and controlling costs so the project can be completed within the approved budget.
- **Project Quality Management:** Ensures the project meets the quality requirements and standards by planning, managing, and controlling quality activities.
- **Project Resource Management:** Deals with organising, managing, and leading the project team and other resources.
- **Project Communications Management:** Ensures timely and appropriate generation, collection, dissemination, storage, and disposition of project information.
- **Project Risk Management:** Focuses on identifying, analysing, responding to, and monitoring project risks.
- **Project Procurement Management:** Covers acquiring products, services, or results from outside the project team.
- **Project Stakeholder Management:** Involves identifying stakeholders, understanding their needs and expectations, and developing strategies to engage them effectively throughout the project.

3. Time management:

3.1 Definition:

Time management in construction projects is the systematic process of planning, scheduling, and overseeing the duration of all construction-related activities to ensure the successful completion of the project within the agreed timeframe. This discipline involves breaking down the project into individual tasks, logically sequencing them to reflect dependencies, accurately estimating the time required for each task, and developing a comprehensive project schedule. The schedule serves as a baseline against which progress is continuously monitored to detect any deviations early on.

3.2. Objectives of project time management:

The main objectives of project time management in construction projects are essential for ensuring efficient execution and timely completion. These objectives include the following:

- **Defining the activities required to complete the project:** This involves systematically breaking down the entire construction project into discrete, manageable tasks. Each activity must be clearly described to ensure all necessary work is identified, covering everything from groundwork to finishing touches.
- **Sequencing activities to determine their logical order:** Once activities are defined, they must be organised in the correct sequence, respecting dependencies. This sequencing establishes which tasks precede or follow others, helping to avoid conflicts and ensuring a smooth workflow.
- **Estimating activity durations based on available resources and scope:** Accurate estimation takes into account the complexity of each activity, workforce skills, equipment

availability, material deliveries, and other factors influencing the time required to complete tasks. This allows for realistic scheduling and reduces the risk of delays.

- **Developing the project schedule by integrating all activities, timelines, and dependencies:** Combining activity definitions, sequences, and durations results in a comprehensive project schedule or timeline. This schedule serves as a roadmap, enabling project managers to coordinate resources effectively and communicate expectations to all stakeholders.
- **Controlling the schedule to ensure the project is completed on time and within planned constraints:** Throughout the project, progress must be closely monitored against the planned schedule. Any deviations or delays are identified early, allowing for timely interventions to bring the project back on track

3.3. Time management process:

The time management process in construction projects typically follows a structured sequence of steps designed to ensure tasks are completed on time and within schedule constraints. These steps include:

- **Scheduling the Timeline:** This process involves establishing internal policies, procedures, and documentation for planning, developing, managing, executing, and controlling the project schedule.
- **Defining Activities:** This involves identifying the specific actions required to produce the project deliverables.
- **Sequencing Activities:** This entails identifying and documenting the relationships and dependencies between project activities.
- **Estimating Activity Resources:** This consists of defining the personnel profile and estimating their number, as well as the type and quantity of materials, equipment, or supplies needed to complete each activity.
- **Estimating Activity Durations:** This involves estimating the amount of working time required to complete each activity using the allocated resources.
- **Developing the Schedule:** This consists of creating the project schedule model based on the analysis of activity sequences, durations, resource requirements, and schedule constraints.
- **Controlling the Schedule:** This entails monitoring the project status to update progress and manage any changes affecting the schedule baseline.

3.4. Time management techniques and tools:

The time required to complete a construction project is generally of major importance to all stakeholders. As a result, several methods and techniques have been employed to effectively control and manage the project's timing.

Time management in construction projects relies on several key techniques and tools designed to optimise scheduling, resource allocation, and workflow efficiency. Here are the primary techniques and tools commonly used:

3.4.1. Time management techniques

- **Critical Path Method (CPM):** CPM identifies the longest sequence of tasks that determine the minimum project duration. By focusing on critical activities, managers ensure no delays occur that would extend the overall timeline.
- **Gantt Charts:** These visual timelines display project tasks against the calendar, showing start and end dates, durations, and dependencies. They effectively communicate schedules and progress to stakeholders.
- **Fast Tracking:** This technique involves performing activities in parallel rather than sequentially to shorten the project duration, though it may increase risk.

- **Crashing:** Crashing accelerates the schedule by adding resources to critical path activities, reducing their duration at an additional cost.
- **Time Blocking and Prioritisation:** Allocating specific periods to tasks and focusing on high-priority activities helps maximise productivity and resource utilisation.
- **Buffer Management:** Adding contingency time buffers to activities or project phases provides a safeguard against unforeseen delays.

3.4.2. Time management tools

- **Project Management Software:** These tools enable detailed scheduling, resource allocation, progress tracking, and scenario analysis.
- **Timesheets and Progress Tracking Systems:** Collect real-time data on completed work hours and task milestones to monitor ongoing progress.
- **Mobile Apps for On-Site Management:** Facilitate instant communication, documentation, and schedule updates directly from construction sites.
- **Dashboards and Reporting Tools:** Provide visual summaries and key performance indicators (KPIs) for quick assessment of schedule adherence and resource use.

These methods and techniques are influenced by the various stages of the project life cycle (Attalla 1996) and are classified according to their nature into traditional and modern methods.

3.4.3. Traditional Methods

The early (traditional) methods are primarily used to visualize and optimize project durations, focusing on the aspects of project planning and management (Pellerin and Perrier 2019).
They are widely used in construction projects, among these methods:

- Gantt Chart
- PERT Network (Program Evaluation and Review Technique)
- Critical Path Method (CPM)
- Critical Chain Project Management (CCPM)
- Line of Balance (LOB)
- S-Curves
- Earned Value Management (EVM)
- Earned Schedule Management (ESM)
- Earned Duration Management (EDM)
- Precedence Diagram Method (PDM)
- Milestone Charts
- Matrix Method

3.4.4. Modern Methods

With the incredible advancement of information technologies, there has been a gradual introduction of more integrated methods and techniques over the past few decades. These methods include Agile and Lean practices, as well as other modern practices, which offer the advantage of managing uncertainties and potential risks while assisting project managers throughout the entire project life cycle.
Among these methods:

- Agile Methods
- Lean Methods
- 4D Visualization
- Monte Carlo Simulation Model
- Forecasting and Modeling
- Combination of PERT and Fuzzy Logic

3.5.The Line of Balance Tool :

3.5.1. Definition:

The Line of Balance (LOB) is a time management and scheduling technique used to control projects with repetitive activities. It represents the rate of production against time, showing the progress of multiple activities across different units or sections.

3.5.2. Process:

- Identify repetitive activities (e.g., excavation per section, waterproofing per wall, tiling per area).
- Determine the sequence of these activities.
- Estimate durations and productivity rates (e.g., tiling 20 m² per day).
- Plot lines on a graph where the X-axis = time and the Y-axis = units/sections completed.
- Monitor progress by comparing planned vs. actual lines to detect delays or bottlenecks.

3.5.3. Benefits:

- Well-suited for repetitive construction activities.
- Quickly shows synchronization between teams.
- Highlights resource idleness or clashes.
- Better than Gantt Chart for linear/repetitive works.

3.6.Primavera P6 Software:

3.6.1. Definition:

Primavera, specifically Primavera P6 by Oracle, is a robust and comprehensive project management software extensively utilised for efficient time management in projects. It facilitates the meticulous planning, scheduling, and overseeing of projects by allocating appropriate durations to tasks, establishing logical task dependencies, and enabling detailed scheduling.This capability allows project managers to accurately forecast project timelines, ensure on-time delivery, and maintain control over task sequences, whilst managing activity relationships and identifying critical paths.

3.6.2. Process:

- Define the Project Structure: Establish the Enterprise Project Structure (EPS) and develop the Work Breakdown Structure (WBS) to organise the project hierarchically into manageable components.
- Create and Define Activities: Catalogue all project activities within the WBS elements, providing each with unique identifiers and realistic durations.
- Establish Activity Relationships: Assign logical dependencies between activities (e.g., Finish-to-Start, Start-to-Start) to build a coherent sequence of tasks.
- Monitor and Update Progress: Continuously record actual progress against the plan, identifying deviations and implementing corrective measures as necessary.

3.6.3. Benefits:

- Enhanced project visibility, enabling stakeholders to monitor multiple projects and understand task dependencies clearly.
- Accurate scheduling and forecasting through robust tools like the Critical Path Method, reducing the likelihood of delays.
- Efficient resource allocation, preventing overallocation and ensuring optimal use of labour, equipment, and materials.
- Real-time progress tracking, allowing prompt identification and rectification of schedule deviations.
- Automation of routine scheduling tasks, minimising human error and saving time.

- Early risk detection and mitigation to avoid costly project overruns and timeline disruptions.
- Improved decision-making with access to up-to-date, accurate data on project timelines and resource utilisation.

4. The Effect of Constraints on Project Time Management

Time constraints play a pivotal role in managing construction projects, as they define the timeframe for completing all activities and delivering outputs. According to Hendrickson and Au (1989), effective time management requires precise critical path analysis, accurate estimation of activity durations, and coordination of available resources to avoid conflicts that may delay the schedule. They also emphasize that these time constraints encompass multiple factors such as task sequencing, labor and equipment availability, and environmental conditions affecting work continuity. Therefore, schedule control, progress monitoring, and risk management related to time are essential elements to ensure project success and adherence to deadlines.

4.1. Uncertainties and Constraints:

Uncertainties are multifaceted phenomena that arise from various sources and can be categorized into distinct types, essential for understanding decision-making in various domains, including science, management, and risk assessments. Two primary classifications of uncertainty are widely recognized: aleatoric and epistemic uncertainties. Aleatoric uncertainty, often referred to as irreducible uncertainty, pertains to inherent variability within a system or process that is characterized objectively through probabilistic distribution functions (Pelz et al., 2021). Conversely, epistemic uncertainty relates to the knowledge limitations surrounding a system, often due to incomplete information, inadequate understanding, or ambiguities in alternatives (Njå et al., 2017).

Constraints represent limitations or restrictions placed on processes, systems, or entities that guide decision-making and operational parameters. The definition of constraints can vary significantly depending on the context in which they are applied, ranging from project management to computer programming.In the context of project management, constraints are often referred to as the "triple constraints" of time, cost, and scope, which collectively influence project performance and success. These constraints are interrelated; a change in one factor may necessitate adjustments in another (Rugenyi & Bwisa, 2016).

4.2. Concepts in relation with constraints and uncertainties:

- **Time Constraints:** Construction projects must adhere to specific timelines, often laid out contractually. Time constraints set the maximum allowable duration for project completion. Delays in any phase can cascade, disrupting subsequent tasks and overall delivery dates. Tools such as scheduling software, Gantt charts, and critical path analysis help teams visualise and monitor these constraints.
- **Resources and Scheduling Uncertainty:** Uncertainty in resource availability (labour, materials, equipment) frequently affects project durations. Resource levelling and smoothing techniques help address unpredictability, ensuring efficient resource allocation without extending project timelines. Fluctuating labour supply, late deliveries, or equipment breakdowns are common sources of uncertainty.
- **External Factors and Risk Management:** Weather conditions, regulatory changes, market volatility, and unforeseen events introduce further uncertainties. Robust risk management involves early identification, risk assessment, and contingency planning. Developing alternative schedules and using probabilistic risk analysis tools support more adaptive planning.
- **Extension of Project Deliverable Dates:** This occurs when the official completion date of the project is lengthened due to delays or changes in scope, agreed upon by stakeholders or required by unforeseen circumstances.
- **Delays:** refer to any event or circumstance that causes the project schedule to extend beyond the originally planned timeline. They can occur at any phase of the project from initiation and

planning to execution and closure. Delays may result from internal factors such as inadequate planning, poor resource management, design changes, or ineffective communication. External factors like adverse weather conditions, regulatory changes, or supply chain disruptions can also cause delays. The impact of delays often cascades across subsequent tasks, affecting dependencies and pushing back the overall project completion date. Understanding the nature and source of delays is critical for effective project control, enabling timely interventions to mitigate adverse effects on cost, quality, and client satisfaction.

5. Delays in Construction Projects:

5.1. Definition:

Dinakar (2014) describes delay as a slowdown in work without complete stoppage, which may lead to exceeding the contractual or agreed project completion date. Aibinu and Jagboro (2002) define delay as a situation where either the contractor or project owner, jointly or individually, cause the project not to be completed within the originally stipulated timeframe. Trauner (2009) considers delay as performing an action later than planned or failing to act in a timely manner. Similarly, Abdullah, Azis, and Rahman (2009) view delay as actual project progress being slower than expected.

Al-Najjar (2008) defines schedule delay as the additional time required to finish the project beyond the planned date, caused by both internal and external factors. Gbahabo and Ajuwon (2017) define schedule overrun (sometimes called schedule slip) as the difference between actual project duration and estimated duration. Stump (2000) defines delay as an event or act prolonging the time needed for contractually planned tasks, often appearing as additional working days or delayed activity starts. Assaf and Al-Hejji (2006) define delay as exceeding the contractually specified or agreed delivery date, which is a common problem in construction projects.

To summarise, delay in construction projects can be defined as the gap between planned and actual execution time and is widely regarded as an endemic and critical issue that adversely impacts project performance, leading to numerous negative consequences.

5.2. Delays types in construction projects:

There are several different types of delays that can occur during the construction phase. According to Trauner (2009), these delays are categorised into four main groups: critical or non-critical; excusable or non-excusable; compensable or non-compensable; and concurrent (simultaneous) or non-concurrent. When analysing the impact of delays, it is essential to determine whether a delay is critical that is, whether it affects the overall project completion date and to assess whether delays happen concurrently. All delays fall into either excusable or non-excusable categories, while further distinctions can be made between compensable delays, which may entitle the affected party to compensation, and non-compensable delays, which do not.

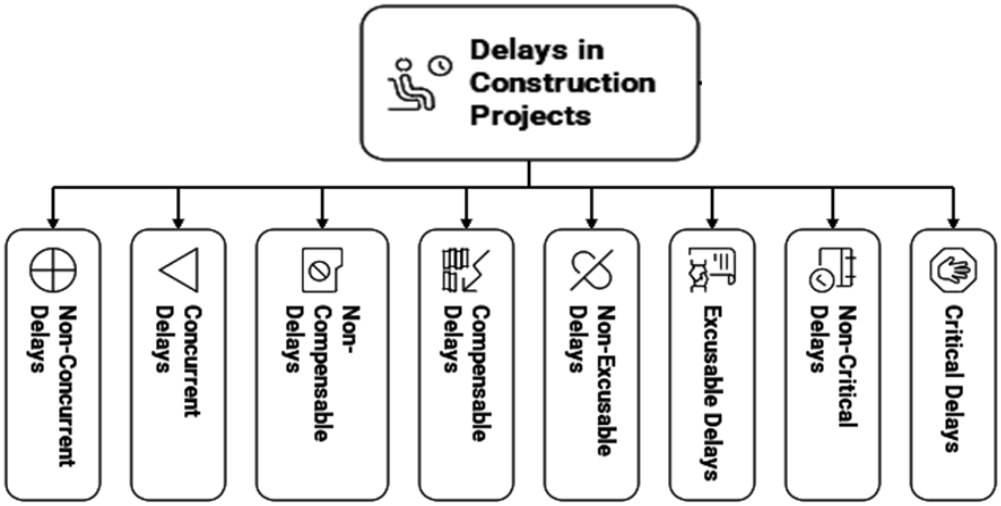

Figure 5. Delays types in construction projects (Source: Author, 2025, processed with Napkin).

5.2.1 Critical and Non-Critical Delays:

Critical delays are setbacks affecting activities on the critical path tasks that directly impact the overall project timeline. Such delays influence the project's completion date as specified in the contract. Non-critical delays affect certain project activities but do not impact the contractual delivery date. According to Dinakar (2014), delays that influence overall project completion or key milestones are deemed critical, whereas those that do not affect such dates are non-critical. However, if delayed activities are crucial, they could eventually postpone the project completion or subsequent milestones.

5.2.2 Excusable and Non-Excusable Delays

Excusable delays arise from unforeseen events beyond the contractor's control and not caused by their actions. Such delays may be either compensable or non-compensable. Non-excusable delays result from the contractor's fault or risks assumed by them. These are non-compensable, meaning the contractor is not entitled to additional time or payment.

5.2.3 Compensable and Non-Compensable Delays

Compensable delays are suspensions or interruptions caused by the owner's acts or breaches of contractual duties (Ahmed et al., 2002). Contractors are entitled to both additional time and financial compensation. Notably, only excusable delays may be compensable (Dinakar, 2014). Non-compensable delays are caused by unforeseen factors outside the contractor's reasonable control, without fault or negligence (Ahmed et al., 2002). These delays excuse the contractor but entitle them only to time extensions, not compensation.

5.2.4 Concurrent and Non-Concurrent Delays

Concurrent delays occur when at least two independent delays happen simultaneously (Enshassi, Al-Najjar, and Kumaraswamy, 2009), or when both client and contractor contribute jointly to the delay. They may be defined as distinct critical path delays (Trauner, 2009) or as overlapping excusable and non-excusable delays, in which case the contractor typically receives partial compensation and time extension, corresponding only to the excusable portion.

5.3. Delays Responsible:

Ahmed et al. (2002) stated that the question of delay responsibility is linked to contract allocation or liability for additional costs and time required to complete the project. The categories of responsibility are:

- **Owner's Responsibility**: If the owner is responsible for the delay, the contractor is entitled to an extension of time and additional costs (including indirect costs), where justified.
- **Contractor's (or Subcontractor's) Responsibility**: If the contractor or subcontractor is responsible for the delay, no additional time or costs will be granted, and they may be liable to pay damages or penalties.
- **Neither Party Responsible**: If neither party is responsible (the delay is caused by force majeure), the contractor will be granted additional time to complete the project but no extra costs or penalties will be awarded.
- **Both Parties Responsible**: In cases where delay results jointly from the contractor and the owner, the contractor will be granted extra time but no additional costs or damages will be awarded.

5.4. The main causes of project delays worldwide:

In the past two decades, numerous studies have been conducted to identify the contributing factors to delays in construction projects. The findings, as presented in Salhi's 2022 thesis, show that financial problems are the most common factors worldwide, followed by poor planning and scheduling. Moreover, design issues were ranked as the third most frequent factor, followed by material problems ranked fourth. However, poor site management and inadequate supervision were ranked fifth. Additionally, slow administrative processes, bureaucracy, slow decision-making, and poor subcontractor performance shared the same rank. In addition, changes in orders, scope, and project

specifications were ranked among the ten most common factors, followed by poor communication and coordination and low productivity.

Figure 6. Causes of project delays (Source: Author, 2025, processed with Napkin).

5.4.1. Financial Problems:

Every project requires funds to carry out the construction operation successfully; however, many projects have been delayed due to insufficient funds necessary for their completion. The owner must ensure that funds are available to pay the contractor for completed works. Nevertheless, owners' financial difficulties, bureaucracy and lack of coordination contribute to delays in the progressive payment of contractors, resulting in the deterioration of the company's cash flow. Consequently, companies struggle to manage the substantial expenses associated with construction, which leads to delays in the payment of workers and the delivery of materials, thus causing disruption of work and project delays.

5.4.2. Poor Planning and Scheduling:

According to Gündüz, Nielsen and Ozdemir (2013), "Only a well-planned project can be well executed." Planning and scheduling are among the core elements of project management, and are considered key factors for project success. Poor planning and scheduling manifest throughout the project and cause delays at different stages. This is evidenced by a lack of experience in project management, insufficient coordination, and the absence of competent managers and planning and monitoring services on site. "The absence of a competent planning service makes the construction process a complex problem" (Kazaz, Ulubeyli, and Tuncbilekli 2012).

5.4.3. Design Problems:

These problems include design changes, which are often caused by alterations in specifications and project scope, limited owner involvement during preliminary phases, or design errors. Such changes can lead to additional work and rework, and may also require temporary stoppages, thereby delaying the overall project completion. Late design and the unavailability of plans on time can result from a lack of coordination between the BET and the ETP, as well as from a failure to provide information promptly, which blocks project activities and causes execution delays. Additionally, design errors stemming from the designer's insufficient competence can halt work due to the time required for review, modification, and approval.

5.4.4. Material Problems (Material Shortages and Delivery Delays):

Materials are one of the main inputs in a construction process, and poor management directly affects the project schedule. Problems hindering effective material management include:

- Late delivery caused by the absence of efficient supply management and the bureaucratic structure established in the material procurement process.

- Price fluctuations resulting from material shortages and inflation.

These issues can affect project performance (as companies wait to obtain better prices), lead to changes in material types, and consequently affect work quality, causing rework and halting work progress.

5.4.5. Poor Site Management and Supervision:

A competent project manager and team play a crucial role in the success of a project and the prevention of delays and additional costs. It is widely accepted that the effectiveness of construction site managers is a key element in the success of construction projects (Enshassi et al., 2009). Lack of project management experience and poor site management lead to poor communication and coordination, misunderstandings and conflicts among different parties, delayed responses to on-site issues, and consequently a negative impact on overall work progress.

5.4.6. Slow Administrative Processes, Bureaucracy, and Slow Decision-Making

Slow decision-making is caused by poor coordination, inadequate communication channels, and internal bureaucracy. Bureaucracy and delays in approving completed work not only cause delays in work execution, but also result in long and complex payment processes, which create financial problems for companies and consequently delay projects.

5.4.7. Poor Subcontractor Performance

In construction projects, certain tasks are subcontracted, coordinated by the main contractor. However, the existence of multiple levels of subcontractors can pose a major obstacle to coordination and communication. This problem becomes more severe in companies operating in the informal sector. Additionally, poor subcontractor performance can lead to low productivity and thus a high risk of delays.

5.4.8. Changes in Orders, Scope, and Project Specifications

During the project's preliminary phases, the owner is responsible for defining the needs, objectives, and scope, and for clearly formulating the requirements. However, preliminary studies are often poorly conducted, leading to numerous change orders in the design. In some cases, the project scope is expanded, causing modifications to the quantity of work and the project schedule, significantly affecting the financial performance of the project.

5.4.9. Poor Communication and Coordination

Construction projects are complex processes involving many resources and stakeholders (client, consultant, contractor, subcontractors, etc.). Communication among these stakeholders is crucial for project success, as it ensures timely development, collection, and dissemination of information needed for project completion, coordination between parties, and harmonisation of all actions. Lack or poor coordination and communication foster misunderstandings that could lead to conflicts, hindering smooth activity flow and causing project delays.

5.4.10. Low Productivity

The ultimate goal of companies is wealth creation through increased profitability. Productivity plays a vital role in profitability and project success. Therefore, companies strive to increase productivity. According to Enshassi and Liska (1999), one of a company's main goals is to achieve high productivity, as it is expected to ensure profitability and thus the survival of the company. However, productivity can be affected by many factors such as absenteeism, unskilled labour, poor supervision, lack of motivation, and poor coordination, all of which influence activity durations and consequently the total project duration.

Conclusion:

This first chapter has provided a comprehensive and integrated thematic and managerial overview of the youth and sports sector, with particular emphasis on swimming pools as essential infrastructures for both recreational and competitive activities. The thematic analysis outlined the pivotal role of the Directorate of Youth and Sports, detailing its organisational structure alongside the national and local programmes that guide the development of sports facilities throughout Algeria. Particular attention was given to the variety of swimming pool types, their defining characteristics, and the strategic programming approaches adopted by public authorities to ensure that facilities are accessible, inclusive, and sustainable, closely aligned with the evolving needs of local communities. The case study of the semi-Olympic pool further enhanced this perspective by illustrating the complex technical, spatial, and functional dimensions inherent in such projects.

From a managerial perspective, the chapter established the foundational concepts crucial to our research, encompassing project definitions, project life cycles, key principles of project management, and time management. The concept of delays was examined in detail—classifying types of delays, identifying responsible parties, and evaluating the prevalent extent of delays in construction projects worldwide. It is clear that the temporal performance of construction projects remains generally poor across many countries. Various methods and tools were explored, from fundamental techniques such as the Critical Path Method (CPM), Programme Evaluation and Review Technique (PERT), and Gantt charts, to more specialised approaches like the Line of Balance (LOB). The selection of LOB Method and Primavera software reflects its particular suitability for construction projects characterised by repetitive activities, such as swimming pool construction, where the synchronisation of tasks and optimisation of resources are critical.

SECOND CHAPTER: ANALYTICAL APPROACH

Introduction:

Public and private swimming pools have become increasingly important in modern society, serving both individuals and groups by offering valuable recreational and sporting opportunities that contribute significantly to physical and mental wellbeing. As a result, demand for such facilities has grown, particularly in large urban centres where swimming pools are commonly integrated within hotels, sports clubs, leisure and tourist complexes, as well as coastal beaches. Additionally, many private residential developments now include pools to cater to their residents' needs. The Djemorah swimming pool is a community facility and one of eleven in the Biskra province. Having recently completed construction, it awaits inauguration and operational launch.

Located in the Al-Mustaqbal neighbourhood within the Djemorah municipality, it serves several nearby municipalities including Tigherghar, Loutaya, Ain Zaatout, and Al-Baranis. Covering some 6,281.68 square metres, the pool is strategically sited in a newly developed area designated for future urban expansion, positioning it to meet the needs of a growing local population.

The second part of this study will provide a detailed exploration of the project through key aspects such as a comprehensive technical profile including geographic location, size, dimensions, and main pool components an urban analysis focusing on the pool's accessibility and surrounding services, an architectural evaluation emphasising compliance with standards for community pools, an examination of the project's administrative process encompassing planning, regulatory approvals, and follow-up, as well as a review of the project's timeline from inception to the present stage.

1. Project Technical Data Sheet:

- **Project**: LOCAL SWIMMING POOL IN DJEMORAH
- **Project owner:** Directorate of Youth and Sports
- **Architect:** Mirad Samira - Design Office
- **Location**: Northwest of Jemoura Municipality,
  On the road to Branis Municipality,
  In Al-Mustaqbal neighborhood.
- **Total floor area:** 1947.40m²
- **PROJECT MANAGER** :DJS BISKRA
- **Construction Company:** Mellas Mohamed
- **Project Supervisor:** Technical Control Authority (CTC)
- **Total Project Cost:** 9.5 billion DZD
- **Start Date:** 31/03/ 2021
- **Construction Duration:** 20 months

Figure 7. Project Technical Data Sheet
(Source: Directorate of Youth and Sports)

2. Urban Analysis:

2.1. Geographic Location:

Djemorah is a municipality located in the northern part of Biskra Province, Algeria, situated between approximately 35.07° latitude north and 5.71° longitude east. It lies along provincial road No. 87, which connects Biskra Province to Batna Province.

Geographically, Djemorah is bordered to the north by the municipality of Ain Zaatout, to the south by El Branis, to the east by Batna Province, and to the west by El Outaya. Renowned for its revolutionary history, it holds the distinction of having the highest number of martyrs in Biskra Province, totaling 334.

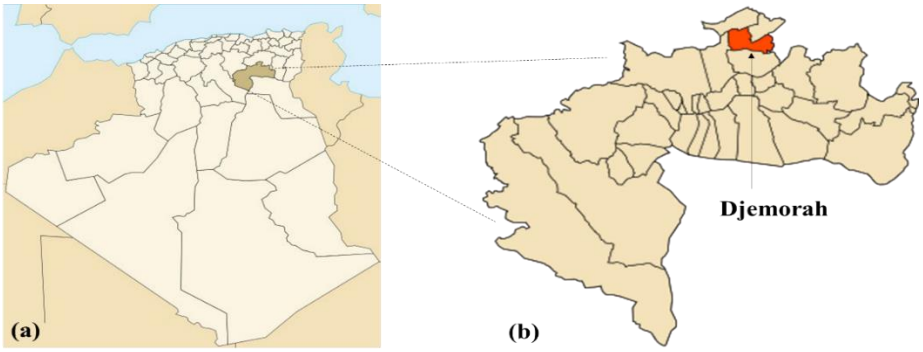

Figure 8. (a) Geographical location of Biskra (b) Djemorah Municipality. (Source: Benhissen et al., 2017)

2.2. Integration with Urban Fabric:

The project site is situated within a subdivision comprising 200 plots, located in the newly developed residential area of Djemorah municipality. To the north, the site is bordered by undeveloped land, while the southern boundary adjoins plots 91, 93, and 95 within the same subdivision.

To the east, the site faces a street alongside a proposed location for a hotel, and to the west, it is flanked by a street and an allocated space for a covered market.

Notably, the site is positioned along Provincial Road No. 87, which serves as a key transport link between Biskra and Batna.

Its proximity to the municipal headquarters, as well as significant educational and public service facilities, enhances its strategic value.

Furthermore, the site lies just a short distance from the centre of Djemorah municipality, within an area that is readily accessible, thereby integrating the project well with the existing urban fabric.

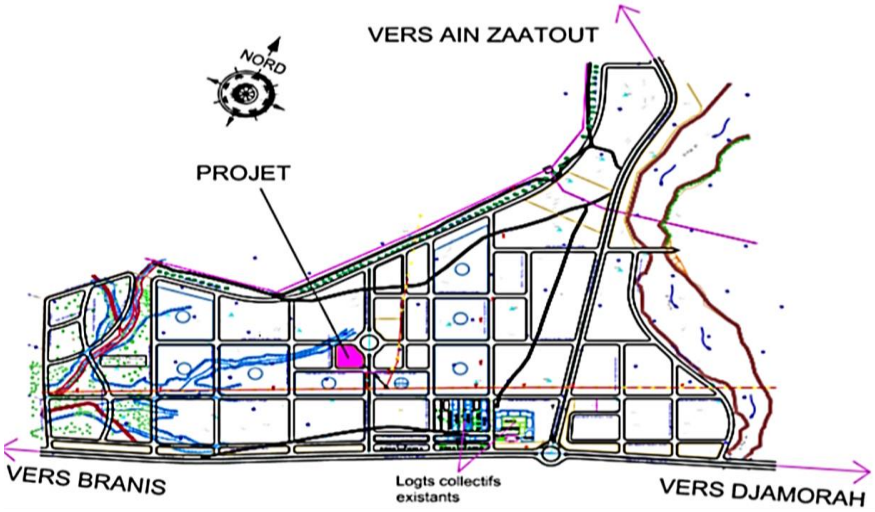

Figure 9. Project Location (Source: Directorate of Youth and Sports, 2025).

2.3. The Site Plan:

The below picture presents a detailed site plan that visually articulates both the organisational structure and the spatial priorities of the project.

The layout balances built form and open space, with the total project area measuring 1,974.40 square metres. The built-up area occupies 776.95 square metres equivalent to 39.35% of the site while the remaining 1,197.45 square metres are allocated to non-built uses, supporting circulation, landscape, and community functions.

Key facilities such as the main and secondary entrances, water tank, and parking spaces have been strategically positioned to optimise access and movement, as indicated by the colour-coded legend.

The plot's boundaries are clearly defined, integrating seamlessly with the adjacent road network and proposed surrounding amenities.

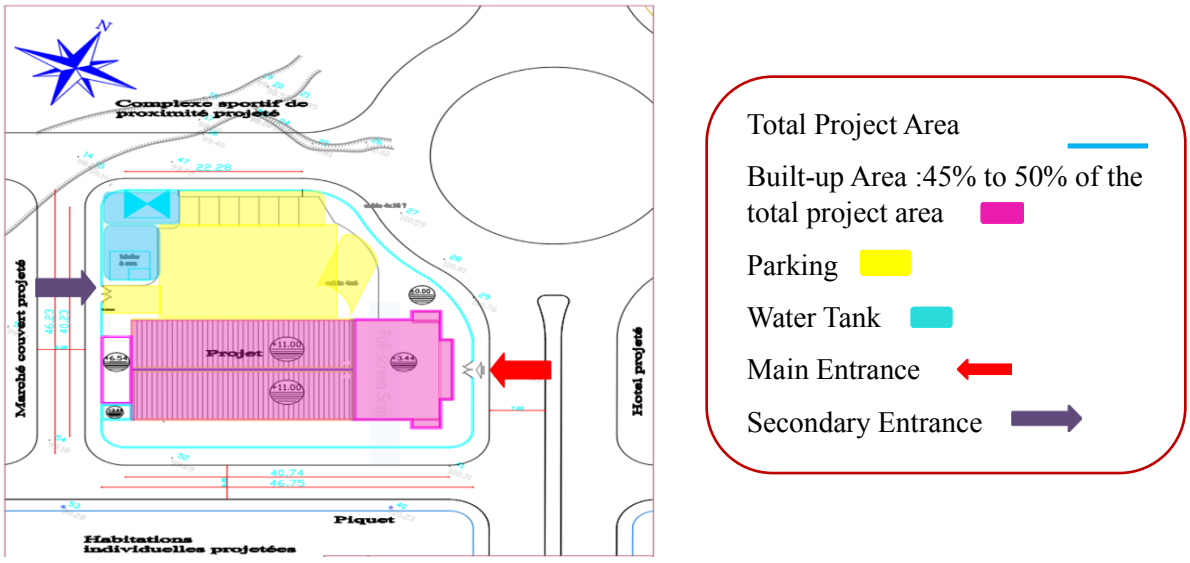

Figure 10. The Site Plan (Source: Directorate of Youth and Sports, 2025, processed by Author).

3. Architectural Analysis:

3.1. Project Connectivity Study:

The project is located in an area planned for future development, including a clinic, covered market, and hotel, indicating that connectivity is sufficient and favorable.

Additional movement pathways could be introduced to further enhance accessibility, given that the project serves as an important facility and a destination for the local community. Taking into account the condition of the main unpaved road, which is under construction and preparation.

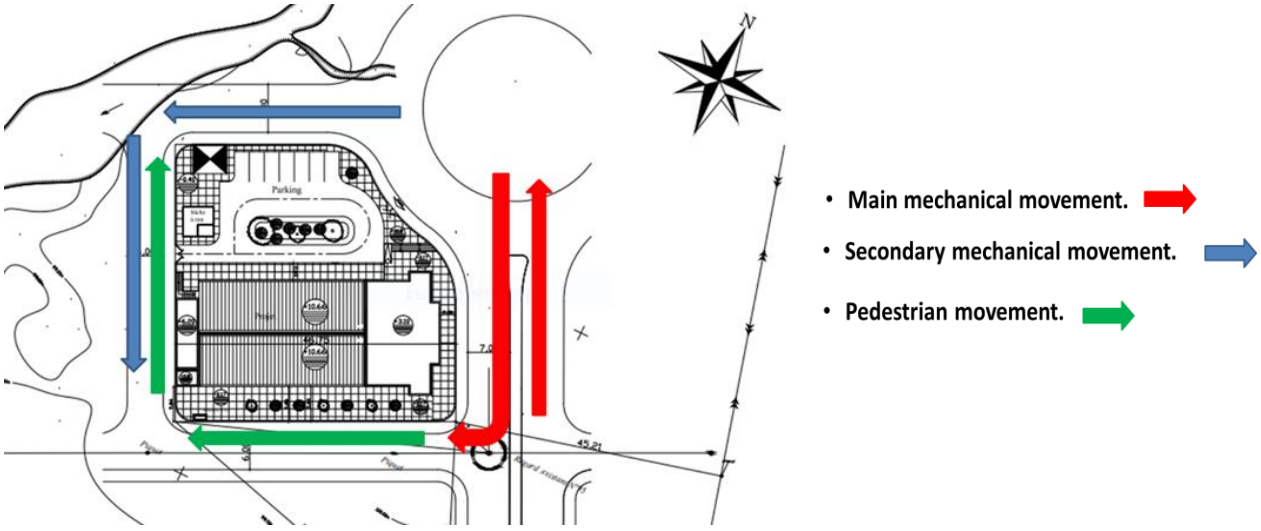

Figure 11. Project Connectivity Study (Source: Directorate of Youth and Sports, 2025, processed by Author).

3.2. Analytical study :

3.2.1. Spatial and functional organisation of the ground floor :

The following plan represents the ground floor layout of the swimming pool, showing the available facilities and circulation areas.

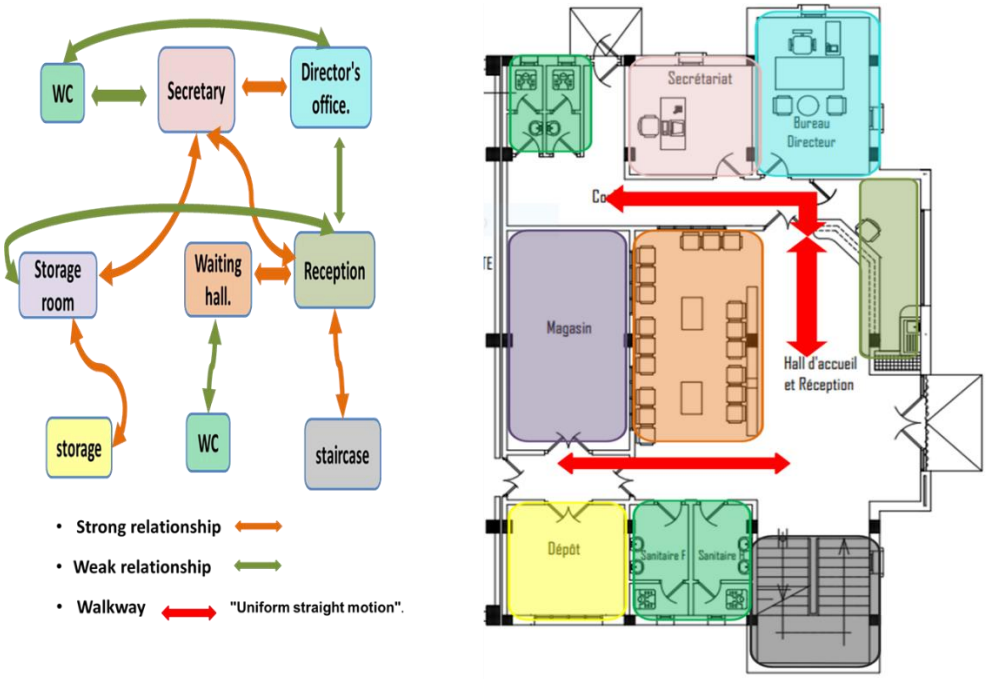

Figure 12. Ground floor spatial and functional organisation (Source: DYS, 2025, processed by Author).

3.2.2. Space Characteristics : Wet and dry areas in the ground floor

The colouring in the ground floor plan distinctly demarcates the dry and wet zones of the swimming pool facility, revealing a considered spatial organisation aimed at optimising safety, hygiene, and operational functionality.

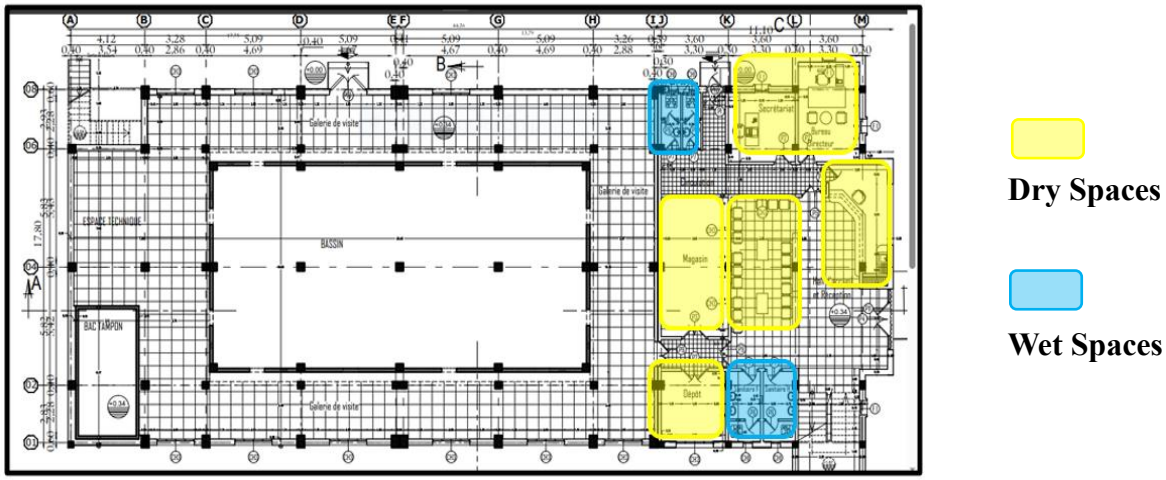

Figure 13. Ground floor Space Characteristics (Source: DYS, 2025, processed by Author).

Notably, the dry areas are consolidated into a cohesive cluster, forming a single mass, whereas the wet zones are dispersed and situated at some distance from each other. Such spatial zoning fortifies the separation between wet and dry areas, thereby minimising the risk of cross-contamination and enhancing

overall user safety. Furthermore, a transitional buffer zone is deliberately integrated between these contrasting spaces, facilitating a gradual changeover that mitigates the potential for accidents.

The differentiation of material finishes further underscores this functional division: wet zones utilise non-porous, easily sanitised surfaces, while dry zones favour warmer, more tactile materials that contribute to user comfort and aesthetic appeal. This nuanced approach reflects best practices in swimming pool design, where the interplay of spatial layout and materiality is pivotal to creating safe, efficient, and welcoming environments.

3.2.3. Spatial and functional organisation of the first floor :

The first-floor plan detailing the swimming pool area reveals a thoughtfully arranged layout that prioritises functional relationships among the key facilities. Central to this design is the pool itself, which enjoys a strong and direct connection with essential adjacent components, notably the swimmers' changing rooms and the on-site clinic, thereby enabling prompt medical response in the event of accidents. Conversely, the linkage between less frequently accessed spaces, such as the storage room and restrooms, and the pool area is comparatively weak, reflecting their ancillary roles.

The spatial organisation on this floor ensures efficient circulation, guiding users seamlessly from the pool through changing rooms and showers to the clinic, thereby enhancing hygiene standards by preventing direct transitions from outdoor or dry areas onto the pool deck. This deliberate sequencing cultivates an environment where functional proximity fosters safety, comfort, and operational efficacy. Furthermore, clear and well-defined circulation routes interconnect all zones, promoting logical, accessible, and user-friendly movement throughout the floor, which is necessary for maintaining both the practical and experiential quality of the swimming facility.

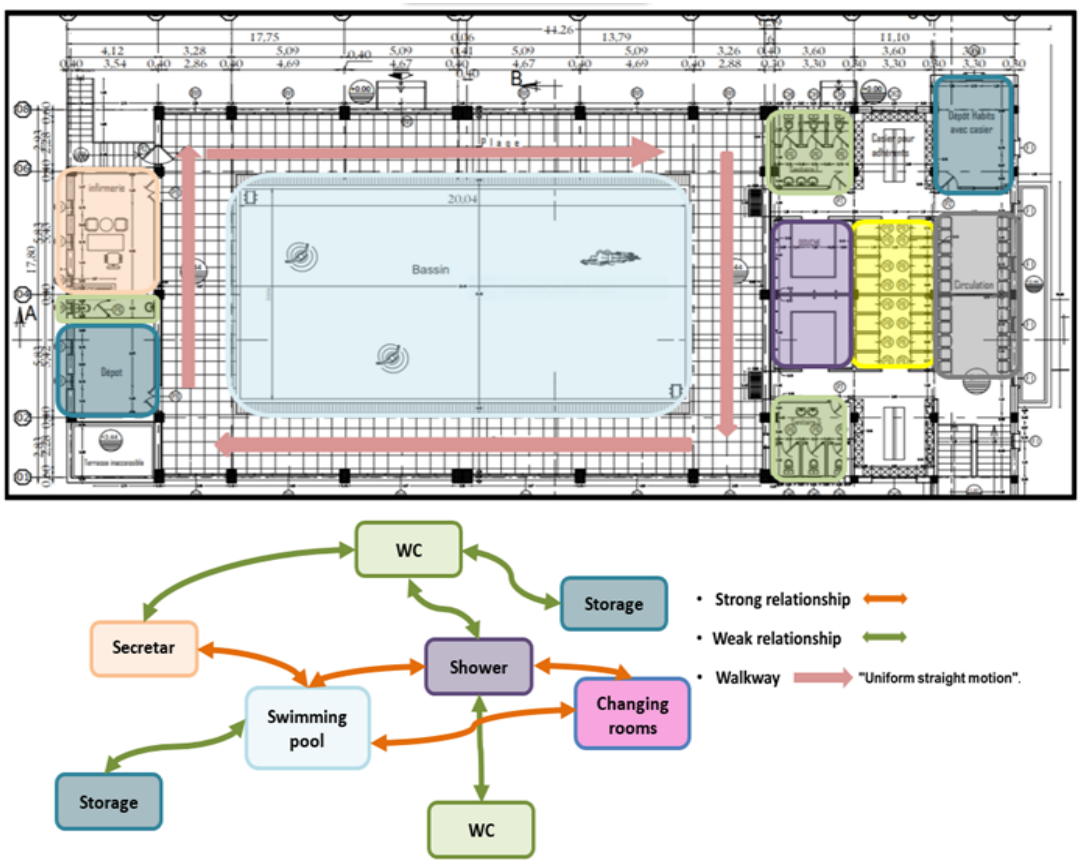

Figure 14. First floor spatial and functional organisation (Source: DYS, 2025, processed by Author).

3.2.4. Space Characteristics: Wet and dry areas in the first floor

The first-floor plan employs colour coding to distinctly delineate the dry and wet zones within the swimming pool area, with dry spaces strategically positioned along the right and left sides, and wet spaces concentrated centrally around the pool itself.

The wet zones, encompassing the swimming pool basin, surrounding deck, showers, and footbaths, are meticulously designed with slip-resistant surfaces, effective drainage systems, and water-resistant materials to ensure safety and durability in high-moisture environments.

In contrast, the dry zones comprise changing rooms, lockers, lounge areas, and access corridors, which are arranged to provide comfort, accessibility, and a conducive environment for users transitioning to and from the pool. This spatial separation of wet and dry areas not only optimises hygiene but also enhances user experience by catering to their differing functional needs, ensuring that the pool environment remains both secure and comfortable.

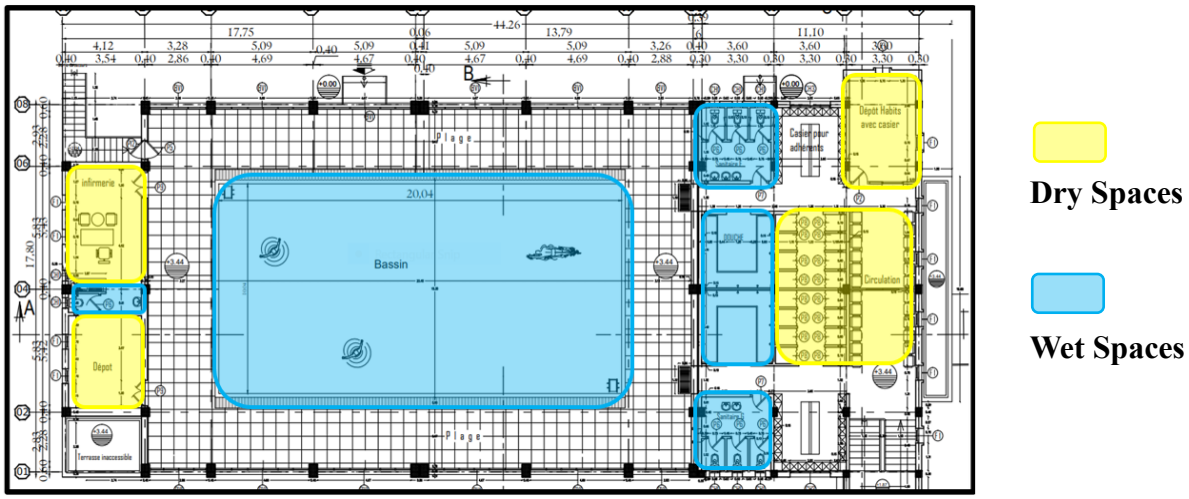

Figure 15. First floor Space Characteristics (Source: DYS, 2025, processed by Author).

3.3. Areas and Floor Distribution:

The table below provides a systematic summary of internal spatial allocation within the facility, distinguishing between ground and upper floor functions and their respective surface areas. Each listed area is identified by its principal use, enabling comprehensive assessment of the building's functional zoning and supporting analyses pertinent to spatial planning and operational management. All dimensions are presented in square metres for clarity and consistency with standard architectural reporting methodologies.

Table 2. Surface Area Measurements (Source: Author, 2025).

Ground Floor	Area m²	Upper Floor	Area m²
Reception	79.88	Swimming Pool 10^20	200.00
Manager's Office	16.21	Pool Deck	260.17
Secretary's Office	11.77	Clinic	24.87
Storage Room	36.67	Storage for Clothing and Equipment	16.50
Administration Restroom	5.93	Male Changing Rooms	12.30

Hallways for Technical Visits + Technical Area	339.28	Female Changing Rooms	12.40
Water Collection and Treatment Basin	19.48	Member Lockers	25.98
Male and Female Restrooms	23.88	Goods Storage	15.90
Movement Corridors	18.69	Bathroom Facilities	48.60
		Movement Corridors	56.60

3.4. Facades and sections:

3.4.1. Facades:

The north and south façades feature a taller main volume highlighted by large rectangular window openings near the roofline, consistent with the concept of open fenestration for natural light and ventilation. The adjacent lower service block, evident on the right side of the south elevation, aligns with the described separation between pool hall and support areas.

The east and west façades show a simpler, more utilitarian aspect with smaller, square windows and a visible external stairway on one side, matching the narrative of contrasting volumes and functional design elements. Overall, the façades accurately reflect the modern, minimalist aesthetic and functional clarity outlined in the previous paragraph, providing an effective architectural expression that balances utility with clean, articulated massing.

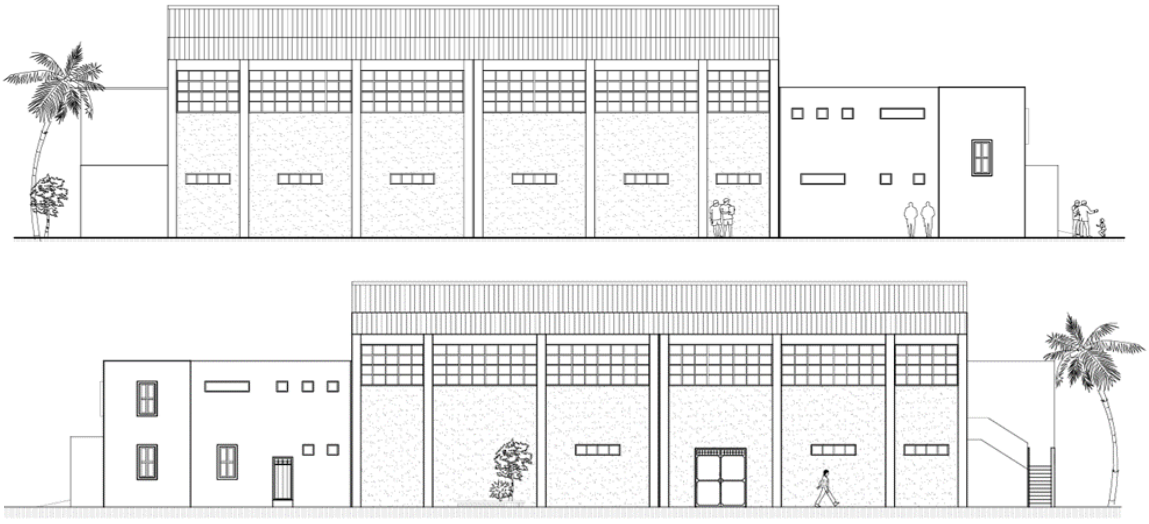

Figure 16. North and South facades (Source: Directorate of Youth and Sports, 2025).

Figure 17. East and West facades (Source: Directorate of Youth and Sports, 2025).

3.4.2. Sections:

The structural framework of the project comprises a steel system relying on vertical iron columns positioned on individually spaced concrete footings, regularly distributed throughout the site. These columns support horizontal beams which act as roof bearers. The roof itself demonstrates effective performance and is clad with insulated sandwich panels, facilitating rainwater drainage and providing thermal insulation.

Building height ranges from +0.00 metres to +11.00 metres, indicating a substantial internal volume, particularly suitable for activities necessitating significant ceiling clearance, such as halls or workshops. Sectional drawings reveal several interior floor levels, each with suitable heights spanning between +0.34 metres and +3.44 metres, interconnected by internal staircases, which reflects the diversity of space functions.

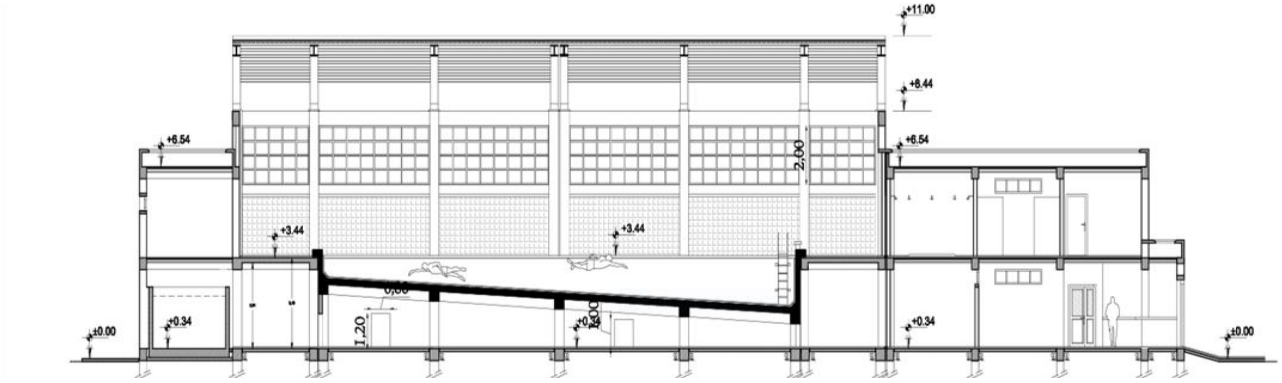

Figure 18. Longitudinal section (Source: Directorate of Youth and Sports, 2025).

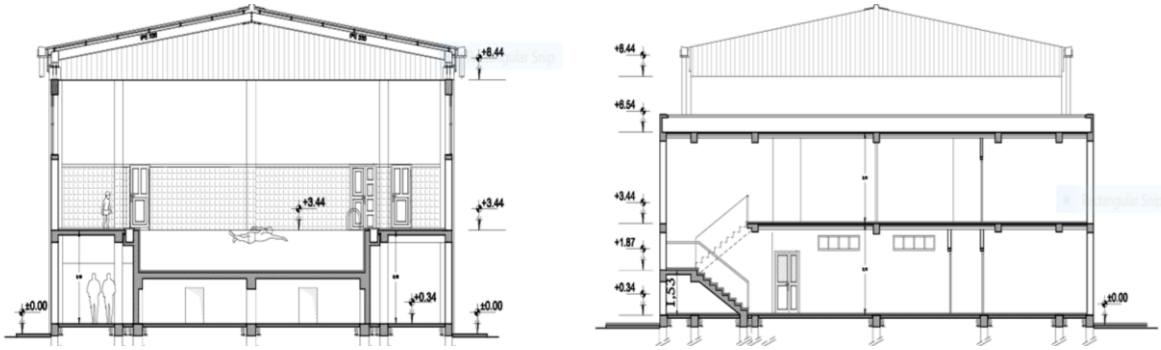

Figure 19. Cross sections (Source: Directorate of Youth and Sports, 2025).

4. Genesis of the project:

In construction projects, genesis of the project is defined as the initial phase or the origin of the project. It encompasses the inception and conceptualisation of the project idea, including feasibility assessments and early planning stages. This phase sets the foundation by outlining the project's purpose, scope, and viability, which subsequently guide all other phases.

4.1. Project Registration:

At the level of the Directorate of Youth and Sports of Biskra Province, the construction of 11 swimming pools distributed across the municipalities was registered, including the swimming pool of Djamora Municipality. On May 23, 2019, under the chairmanship of the Secretary-General of the province, the approval was granted for the establishment of the development project site, which is programmed across the province with an estimated cost of 65,573,000.00 DZD.

4.2. Site Selection:

A plot of land with an area of 1,947.40 m² was allocated within the subdivision of 200 lots in the new residential area of Djamora Municipality. The project site was confirmed based on the initial selection report dated 28-02-2019.

4.3. Project stady:

In accordance with Articles 42 and 44 of Presidential Decree No. 15-247 dated 16/09/2015, concerning the regulation of public procurement and public service delegations, a contract for the execution of a neighborhood swimming pool project in the municipality of Jemoura, Biskra Province, was signed on 04/05/2020 through an open national call for tenders with minimum capacity requirements, as published in the daily newspapers Echourouk El Jadid (in Arabic) and CRESUS.

Following a meeting of the financial offer evaluation committee held at the Directorate of Youth and Sports, the project was awarded to the three best offers in terms of economic advantages and technical qualification, with the execution assigned to the Public Works and Construction Company and all affiliated state structures. The implementation period was set at 18 months, as the best-ranked offer was granted a share of the project.

The contract was then provisionally awarded on 06/07/2020. However, following an appeal submitted by contractor No. 17/2020 regarding the neighborhood swimming pool project in the municipality of Jemoura on 14/07/2022, which was reviewed on 22/07/2022 under minute's No. 54, the appeal was accepted both in form and substance. Consequently, the provisional award was annulled and reissued through a correction notice published on 11/10/2022 in the same national newspapers in which the original call for tenders appeared.

4.4. Project implementation:

After the provisional awarding of the project contract to the contractor, dated 17/12/2020, the construction works were suspended due to the COVID-19 pandemic. On 28/06/2024, the contractor submitted a request for exemption from delay penalties related to the construction works, based on the Prime Minister's instruction No. 255 concerning the execution of public contracts, issued in light of the price increase of certain raw materials.

Based on the above, the Directorate of Youth and Sports considered that the contractor's request falls within the provisions of the Prime Minister's instruction, which includes issuing administrative orders to suspend construction projects and resume works. Furthermore, it should be noted that the tender procedure for the construction of swimming pools which resulted in the provisional awarding and notification of contracts for seven neighborhood pools ultimately led to the withdrawal from five of them due to rising prices caused by the COVID-19 pandemic.

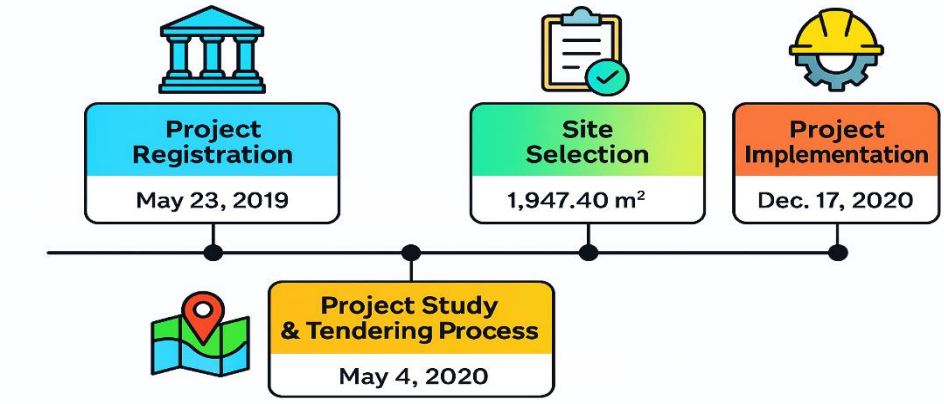

Figure 20. Genesis of the project (Source: Author, 2025).

4. The synoptic table:

A synoptic table is a structured visual or tabular format that organises information according to its logical hierarchy. This table demonstrates that the project underwent a series of administrative, technical, and legal stages prior to the commencement of actual construction works, thereby highlighting the inherent complexity of public project lifecycles. It emphasises the crucial importance of effective time management and coordinated collaboration among various stakeholders to ensure successful project delivery.

Table 3. Synoptic Table (Source: Author, 2025).

Phase	Detailed Description	Responsible / Entity	Date
Definition of the Need and Budget	Drafting of a project framework note, identification of needs (pool, changing rooms, bleachers, technical rooms, etc.).	Project Owner (Municipality / Directorate of Youth and Sports)	12-2018
Land Study	Selection of the land**,** verification of the legal status (land title or certificate of possession).	State Property Services + Urban Planning Department	28-02-2019
Development of the Functional Program	Determination of required spaces**:** pools (Olympic / learning), technical rooms, bleachers, sanitary facilities, etc.	Architect + Project Owner	17-12-2020
Preliminary Architectural Study (Sketch Design)	Initial graphic proposal**s**, layout concepts, integration into the site.	Architect	09-2020
Outline Proposal	Technical feasibility study**,** choice of materials, rough budget estimate.	Design Office + Architect	07-01-2023
Technical Validation (Commission Review)	Presentation of the project to the relevant technical commission for validation.	Municipal or Wilaya Technical Committee	30/04/2020
Final Proposal (APD)	Development of detailed plans**,** final technical choices, integration of standards (accessibility, safety, etc.).	Architect + Engineers	/
Building Permit	Preparation and submission of the building permit application to the urban planning services.	Architect + Project Owner	31-03-2021
Preparation of the Specifications Document	Definition of technical specifications, implementation procedures, environmental and safety standards**.**	Public Procurement Department	/
Launch of the Call for Tenders	Publication of the call for tenders**,** receipt and registration of bids.	Public Procurement Department	04/05/2020
Bid Evaluation and Contract Awarding	Opening of bids, technical and financial analysis, selection of the awarded company.	Procurement Committee	26/05/2020
Service Order and Project Start	Contract signing, site handover, official start of construction.	Project Owner + Contracted Company	02/2021

Provisional Acceptance	Inspection of works**,** drafting of a provisional acceptance report with possible remarks.	Reception Committee	/
Guarantee of Perfect Completion	Observation period during which the contractor must correct any identified defects.	Awarded Company	01/11/2023
Final Acceptance	Lifting of reservations, final validation, and commissioning of the public facility.	Project Owner + Final Acceptance Committee	/

Conclusion:

The study of the community swimming pool in the municipality of Djemorah provides a thorough and multifaceted analysis of the project's essential facilities and components. Beginning with a detailed technical profile, the examination covers the pool's geographic location, total site area, spatial dimensions, and the key functional elements integral to its operation.

An urban and contextual analysis evaluates the pool's integration within its surroundings, focusing on accessibility, connection to main and secondary road networks, and proximity to essential public services, ensuring the facility effectively serves the local population and harmonises with the municipality's urban fabric. From an architectural perspective, the design adheres to established standards for community pools, fulfilling spatial, safety, and ergonomic criteria.

Auxiliary spaces such as changing rooms, sanitary facilities, showers, and rest areas are thoughtfully incorporated to enhance user comfort. Internally, the spatial configuration optimises circulation, safety, and comfort for diverse user groups, fostering a cohesive relationship between the pool and its environment. Overall, these considerations culminate in a well-integrated, accessible recreational facility that satisfactorily addresses both social needs and functional requirements, thereby contributing positively to community wellbeing and urban development.

THIRD CHAPTER: EVALUATION OF THE MANAGERIAL DIMENSION

Introduction

This chapter provides a comprehensive evaluation of the managerial and temporal dimensions of the Djemorah community swimming pool project, with a particular focus on the application of time management methodologies to enhance efficiency and ensure adherence to established deadlines.

It commences with a detailed overview of the construction company responsible for the project, outlining the human and material resources mobilised to support execution. Subsequently, the chapter presents a systematic account of the construction progress across various stages, utilising site reports and periodic monitoring documents as its evidential basis.

Following this, a comparative analysis is undertaken with the Sidi Okba swimming pool project, aimed at elucidating differences in time management approaches and the capacity to respond effectively to emerging constraints. The chapter further explores the principal constraints and uncertainties encountered during project execution and critically assesses their impact on the overall timeline.

Concluding the discussion, it examines the implementation of the Line of Balance (LOB) method alongside Primavera scheduling software within the context of the Djemorah project, illustrating their efficacy as tools for identifying temporal imbalances and enhancing project planning and coordination.

1. Presentation of the realisation company (human resources + material resources):

In the context of the Djemorah semi-Olympic swimming pool construction project, the construction works were entrusted to a specialised contracting firm: the Construction, Public Works, and Waterworks Company Malas Mohamed Cherif. Below is a presentation of this executing company:

1.1. Human Resources:

Table 4. Human Resources (Source: Author, 2025).

Different Categories of Workers	Scoring scale	Contractor rating	number
Architect	08	08	01
Senior Technician	05	05	01
Technician in the field of construction	02	00	
Formworker	10	10	/
Rebar Worker			/
Mason			/
Laborer			/
Construction Site Manager			/
Site Supervisor			/
Team Leader			/
Rebar Workshop Supervisor			/
Welder			/
Total	**25**	**23**	

1.2. Material Resources:

Table 5. Material Resources (Source: Author, 2025).

Material	number	Scoring scale	Contractor rating
Cement preparation machine	01	05	05
Trucks	01	08	02
Mechanical drilling machine	01	03	03
Loader	00	03	03
Crane	00	05	00
Utility vehicle	01	01	02
Cement mixer	01	03	02
Cement transporter	00	02	01
Total		**30**	**18**

2. Progress of the project implementation work

The process of constructing a swimming pool requires a series of interconnected and sequential stages, starting with the technical and financial studies, followed by excavation and site preparation, then the construction of the concrete structure, waterproofing, installation of technical equipment, and finally the finishing works and project handover. However, this process does not always proceed smoothly, as the project may face a number of constraints and obstacles that have a direct or indirect impact on construction costs. The project is considered completed, delivered, and operational for its intended purpose, according to the latest site visit.

2.1. Site preparation and earthworks:

Site preparation and earthworks for the Djemorah semi-Olympic swimming pool project commenced with the execution of excavation works, including the removal of the topsoil layer to a depth of 20 centimetres.

Initial progress stood at approximately 30% completion as of December 2021. By February 2022, the project advanced significantly, reaching around 50% completion with the inclusion of backfilling activities. These preparatory steps were fundamental to establish a stable and well-prepared foundation.

Figure 21. Placement of foundation reinforcement (Source: Author, 2025).

2.2. Major works and Substructure:

Foundations work for the project progressed steadily between December 2021 and February 2022. By December 2021, approximately 50% of the reinforcement for the foundations was completed. In January 2022, continuous foundations were poured, reaching 70% progress. By February 2022, all isolated and continuous foundations were fully completed, achieving 100% completion.

Regarding the column bases, progress was also significant: by December 2021, 70% of the bases were reinforced but not yet poured; by January 2022, 50% were partially reinforced and poured, and by February 2022, 80% of the column bases were completed.

Progressing to major superstructure works, construction of the side walls beneath the pool began and reached 50% completion by February 2022. Simultaneously, the water tank site witnessed notable progress: by December 2021, 80% of reinforcement and concrete works had been concluded; by January 2022, base and wall pouring achieved 60% completion; and by February 2022, major construction works were fully completed (100%), with only finishing and equipment installations remaining.

Secondary and delayed works included the fence, which was not started due to site constraints and difficulties in machinery movement. Future works anticipated include mechanical installations, waterproofing, electrical systems, plumbing, heating, fire protection, finishing (painting and glazing), and external equipment installations.

Figure 22. Pouring of foundation concrete (Source: Author, 2025).

2.3. Summary of Construction Progress on April 1st, 2022:

As of April 1st, 2022, the construction progress of the Djemorah semi-Olympic swimming pool was substantial across multiple components. Earthworks were nearing completion at 90%, with only external landscaping remaining.

Figure 23. Casting of foundation column concrete elements (Source: Author, 2025).

Substructure works, including foundations, column bases, and ground beams, were fully completed at 100%. Installation of inspection chambers, connection boxes, and gutters reached 75%, while gravel bedding and the floating slab were 70% complete.

Superstructure works showed that the basin slab was entirely finished at 100%, whereas basin walls had reached 50% progress. The water tank works were also completed at 100%, with finishing tasks yet to be undertaken. The construction of the fence had not started, and overall progress for the project was approximately 30%.

2.4. Summary of Construction Progress on May 1st, 2022:

Earthworks were largely complete at 90%, with remaining tasks focused on external landscaping. Substructure works were almost entirely finished, with foundations, column bases, and ground beams fully completed at 100%.

Inspection chambers, connection boxes, and gutters reached full completion at 100%, while gravel bedding was at 70%, and the floating slab was complete. In terms of superstructure works, the basin slab was entirely finished, while basin walls remained at 50% completion.The water tank had its major works fully completed, with finishing and equipment installation still pending.

Figure 24. Placement of insulating stones for the ground layer (Source: Author, 2025).

2.5. Summary of Construction Progress on June 1st, 2022

Earthworks remained at 90%, with the focus on remaining external landscaping. Substructure elements, including foundations, column bases, and ground beams, were fully completed at 100%, as were inspection chambers, connection boxes, and gutters.

Figure 25. Casting of ground floor column concrete (Source: Author, 2025).

The gravel bedding and floating slab also reached full completion at 100%. Within the superstructure, basin walls achieved complete construction at 100%, with the basin slab fully finished and ground floor columns nearing completion at 95%.

The water tank's major construction works were concluded at 100%, while masonry, equipment installation, and finishing tasks remained outstanding. This progress summary reflects disciplined project management and operational efficiency, laying a solid groundwork for the forthcoming phases leading to the pool's finalisation and commissioning.

2.6. Summary of Construction Progress on July 1st, 2022

As of July 1st, 2022, the construction of the Djemorah semi-Olympic swimming pool exhibited marked progress. Earthworks remained nearly complete at 90%, with outstanding tasks limited to external landscaping.

Substructure works were fully concluded, including foundations, column bases, ground beams, inspection chambers, connection boxes, gutters, and gravel bedding, all at 100%. The floating slab also reached complete status.

Within the superstructure, the basin walls and slab were entirely finished; ground floor columns were fully completed. Additionally, the ground floor hollow-core slab at the North annex was completed, while formwork and reinforcement for the northern joint slab at the same level achieved 80% completion.

Overall slab works, encompassing both hollow-core and solid slabs, reached approximately 45% completion. The water tank's major works were fully completed, with masonry, equipment installation, and finishing works pending. This detailed account reflects diligent construction management and consistent advancement towards project finalisation.

Figure 26. Start of concrete casting for the ground floor slab (Source: Author, 2025).

2.7. Summary of Construction Progress on September 1st, 2022:

Earthworks remained at 90% completion, focusing on the remaining external landscaping. Substructure works were largely finished, with foundations, column bases, ground beams, inspection chambers, connection boxes, and gutters all complete at 100%. Gravel bedding and floating slab works were fully completed as well.

Sanitation and connection installations had progressed to 90%. Superstructure works also advanced notably: basin walls and slab reached 100% completion, ground floor columns were fully completed, and first-floor columns were 80% finished.

The ground floor hollow-core slab and solid slab were fully completed, with the first-floor hollow-core slab also 100% finished. The solid slab of the southern pool deck reached 80%.

Masonry works and plastering/coating were underway at 25% completion each. The water tank's major construction was complete, with masonry, equipment installation, and finishing works still pending.

Figure 27. (Source: Author, 2025).

2.8. Summary of Construction Progress on October 1st, 2022:

Earthworks were 90% complete, focusing on the remaining external landscaping. Substructure works including foundations, column bases, ground beams, inspection chambers, gutters, and gravel bedding were fully completed at 100%, with sanitation and connections at 90%.

Superstructure works showed complete basin walls and slab, ground floor columns fully completed, and first-floor columns at 80%. Hollow-core and solid slabs across the north and south annexes reached 100%.

Masonry and plastering/coating works were underway at 30%. Tiling under the pool, using 25×25 granito tiles, was half-completed at 50%. The water tank’s major construction works were entirely finished, with only finishing tasks pending.

The fence construction had not yet started. The project’s overall progress was approximately 55%, reflecting effective project management and advancing structural completion toward finalisation.

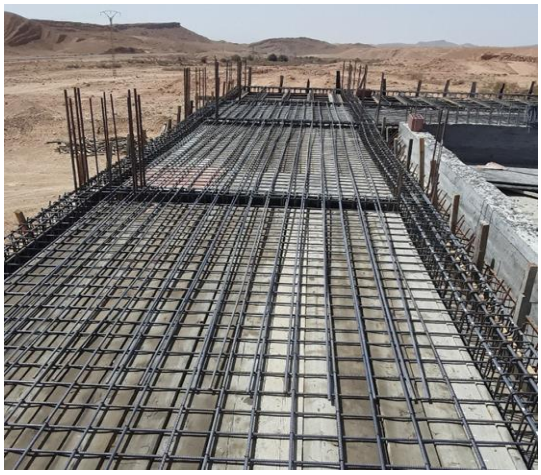

Figure 28. Casting of the first floor slab concrete (Source: Author, 2025).

2.9. Summary of Construction Progress on November 1st, 2022:

Earthworks stood at 90% completion, with the focus remaining on external landscaping. Substructure works including foundations, column bases, ground beams, inspection chambers, gutters, gravel bedding, and floating slab were fully completed at 100%. Sanitation and connection installations progressed to 90%.

Superstructure works showed that basin walls and slabs were fully completed, with ground floor columns at 100% and first-floor columns at 80% completion. Hollow-core and solid slabs for the north and south annexes, had reached 100% completion, while formwork for the southern slab was 60% complete.

Masonry works had progressed to 80%, and plastering and coating works were at 50%. Tiling under the pool, using 25×25 granito tiles, was 50% completed, although some tiles required replacement due to damage.

Major works on the water tank were finalised; however, finishing works were still pending. Fence works had yet to commence. Overall, the project was approximately 60% complete, reflecting robust project governance and consistent progress towards the finalisation of this valuable community asset.

Figure 29. Stripping of formwork for first floor columns (Source: Author, 2025).

Figure 30. Cement plastering works on the first floor walls (Source: Author, 2025).

2.10. Summary of Construction Progress on December 1st, 2022:

The construction of the Djemorah semi-Olympic swimming pool had reached approximately 65% completion. Earthworks were largely finalised, with 90% completed and remaining efforts concentrated on external landscaping. Substructure activities including foundations, column bases, ground beams, inspection chambers, gutters, gravel bedding, and floating slabs were all fully accomplished.

Sanitation and connection works were approaching completion at 90%. Superstructure progress was substantial, with basin walls and slabs complete, alongside ground and first-floor columns also nearing full completion at 100% and 80% respectively.

The formwork and reinforcement of the peripheral U-shaped beam, essential for supporting the steel structure, were finalised, awaiting only the installation of anchor bolts and plates. The hollow-core slab at the south annex and side gutters with raised pool edges were fully installed.

Masonry works continued to advance, reaching approximately 90%, while coating and plastering works were at around 65%. Tiling of the pool floor, utilising 25×25 granito tiles, was half completed, although some tiles required replacement due to damage.

Major construction activities for the water tank had been completed, though finishing works remained outstanding. The perimeter fence layout had been prepared, albeit actual erection had yet to commence.

Figure 31. Execution of brick wall construction and plastering for the first floor (Source: Author, 2025).

2.11. Summary of Construction Progress on January 1st, 2023:

The construction progress had advanced to approximately 67% completion. Earthworks remained 90% complete, primarily addressing remaining external landscaping. Substructure activities, including foundations, column bases, ground beams, inspection chambers, gutters, gravel bedding, and floating slabs, were fully completed. Sanitation and connection works had progressed to 95%.

Superstructure works were highly advanced; basin walls and slabs were finished, and ground and first-floor columns were at 100% completion. The peripheral U-shaped beams, providing critical support for the steel structure, were fully formed and reinforced, with the northern section concreted and installation of anchor bolts and plates pending. The hollow-core slab at the south annex, side gutters, and raised pool edges were completely installed.

Masonry works had reached approximately 90%, with coating and plastering at around 75%. False ceilings on the ground floor were fully installed. Tiling beneath the pool, composed of 25×25 granito tiles, was half completed, with certain tiles identified for replacement due to damage.

Major structural works on the water tank were concluded, though finishing and equipment installation remained outstanding. The fence's perimeter layout was prepared, though actual construction had not yet commenced.

Figure 31. Progress of exterior plastering works on the first floor walls (Source: Author, 2025).

Figure 32. Water filling of the swimming pool basin for testing and commissioning (Source: Author, 2025).

2.12. Summary of Construction Progress on February 1st, 2023:

The construction progress comprised 90% completion of earthworks with only external landscaping remaining. Substructure works showed full completion of foundations, column bases, ground beams, inspection chambers, gutters, gravel bedding, and the floating slab, while sanitation and connection works reached 95%.

Superstructure works were fully completed, including basin walls and slab, ground and first-floor columns, the U-shaped beam at level +8.44 supporting the steel structure, hollow-core slab at level +6.54 in the South annex, side gutters, and raised pool edges. Masonry works were approximately 95% finished, incorporating wall openings for glass façades near the pool, and interior plastering works were around 90%, with exterior finishing still pending.

The ground floor false ceiling was entirely completed, while tiling (25×25) was about 75% done. The water tank's major structural works were fully completed, with masonry, equipment installation, and finishing works remaining. The fence perimeter layout was completed, with the overall project progress at approximately 70%.

Figure 33. Setting out and defining the lighting openings on the first floor (Source: Author, 2025).

2.13. Summary of Construction Progress on March 1st, 2023:

The construction progress included earthworks at 90% completion, with remaining works focused on external landscaping. All substructure concrete works were fully completed, while sanitation and connection networks reached 95%.

Superstructure concrete works were also completed at 100%, with steel structure progress at approximately 40%, covering ground assembly and partial roof installation. Masonry works were about 95% finished, including glass openings along the pool walls. Interior plastering works were around 90% complete, and exterior plastering about 75%. Tiling (25×25) was approximately 90% done, with faience wall tiling in the North annex at around 80%, and compacto floor tiling (60×60, ground floor) fully completed though some finishing corrections remained.

Figure 34. Exterior view showing the completion of first floor wall plastering and lighting window openings (Source: Author, 2025).

The water tank's structural works were completely finished, with equipment and finishing works soon to commence. The fence perimeter layout was completed but required redoing with topographic equipment; despite repeated requests and on-site supervision availability, work had not started due to poor coordination and management by the contractor. Overall progress was roughly 75%.

2.14. Summary of Construction Progress on April 1st, 2023:

All substructure concrete works were fully completed, and sanitation and connection networks reached 95%. Superstructure concrete works were also entirely completed, while steel structure progress remained approximately 40%, including ground assembly and partial roof installation, with no advancement during March. Masonry works were about 95% finished, including wall openings for glass façades near the pool. Interior plastering was around 90% completed, while exterior plastering and tiling (25×25) were both fully completed.

Faience wall tiling in the North annex was 100% completed, and compacto floor tiling (60×60, ground floor) was also finished with some finishing reservations remaining. Faience wall tiling around the pool area was about 80% completed, with some imperfections near glass frame boxes requiring adjustments. Plumbing drainage system evacuation pipes at the North annex were approximately 80% finished.

The water tank's major structural works were 100% completed, while masonry, equipment installation, and finishing works were still pending. The fence perimeter layout was completed but required rechecking by topographic equipment; despite repeated calls and on-site readiness, lack of coordination and supervision from the contractor continued to delay progress. Overall project progress was around 78%.

Figure 35. Execution of full exterior cement plastering works on the building façade (Source: Author, 2025).

Figure 36. Beginning of interior wall tiling works with swimming pool faience (Source: Author, 2025).

2.15. Summary of Construction Progress on May 1st, 2023:

All substructure concrete works were fully completed, and sanitation and connection networks reached 95%. Superstructure concrete works were also entirely finished, while steel structure progress remained at approximately 40%, encompassing ground assembly and partial roof installation, with no progress recorded during April 2023. Masonry works stood at about 95%, including wall openings for glass façades along the pool, with interior plastering approximately 90% done and exterior plastering fully completed.

Tiling (25×25) and faience wall tiling in the North annex were 100% completed, alongside compacto floor tiling (60×60, ground floor), though finishing corrections were still pending. Faience wall tiling around the pool interior walls was about 85% completed, exhibiting minor defects near glass frame boxes needing correction. Whitewashing and general plaster finishing were nearly complete in the North annex, but technical gallery finishing at ground floor level remained around 50%. Plumbing drainage system visible evacuation pipes in the North annex were approximately 80% completed.

The water tank's major structural works were fully done, with finishing and equipment installation still outstanding. The fence perimeter layout was completed but required retracing with topographic

equipment, with work delayed due to lack of coordination and on-site supervision from the contractor. Overall progress was around 79%.

Observations noted near inactivity during April 2023, coinciding with Ramadan, and emphasised the contractor's need to resume corrective work on faience wall tiling and granito floor tiles (25×25) to address visible defects.

2.16. Summary of Construction Progress on June 1st, 2023:

All substructure works of the main building were fully completed, with sanitation and connection networks at 95%. Superstructure reinforced concrete works were 100% finished, while steel structure progress was estimated at 80%, with sandwich panels supplied but not yet installed. Masonry works, including triangular gable walls beneath metal trusses, were fully completed.

Interior and exterior plastering, tiling (25×25), faience wall tiling in the North annex, compacto floor tiling (60×60, ground floor), and faience wall tiling around pool interior walls were all 100% done, although finishing corrections were pending across tiling areas, particularly near window boxes, columns, and vertical joints. Whitewashing and general finishing were complete. Plumbing drainage system evacuation pipes in the North annex were about 80% completed, with waterproofing under tiles in showers and sanitary areas fully done. The water tank's structural works were fully completed, while masonry, equipment install

lation, and finishing still awaited completion. The fence perimeter layout was corrected and re-traced using topographic equipment, with the contractor instructed to promptly finalise implementation while ensuring accurate boundary alignment. Overall project progress was approximately 81%.

Figure 37. Installation of the metallic structure for the swimming pool roof (Source: Author, 2025).

2.17. Summary of Construction Progress on July 1st, 2023:

The construction progress showed approximately 92% completion of earthworks, with excavation for fence foundations finalized and remaining external landscaping works pending. All substructure concrete works of the building were fully completed, with sanitation and connection networks at 95%. Superstructure concrete works were 100% finished, and steel structure roof covering was also complete.

Masonry works, including triangular gable walls under metal trusses, were completed. Interior and exterior plastering, tiling (25×25), faience wall tiling in the North annex, compacto floor tiling (60×60, ground floor), and faience wall tiling around pool interior walls were all fully done, though minor finishing corrections and defect resolutions were pending, particularly around glass frames and columns.

Mosaic tiling of the main pool was approximately 50% completed. Whitewashing and general finishing were finished. Plumbing drainage pipes in the North annex were about 80% completed, waterproofing beneath tiles in showers and sanitary areas was complete, while plumbing conduits for sanitary water and heating were approximately 50% done. The water tank's structural works were

fully completed, with finishing and equipment installation still outstanding. Fence substructure works were also fully completed.

Overall project progress reached around 83%. Despite the contractor's commitment to complete the pool section before July 5, 2023, the deadline was missed, and previous issues related to delays, finishing defects, and slow progress persisted and are reaffirmed in this report.

Figure 38. Covering of the metallic structure of the swimming pool roof (Source: Author, 2025).

2.18. Summary of Construction Progress on August 1st, 2023:

All substructure concrete works were fully completed, and sanitation and connection networks reached 95%. Superstructure concrete works and steel structure roofing were both 100% completed. Masonry works, including triangular gable walls beneath metal trusses, were finished. Interior and exterior plastering, tiling (25×25), faience wall tiling in the North annex, compacto floor tiling (60×60, ground floor), and faience wall tiling around pool interior walls were all fully completed, though some minor finishing corrections and defect resolutions remained, particularly around window boxes and columns.

Mosaic pool lining and decorative faience finishes were also 100% completed, with some corrective work still required. General whitewashing, plaster finishing, and staircase finishing were complete. Plumbing visible drainage pipes in the North annex were approximately 80% completed, waterproofing under tiles in showers and sanitary areas was finished, and plumbing conduits for sanitary and heating water were about 90% done.

Joinery supply was around 90% complete, with installation approximately 60% finished. The water tank's structural works were fully completed, while masonry, equipment installation, and finishing were still pending. Fence infrastructure and reinforcement of posts were both fully completed. Overall project progress was approximately 85%.

Figure 39. Execution of exterior wall painting works (Source: Author, 2025).

2.19. Summary of Construction Progress on September 1st, 2023:

The construction progress showed approximately 95% completion of earthworks, including the beginning of external landscaping works. All substructure works were fully completed, with sanitation and connection networks at 95%. All reinforced concrete superstructure works and steel structure roof covering were 100% completed.

Masonry works, including triangular gable walls beneath steel trusses, interior and exterior plastering, tiling (25×25), faience wall tiling in the North annex, compacto floor tiling (60×60, ground floor), faience wall tiling around pool interior walls, mosaic pool lining, decorative faience finishes, general whitewashing and plaster finishing, and staircase finishing were all fully done, though minor finishing corrections remained on some tiling areas.

Visible drainage pipes in the North annex were around 95% completed, with waterproofing beneath tiles in showers and sanitary areas finished, plumbing conduits for sanitary and heating systems approximately 95% done, and radiator installation at about 70%.

Joinery supply, including railings, was about 90% completed, with installation near 60%, and false ceiling (LSP type) started and around 30% complete. Interior and exterior painting reached approximately 80% completion.

The water tank's structural works were fully completed, with finishing and equipment installation still pending. Fence infrastructure and superstructure were fully completed, while masonry and plastering works were around 70%. Overall project progress reached approximately 88%.

Figure 40. Finalisation of interior finishing and fitting works in the swimming pool hall (Source: Author, 2025).

2.20. Summary of Construction Progress on October 1st, 2023:

The construction progress included approximately 98% completion of earthworks, with external landscaping works nearing completion. All substructure works were fully completed, with sanitation and connection networks at 95%, alongside water supply connection (AEP) also at 95%.

All reinforced concrete superstructure works and steel structure roof covering were 100% finished. Masonry, interior and exterior plastering, tiling (25×25), faience wall tiling in the North annex, compacto floor tiling (60×60, ground floor), faience wall tiling around pool interior walls, mosaic pool lining, decorative faience finishes, whitewashing and general plaster finishing, and staircase finishing were fully completed, though minor finishing corrections and defect resolutions remained on some tiling areas.

Plumbing visible drainage pipes, including pool deck drainage, were about 95% done, with waterproofing under tiles in showers and sanitary areas fully completed, waterproofing under ceramic tiling about 95% complete with some corrections pending.

Plumbing conduits for sanitary and heating systems were approximately 95% finished, as was radiator installation. Joinery supply, including railings, was around 95% completed, with installation at approximately 90%.

False ceiling (LSP type under the roof structure) was fully completed with minor finishing reservations, while interior and exterior painting reached approximately 90%.

The water tank's structural works were all completed, with masonry, equipment installation, and finishing to follow shortly.

Fence infrastructure and superstructure works were 100% done, with masonry and plastering works approximately 95% completed. Overall project progress was around 92%.

2.21. Summary of Construction Progress on November 1st, 2023:

As of November 1st, 2023, construction progress reached 100% completion of earthworks and structural works with finishing. Electrical works and plumbing and drainage were approximately 98% completed, with waterproofing at 95%. Joinery work was fully completed, while painting and glazing, pool equipment installation, water tank (Bâche à eau), and fence and external landscaping were about 98% done. Overall progress was approximately 98% completed.

The remaining 2% of work includes minor corrections and adjustments, along with the installation of remaining pool equipment.

Hydraulic, electrical, and gas tests are pending completion of necessary connections and the installation of the transformer and gas pressure-reducing stations.

Figure 41. Water filling and final completion of all construction and finishing works in the swimming pool hall (Source: Author, 2025).

Figure 42. Completion of exterior painting and site landscaping around the swimming pool (Source: Author, 2025).

3. Comparative study with a reference project

The comparative study between the Djemorah local swimming pool project and the Sidi Okba swimming pool project highlights significant differences in the progress rate and completion time of both projects, mainly due to the context and management of external constraints.

3.1. Project Technical Data Sheet:

- **Project**: LOCAL SWIMMING POOL IN SIDI OKBA
- **Project owner:** Directorate of Youth and Sports
- **Architect:** Tajmoua Architecture Office for Architectural and Urban Studies – Biskra
- **Location**: SIDI OKBA – BISKRA
- **Total floor area:** 877.36m²
- **PROJECT MANAGER** :DJS BISKRA
- **Construction Company:** KEBAILI RACHID
- **Project Supervisor:** Technical Control Authority (CTC)
- **Total Project Cost:** 139 473 906.20 DZD
- **Start Date:** 25/09/ 2023
- **Construction Duration:** 14 months

3.2. Comparative Analysis of Time Management between Djemorah and Sidi Okba Swimming Pool Projects:

The comparative analysis highlights that the Djemorah swimming pool project suffered major delays primarily due to the unforeseen impact of the COVID-19 pandemic, the suspension of activities, and the unavailability of key construction materials, compounded by post-crisis economic challenges such as increased material costs.

In contrast, the Sidi Okba project, launched after the pandemic with adjusted cost estimates and improved project management strategies, maintained its timeline efficiently. This demonstrates the critical importance of adaptive planning, flexible pricing mechanisms, and proactive coordination in minimizing schedule overruns in public construction projects.

Table 6. Comparison of Managerial and Temporal Aspects between the Jemorah and Sidi Okba Swimming Pool Projects (Source: Author, 2025).

Aspect	Djamorah Swimming Pool Project	Sidi Okba Swimming Pool Project
Project Launch Period	Initiated before the COVID-19 pandemic (pre-2020).	Initiated after the COVID-19 pandemic (post-2021).
Duration of Completion	Experienced major delays; project delivery extended beyond planned deadlines.	Progressed steadily with minor, quickly resolved delays.
Causes of Delay	Nationwide suspension of works during the pandemic; unavailability of waterproofing materials; significant increase in steel prices; absence of cost updating.	Benefited from revised post-pandemic prices; materials readily available; improved planning and coordination.
Price Adjustment	No price revision was applied, leading to financial imbalance.	A price updating was approved, ensuring financial stability.

Material Supply	Shortage of specific materials, especially waterproofing components.	Materials supplied regularly with minimal shortage.
Project Management	Weak coordination between stakeholders and reduced workforce after COVID-19.	Better communication and resource management ensured steady progress.
Administrative Procedures	Slow response to price and contract adjustments; bureaucratic delays.	Faster administrative handling adapted to post-crisis conditions.
Final Outcome	Project delayed and exceeded expected timeframe.	Project advanced within revised schedule and budget.

4. Constraints and causes encountered at the project level

4.1. Identification of Time Constraints

The construction project of the local swimming pool in Djemorah Municipality, designed by the Mirad Samira Design Office and executed by the Mellas Mohamed Construction Company under the supervision of the Directorate of Youth and Sports of Biskra, encountered a set of time constraints that negatively affected the progress of works and compliance with the contractual duration of twenty (20) months.

Although the project officially started on March 31, 2021, its execution experienced several interruptions and repeated delays due to administrative and technical conditions, in addition to unforeseen external obstacles. Among the most significant constraints identified:

- Delays in obtaining technical approval from the National Technical Control Authority (CTC) for some structural plans.
- Lack of coordination among the various parties involved during the early stages of implementation.
- Delays in supplying essential materials, particularly waterproofing materials, which led to the temporary suspension of some works.
- Withdrawal of the initial contractor and reassignment of the project to another company, which affected the work pace and required revising parts of the design.
- Insufficient monitoring of work progress by some authorities during critical phases of execution.

Despite these challenges, the project reached its final stages and was officially delivered after March 11, 2023, with an additional delay of approximately three months compared to the original schedule clearly demonstrating the direct impact of time constraints on the project timeline.

4.2.Impact of Uncertainty Factors on the Project Schedule

The Djemorah community swimming pool project faced several uncertainty factors that were not anticipated during the initial planning phase, significantly affecting adherence to the defined timeline.

The main uncertainty factors were as follows:

- The COVID-19 pandemic, which coincided with the early execution phase, disrupted work progress due to preventive measures and delays in the delivery of materials and workforce to the site.
- Shortage of waterproofing materials specific to swimming pools in the national market during 2022, causing temporary suspension of works until an alternative material was approved by the technical control authority.
- Harsh climatic conditions, particularly high temperatures during the summer in Djemorah, which hindered some concrete works requiring specific thermal conditions.

All these factors contributed to creating a state of temporal instability within the project, necessitating rescheduling of certain tasks and the adoption of alternative solutions to reduce delays and ensure project completion as soon as possible.

4.3.Evaluation of Time Management in the Project

Through an analysis of the progress of the Djemorah community swimming pool project, it can be concluded that time management represented a major challenge for all involved parties.

Although the contractor and design office adhered to the initial schedule during the early stages, the absence of a strict and effective monitoring system led to discrepancies between the planned and actual durations.

Field observations revealed the main weaknesses in time management to be:

- Weak time-tracking mechanisms (absence of detailed weekly progress reports).
- Lack of use of digital tools to monitor work progress (such as Gantt Charts or execution calendars).
- Delays in making corrective decisions when facing technical or logistical obstacles.
- Lack of regular performance evaluation of the contractor by the contracting authority.

Despite these shortcomings, the project was completed within a relatively acceptable timeframe, thanks to intensive follow-up during the final stages and a strong focus on completing finishing works before official delivery.

5. Application of the Line of Balance Method to the Djemorah Swimming Pool Project

5.1. Definition of the Line of Balance (LOB) Method:

The Line of Balance is a scheduling method used particularly in projects that involve repetitive or sequential activities across different zones or stages (such as concrete works, finishes, or waterproofing). It is based on illustrating the relationship between time and production or progress in a graphical form that shows the sequence and balance of activities, helping to avoid overlap or delays.

5.2. Basic Concept :

The main goal is to achieve balance between activities, ensuring that each task is executed at its designated time without interruption or interference. If one activity (for example, concrete pouring or waterproofing) is delayed, it will affect the subsequent task (such as tiling or equipment installation). Through the Line of Balance chart, such delays can be detected early and corrected to maintain workflow continuity.

5.3. Application of the Line of Balance Method to the Djemorah Community Swimming Pool Project

5.3.1. Identification of Sequential Activities

In the swimming pool project, the work can be divided into a sequence of interrelated tasks as follows:

- Excavation and site preparation
- Foundation and reinforced concrete works
- Wall construction and waterproofing
- Installation of plumbing and sanitary equipment
- Finishing works (tiling, painting, final fixtures)
- Testing and final delivery.

5.3.2. Duration of Each Activity:

Table 7. Estimated Schedule of Main Construction Activities (Source: Author, 2025).

Activity	Estimated Duration	Start Date	End Date
Excavation & Preparation	1 month	April 2021	May 2021
Foundation & Concrete	3 months	May 2021	July 2021
Waterproofing	1 month	August 2021	September 2021
Plumbing & Equipment	2 months	September 2021	November 2021
Finishing Works	4 months	November 2021	March 2022
Testing & Delivery	1 month	March 2022	April 2022

Table 8. Real Duration of Main Construction Activities (Source: Author, 2025).

Activity	Duration	Start Date	End Date
Excavation & Preparation	3 months	April 2021	July 2021
Foundation & Concrete	3 months	May 2021	August 2021
Waterproofing	8 months	September 2021	May 2022
Plumbing & Equipment	15 months	December 2021	February 2022
Finishing Works	5 months	April 2023	September 2023
Testing & Delivery	1 month	August 2023	September 2023

5.3.3. Representation on the Line of Balance Chart:

- **Horizontal axis:** Time (in months)
- **Vertical axis:** Work progress or sequence of activities

An inclined line indicating the rate of progress represents each activity (amount of work completed over time).

- The steeper the line → the faster the execution.
- If two lines intersect → it indicates a time overlap that needs adjustment in the schedule.

5.3.4. Analysis of Results:

When applying the Line of Balance to the Djemorah swimming pool project, it was observed that:

- The interruption caused by the shortage of waterproofing materials created a visible gap between the concrete and waterproofing stages.
- The reassignment of the project to a new contractor also generated a clear delay between the previous and new execution timelines.

These gaps can be represented in the chart to visually demonstrate where time deviations occurred.Applying the Line of Balance method to the Djemorah community swimming pool project revealed significant time imbalances during the waterproofing and reassignment phases, which affected the regular sequencing of activities.

This analysis highlights the importance of adopting advanced scheduling tools to ensure the continuity and balance of project execution phases.

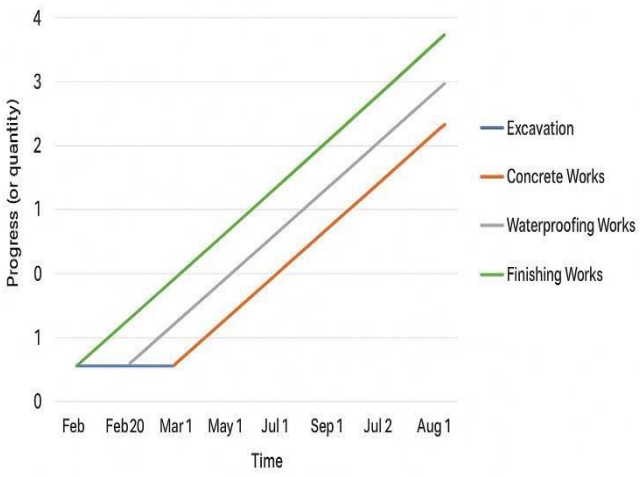

Figure 43. Line of Balance of the estimated duration (Source: Author, 2025).

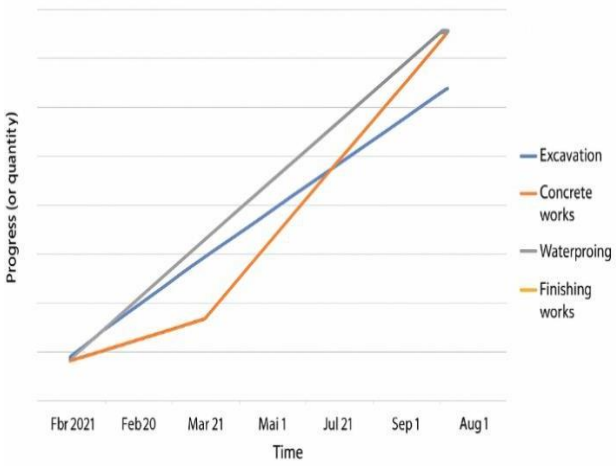

Figure 44. Line of Balance of the real duration (Source: Author, 2025).

The Line of Balance (LOB) chart illustrates the progress of the different construction activities of the swimming pool project over time. The horizontal axis represents time, while the vertical axis represents work progress or executed quantities.

The second chart also reveals a time overlap between certain activities, particularly between concrete and waterproofing works, highlighting an imbalance in the sequencing of construction activities. Such overlaps may lead to scheduling pressure or technical risks if not properly managed.

6. Application of the Line of Balance Method to Sidi Okba Swimming Pool Project:

6.1. Identification of Sequential Activities

The Sidi Okba swimming pool project follows a sequential organisation similar to Djemorah's, including:

- Excavation and site preparation
- Foundation and reinforced concrete works
- Wall construction and waterproofing
- Installation of plumbing and sanitary equipment
- Finishing works (tiling, painting, final fixtures)
- Testing and final delivery

6.2. Planned and Actual Duration

Total project duration: 14 months (Sept 2023 → Nov 2024).
Final completion: On time (no overall delay

Table 9. Estimated Schedule of Main Construction Activities (Source: Author, 2025).

Activity	Estimated Duration	Start Date	End Date
Excavation & Preparation	1 month	September 2023	October 2023
Foundation & Concrete	3 months	October 2023	December 2023
Waterproofing	2 months	December 2024	February 2024
Plumbing & Equipment	3 months	February 2024	May 2024
Finishing Works	4 months	June 2024	September 2024
Testing & Delivery	2 months	October 2024	November 2024

Table 10. Real Duration of Main Construction Activities (Source: Author, 2025).

Activity	Duration	Start Date	End Date	Notes
Excavation & Preparation	1.5 month	September 2023	October 2023	minor delay due to site clearance
Foundation & Concrete	3 months	October 2023	December 2023	completed on time
Waterproofing	2.5 months	December 2024	February 2024	shortage of materials (temporary delay)
Plumbing & Equipment	3.5 months	February 2024	June 2024	slightly delayed, recovered later
Finishing Works	3 months	June 2024	August 2024	accelerated to recover time
Testing & Delivery	1.5 month	September 2024	November 2024	delivered as planned

6.3 Representation on the Line of Balance Chart:

- **Horizontal axis:** Time (months from Sept 2023 to Nov 2024)
- **Vertical axis:** Sequence of activities (from excavation to delivery)
- Each activity represented by an inclined line (rate of progress).
- Small gaps appear in the middle (especially between concrete and waterproofing, and plumbing stages).
- Later lines become steeper (indicating acceleration) this shows how the team recovered lost time to meet the planned deadline.

6.4. Analysis of Results:

The Line of Balance analysis for the Sidi Okba swimming pool project demonstrates that:

- Temporary delays occurred mainly during waterproofing and plumbing, caused by supply and coordination issues.
- However, workforce redistribution and schedule compression during finishing phases allowed the team to regain lost time.
- As a result, the overall completion time remained within the planned 14 months, and the project was delivered on schedule (25 November 2024).

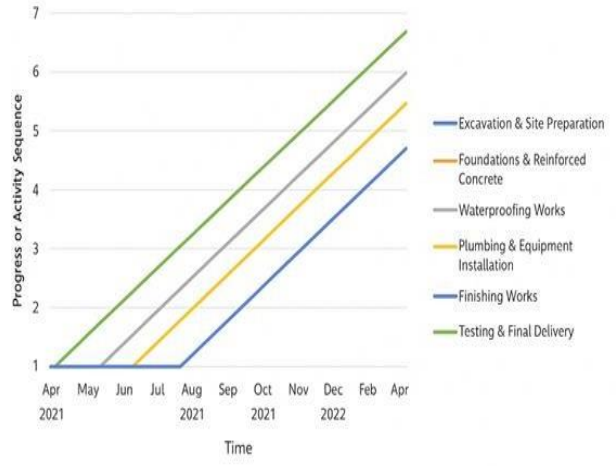

Figure 45. Line of Balance of the estimated duration (Source: Author, 2025).

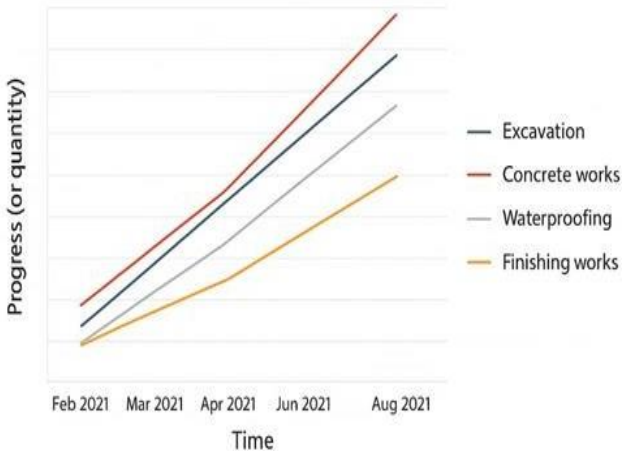

Figure 46. Line of Balance of the real duration (Source: Author, 2025).

7. Project Gant chart view using Primavera P6:

7.1. Djemorah swimming pool:

The below Gantt chart presents a comparative analysis between the planned and actual durations for the Djemorah swimming pool construction project in Biskra, Algeria. The chart highlights major deficiencies in initial project estimation and sequencing. The pronounced divergences between planned and actual durations suggest systemic issues such as resource mismanagement, unforeseen site conditions, scheduling inaccuracies, or coordination failures among project stakeholders. The lack of concurrency in later stages further implies potential bottlenecks or interdependent delays.

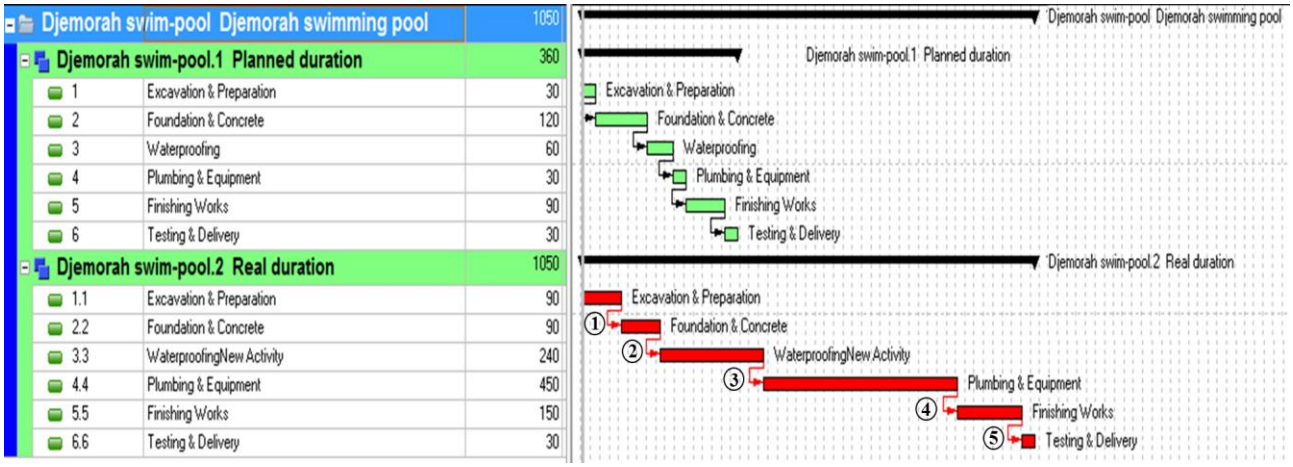

Figure 47. Gantt view of Planned and Actual Durations in Djemorah Swimming Pool Project (Source: Author, 2025).

The Gantt chart presented offers an incisive visual comparison of the planned and actual durations for each principal phase of the Djemorah swimming pool construction project in Biskra, Algeria. Initially, the project was scheduled to be completed in 360 days, with tasks such as excavation, foundation works, waterproofing, plumbing and equipment installation, finishing works, and final testing carefully sequenced and, in some instances, overlapped to optimise efficiency. However, the real progression stands in stark contrast, with the aggregate duration ballooning to 1,050 days, and each activity substantially exceeding its planned timeline, notably plumbing and equipment, which alone took 450 days against an original estimate of 30 days.

The chart reveals that these activities often ran sequentially rather than concurrently, exacerbating project overruns. This marked divergence between planned and realised performance highlights significant planning inaccuracies, resource constraints, or on-site uncertainties, providing its audience with clear evidence of systemic scheduling deficiencies and illustrating the profound impact such misestimations can have on public infrastructure delivery.

Table 11. Delay durations and constraints for Djemorah swimming pool (Source: Author, 2025).

Number	Delay duration	Kind of constraints and uncertainties
1	1 month	Delay in site preparation and mobilization due to the COVID-19 pandemic and suspension of works nationwide
2	3 months	Work progressed normally after resumption post-pandemic
3	2 months	Shortage of waterproofing materials and technical approval delays (CTC)
4	3 months	Withdrawal of the first contractor and reassignment to a new company; lack of coordination among stakeholders
5	4 months	Harsh climatic conditions (high summer temperatures affecting concrete works)

7.1. Sidi Okba swimming pool:

The Gantt chart provides a comparative overview of the planned and actual durations for the Sidi Okba Swimming Pool Project, offering valuable insights into project execution versus initial forecasts. According to the schedule, both the planned and real project durations were set at 450 days; however, a disaggregation of tasks reveals notable discrepancies at the activity level.

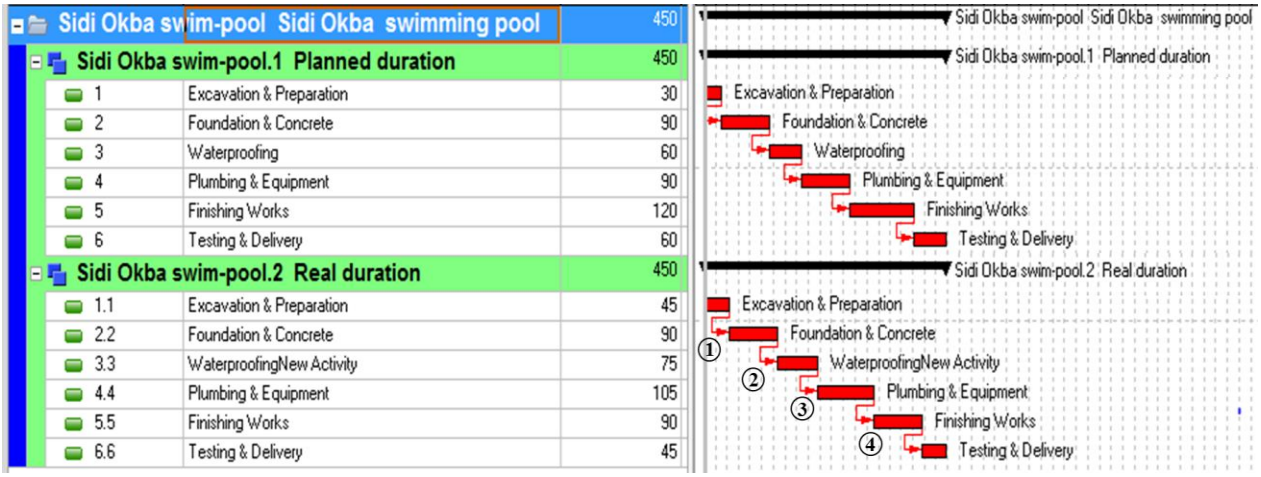

Figure 48. Gantt view of Planned and Actual Durations in Sidi Okba Swimming Pool Project (Source: Author, 2025).

Tasks such as "Excavation & Preparation" and "Foundation & Concrete" experienced an overrun each extended from an initially planned 30 days to an actual 45 dayswhile "Waterproofing" also increased in duration. More strikingly, "Plumbing & Equipment" and "Finishing Works" significantly exceeded their planned durations, reaching 105 and 90 days respectively, compared to original estimates of 60 and 120 days.

The Gantt visualisation illustrates these variances through the length and sequencing of activity bars, signalling a cascading effect where early delays propagate through subsequent phases. The overall structure of the real schedule suggests diminished concurrency and workflow disruption, possibly attributable to resource limitations, unforeseen site conditions, or coordination challenges common in public infrastructure works. This analysis demonstrates the importance of dynamic project controls and underscores the necessity for continual monitoring and risk mitigation to address deviations in similar future undertakings

Table 11. Delay durations, constraints and solutions for Sidi Okba swimming pool (Source: Author, 2025).

Number	Delay duration	Kind of constraints and uncertainties	Solutions
1	1.5 month	Delay in site mobilisation due to late delivery of materials	Expedite procurement, coordinate with suppliers, adjust workforce allocation
2	3 months	Delay due to administrative approvals (permits, inspections)	Follow up with authorities, submit documents early, assign dedicated staff for approvals
3	2.5 months	Labor shortages and unavailability of skilled workers	Hire temporary labor, implement shift work, train local workers
4	3.5 months	Delay in delivery of construction materials or equipment	Coordinate with suppliers, plan early procurement, have backup suppliers

Conclusion

The analysis conducted in this chapter revealed that the Djemorah swimming pool project experienced several time-related challenges, primarily due to administrative delays, material shortages, and the COVID-19 pandemic. Despite these constraints, the project was successfully completed after additional corrective measures were implemented.

The study demonstrated that effective time management is essential for achieving project objectives and avoiding schedule overruns. The application of the Line of Balance method provided valuable insights into the temporal relationships between different construction activities and helped visualize where delays occurred.

The comparison with the Sidi Okba project also highlighted the importance of adaptive planning, flexible pricing, and proactive coordination in overcoming uncertainties.

Ultimately, this chapter underscores the need to integrate modern project management tools and uncertainty analysis into the early planning phases of construction projects to enhance their performance in terms of time, cost, and quality.

GENERALE CONCLUSION

1. Conclusion:

Delays represent one of the most critical and commonly encountered challenges within construction projects worldwide. Such delays can be mitigated effectively when their underlying causes are clearly identified. The primary objective of this research was to pinpoint the major factors inducing delays and their principal effects, thereby enabling proper control measures.

A comprehensive review of the literature concerning causative factors of delays and their induced effects over the past two decades revealed that the ten predominant delay factors globally are: financial issues; poor planning and scheduling; design problems; material-related issues; inadequate site management and supervision; slow administrative processes, bureaucracy, and delayed decision-making; poor subcontractor performance; changes in orders, project scope, and specifications; poor communication and coordination; and low productivity.

A case study project alongside an additional reference framework was analysed to this end. The findings demonstrated that time deviations on the project were the direct result of several factors, including unforeseen natural conditions such as the COVID-19 pandemic, delays in the commencement of works due to poor coordination among stakeholders, work suspension orders issued by higher authorities during certain periods, weak on-site monitoring particularly during major construction activities and technical installations, shortages of qualified labour and challenges in material supply, and the absence of a unified digital system to monitor project progress and control deadlines.

A comparative study between the original schedule and the actual progress indicated that the project exceeded its contractual duration by approximately ten months, with execution extending from November 2021 to August 2023, rather than the initially planned completion date of October 2022. Despite this delay, the project was brought to a successful conclusion through enhanced supervision and corrective measures during the final stages. This outcome highlights the stakeholders' capacity to adapt to obstacles and improve performance under adverse conditions.

2. Recommendations and Suggestions:

In this section, recommendations are proposed to minimise delays in future construction projects by addressing key factors related to methods, technology, management, and stakeholder coordination.

- Employ appropriate construction methods to ensure efficient progress.
- Use adequate and modern construction equipment to support productivity and quality.
- Incorporate new technologies like « Building Information Modeling » into the construction process to enhance coordination and project information management.
- Utilise established time planning and control techniques such as PERT, GANTT charts, and Critical Path Method.
- Implement newer duration estimation methods to improve scheduling accuracy.
- Apply project management principles from the earliest project stages to ensure systematic oversight.
- Maintain effective and clear communication channels among all project stakeholders to avoid misunderstandings.
- Define responsibilities and priorities clearly to ensure smooth project workflow.
- Train engineers and managers in digital project management tools, especially scheduling and analytical software.

3. Research limitation:

- The reliance on a single case study (the Djemorah community swimming pool project) limits the generalization of the results.
- The study focused mainly on the execution phase of the project, without covering the planning and design stages, because of obstacles in obtaining the related technical information and documents.
- The full impact of administrative and financial constraints could not be assessed due to limited access to official documents.
- The findings were partially based on field observations and periodic reports, which may include subjective interpretations rather than fully quantitative data.

BIBLIOGRAPHY

APPENDICES

الجمهورية الجزائرية الديمقراطية الشعبية

ولايـة بسكـرة
الأمانـة العامـة
رقم: 96/وب/أع/19

محضر معاينة و تثبيت ارضية مشـــروع

في عـام ألفين و تسـعة عشـر ، وفي اليـوم الثالـث و العشـرون من شـهر مـاي ، وعلـى الساعة التاسـعة (00 : 09) صباحا ، وبرئاسـة السـيد /الأمـين العـام للولايـة ، اجتمعـت اللجنـة الولائيـة المكلفـة بالمصـادقة علـى تثبيـت أرضيـات المشـاريع التنمويـة لمختلـف القطاعـات (سكنية ، مدرسـية ، مرافـق عموميـة ، . . .) ، و بعـد التحقيقـات العقاريـة التي أجريـت لهـذه الأوعيـة العقاريـة و التحقـق من طبيعتهـا القانونيـة من طرف مصالح التعمير و بناءا على محاضر الاختيار الأولية المذكورة ضمن كل مشروع عن دائرة جمورة ، تمت المصادقة و بالاجماع ، وهذا بحضور السادة :

- جميع مدراء مجلس الولاية
- جميع رؤساء الدوائر
- جميع رؤساء المجالس الشعبية البلدية .
- جميع رؤساء المصالح التقنية للبلديات .
- مدير اتصالات الجزائر .
- مدير الوكالة العقارية (ممثل) .
- مدير توزيع الكهرباء و الغاز (ممثل) .

جدول الأعمال : المصادقة على تثبيت أرضيات المشاريع التنموية المبرمجة عبر تراب الولاية .

المشروع 01 : تثبيت أرضية مشروع إنجاز مسبح جواري ببلدية جمورة .

- ✓ خصائص هذا الموقع : الأرضية المخصصة تقع بتجزئة 200 قطعة بالتجمع السكاني الجديد ببلدية جمورة .
- ✓ الحدود :
  - شمالا : ارض بيضاء .
  - جنوبا : القطع الارضية 91 - 93 - 95 لتجزئة 200 قطعة .
  - شرقا : شارع + ارضية مقترحة لانجاز فندق .
  - غربا : شارع + ارضية مقترحة لانجاز سوق مغطاة .
- ✓ المساحة : تحدد بعد الدراسة و الرفع الطوبوغرافي .
- ✓ الطبيعة القانونية للأرضية : ملك للدولة .
- ✓ رأي أعضاء اللجنة : بالموافقة .
- ✓ إمكانية الربط بالشبكات : ممكنة .
- ✓ التحفظات المسجلة : - -
- ✓ ملاحظة هامة : على صاحب المشروع الالتزام بوضع مخطط عمراني جمالي و مخطط تهيئة للموقع (الوعاء العقاري المثبت) يتناسب مع طبيعة المشروع و محيطه .

- تم تثبيت أرضية المشروع بناءا على محضر الاختيار الأولي المؤرخ في : 2019/02/28 عن دائرة جمورة .

❖ **المشروع 02 :** تثبيت أرضية مشروع إنجاز توسعة ملحقة التكوين المهني ببلدية جمورة .

- ✓ خصائص هذا الموقع : الأرضية المخصصة تقع بجانب ملحقة التكوين المهني جمورة حي 60 سكن اجتماعي جمورة
- ✓ الحدود :
  - شمالا : منحدر جبلي .
  - جنوبا : منحدر جبلي .
  - شرقا : ارضية شاغرة .
  - غربا : ملحقة التكوين المهني .
- ✓ المساحة : تحدد بعد الدراسة و الرفع الطوبوغرافي .
- ✓ الطبيعة القانونية للأرضية : ملك للدولة .
- ✓ رأي أعضاء اللجنة : بالموافقة .
- ✓ إمكانية الربط بالشبكات : ممكنة .
- ✓ التحفظات المسجلة : - -
- ✓ ملاحظة هامة : على صاحب المشروع الالتزام بوضع مخطط عمراني جمالي و مخطط تهيئة للموقع (الوعاء العقاري المثبت) يتناسب مع طبيعة المشروع و محيطه .

- تم تثبيت أرضية المشروع بناءا على محضر الاختيار الأولي المؤرخ في : 2019/04/17 عن دائرة جمورة .

مكتب مراد للدراسات المعمارية و العمرانية

مراد سميرة حي المجاهدين بسكرة الهاتف: 87-49-51-033

ولاية : بسكرة الرقم:...../:.....

دائرة : جمورة المشروع : مسبح جواري بجمورة بسكرة

بلدية : جمورة

صاحب المشروع:مديرية الشباب و الرياضة لولاية بسكرة

كشف وصفي و تقويمي للأشغال

1- الموقع: المشروع يقع : بلدية جمورة دائرة جمورة ولاية بسكرة

2- الموضوع: هذا الكشف يتضمن قواعد و شروط تنفيذ الأشغال بناء المشروع.

3- تعيين المشروع: يتكون المشروع من:

الرقم	طابق أرضي	طابق علوي
01	الإستقبال	حوض السباحة 10م × 20م
02	مكتب المسير	شاطئ الحوض
03	أمانة مكتب المسير	العيادة
04	02 مخزن	مخازن الأليسة و المعدات (Dépôt habits avec casier)
05	دورة مياه الإدارة	غرف تبديل الملابس (ذكور)
06	أروقة الزيارات التقنية+ فضاء تقني	غرف تبديل الملابس (إناث)
07	حوض تجميع و معالجة المياه.	خزائن الأعضاء (Casier pour adherents)
08	دورة مياه (ذكور+إناث)	مخزن بضائع
09	أروقة للحركة	دورة المياه+حمام (ذكور)
10		دورة المياه+حمام (إناث)
		أروقة للحركة

بمساحة إجمالية المبنية:. 1538,45 م2

4- البناء : ترتيب و تنظيم الأشغال مدرج في الرسومك و المخططات المرفقة للمشروع.

(أ)الأساس: تحفر حتى الأرض الجيدة،الجدران المحيطة تكون بالبناء 30 سم*30سم الجدران الفاصلة تكون بالأجر ،العتبات العلوية للأبواب و النوافذ ،ومرتكز النوافذ الكمرات ،الأعمدة ، العوارض و الغروفو مرفأ المطبخ و السلم تكون كلها بالخرسانة المسلحة.

(ب) الأرضية: يجب أن تكون الخرسانة معدة بالحديد و اللبنات المجوفة ذات سمك (20-16 سم) تتضمن البلاط المقسم.

(ج) الكساء بالبلاطة الأرضية: يكون في جميع الفضاءات.

(د) كساء بالخزف الحائطي: يجب أن يكون في حوض السباحة ، شاطئ الحوض و دورة مياه.

5-التمليط: التمليط الخارجي يجب أن يكون بالإسمنت المنجالس، أما الداخلي فيكون بالجبس.

6-تصريف المياه:

أ-مياه الأمطار تجمع في بالوعة و منها تنقل بواسطة قنوات من الإسمنت المضغوط إلى القناة العمومية.

ب-مياه الإستعمال تصرف وإيصالها بالقناة الرئيسية بواسطة مواسير من الإسمنت أو المرصص البلاستيك مع إستعمال بالوعات للجمع و تغيرالإتجاه.

ج-مياه الشرب :تجهيز الشبكة الداخلية يجب أن يكون بأنابيب PPRC .

7- النجارة: النجارة يجب أن تكون من الخشب الجيد و الألمنيوم ، الأبواب و النوافذ من فة واحدة و من نوع واحد كل النجارة تكون بها أدوات أمنية و بها الطلاء و الحدادة.

8- الكهرباء: وجوب إستعمال عداد فردي ممون و يوضع من طرف الشركة الوطنية للكهرباء و الغاز. التجهيز يكون بأنابيب بلاستيكية مدمجة بالحائط ،المصابيح تكون كمنة في الفضاءات الرطبة.

9- التهوية :يجب أن تكون في جميع فضاءات قصد إيصال الهواء النظيف و إخراج الهواء الملوث.

10- طلاء و الزجاج : الطلاء يكون مائي و فاتح مكون من ثلاث طبقات بالخارج و كذلك الفضاءات الرطبة

-طلاء زيتي مكون من ثلاث طبقات في الداخل.

-زجاج معدني للأبواب، زجاج نصف ثنائي للنوافذ.

التقويم

البناء، 65 %..... 33.242.950,00..... دج

-النجارة15 %..... 7.671.450,00..... دج

-التزويس الحديد، 12 %..... 6.137.160,00..... دج

-الطلاء و الزجاج 08 %..... 4.091.440,00..... دج

المجموع(الحوض + الإنجارة) ..... 51.143.000,00..... دج

* التهيئة الخارجية ..... 7.258.500,00..... دج

* السور الخارجي (بنوعيه بما فيه البوابات)..... 5.440.000,00 ..... دج

* جدران المياه (مع محل المعدات)..... 1.731.500,00 ..... دج

المجموع العام..... 65.573.000,00. ..... دج

يوقف هذا التحقيق بمبلغ (بكامل الرسوم) ،خمسة و ستون مليون و خمسمائة و ثلاثة و سبعون ألف دينار جزائري

2021 ماي 30

صاحب المشروع

مكتب الدراسات

مراد سميرة

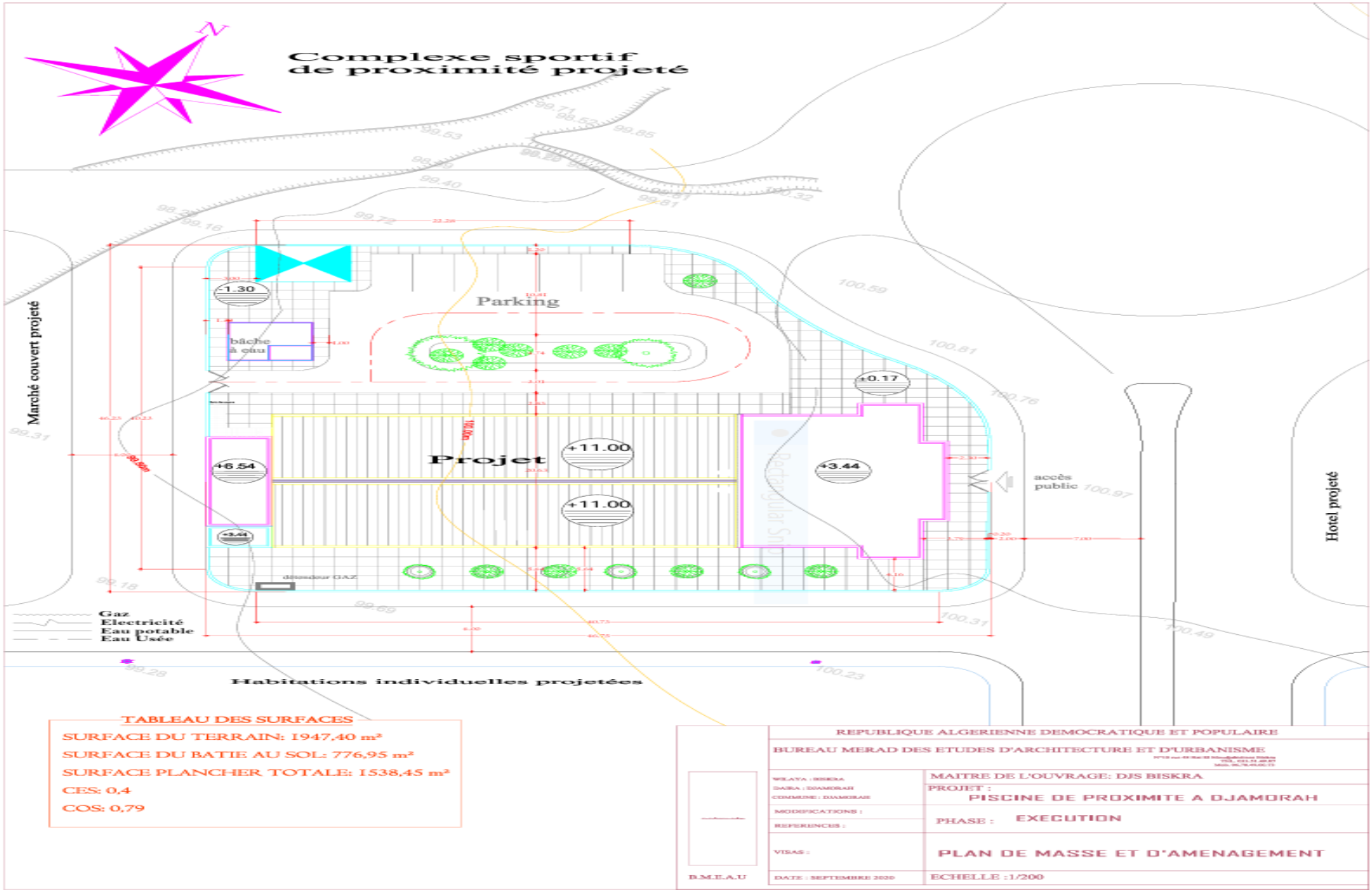

TABLEAU DES SURFACES

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SURFACE DU BATIE AU SOL: 776,95 m²

SURFACE PLANCHER TOTALE: 1538,45 m²

CES: 0,4

COS: 0,79

REPUBLIQUE ALGERIENNE DEMOCRATIQUE ET POPULAIRE

BUREAU MERAD DES ETUDES D'ARCHITECTURE ET D'URBANISME

WILAYA : BISKRA
DAIRA : DJAMORAH
COMMUNE : DJAMORAH

MAITRE DE L'OUVRAGE: DJS BISKRA

PROJET :
PISCINE DE PROXIMITE A DJAMORAH

MODIFICATIONS :

REFERENCES :

PHASE : EXECUTION

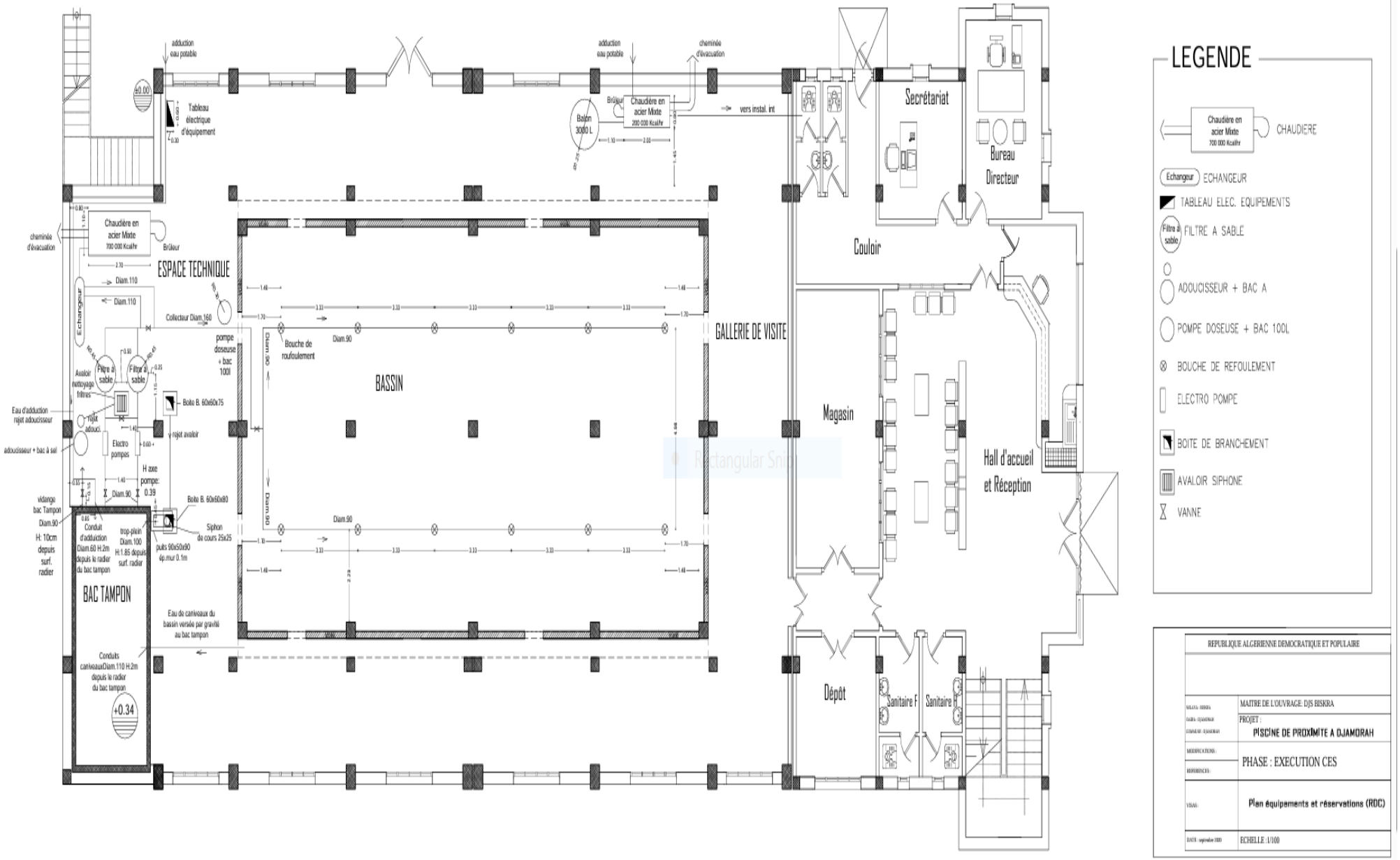
VISAS :

PLAN DE MASSE ET D'AMENAGEMENT

B.M.E.A.U

DATE : SEPTEMBRE 2020

ECHELLE :1/200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adduction eau potable
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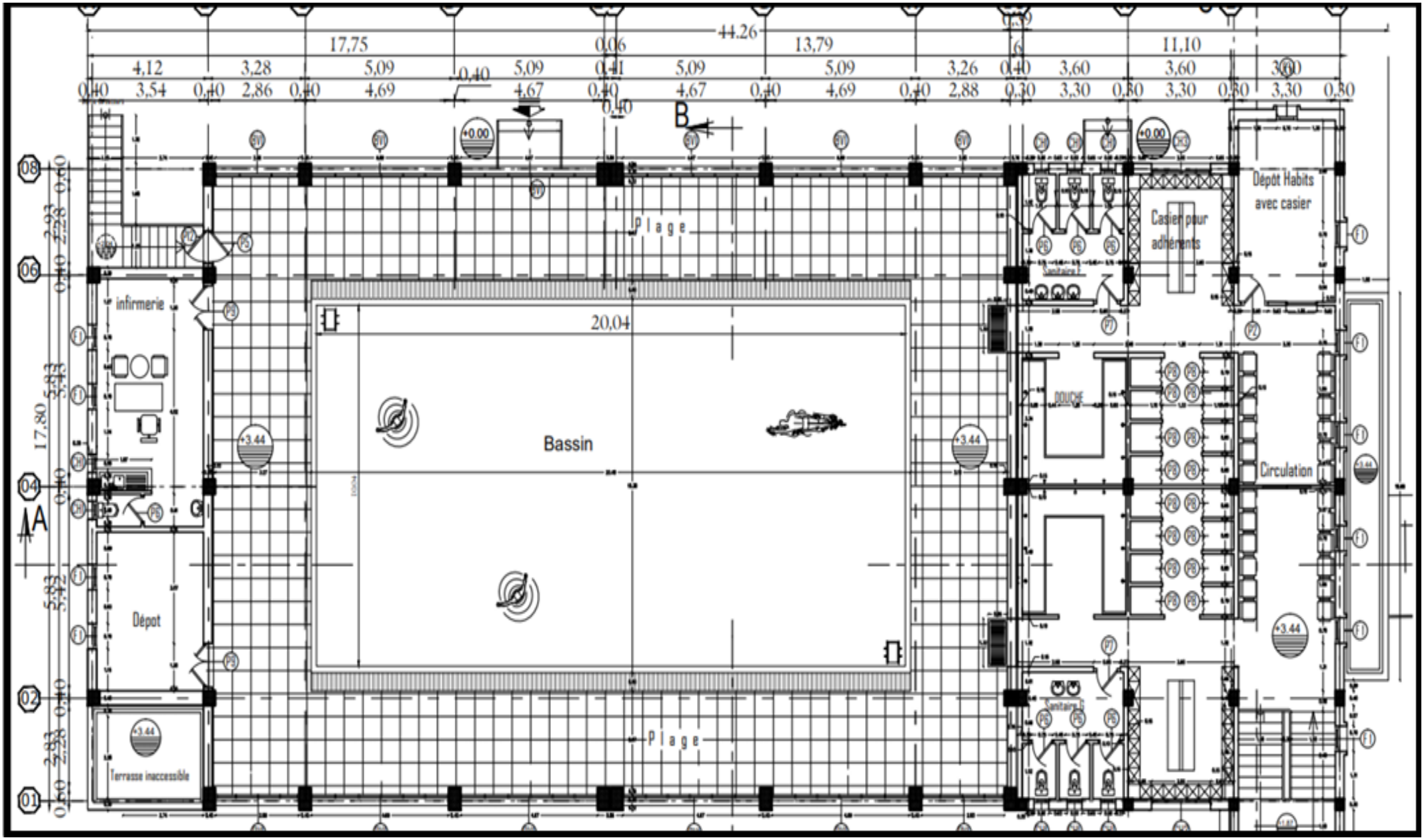
vers instal. int
Secrétariat
Bureau Directeur
Couloir
Chaudière en acier Mixte 700 000 Kcal/hr
Brûleur
cheminée d'évacuation
ESPACE TECHNIQUE
Diam.110
Diam.110
Collecteur Diam.160
Echangeur
pompe doseuse + bac 100l
Bouche de roufoulement
Diam.90
BASSIN
GALLERIE DE VISITE
Diam.90
Diam.90
Diam.90
Filtre à sable
Filtre à sable
Avaloir nettoyage filtres
Boite B. 60x60x75
Eau d'adduction rejet adoucisseur
rejet adouci.
rejet avaloir
adoucisseur + bac à sel
Electro pompes
H axe pompe: 0.39
Diam.90
Boite B. 60x60x80
vidange bac Tampon Diam.90 H: 10cm depuis surf. radier
Conduit d'adduction Diam.60 H:2m depuis le radier du bac tampon
trop-plein Diam.100 H:1.85 depuis surf. radier
puits 90x50x90 ép.mur 0.1m
Siphon de cours 25x25
BAC TAMPON
Eau de caniveaux du bassin versée par gravité au bac tampon
Conduits caniveauxDiam.110 H:2m depuis le radier du bac tampon
+0.34
Magasin
Hall d'accueil et Réception
Dépôt
Sanitaire F
Sanitaire
LEGENDE
Chaudière en acier Mixte 700 000 Kcal/hr
CHAUDIERE
Echangeur
ECHANGEUR
TABLEAU ELEC. EQUIPEMENTS
Filtre à sable
FILTRE A SABLE
ADOUCISSEUR + BAC A
POMPE DOSEUSE + BAC 100L
BOUCHE DE REFOULEMENT
ELECTRO POMPE
BOITE DE BRANCHEMENT
AVALOIR SIPHONE
VANNE
REPUBLIQUE ALGERIENNE DEMOCRATIQUE ET POPULAIRE
MAITRE DE L'OUVRAGE: DJS BISKRA
PROJET :
PISCINE DE PROXIMITE A DJAMORAH
PHASE : EXECUTION CES
Plan équipements et réservations (RDC)
ECHELLE :1/100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Plage
Plage
infirmerie
Dépot
Terrasse inaccessible
Dépôt Habits avec casier
Casier pour adhérents
Circulation
DOUCHE
Sanitaire
+0.00
+3.44
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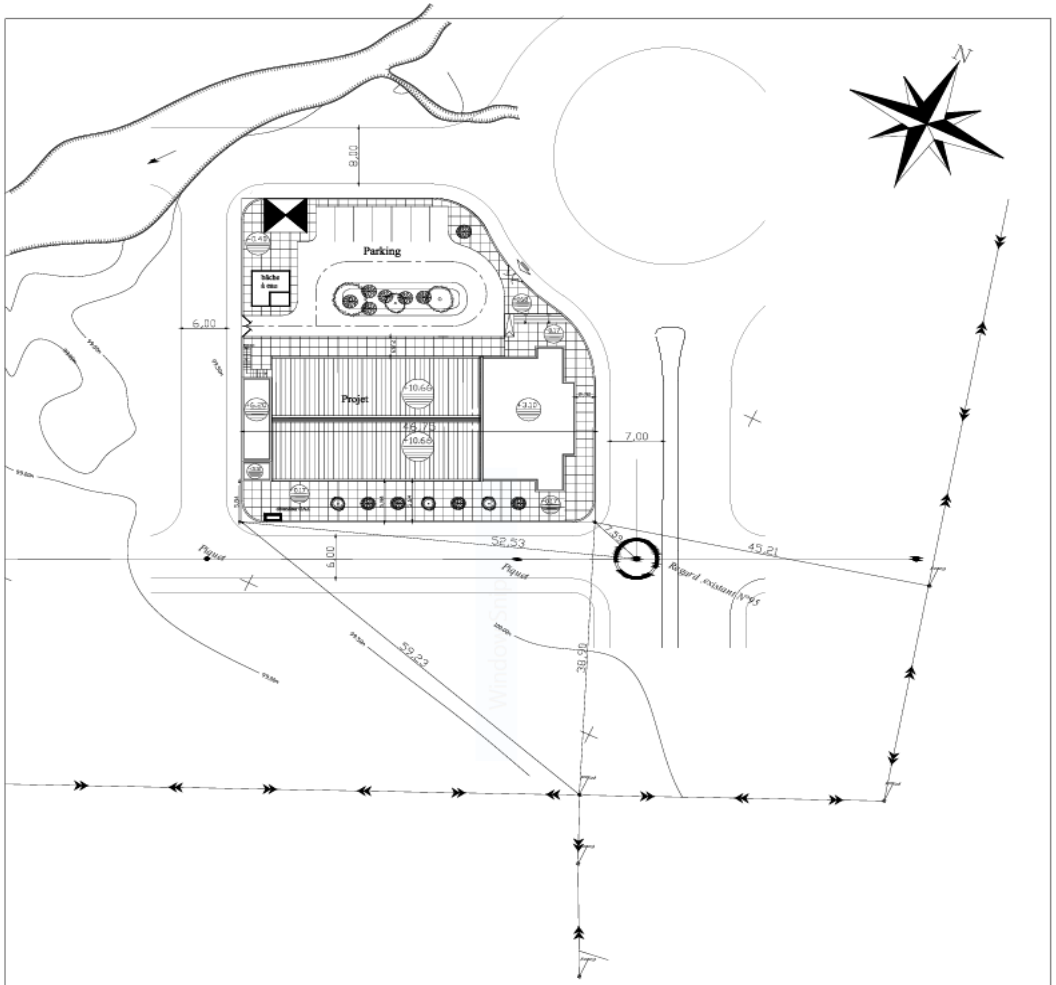
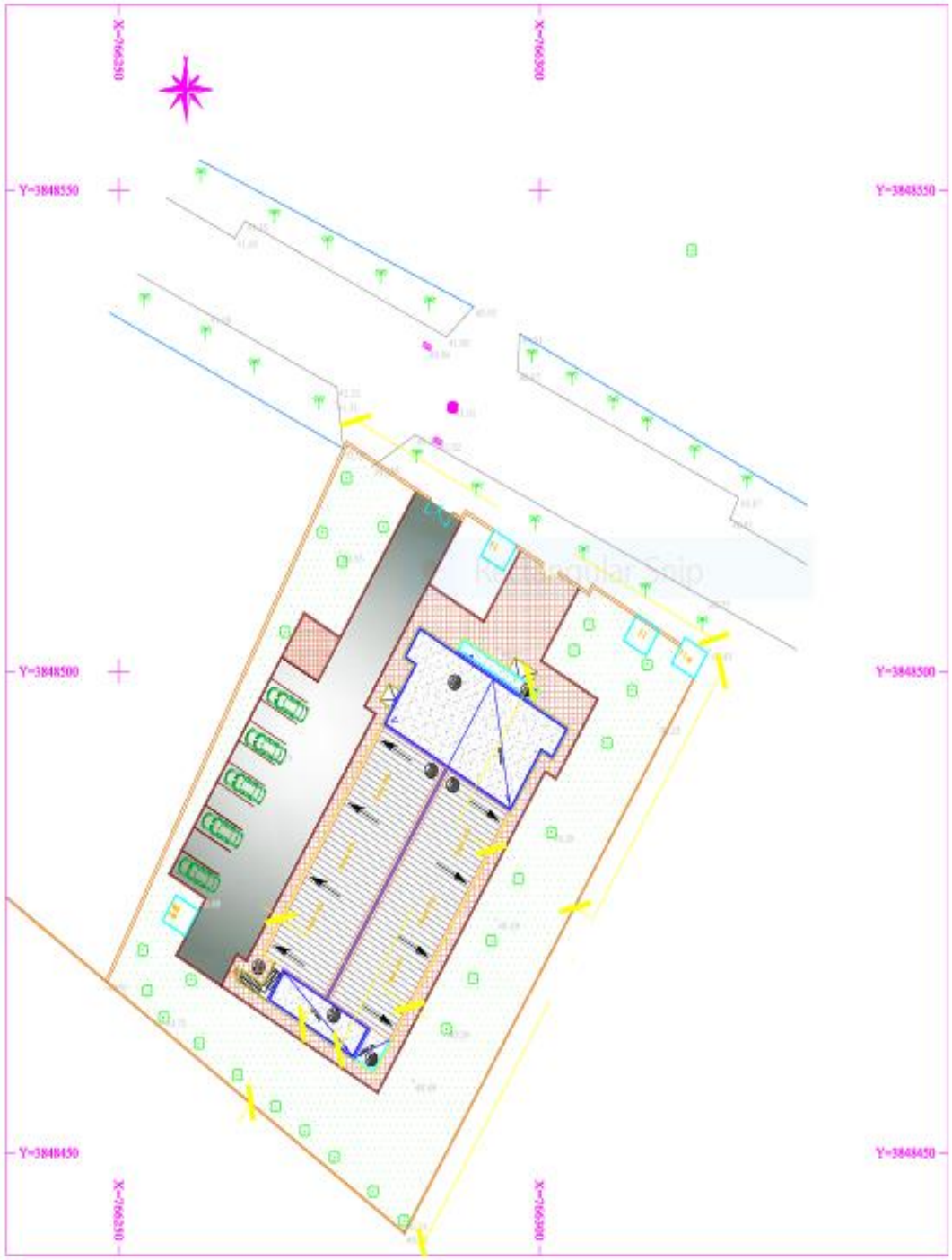
06
08





REPUBLIQUE ALGERIENNE DEMOCRATIQUE ET POPULAIRE

BUREAU MERAD DES ETUDES D'ARCHITECTURE ET D'URBANISME

N°10 rue 48 Ilot El Mouflahiderat Biskra
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Mob. 06.70.49.00.73

WILAYA : BISKRA
DAIRA : DJAMORAH
COMMUNE : DJAMORAH

MAITRE DE L'OUVRAGE: DJS BISKRA

PROJET : PISCINE DE PROXIMITE A DJAMORAH

MODIFICATIONS :

REFERENCES :

PHASE : EXECUTION

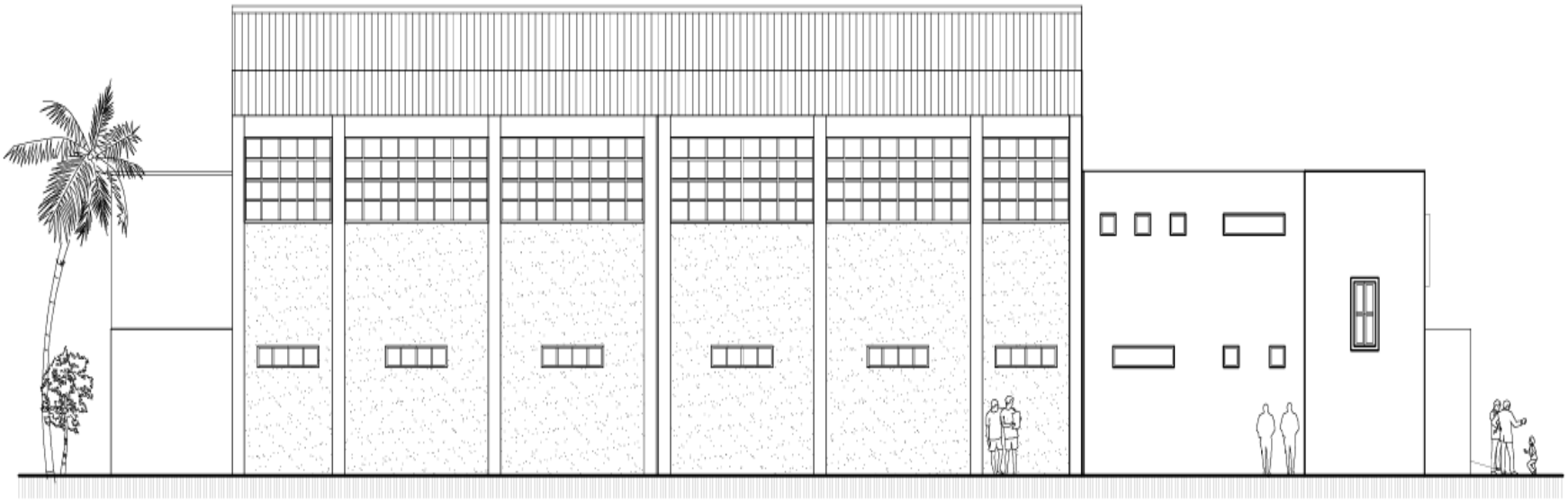
VISAS :

PLAN IMPLANTATION

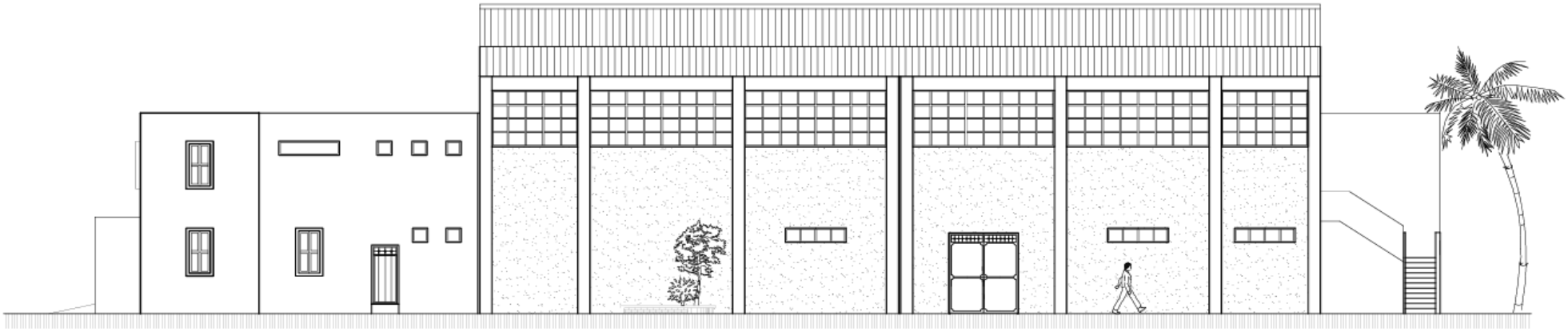
B.M.E.A.U

DATE : MARS 2021

ECHELLE :1/200

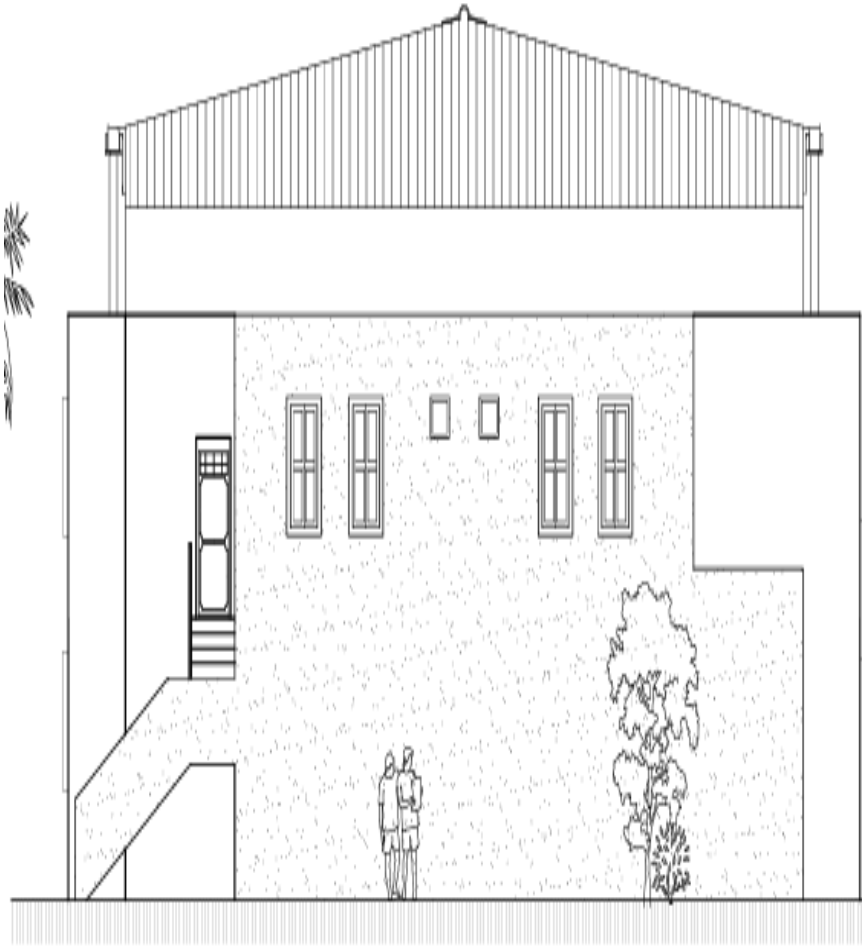


FAÇADE SUD Ech: 1/50

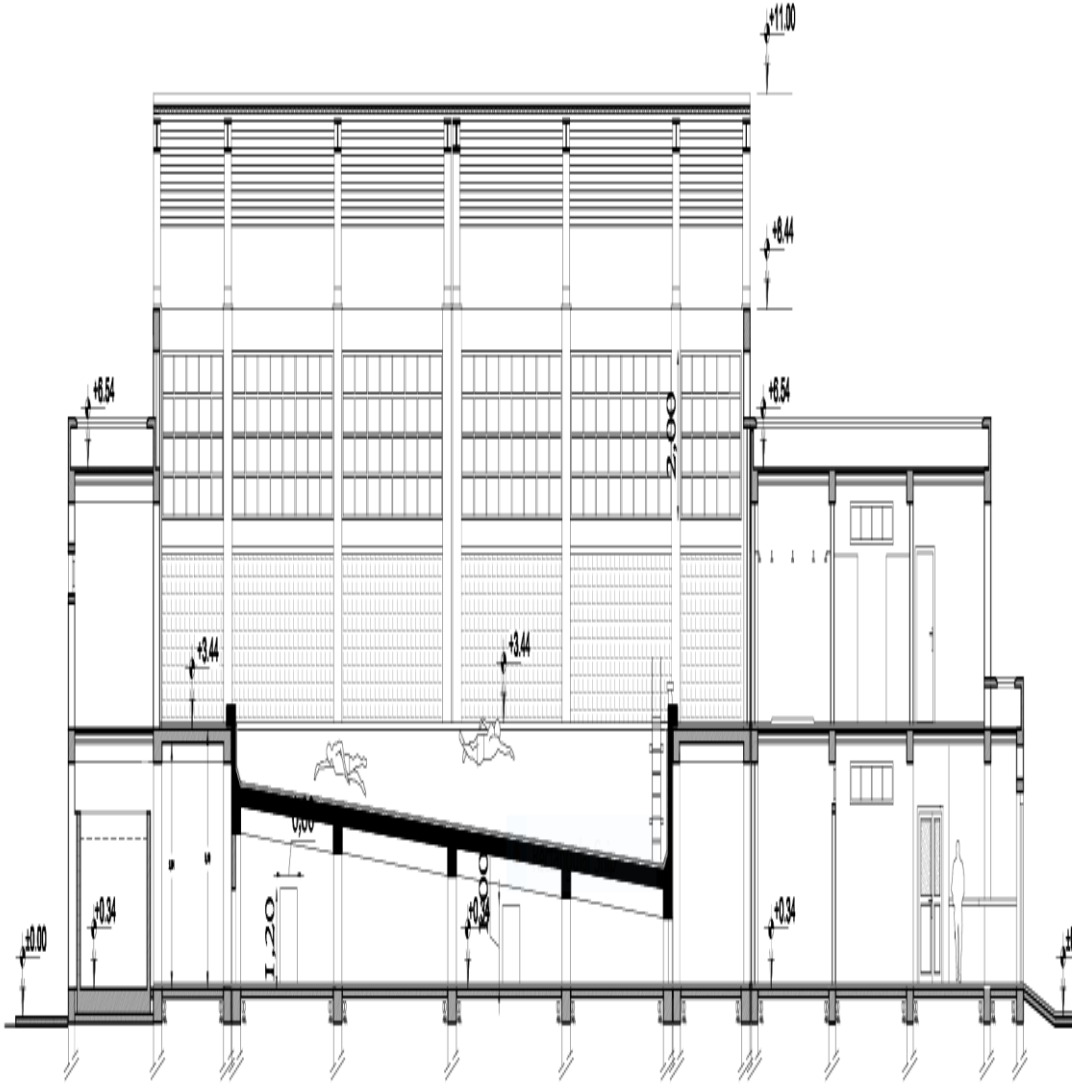


FAÇADE NORD Ech: 1/50

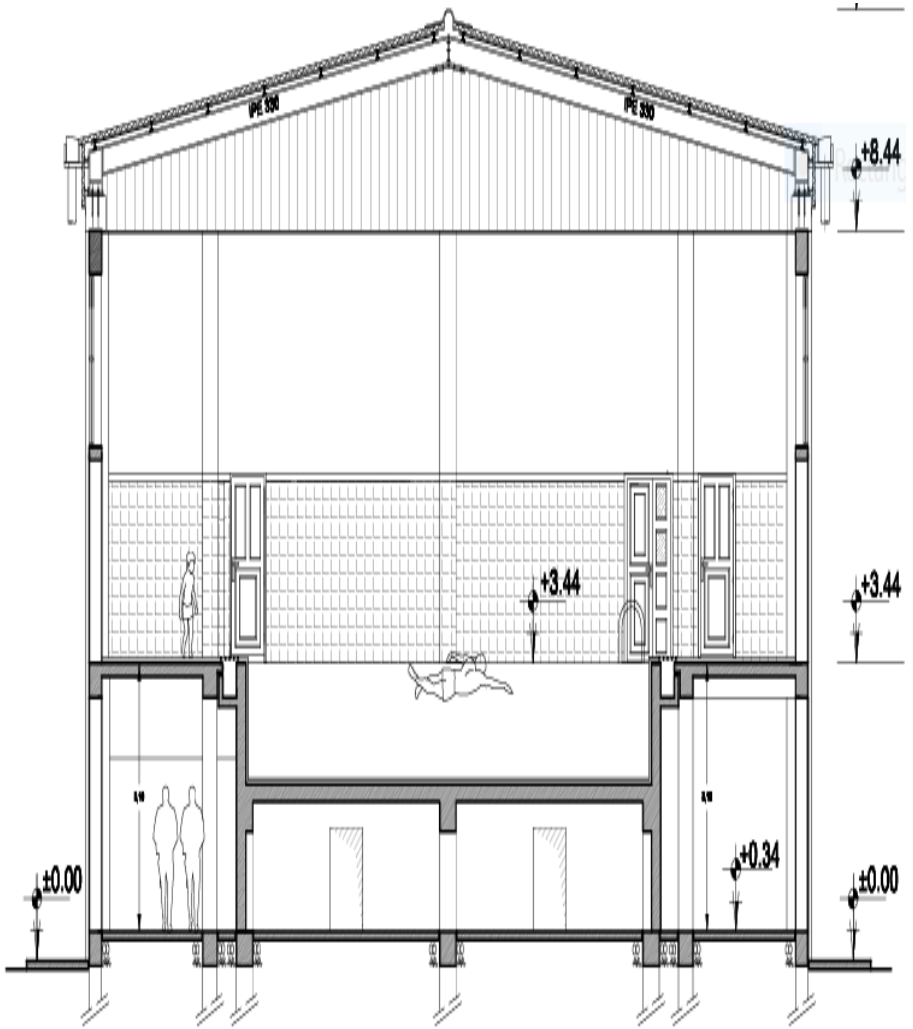
FAÇADE EST Ech: 1/50



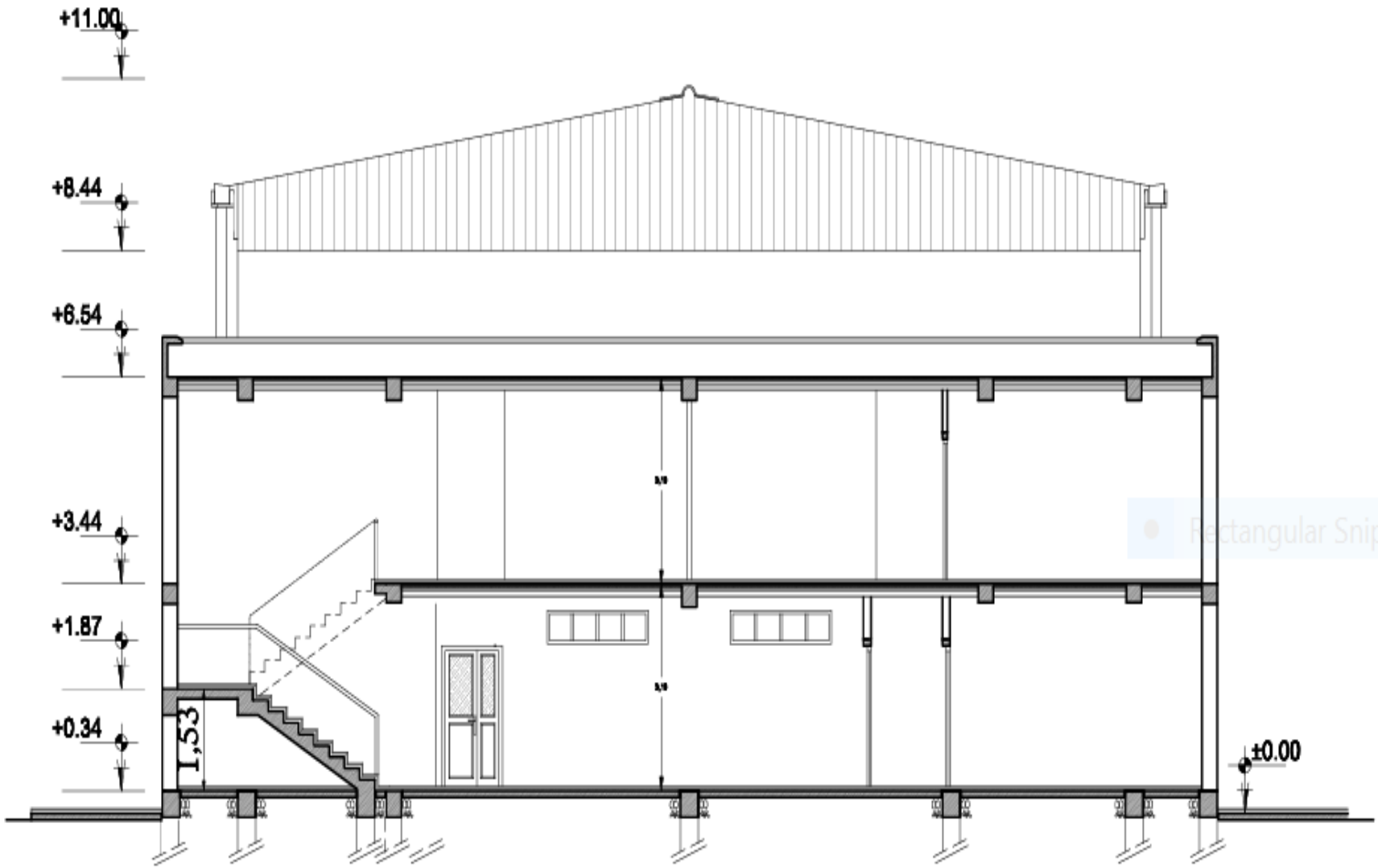
FAÇADE OUEST 1/50



COUPE A-A Ech: 1/50



COUPE B-B Ech: 1/50



COUPE C-C Ech: 1/50

الجمهورية الجزائرية الديمقراطية الشعبية

ولاية بسكرة
مديرية الشباب والرياضة

407 2023

تاريخ الجلسة
13 سبتمبر 2023

تأشيرة اللجنة الولائية للصفقات
رقم: 23.407
بتاريخ: 25 سبتمبر 2023

صفقة

تأشيرة المراقب المالي
رقم: 23/131
تاريخ: 23/10/24

مشـــروع: **إنجاز 11 مسبح جواري عبر بلديات بسكـرة.**

الشطـر (I): 11/07 مسبح جواري عبر بلديات بسكـرة.

حصة 03: مسبح جواري سيدي عقبة

برنامج:.....2018/18 ميزانية الولاية .....

تسمية العملية: إنجاز 11 مسبح جواري عبر ولاية بسكـرة.

---(مؤسسة الانجـــاز)---

مؤسسة أشغال البناء في مختلف مراحله والترقية العقارية– صوالحي عمار -
رقم 29 نهج الحدائق حي بارك أفوراج- ولاية باتنة

ولاية بسكرة
مديرية الشباب و الرياضة

البرنامـــــج : 2018/18 ميزانية الولاية
تسمية العمليـة : انجاز 11 مسبح جواري عبر ولاية بسكرة .
طبيعة الأشغـال: انجاز 11 مسبح جواري عبر بلديات بسكرة
الشطر (I) : 11/07 مسبح جواري عبر بلديات بسكرة
حصة رقم 03 : مسبح جواري سيدي عقبة.
المقاولة : مؤسسة أشغال البناء في مختلف مراحله والترقية العقارية – صوالحي عمار -

أمـــر بعمـــل

المرسل اليه : مكتب الدراسات
المسجل تحت رقم :.....

السيد مسير مؤسسة : مؤسسة أشغال البناء في مختلف مراحله والترقية العقارية – صوالحي عمار - الحائز على الصفقة رقم 23/407 بتاريخ في : 2023/09/25 و المتعلق انجاز 11 مسبح جواري عبر بلديات بسكرة الشطر (I) : 11/07 مسبح جواري عبر بلديات بسكرة . حصة رقم 03 : مسبح جواري - سيدي عقبة-
مدعوة لأخذ و تبليغ نسخة من الصفقة وهي مطالبة بالشروع في الأشغال ذلك ابتداء من تسلمها هذا الأمر
يبلغ أمر بالعمل المسجل تحت رقم : .....
إلى السيد : صوالحي عمار
الساكن بـ : باتنة

24 أكتوبر 2023

ع/الوالي
من طرف مدير الشباب و الرياضة

ولاية بسكرة
مديرية الشباب و الرياضة

البرنامـــــج : 2018/18 ميزانية الولاية
تسمية العمليـة : انجاز 11 مسبح جواري عبر ولاية بسكرة .
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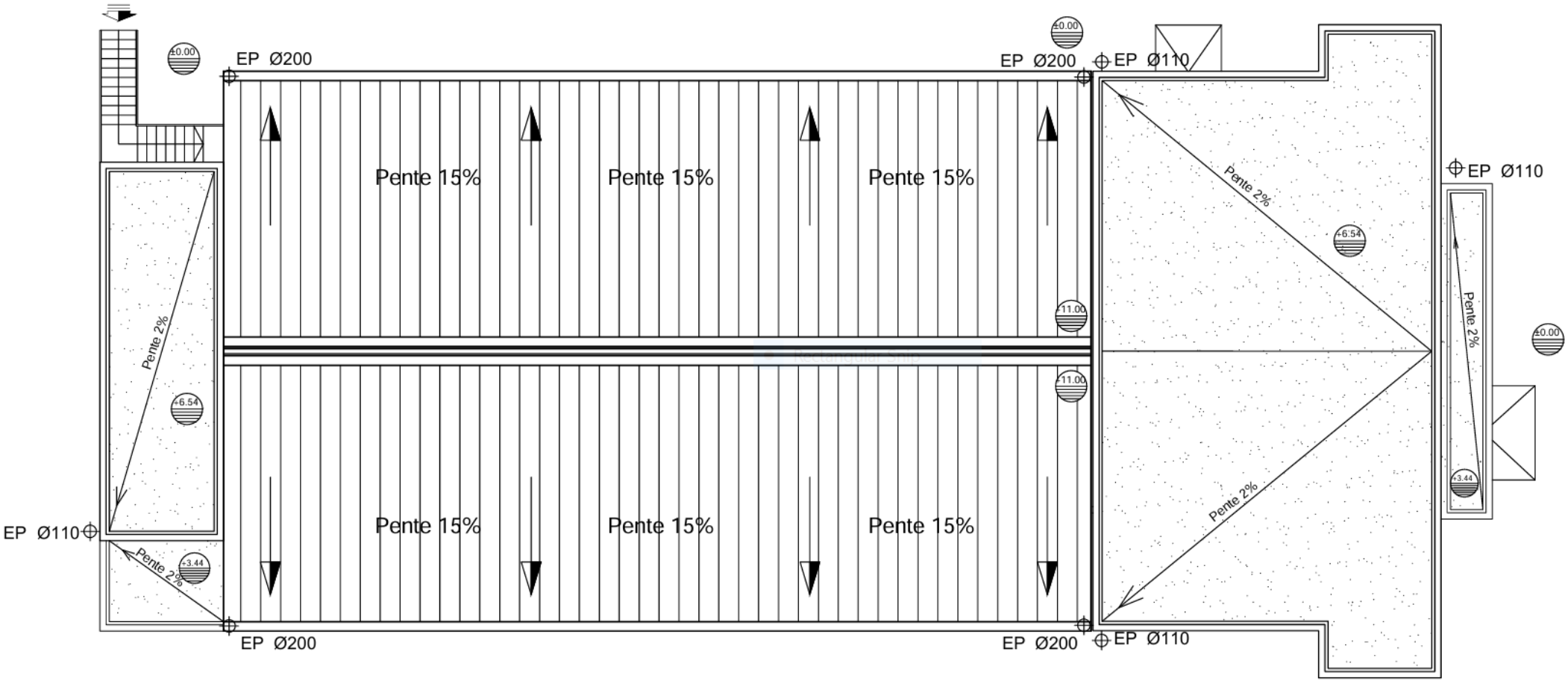
المقاولة : مؤسسة أشغال البناء في مختلف مراحله والترقية العقارية – صوالحي عمار -

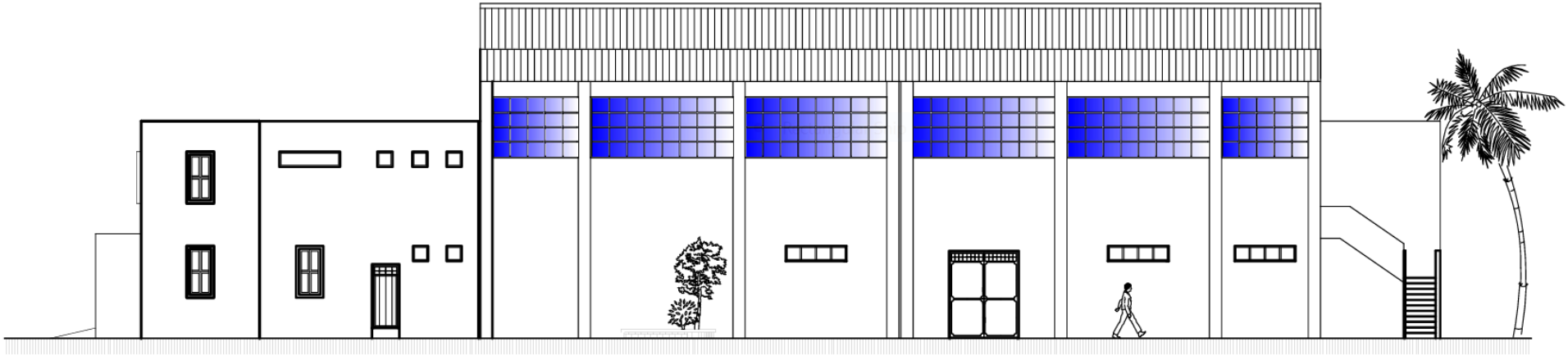
تبليـغ

في:.....تسليم السيد : صوالحي عمار
نسخة من أمر بعمل المسجل تحـــت رقـــم:.....
المؤرخ في : .....

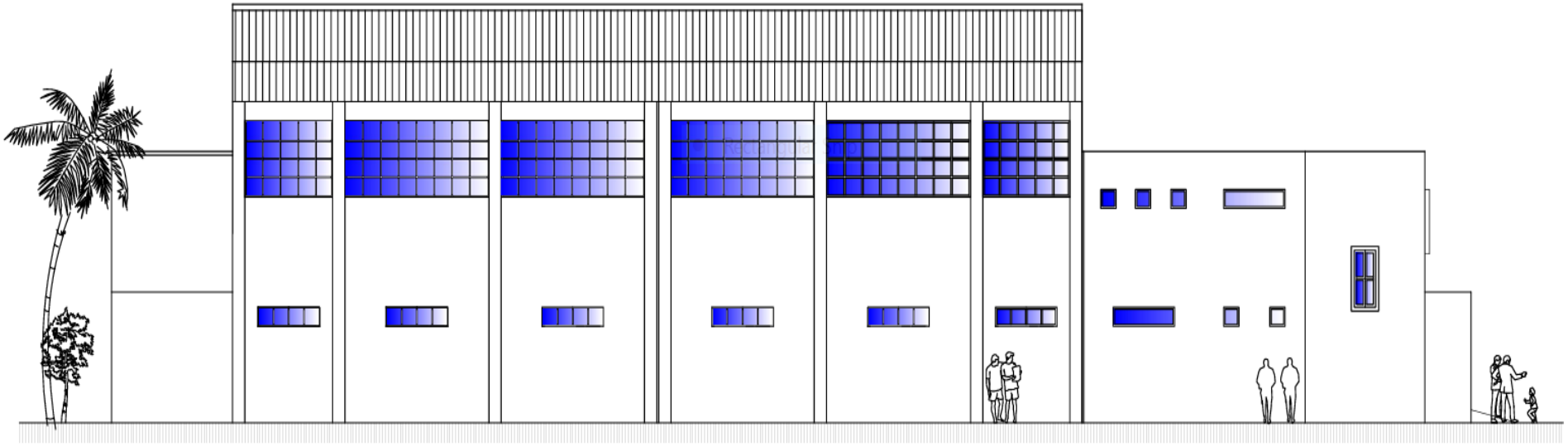
19 نوفمبر 2023



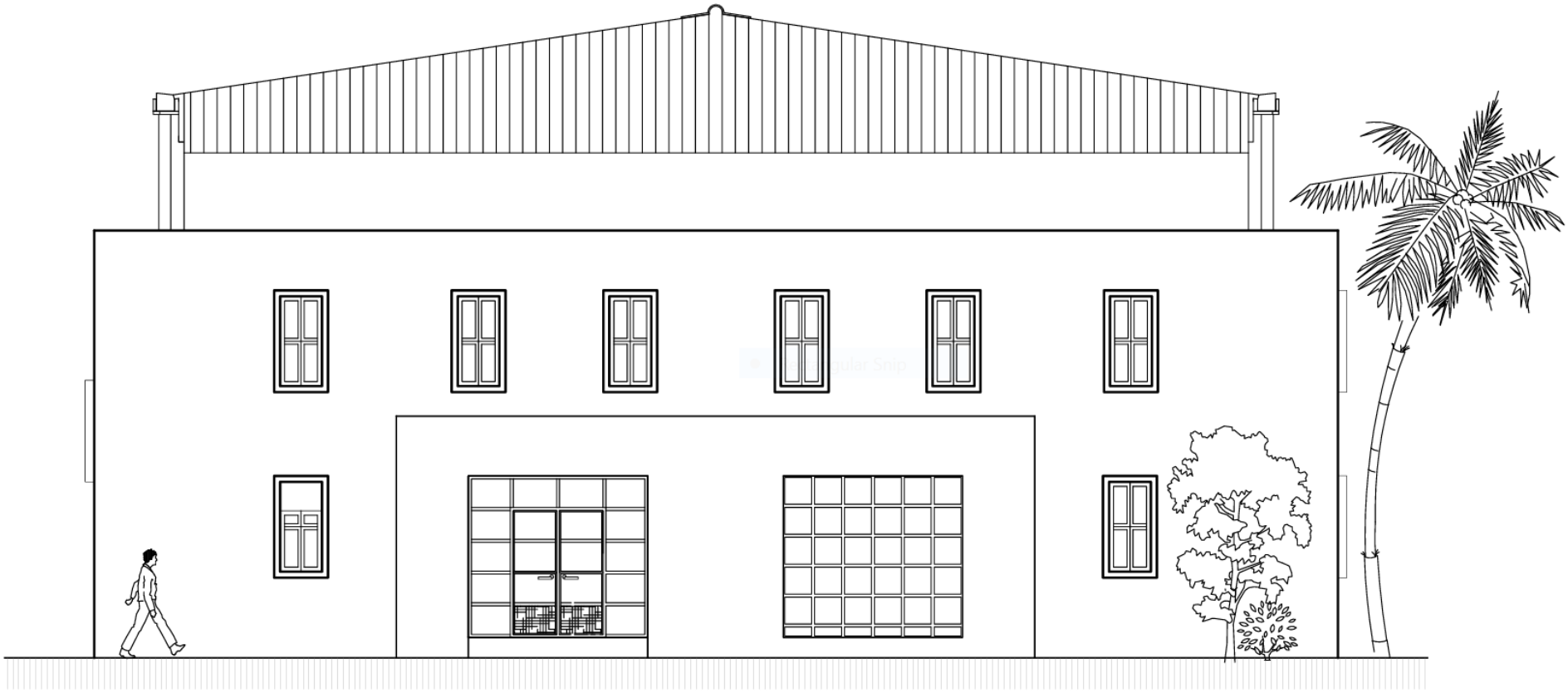
PLAN TERRASSE Ech: 1/100



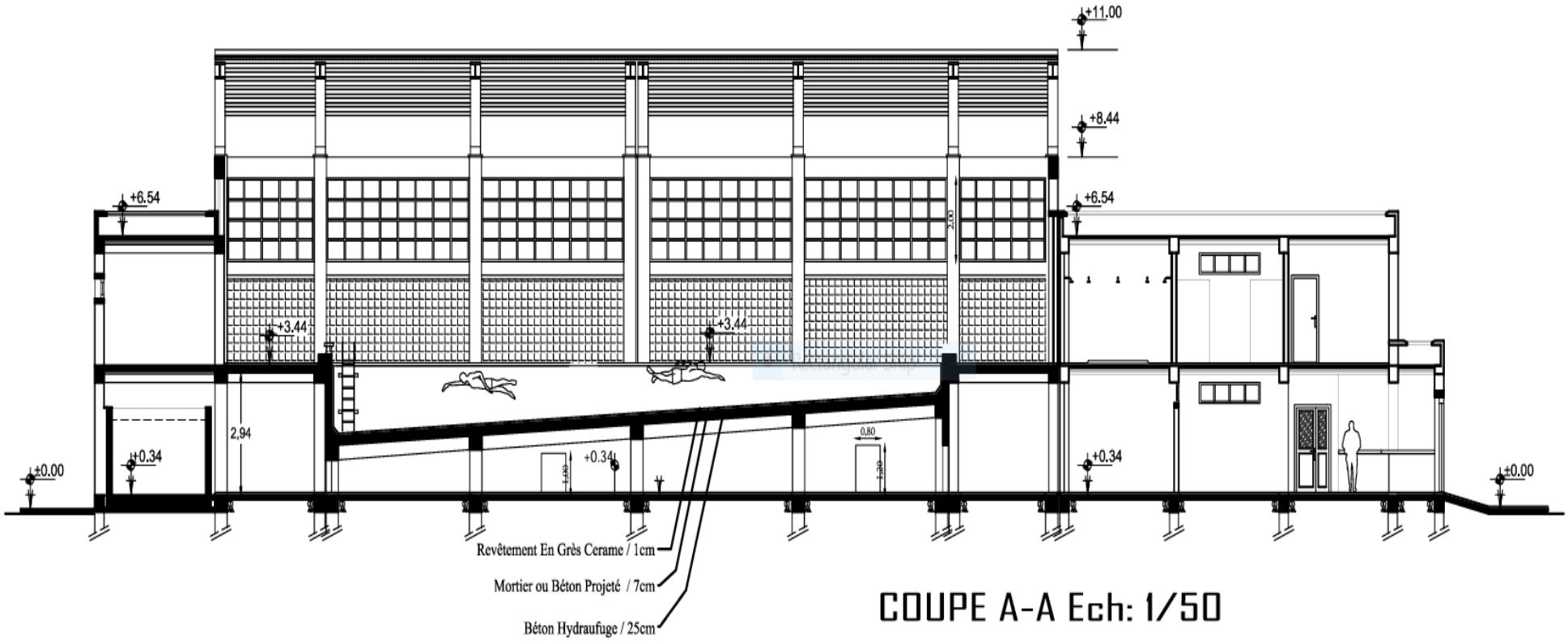
FAÇADE NORD Ech: 1/50



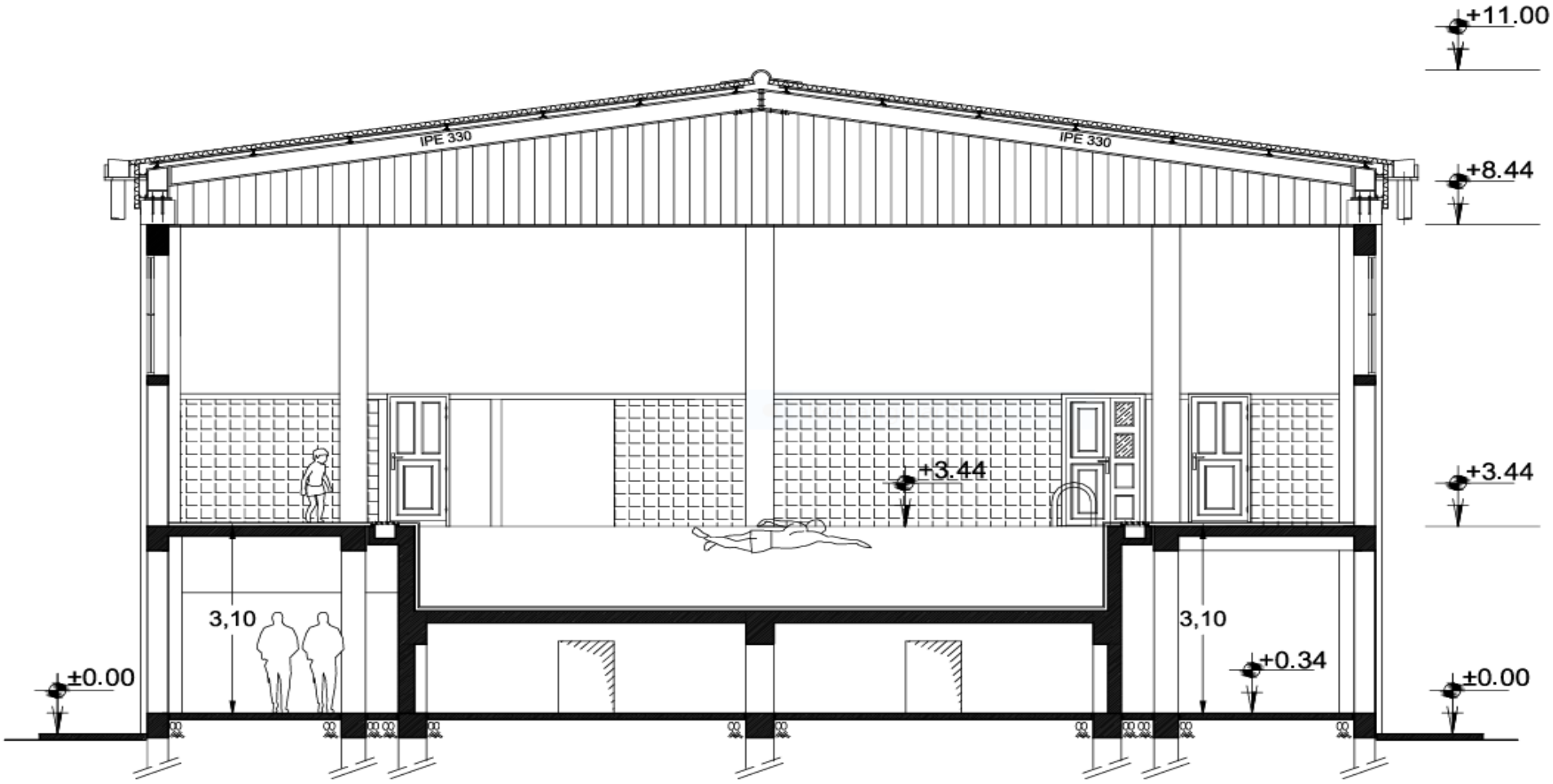
FAÇADE SUD Ech: 1/50



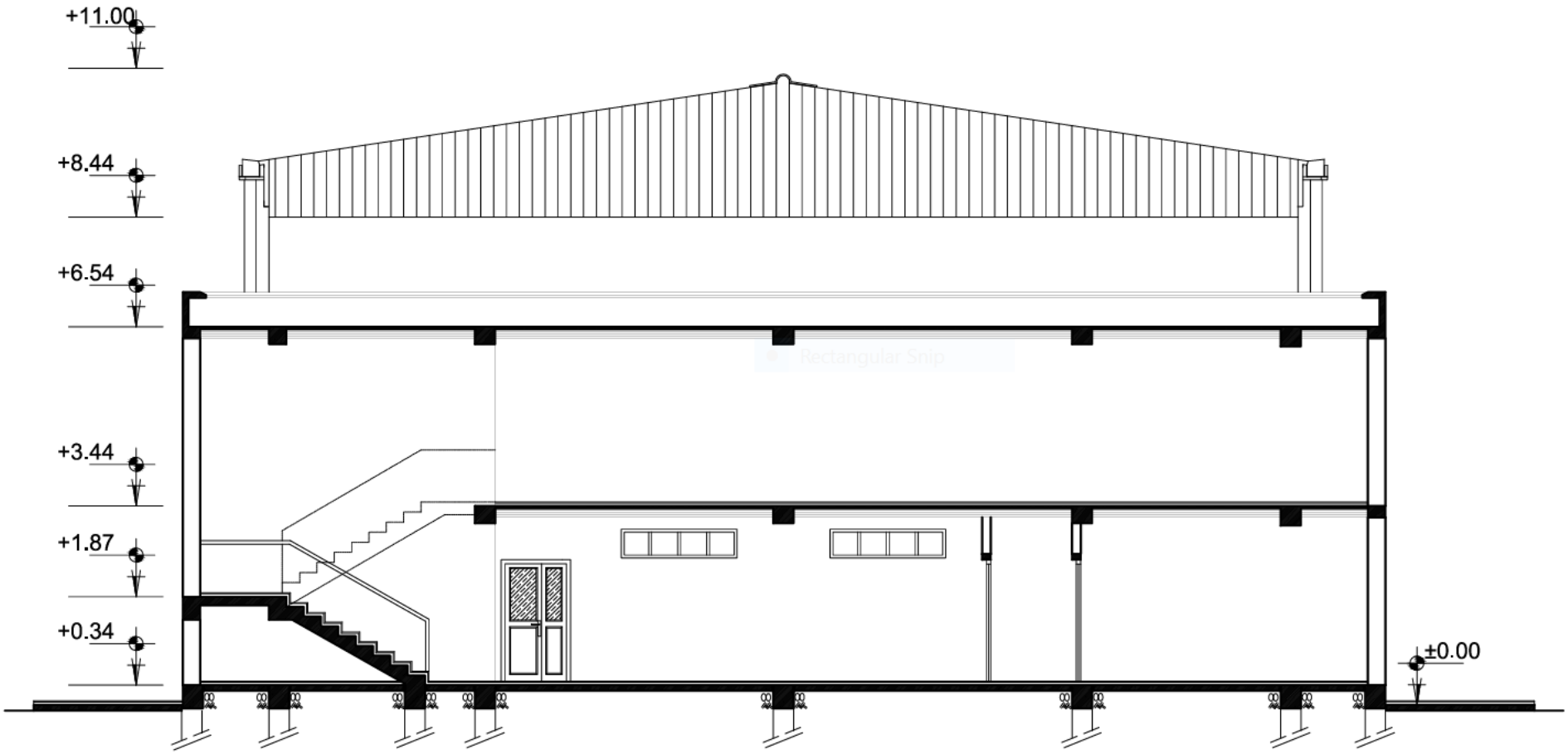
FAÇADE EST Ech: 1/50



COUPE A-A Ech: 1/50



COUPE B-B Ech: 1/50



COUPE C-C Ech: 1/50

RECAP GENERALE

PROJET : 11 piscines de prximités à travers les communes de BIS
TRANCHE I : 07/11 piscines de prximités
à travers les communes de BISKRA
Lot 03 : Piscine de proximité à sidi okba

I-	TERRASSEMENT en H.T	:	679 425,00
II-	GROS ŒUVRE en H.T	:	40 169 328,40
III-	CHARPENTE METALIQUE en H.T	:	14 259 631,40
IV-	MACONNERIE REVËTEMENT ENDUIT en H.T:		12 808 366,00
V-	ETANCHEITE en H.T	:	1 211 880,00
VI-	ELECTRICITE en H.T	:	2 892 900,00
VII-	PLOMBERIE/ EVACUATION / RESEAU ANTI-INCENDIE EQUIPEMENTS / INSTALLATIONS HYDRAULIQUE DU BASSIN en H.T...	:	15 247 536,00
VIII-	MENUISERIE en H.T	:	5 496 840,0
IX-	PEINTURE - VITRERIE en H.T	:	1 466 461,8
X-	TRAVAUX DIVERS (AMENAGEMENT, VOIRIE ET PARKING, ECLAIRAGE EXTERIEUR, BACHE A EAU) en H.T	:	22 972 595,(
	TOTAL GENERAL EN H,T	:	117 204 463,2
	MONTANT DE LA T.V.A 19%	:	22 268 943,0
	TOTAL GENERAL EN T.T.C	:	139 473 906,2

Arrêter le Présent Devis Quantitatif Estimatif en T.T.C à la somme de : *Cent trente n millions quatre cent soixante treize mille neuf cent six Dinars Algérien et vingt six centime*

Biskra le: .....
Le contractent
(Cachet et signature)

Biskra le: .....
Le service contractent
(Cachet et signature)