

**MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH OF THE  
REPUBLIC OF TUNISIA**

&

**DEPARTMENT OF SCIENCE & TECHNOLOGY (DST), GOVERNMENT OF INDIA**

**APPLICATION FOR A JOINT RESEARCH GRANT UNDER THE TUNISIA/INDIA  
AGREEMENT ON SCIENCE AND TECHNOLOGY COOPERATION**

The deadline for proposal submission is **31July 2025**

**PART I: GENERAL INFORMATION**

**1. Key area of Research**

Identification and Processing of Industrial, Agricultural, and Municipal Wastes from India and Tunisia for Use in Concrete Applications

**2. Title of Project**

**Eco-Concrete from Waste: Comparative Innovation between India and Tunisia**

**3. Specific research field**

Field	*	Sub-field
climate change and eco- innovation	*	Eco-Innovative Concrete
e-health		
geospatial technology		

**4. Project Duration**

Project Start Date:	Project End Date:	Duration
08.12.2025	07.10.2028	2 years 10 months

## 5. Budget

	Ist Year	IIInd Year	IIIrd Year	TOTAL
Overall Budget Distribution TND:	49 000	49 500	49 500	148 000
Overall Budget Distribution INR:	17,00,000	15,00,000	12,00,000	44,00,000

## 6. Summary of Project

Keywords	Eco-innovation	Sustainable concrete	Waste valorization
	Industrial by-products	Recycled aggregates	Waste management
<b>Objectives</b>		<ol style="list-style-type: none"> <li>Identify and process selected industrial, agricultural, and municipal waste materials from India and Tunisia for potential use in concrete.</li> <li>Analyze the physical, chemical, and environmental characteristics of the selected wastes to assess their suitability as partial replacements for cement and aggregates.</li> <li>Design and optimize concrete mix formulations incorporating waste materials at varying replacement levels.</li> <li>Evaluate the mechanical properties, durability, and structural performance of the modified concrete mixes.</li> <li>Perform a comparative analysis of the sustainability and technical performance of waste-based concretes developed in India and Tunisia.</li> </ol>	
<b>Approach</b>		<ol style="list-style-type: none"> <li>Select regionally abundant waste materials in both countries based on availability and relevance.</li> <li>Process the collected wastes into usable forms—powders for binder substitution and graded particles for aggregate replacement.</li> <li>Conduct material characterization to assess physical (e.g., particle size, porosity), chemical (e.g., XRF/XRD), and environmental properties (e.g., leaching behavior).</li> <li>Design concrete mixes with varying levels of waste replacement, following IS and ACI standards.</li> <li>Cast and test concrete specimens (cubes, cylinders, prisms, and RCC beams) under standardized conditions.</li> <li>Assess mechanical properties (compressive, tensile, flexural strength) and durability indicators (RCPT, sulphate/acid resistance).</li> <li>Perform accelerated corrosion tests on reinforced specimens to evaluate long-term reinforcement integrity.</li> <li>Compare performance across Indian and Tunisian waste-based concretes under similar testing protocols.</li> <li>Conduct environmental (LCA) and economic (cost-benefit) analyses to determine sustainability and feasibility.</li> </ol>	

<b>Expected Outcome</b>	<ol style="list-style-type: none"> <li>1. Development of eco-innovative concrete solutions using processed waste materials from both India and Tunisia.</li> <li>2. Demonstrated improvement in mechanical, durability, and structural performance of waste-based concretes relative to conventional mixes.</li> <li>3. Contribution to low-carbon, resource-efficient construction practices by promoting waste valorization and advancing circular economy principles.</li> <li>4. Generation of region-specific technical data and design guidelines for the use of alternative materials in infrastructure applications.</li> </ol>
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## 7. Personal Data

	<b>INDIA</b>	<b>Tunisia</b>
<b>Name of PI</b>	Dr. A. Hemalatha	Dr Ahmed Siala
<b>Nationality</b>	Indian	Tunisian
<b>Gender</b>	Female	Male
<b>Organization</b>	N P R College of Engineering and Technology (Autonomous),	Military research Centre
<b>Department/ Laboratory</b>	Department of Civil Engineering	Defence Science and Technology laboratory
<b>Title</b>	Professor & Head of Department	Professor & General Director of the Military Research Centre
<b>Address of Institution</b>	Department of Civil Engineering Punnappatti Village, Uluppakudi, Natham, Dindigul District-624401	L'Aouina, Tunisia
<b>Office phone #</b>	04544-246500	-
<b>Cell phone #</b>	+91-9894879990	+216 55336139
<b>Fax #</b>	04544-246511	-
<b>e-mail</b>	<a href="mailto:hemalathaa@nprcolleges.org">hemalathaa@nprcolleges.org</a>	<a href="mailto:ahmed.siala.71@gmail.com">ahmed.siala.71@gmail.com</a>
<b>Date of Birth</b>	09.05.1966	01/10/1971
<b>Name of Co-Investigator</b>	Iyappan G	Dr Azer Maazoun
<b>Organization</b>	N P R College of Engineering and Technology (Autonomous),	Military Academy of Fondouk Jedid, Tunisia
<b>Department</b>	Department of Civil Engineering	Civil Engineering Department
<b>Title</b>	Assistant Professor	Assistant Professor & Head of Department
<b>Address of Institution</b>	Department of Civil Engineering Punnappatti Village, Uluppakudi, Natham, Dindigul District-624401	Military Academy of Fondouk Jedid, Civil Engineering Department, 8021 Nabeul, Tunisia

<b>Office phone #</b>	04544-246500	-
<b>Cell phone #</b>	+91-7373208209	+216 29700034
<b>Fax #</b>	04544-246511	-
<b>e-mail</b>	<a href="mailto:iyappang@nprcolleges.org">iyappang@nprcolleges.org</a>	<a href="mailto:Maazouazer@yahoo.com">Maazouazer@yahoo.com</a>

**Names and affiliations of Tunisian researchers/students to participate in the project (add rows where required)**

Full name	Current Academic Qualification	Institution	Nationality	Gender
Ahmed Siala	Professor	Military research Centre	Tunisian	Male
Abdelkhader louati	Professor	Military research Centre	Tunisian	Male
Karim Miled	Professor	National school of Engineering of Tunis	Tunisian	Male
Azer Maazoun	Assistant Professor	Military Academy of Fondouk Jedid,	Tunisian	Male
Oussama Atoui	Assistant Professor	Military Academy of Fondouk Jedid,	Tunisian	Male
Mohamed Ben Rhouma	PhD student	Military research Centre	Tunisian	Male

**Names and affiliations of Indian researchers/students to participate in the project (add rows where required)**

Full name	Current Academic Qualification	Institution	Nationality	Gender
Mr. C. Vijayakumar	M.E, (Ph.D)	N P R College of Engineering and Technology (Autonomous)	Indian	Male
Mr.S.Nagamani	M.E, (Ph.D)		Indian	Male
Mr.P.M Dhureen Karthik	M.E, (Ph.D)		Indian	Male
Mr.P.Jayaraj	M.E,		Indian	Male
Mr. P Manikandan	M.E, (Ph.D)		Indian	Male
Mr. C.Vijayakumar	M.E, (Ph.D)		Indian	Male
Mr. N.Kartick	M.E,		Indian	Male

## PART II: TECHNICAL INFORMATION

### 1. Objectives of Project (up to 200 words)

The primary objective of this research is to develop a sustainable, eco-innovative concrete by partially replacing conventional cement and natural aggregates with processed waste materials sourced from India and Tunisia. The project targets the valorization of industrial, agricultural, and municipal wastes such as fly ash, rice husk ash, glass powder, and plastic waste by converting them into viable alternative binders and aggregates.

Comprehensive material characterization will be conducted to evaluate the physical, chemical, and microstructural properties of each waste type, determining its suitability for binder or filler functions. Optimized concrete mix designs will be developed with varying replacement ratios, adhering to international standards to ensure sufficient strength, workability, and long-term durability.

The modified concretes will undergo extensive mechanical testing (compressive, tensile, and flexural strength), durability evaluation (acid/sulphate resistance, RCPT), and structural performance assessment through reinforced concrete (RC) beam testing. Corrosion resistance of embedded reinforcement will also be studied.

This project ultimately aims to reduce the environmental footprint of concrete production, promote circular economy principles, and support sustainable construction practices by integrating regionally available waste materials into concrete infrastructure applications in both India and Tunisia.

### 2. Justification for collaboration & brief introduction to the national and international backdrop to the proposed area of research (up to 400 words)

The global construction industry stands at a critical juncture, grappling with its substantial contribution to carbon emissions and resource depletion, primarily driven by the extensive use of cement and natural aggregates in concrete production. In response, there is an urgent and growing international impetus towards adopting eco-innovative practices and integrating alternative, sustainable materials into construction. A highly promising avenue lies in the valorization of industrial, agricultural, and municipal wastes as partial replacements for conventional concrete constituents. This approach directly aligns with the burgeoning principles of the circular economy and waste valorization, which are gaining significant traction worldwide.

Both India and Tunisia face distinct yet complementary challenges and opportunities in this context. India, a rapidly developing economy, generates vast quantities of industrial by-products like fly ash and rice husk ash, alongside a burgeoning volume of plastic waste. While the potential for their reuse in construction is immense, effective and widespread application remains largely under-researched. Concurrently, Tunisia, representative of many North African nations, contends with pressing waste management issues and resource scarcity in its construction sector, with abundant agricultural residues, plastic waste, and demolition waste often underutilized. Both nations are actively seeking cost-effective, sustainable solutions to enhance waste reuse and diminish their reliance on virgin raw materials.

This proposed collaboration between India and Tunisia is not merely a convergence of research interests but a strategic synergy that leverages diverse regional strengths. It brings together two distinct waste profiles, varied climatic conditions, and unique construction practices, enabling a truly comparative and complementary research approach. India's extensive experience with large-scale industrial by-products can be synergistically combined with Tunisia's focus on agricultural and municipal waste reuse. This exchange of specialized knowledge, methodologies, and experimental results is paramount, fostering the development of a more universally adaptable and robust eco-innovative concrete product that transcends regional specificities.

Beyond the immediate technical advancements, this joint will significantly strengthen academic and technical ties between India and Tunisia. It will foster interdisciplinary research in critical areas such as materials engineering, environmental sustainability, and resilient infrastructure development. Crucially, this collaboration directly supports both countries' national development goals, which are firmly aligned with the United Nations Sustainable Development Goals (SDGs), particularly SDG 11 (Sustainable Cities and Communities) and SDG 12 (Responsible Consumption and Production). By addressing specific regional waste challenges through shared innovation, this project has the profound potential to create scalable, low-cost, and high-performance concrete solutions suitable for diverse environments, thereby making a meaningful and lasting contribution to sustainable infrastructure development in both India and Tunisia, and potentially serving as a model for global application.

### **3. Technical description of the project including methodology**

This joint Indo-Tunisian research project aims to develop an eco-innovative concrete by incorporating selected industrial, agricultural, and municipal wastes from both countries as partial replacements for cement and natural aggregates. The overarching goal is to evaluate the technical feasibility, mechanical performance, durability, and structural behavior of these waste-integrated concretes, offering a sustainable alternative to traditional materials while reducing the environmental footprint of the construction sector.

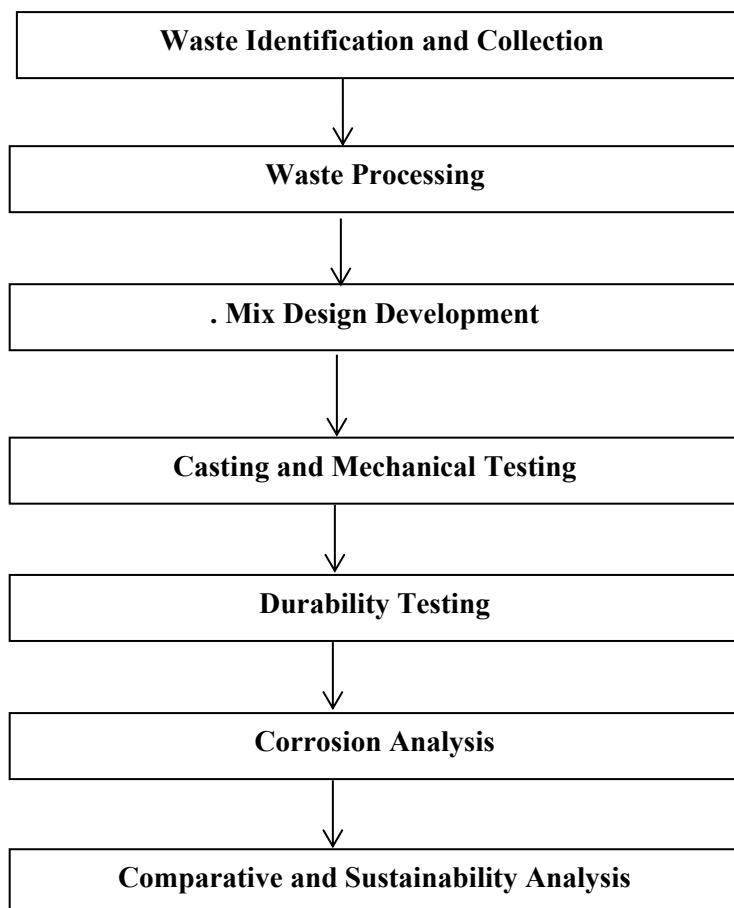
#### **The project will adopt the following structured methodology:**

The project initiates with the identification and selection of locally available waste materials from both India and Tunisia. Target waste streams such as fly ash, rice husk ash, phosphogypsum, plastic waste, and demolition debris will be chosen based on factors like regional availability, consistency, and chemical reactivity. Representative samples from both countries will be collected through field visits and collaborations with municipal and industrial partners. These materials will be subjected to appropriate pre-treatment processes such as drying, grinding, sieving, and thermal activation to make them suitable for incorporation into concrete. The processed wastes will then undergo detailed material characterization to determine their physical properties (e.g., particle size distribution, porosity, specific gravity), chemical composition (via XRF, XRD, and pH analysis), and environmental safety through leaching and biological behavior tests.

Based on the characteristics of the processed materials, concrete mixes will be developed in which 5–30% of cement and/or aggregates will be replaced with the selected waste materials. Mix designs will be carried out according to Indian (IS 10262) and American (ACI) standards, primarily

targeting M25 and M30 grade concretes. These concrete mixes will be evaluated through a rigorous series of tests. Specimens such as cubes, cylinders, and prisms will be cast and tested for mechanical strength (compressive, split tensile, and flexural) at 7, 28, and 56 days. Durability assessments will include water absorption, acid and sulphate resistance, and chloride permeability (RCPT). Furthermore, optimized mixes will be used to cast reinforced concrete (RC) beams, which will undergo structural testing under both static and dynamic loading. This experimental program will be complemented by numerical simulation using finite element modeling to assess performance parameters such as load-bearing capacity, cracking behavior, and failure modes. The durability of embedded reinforcement will also be studied through accelerated corrosion testing methods such as the impressed current technique.

To evaluate the broader implications of the proposed materials, a comparative analysis will be conducted between Indian and Tunisian waste-based concretes in terms of mechanical and durability performance. In addition to technical performance, a Life Cycle Assessment (LCA) and a cost-benefit analysis will be carried out to evaluate the environmental and economic viability of these alternatives. This India–Tunisia collaboration is designed not only to support the scientific validation of sustainable concrete technologies but also to promote circular economy principles by transforming regional waste into value-added construction materials. The outcome will be a set of actionable insights and context-specific solutions aimed at eco-efficient infrastructure development in both partner countries.



#### 4. Plan of work (per annum)

Timeline	Responsibilities of Indian team	Responsibilities of Tunisian team
	<b>Waste Material Identification and Characterization</b>	
1 <sup>st</sup> Year 2025-2026	<p>-Identify and collect one or more regionally abundant waste materials (e.g., fly ash, rice husk ash, plastic waste) for potential use in concrete.</p> <p>-Perform initial physical and chemical characterization (e.g., specific gravity, particle size distribution, XRF analysis).</p> <p>-Develop preliminary processing protocols (grinding, thermal treatment, sieving).</p> <p>-Prepare and ship representative samples to the Tunisian team for cross-validation.</p> <p>-Conduct initial concrete mix trials using Indian waste materials and analyze workability and early-age strength.</p> <p>-Organize virtual technical exchange meetings to discuss testing protocols and share best practices.</p>	<p>-Identify and collect at least one suitable local waste material (e.g., rubber waste, demolition waste, plastic waste) for concrete incorporation.</p> <p>-Conduct detailed mineralogical and chemical characterization (pH, leaching behavior).</p> <p>-Establish optimal processing techniques (e.g., thermal activation or mechanical grinding).</p> <p>-Send representative samples to the Indian team for parallel testing and validation.</p> <p>-Perform initial mix design feasibility tests using Tunisian waste-based concrete and assess basic mechanical properties.</p>
<ul style="list-style-type: none"> <li>➤ <b>Joint selection of waste materials for study.</b></li> <li>➤ <b>Exchange of waste samples and characterization data for comparative analysis.</b></li> <li>➤ <b>Harmonization of characterization methods to ensure data comparability.</b></li> <li>➤ <b>Lead the compilation of a joint technical report summarizing Year 1 progress and findings.</b></li> </ul>		

<b>Mix Design and Mechanical/Durability Testing</b>					
<p>2<sup>nd</sup> Year 2026-2027</p>	<p>-Design and optimize concrete mixes using both Indian and Tunisian waste materials at varying replacement levels.</p> <p>-Conduct mechanical testing on concrete specimens: compressive strength, split tensile strength, and flexural strength at 7, 28, and 56 days.</p> <p>-Perform durability testing, including Rapid Chloride Penetration Test (RCPT), water absorption, and acid resistance.</p> <p>-Share mix design methodologies and test results with the Tunisian team for cross-comparison.</p> <p>-Refine mix designs based on performance outcomes and collaborative feedback.</p>				
	<ul style="list-style-type: none"> <li>➤ <b>Joint development of concrete mix designs to incorporate waste from both regions.</b></li> <li>➤ <b>Cross-testing of mixes with materials from both countries.</b></li> <li>➤ <b>Shared analysis of mechanical and durability performance</b></li> <li>➤ <b>Draft a joint progress report summarizing mechanical and durability findings, with recommendations for structural testing in Year 3.</b></li> </ul>				
<p>3<sup>rd</sup> year 2027-2028</p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="background-color: #cccccc; text-align: left; padding: 5px;"><b>Static Load Testing and Analysis</b></th><th style="background-color: #cccccc; text-align: left; padding: 5px;"><b>Extreme Load Testing and Analysis</b></th></tr> </thead> <tbody> <tr> <td style="padding: 10px;"> <p>-Cast and test reinforced concrete (RCC) beams using the optimized mixes incorporating both Indian and Tunisian waste materials.</p> <p>-Conduct structural performance tests under static loading to assess load-bearing capacity, cracking behavior, and deflection.</p> <p>-Perform corrosion resistance testing using accelerated corrosion methods (e.g., impressed current technique).</p> <p>-Carry out a comprehensive Life Cycle</p> </td><td style="padding: 10px;"> <p>-Participate in RCC beam casting and testing using local materials and experimental setups.</p> <p>-Perform structural testing of RCC beams under both static and extreme dynamic loads (e.g., impact and contact/blast loading) using specialized experimental facilities.</p> <p>-Develop numerical models using Finite Element Analysis (FEA) to simulate structural behavior under dynamic conditions.</p> <p>-Collaborate with the Indian team on the final</p> </td></tr> </tbody> </table>	<b>Static Load Testing and Analysis</b>	<b>Extreme Load Testing and Analysis</b>	<p>-Cast and test reinforced concrete (RCC) beams using the optimized mixes incorporating both Indian and Tunisian waste materials.</p> <p>-Conduct structural performance tests under static loading to assess load-bearing capacity, cracking behavior, and deflection.</p> <p>-Perform corrosion resistance testing using accelerated corrosion methods (e.g., impressed current technique).</p> <p>-Carry out a comprehensive Life Cycle</p>	<p>-Participate in RCC beam casting and testing using local materials and experimental setups.</p> <p>-Perform structural testing of RCC beams under both static and extreme dynamic loads (e.g., impact and contact/blast loading) using specialized experimental facilities.</p> <p>-Develop numerical models using Finite Element Analysis (FEA) to simulate structural behavior under dynamic conditions.</p> <p>-Collaborate with the Indian team on the final</p>
<b>Static Load Testing and Analysis</b>	<b>Extreme Load Testing and Analysis</b>				
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<p>Assessment (LCA) to evaluate the environmental impact of waste-integrated concrete.</p> <p>-Coordinate final workshops and stakeholder engagement sessions in both countries.</p>	<p>project report and roadmap for future research or pilot implementation.</p>
<ul style="list-style-type: none"> <li>➤ Collaborative structural design and testing protocols for RCC beams.</li> <li>➤ Shared responsibility in analyzing static and dynamic structural behavior.</li> <li>➤ Joint efforts in validating numerical models with experimental data</li> <li>➤ Integrated sustainability assessment (LCA, cost-benefit) considering both Indian and Tunisian contexts.</li> <li>➤ Co-authorship of publications and joint presentations at international conferences/workshops.</li> </ul>	

## Work Plan

### 1. Work Packages (WP) and Tasks

Please present the work packages in detail, using the table provided below. Use one table per work package (please copy the table as many times as you need it). The explanations included in the table must be sufficient for justifying the proposed effort and allow for progress monitoring.

WP Number	1		
WP Title	Identification, Processing, and Characterization of Waste Materials		
WP Leader	Mr. C. Vijayakumar		
Start Date	08.12.2025	End Date	07.12.2026
<b>Objective</b>			
<p>To identify and prepare two region-specific waste materials—one from India and one from Tunisia—for their potential use as partial replacements for cement or aggregates in concrete. This involves a comprehensive review of available wastes, processing them into suitable forms, and characterizing their physical, chemical, and environmental properties.</p>			
<b>Tasks</b>			
<p>Work Package 1 consists of five major tasks that will be undertaken in a sequential and collaborative manner. The first task involves conducting a comprehensive survey and literature review in both India and Tunisia to identify regionally available waste materials—industrial, agricultural, or municipal—that show potential for use in concrete as binder or aggregate substitutes. Following this, each partner will collect representative raw samples of the selected waste materials for further analysis. The third task focuses on processing these wastes using appropriate mechanical (e.g., grinding, sieving) or</p>			

*chemical/thermal treatments to produce materials suitable for incorporation into concrete mixes. This will be followed by an extensive characterization phase, where both teams will analyze the physical (e.g., fineness, specific gravity), chemical (e.g., XRF, XRD, pH), and environmental (e.g., leaching potential) properties of the processed materials, following relevant IS, ASTM, or EN standards. The final task includes the exchange of processed waste samples between the Indian and Tunisian teams, enabling cross-country validation and compatibility testing. This mutual verification will ensure that both materials are suitable for joint mix design trials in subsequent work packages and will support material adaptability in varied regional contexts.*

### **Interdependence with Other Work Packages**

*Feeds into WP2 (Mix Design and Testing): Data and processed materials are required for designing trial concrete mixes.*

*Feeds into WP3 (Structural and Corrosion Analysis): Optimal material properties are necessary to ensure structural integrity and durability.*

### **Deliverables**

*Work Package 1 will produce four key deliverables over the course of its 12-month duration. The first deliverable, due by Month 4, will be a comprehensive Waste Material Selection Report that documents the identification of suitable industrial, agricultural, or municipal waste materials from both India and Tunisia, including the rationale for their selection and potential for use in concrete. The second deliverable, due by Month 6, will be the preparation and delivery of Processed Waste Material Samples, which have undergone mechanical or chemical treatments to make them usable in concrete production. These samples will also be shared between both partner teams to enable bilateral testing. The third deliverable, a Material Characterization Report, will be completed by Month 10 and will provide a detailed analysis of each processed waste material's physical, chemical, and environmental properties, using standardized testing protocols. The final deliverable, due by Month 12, will be a Cross-Validation and Compatibility Report, summarizing the results of the exchange tests conducted in both countries and providing final recommendations on the suitability and compatibility of the selected materials for further use in concrete mix development in WP2.*

### **Milestones**

*Work Package 1 includes three key milestones that signify the completion of critical phases of the project. The first milestone, scheduled for Month 4, will mark the completion of waste identification and raw sample collection in both India and Tunisia, alongside the submission of the Waste Material Selection Report. The second milestone, planned for Month 6, will confirm the completion of waste processing and the availability of processed samples that are ready for laboratory testing and cross-country exchange. The final milestone, due by Month 12, will represent the completion of all material characterization and bilateral validation efforts, culminating in the submission of the Cross-Validation and Compatibility Report. These milestones are critical checkpoints to ensure that WP1 delivers robust and verified input data and materials for the mix design and structural testing activities in the following work packages.*

<p><b>1. Work Packages (WP) and Tasks</b></p> <p>Please present the work packages in detail, using the table provided below. Use one table per work package (please copy the table as many times as you need it). The explanations included in the table must be sufficient for justifying the proposed effort and allow for progress monitoring.</p>			
<b>WP Number</b>	2		
<b>WP Title</b>	<b>Concrete Mix Design, Mechanical Testing, and Durability Evaluation</b>		
<b>WP Leader</b>	Mr.P.M Dhureen Karthik		
<b>Start Date</b>	07.12.2026	<b>End Date</b>	07.10.2027
<p><b>Objective</b></p> <p>The objective of WP2 is to develop optimized concrete mix designs incorporating the waste materials identified and validated in WP1. This phase will involve the preparation of concrete mixes by partially replacing cement or aggregates with the selected waste materials (individually and in combination), followed by rigorous testing of their mechanical and durability properties. The goal is to determine mix proportions that meet or exceed structural-grade concrete standards while demonstrating environmental and economic advantages.</p> <p>The work will be jointly executed by the Indian and Tunisian teams, with each team testing both its local material and the partner country's material. This cross-evaluation ensures universal applicability and comparative validation of mix performance</p>			
<p style="text-align: center;"><b>Tasks</b></p> <p>The work under WP2 will begin with the design of concrete mixes using the processed waste materials developed in WP1. The Indian and Tunisian teams will each prepare multiple trial mixes targeting grades M25 and M30 (or equivalent regional standards), incorporating the waste materials as partial replacements for cement (binder) or aggregates in varying percentages (e.g., 5%, 10%, 15%, 20%). These mixes will be designed using standard mix design procedures (IS 10262, ACI, or EN methods). Once designed, the mixes will be prepared, and specimens such as cubes (150 mm), cylinders (150 × 300 mm), and prisms will be cast. After curing for 7, 28, and 56 days, the specimens will be tested for compressive strength, split tensile strength, and flexural strength to evaluate mechanical performance. In parallel, durability studies will be conducted on selected mixes, including water absorption, sulphate attack resistance, acid resistance, and Rapid Chloride Penetration Test (RCPT). Both teams will analyze their results and collaborate to identify optimal mixes for structural testing in WP3.</p>			
<p><b>Interdependence with Other Work Packages</b></p> <p>WP2 is directly dependent on the material inputs and characterization data from WP1. The outputs of WP2—optimized concrete mixes with confirmed performance—will serve as the input for WP3, where structural elements (like RCC beams) will be cast and tested. Thus, WP2 acts as the critical bridge between material development and full-scale structural application.</p>			
<p><b>Deliverables</b></p>			

*WP2 will result in four key deliverables. By Month 4, a Mix Design Report will be produced, detailing the proportions and rationale for each trial mix. By Month 7, a Mechanical Properties Report will summarize test results for compressive, split tensile, and flexural strength. A third deliverable due by Month 9 will be the Durability Performance Report, outlining the outcomes of environmental resistance tests. Finally, by Month 12, a Mix Optimization Summary will be submitted, highlighting the most promising mixes to be used for structural testing in WP3.*

## Milestones

*WP2 includes three milestones. The first, at Month 4, will mark the completion of mix design trials and selection of test specimens. The second, at Month 9, will confirm the completion of all mechanical and durability testing. The third milestone, at Month 12, will represent the finalization of optimized concrete mixes and readiness for RCC beam casting in WP3.*

### 1. Work Packages (WP) and Tasks

*Please present the work packages in detail, using the table provided below. Use one table per work package (please copy the table as many times as you need it). The explanations included in the table must be sufficient for justifying the proposed effort and allow for progress monitoring.*

<b>WP Number</b>	<b>3</b>		
<b>WP Title</b>	<b>Structural Testing, Corrosion Assessment, and Sustainability Evaluation</b>		
<b>WP Leader</b>	Mr.S.Nagamani		
<b>Start Date</b>	<b>07.10.2027</b>	<b>End Date</b>	<b>07.10.2028</b>
<b>Objective</b>			
<p><i>The objective of WP3 is to evaluate the structural performance, corrosion resistance, and sustainability of the concrete mixes optimized in WP2. This phase involves casting and testing full-scale Reinforced Cement Concrete (RCC) beams using the selected waste-integrated concrete. The beams will be tested under static loading conditions to assess load-bearing capacity, crack behavior, and failure modes. Additionally, corrosion resistance will be studied using accelerated corrosion techniques. A comparative Life Cycle Assessment (LCA) and cost-benefit analysis will be conducted to evaluate the economic and environmental impacts of using waste-based concrete compared to conventional materials.</i></p>			
<b>Tasks</b>			
<p><i>Work under WP3 will begin with the casting of RCC beams (standard size, e.g., 150 mm × 230 mm × 2000 mm) using the most promising concrete mixes developed in WP2. Each partner will prepare at least two sets of beams using different waste combinations and reinforcement configurations. These beams will be subjected to flexural testing using a universal testing machine (UTM) to determine parameters such as first crack load, ultimate load, ductility, and stiffness. Simultaneously, corrosion testing will be carried out using impressed current techniques or chloride exposure chambers to simulate long-term durability and steel protection</i></p>			

performance. The observed corrosion activity (via half-cell potential, mass loss, and visual inspection) will be recorded and analyzed. Lastly, each team will perform a **Life Cycle Assessment** to measure environmental impacts ( $CO_2$  reduction, energy savings) and a **cost-benefit analysis** comparing the waste-based concrete with traditional alternatives. These findings will provide scientific evidence for promoting the use of sustainable concrete in structural applications across both countries.

### Interdependence with Other Work Packages

*WP3 is entirely dependent on the outputs of WP2—specifically, the optimized concrete mixes validated for mechanical and durability performance. WP3 builds upon WP2 by demonstrating the structural viability and real-world applicability of the mixes under loading and exposure conditions. Additionally, results from WP3 will support the final dissemination, joint publications, and potential patent filing.*

### Deliverables

*WP3 will generate four critical deliverables. By Month 4, an initial Beam Casting and Mix Implementation Report will document reinforcement details and mix placement. By Month 7, a Structural Performance Report will summarize load-deflection behavior, failure modes, and stress-strain analysis of the RCC beams. The Corrosion Resistance Report, due by Month 9, will present experimental results from accelerated corrosion tests. Finally, by Month 12, a comprehensive Sustainability and Cost-Benefit Report will consolidate the LCA findings and financial viability of the developed concrete system, enabling replication in other regions.*

### Milestones

*WP3 includes three milestones. The first milestone, at Month 4, will signify the successful casting of RCC beams using optimized concrete. The second, at Month 9, will confirm the completion of all structural and corrosion testing. The final milestone, at Month 12, will mark the completion of the sustainability assessment, culminating in the delivery of final reports and recommendations for field-level implementation.*

## 2. Success Criteria

*Please define the objectives, success criteria and importance level of the main work packages in the Worktime schedule by also regarding deliverables and milestones. The rows and columns in the schedule can be enlarged and increased. The sum of percentages in the columns should be 100.*

W P No	Objective of the Main WP	Success Criteria (%, number, statement etc.)	Importance of the WP for Success of the Project (%)
1	To identify, process, and characterize two suitable waste materials (one from India, one from	2 materials selected and characterized (100%) - 2 exchange samples tested - 4 deliverables submitted on time	30%

	Tunisia)		
2	To develop and test concrete mix designs using identified waste materials for mechanical and durability performance	6+ mix designs tested - 90% compliance with target strength and durability standards - 3 technical reports submitted	40%
3	To evaluate structural and corrosion behavior of optimized concrete in RCC beams and assess sustainability	- 8+ RCC beams tested - 2 corrosion test methods completed - LCA and cost report delivered (100%)	30%

### 3. Risk Management

*Please describe the risks that can affect the success of the project negatively and clearly describe the alternative plan(s) (Plan-B) that will be implemented in case of encountering with those by regarding the related work packages.*

WP No	Main Risks	Plan-B
1	Selected waste material is unsuitable due to poor reactivity or contamination  Delay in customs clearance or shipping of processed samples between India and Tunisia	Use alternative waste from pre-validated shortlist; initiate rapid screening tests to avoid timeline delay  Conduct parallel testing on local equivalents and compare digitally shared data; use simulation models for validation
2	Concrete mixes fail to meet required strength or durability standards  Lack of consistency in test protocols or equipment between both countries	Adjust mix design ratios or include supplementary cementitious materials (e.g., silica fume, GGBS); repeat critical tests  Standardize procedures using globally accepted norms (e.g., ASTM/EN); hold virtual harmonization workshops
3	RCC beam specimens exhibit unexpected failure modes or underperform structurally  Corrosion test setup unavailable or gives unreliable results	Recast using revised mix proportions; conduct small-scale model tests before full beam casting  Use alternative durability test methods (e.g., carbonation depth, water permeability); collaborate with external labs

**5. Facilities related to project activity available at the institutions where the project will be carried out:**

At the Collaborating Indian Institutions	At the Collaborating Tunisian Institutions
<p>1. Beam testing frame capacity 100 Ton</p> <p>2. Column testing frame capacity 100 Ton</p> <p>3. Rapid moisture meter</p> <p>4. Pan mixer</p> <p>5. slump cone</p> <p>6. compaction tools, curing tanks</p> <p>7. Cube &amp; cylinder molds as per <b>IS 10086</b></p> <p>8. Compressive strength testing Machine</p> <p>9. UTM (1000 kN capacity with flexure, tensile, and compression fixtures – Beam testing setup as per <b>IS 456, IS 516</b>)</p> <p>10. <b>Cement Testing Facility</b> as per <b>IS 4031</b></p> <ul style="list-style-type: none"> <li>– Setting time apparatus</li> <li>– Blaine's air permeability</li> <li>– Soundness, consistency, and compressive strength test setups</li> </ul> <p>11. <b>Aggregate Testing Lab</b> with all standard tests as per <b>IS 2386</b> (Parts I–VIII):</p> <ul style="list-style-type: none"> <li>– Sieve analysis, flakiness, elongation, impact, crushing, specific gravity, and water absorption</li> </ul>	<p><b>Concrete and Mortar Preparation:</b></p> <ul style="list-style-type: none"> <li>• Pan mixer, slump cone, compaction tools, curing tanks</li> <li>• Cube &amp; cylinder molds as per IS 10086</li> <li>• Mechanical Testing:</li> <li>• Compressive strength testing Machine</li> <li>• Universal Testing Machine (UTM) with 1000 kN capacity, equipped with flexure, tensile, and compression fixtures, and a beam testing setup as per IS 456, IS 516.</li> <li>• Beam testing frame with 100 Ton capacity</li> </ul> <p><b>Material Characterization:</b></p> <ul style="list-style-type: none"> <li>• Rapid moisture meter</li> <li>• Cement Testing Facility as per IS 4031 (including setting time apparatus, Blaine's air permeability, soundness, consistency, and compressive strength test setups).</li> <li>• Aggregate Testing Lab with all standard tests as per IS 2386 (Parts I–VIII), covering sieve analysis, flakiness, elongation, impact, crushing, specific gravity, and water absorption.</li> </ul> <p><b>Dynamic Testing and Numerical Analysis:</b></p> <p>Explosive Lab, equipped with:</p> <ul style="list-style-type: none"> <li>• High-speed cameras</li> <li>• Pressure and Load sensors</li> <li>• Accelerometers</li> <li>• LS-DYNA software for finite element analysis of dynamic events.</li> </ul> <p>These facilities provide a robust foundation for executing the experimental work outlined in the project, from material processing and characterization to concrete mix design, mechanical, durability, and structural performance evaluation.</p>

**6. Information of visiting persons for technical mission (*per annum*).**

**A. India to Tunisia**

	Name	Organization	Duration	Purpose
1 <sup>st</sup> Year	Mr.G.Iyappan Dr. AHemalatha	N P R College of Engineering and Technology (Autonomous)	05 days	Waste material site assessment and joint sample characterization
2 <sup>nd</sup> Year	Mr.G.Iyappan Mr. C.Vijayakumar	N P R College of Engineering and Technology (Autonomous)	05 days	Mix design discussion and joint mechanical testing review
3 <sup>rd</sup> year	Mr.G.Iyappan Mr.S. Nagamani	N P R College of Engineering and Technology (Autonomous)	05 days	Observation of RCC beam testing and final report consolidation

**B. Tunisia to India**

	Name	Organization	Duration	Purpose
1 <sup>st</sup> Year	Prof Ahmed Siala Dr Azer Maazoun	Military Research Center	05 days	Participation in joint laboratory activities for the characterization of selected Indian and Tunisian waste samples.
2 <sup>nd</sup> Year	Dr Azer Maazoun Dr Oussama Atoui	Military Research Center	05 days	Technical meetings on collaborative review of mechanical and durability testing results for waste-based concretes.
3 <sup>rd</sup> year	Dr Azer Maazoun Dr Oussama Atoui	Military Research Center	05 days	Discussion of dynamic load testing outcomes, and consolidation of final technical report and joint publications.

**7. Expected results of Cooperation (e.g. joint publications, patents etc.)**

Are any of the expected results likely to have commercial value? (Up to 100 words)

The cooperation is expected to yield multiple joint research publications in high-impact journals, conference presentations, and potential filing of a joint patent on sustainable concrete mix formulations using region-specific waste. Technical reports and shared experimental data will strengthen bilateral academic exchange. The developed green concrete solutions may be piloted for commercial use in eco-construction and infrastructure sectors, especially in low-cost housing and rural development. Given the emphasis on sustainability and cost-effectiveness, the outcomes have strong potential for commercialization by precast concrete industries and public works departments in both countries.

### PART III - BIOGRAPHICAL AND PROFESSIONAL INFORMATION

#### Personal Data of Indian and Tunisian investigators to be attached.

**Principal Investigator – Indian** (This resume concerns the Principal Indian Investigator whose name appears in Part 1.) - Resume attached in separate sheet.

Title	Dr.
First Names	Hemalatha
Family Name	A
Nationality	Indian
Year of Birth	1968

#### Resume (Relevance of the researcher's professional background to the proposed research)

Dr. A. Hemalatha has obtained her B.E., (Civil Engineering) from Madurai Kamaraj University in the year 1989. Obtained master's from NIT Trichy in 2004 and secured Ph. D from Anna University Chennai in 2016. She worked as an Assistant Engineer in Agricultural Department (NWADPRO) Scheme from 2004 to 2005. She joined as an Assistant Professor in Christian College of Engineering & Technology in the year 2005. In the year 2015 she worked as Associate Professor at RVS School of Engineering. Presently she is a Professor at NPR College of Engineering & Technology. She has published 5 patent and 1 Granted She has Published 25 Papers in National, International, Journals and Conferences. She has guided 4 PG Scholars and more than 30 UG Scholars. She received Innovative Technological Research and Dedicated Teaching Professional Award from Society of Engineers and Technicians from Kuala Lumpur, Malaysia. She got Life membership from various Professional Bodies, like ISTE, IGS, ICI, ISH, IAENG. Fellow member in Institution of Engineers (FIE). She is doing her Consultancy services for many Construction Industries for their materials and soil testing. She has delivered 9 Guest Lectures and organized more than 20 workshop/seminars/short term courses in various colleges. She acted as a co-chair in National conference in NIT Trichy. She has given keynote address under the topic Digital Transformation in Civil Engineering." She has elected as an Executive member in Geotechnical Society Trichy Chapter. Her area of Research was Geotechnical Engineering which includes Foundation, Soil Structure, Interaction on Ground Improvement. Selected as reviewer in Arabian Journal for Science and Engineering. Springer, Elsevier journal

**Principal Investigator - Tunisia** (This resume concerns the Principal Tunisian Investigator whose name appears in Part 1).

Title	Professor
First Names	Ahmed
Family Name	Siala
Nationality	Tunisian
Year of Birth	01/10/1971

**Resume** (Relevance of the researcher's professional background to the proposed research).

Dr. Ahmed Siala is a highly accomplished civil engineer and strategic leader with over 28 years of diverse experience in military research, infrastructure development, and academic leadership. He has published many Papers in National, International, Journals and Conferences. He has guided many Scholars and more than 50 EOA for their project of end of courses. Currently serving as General Director of the Military Research Center since June 2023, he oversees strategic operations with expertise in recruitment and team management. Prior to this role, he dedicated 17 years (2005-2023) as Professor and head of Civil Eng department at the Military Academy, where he demonstrated exceptional skills in strategic planning and project coordination while shaping future engineering professionals. Since December 2005, he has concurrently worked as a self-employed expert in transport infrastructure, offering specialized consultancy in team leadership and infrastructure development. His earlier career includes pivotal roles as Co-Manager at a Civil Engineering Corporation (2001-2005) and Chef de Projets at STUDI (1995-2000), where he honed his expertise in strategic project planning and execution across complex engineering initiatives. This extensive career showcases his unique combination of technical engineering prowess, academic excellence, and executive leadership in both public and private sectors, with a consistent focus on infrastructure innovation and organizational development.

#### **Research history of both PIs. (Ongoing / Completed projects with the PIs (last 5 years)**

##### **Indian PI**

###### **National Projects:**

S. No.	Project Title	Sponsoring Agency	Budget	Status
		NIL		

###### **International Projects:**

S. No.	Project Title	Name of the Collaborating Scientist & Institute	Sponsoring Agency	Budget	Status
			NIL		

##### **Tunisian PI**

###### **National Projects:**

S. No.	Project Title	Sponsoring Agency	Budget	Status
		NIL		

###### **International Projects:**

S. No.	Project Title	Name of the Collaborating Scientist & Institute	Sponsoring Agency	Budget	Status
			NIL		

## PART IV: FINANCIAL INFORMATION

### Budget plan (Project Cost) – Indian side

(All costs should be in Indian Rs. for projects submitted by Indian PIs to DST)

(Rs.)

	1 <sup>st</sup> Financial Year	2 <sup>nd</sup> Financial year	3rd Financial year
Consumables and Accessories	8,60,000	7,98,000	5,50,000
Manpower	1,80,000	1,92,000	1,80,000
Contingency	1,40,000	1,90,000	1,20,000
Visit of Indian Scientists to Tunisia	2,1,10,000	1,20,000	1,30,000
Visit of Tunisian scientist to India (Local hospitality)	90,000	2,00,000	2,20,000
<b>Total</b>	17,00,000	15,00,000	12,00,000

- ❖ Please list our consumable and accessories items
- ❖ Full justification should be given for each budget head

### LIST OF CONSUMABLE AND ACCESSORIES ITEMS

Category	Item	Purpose / Use
Cement and Binders	Ordinary Portland Cement (OPC 43 & 53 grade)	Main binder for concrete production.
	Portland Pozzolana Cement (PPC)	Alternative binder for sustainability comparison.
	Blended Cement	For assessing compatibility with specific waste types.
Aggregates	Fine Aggregates (River Sand)	Used as base/reference in concrete mixes.
	Coarse Aggregates (Crushed stone)	Provides volume and strength in concrete.
	Recycled Aggregates (from demolition debris)	For comparison with conventional aggregates.

<b>Waste Materials(Will be identified)</b>	Fly Ash	Pozzolanic material sourced from thermal plants.
	Rice Husk Ash	Agricultural by-product used to partially replace cement.
	Phosphogypsum	Industrial by-product used as binder or filler.
	Waste Plastic Flakes	Used as lightweight aggregate or filler.
	Crushed Brick Waste	Replacement for coarse aggregate.
	Waste Glass Powder	For partial replacement of fine aggregate or cement.
	Silica Fume	Enhances strength and durability.
	Red Mud / Slag	Industrial waste considered for binder development.
<b>Admixtures</b>	Superplasticizers (PCE-based)	Improves workability of mixes.
	Retarders	Delays setting time of mixes with reactive waste.
	Accelerators	Promotes early strength development.
	Air-Entraining Agents	Enhances durability in freeze-thaw conditions.
<b>Water</b>	Potable / Distilled Water	Required for mixing and curing under controlled conditions.
<b>Chemical Reagents</b>	pH Buffers / Indicators	For characterizing waste and leaching tests.
	Acids (HCl, H <sub>2</sub> SO <sub>4</sub> , HNO <sub>3</sub> )	For durability/acid resistance tests.
	Sodium Chloride (NaCl)	Used in chloride penetration and corrosion studies.
	Sodium Hydroxide (NaOH)	For alkali reactivity and waste neutralization.
<b>Corrosion Testing Items</b>	Reference Electrodes (e.g., Cu-CuSO <sub>4</sub> )	Required for half-cell potential measurements.
	Electrolyte Solutions (e.g., 3.5% NaCl)	Simulates aggressive environments.
	Wires, Clips, and Electrode Holders	For corrosion setup in reinforced specimens.

<b>Casting &amp; Testing Tools</b>	Concrete Moulds (cube, cylinder, prism, beam)	For preparing test specimens.
	Steel Reinforcement Bars (6mm–12mm)	For preparing RC beams and corrosion testing.
	Tie Wires and Bar Spacers	Used in rebar placement.
<b>General Lab Supplies</b>	Weighing Papers, Filters, Funnels	For sample preparation and weighing.
	Storage Containers, Sealable Bags	For organizing and preserving samples.
	Tags, Labels, Permanent Markers	For proper identification and tracking of materials.
	Thermometers / Hygrometers	For controlling curing conditions.
<b>Packaging and Transport</b>	Sample Bags, Drums, and Corrugated Boxes	Used for transporting raw and processed waste samples.
	Strapping Tape / Pallet Wrap	To secure materials for international transfer.
<b>Safety and PPE</b>	Gloves (Nitrile/Latex), Goggles, Lab Coats, Face Masks	Ensures safety while handling waste and chemicals.
	First Aid Kit	Emergency use during laboratory operations.

## **BUDGET JUSTIFICATION**

<b>Budget Head</b>	<b>Justification</b>
<b>Consumables and Accessories</b>	To explore eco-friendly concrete options, we need a wide range of materials sourced from India and Tunisia, including fly ash, phosphogypsum, rice husk ash, plastic flakes, and demolition waste. These will be compared with conventional materials like cement and natural aggregates. The budget supports purchasing these items, along with casting moulds, reinforcement bars, corrosion test kits, lab reagents, and protective gear. It also includes packing materials to safely exchange samples between the two countries.
<b>Manpower</b>	This project depends on skilled people at every stage. Field teams in both countries will help identify and collect waste materials. In the lab, technicians and research assistants will process these materials, cast concrete specimens, and conduct tests. Their expertise ensures accuracy, safety, and repeatability across all phases. The budget supports hiring and maintaining these vital human resources.
<b>Contingency</b>	Working with unconventional materials comes with unpredictability. A waste type may become unavailable, or special processing might be needed. Equipment may fail or transport delays might occur. This contingency allocation gives us the flexibility to respond quickly to such situations, ensuring the project stays on schedule without compromising quality.
<b>Visit of Indian Scientists to Tunisia</b>	Indian researchers will travel to Tunisia to work with their counterparts in real-time. These visits include inspecting local waste sources, participating in laboratory work, developing mix designs, and troubleshooting field issues. The visits help ensure scientific consistency, build collaboration, and foster cross-cultural understanding. Costs include travel, stay, and local logistics.
<b>Visit of Tunisian Scientists to India (Local Hospitality)</b>	Tunisian scientists will visit India to participate in joint experimental activities. These visits support hands-on knowledge sharing, collaborative testing, and deeper insight into Indian waste utilization practices. The budget covers their local hospitality—accommodation, meals, and travel—during these important exchange periods.

**Budget plan (Project Cost) – Tunisian side**

(TND)

	1st Financial Year	2nd Financial year	3rd Financial year
<b>Consumables a small equipment</b>	12 000	11 000	10 000
<b>Scientific Events and Meetings:</b> Support is available for organizing and participating in scientific conferences, seminars, and meetings.	15 000	12 500	13 000
Publication and filing fees for scientific publications and patent applications.	–	5 000	6 000
Analyses and processing samples	4 000	3 000	2 500
Visit of Tunisian scientist to India	10 000	10 000	10 000
Visit of Indian scientist to Tunisia (local hospitality)	8 000	8 000	8 000
<b>Total</b>	49 000	49 500	49 500

**Consumables and Accessories List with Justification**

Item	Justification
<b>Cement (OPC, PPC, etc.)</b>	Required as a primary binder for all concrete mix designs. Various types of cement may be needed to evaluate performance compatibility with different waste materials.
<b>Fine and Coarse Aggregates</b>	Used as the control material in mix design to benchmark the performance of waste-substituted mixes. Also needed for blending with waste-based aggregates.
<b>Waste Material Samples (Processed and Raw)</b>	Includes fly ash, rice husk ash, plastic flakes, phosphogypsum, demolition debris, etc., sourced from India and Tunisia. Necessary for concrete production, testing, and cross-validation.
<b>Chemical Admixtures (e.g., superplasticizers, retarders)</b>	Improve workability and setting time of concrete, especially when incorporating unconventional materials like ash or plastic waste.
<b>Water (for mixing and curing)</b>	Essential for all specimen casting and curing processes. Purified or potable water will be used to maintain standard testing conditions.
<b>Moulds for Casting Specimens (cubes, cylinders, prisms, beams)</b>	Required for casting different types of specimens for mechanical and durability testing. Repetitive use over the duration of the study necessitates replacements or backups.
<b>pH Indicators, Acids, and Reagents (for chemical testing)</b>	Used in leaching studies, acid resistance tests, and characterization of waste materials.
<b>Steel Reinforcement Bars</b>	Needed for casting reinforced concrete beams and for corrosion testing. Different diameters may be required depending on structural testing protocols.
<b>Corrosion Testing Consumables (electrodes, wires, solutions)</b>	Used in accelerated corrosion tests (e.g., impressed current setup), crucial for assessing reinforcement durability.
<b>Protective Equipment &amp; Lab Safety Gear (gloves, masks, goggles)</b>	Mandatory for safe handling of waste materials, chemicals, and during specimen preparation.
<b>Packaging Materials (bags, boxes, containers)</b>	For safe transport and storage of raw waste materials and prepared samples between India and Tunisia.

<b>Miscellaneous Lab Supplies</b> (weighing papers, filters, sample containers)	Daily laboratory use items essential for testing, measurement, and sample storage.
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**Note on Budget Justification per Head**

<b>Budget Head</b>	<b>Justification</b>
<b>Consumables &amp; Small Equipment</b>	This budget covers essential laboratory materials required for concrete casting, testing, and analysis. Includes cement, aggregates, admixtures, processed waste materials, moulds, reinforcement bars, corrosion testing accessories, and safety gear. A higher allocation in the first year supports initial setup and bulk procurement of materials. Gradual reduction reflects reuse and optimization in subsequent years.
<b>Scientific Events and Meetings</b>	Funds allocated for organizing joint seminars, technical meetings, and participation in national/international conferences. This supports knowledge exchange, mid-term technical discussions, and final dissemination of project findings. Year 1 includes kick-off workshops; Year 3 supports final presentation and reporting events.
<b>Publication and Filing Fees</b>	Covers the cost of publishing joint scientific articles in peer-reviewed journals and filing patent applications (if applicable) related to innovative concrete formulations or sustainable techniques.
<b>Analyses and Processing of Samples</b>	Includes expenses for material characterization (XRF, XRD, FTIR, SEM), corrosion and durability testing, and thermal/chemical processing of waste samples. Covers the cost of sending prepared samples between India and Tunisia.
<b>Visit of Tunisian Scientists to Indian</b>	Supports international collaboration and exchange visits by Tunisian researchers to Indian partner institutes. Covers travel. Annual visits ensure continuity and joint validation.
<b>Visit of Indian Scientists to Tunisia</b>	Covers local hospitality, accommodation, and in-country logistics for Indian scientists visiting Tunisia. Supports joint testing, workshops, and field/lab coordination. Equal annual allocation ensures reciprocal engagement.

## **PART V OTHER SOURCES OF SUPPORT**

**1 Is this research currently being supported by other sources?**

<b>YES</b>	<b>NO</b>
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If yes, please indicate the sources, amounts and periods of support.

**Indian side:**

NA

**Tunisian side:**

NA

**2 Has this project been submitted to other agencies for financial support?**

<b>YES</b>	<b>NO</b>
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If yes, please indicate which agencies, and when.

**Indian side:**

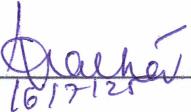
NA

**Tunisian side:**

NA

## A. Signatures of the Principal Investigators & Institutions

### ► Indian PI

Name Dr.A.Hemamalatha Signature  Date 16.07.2025

**Head of the Department**  
Department of Civil Engineering  
NPR College of Engineering & Technology  
Natham, Dindigul (DT) - 624 401.

### ► Tunisian PI

Name Prof Ahmed Siala Signature  Date 16.07.2025

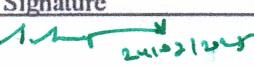
## B. Declaration from the Heads of the Collaborating Institutions

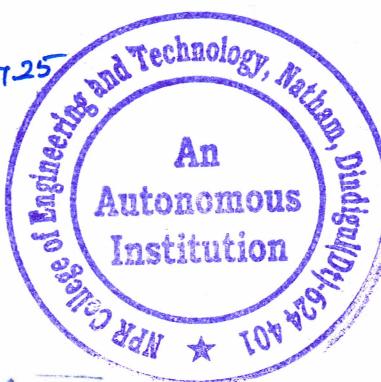
It is certified that

- i) the Institutions agree to participate in this Joint Research Project;
- ii) the Institutions shall provide necessary facilities for implementing the Joint Research Project;
- iii) the Institutions assume financial & other management responsibilities for the duration of the project to be carried out at their institution; and
- iv) the back-up funding for manpower, consumable etc. is available for this Joint Research Project.

## C. Signature of the Heads of the Institutions

### ► Head of the Indian Institution

Name Dr. S. Selvaperumal Signature  Date 24.07.2025  
Dr.S.SELVAPERUMAL, ME., Ph.D.  
Principal  
NPR College of Engineering and Technology (Autonomous)  
Natham, Dindigul (Dt)-624 401



### ► Designated authority at Tunisian Institution

Name Prof Ahmed Siala Signature  Date 21 JUIL 2025

*Ahmed SIALA*  
Directeur Général  
Centre de Recherches Militaires

# CURRICULUM VITAE

## Ahmed SIALA

Email : [ahmed.siala.71@gmail.com](mailto:ahmed.siala.71@gmail.com)  
Date of birth : October 1, 1971  
Nationality : Tunisian  
Current occupation : **General Director of the Military Research Centre**  
Professor of Military High education  
Expert in Civil Engineering



ResearchGate: [Ahmed Siala](#)

Google Scholar: [Ahmed SIALA - Google Scholar](#)

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### INSTRUCTIONS - DIPLOMAS

February 2021 **PhD in Civil Engineering**  
National Engineering School of Tunis (ENIT)  
February 2000 **MBA in Strategic Organization Management**  
“Institut des Hautes Etudes Commerciales (IHEC) of Carthage.”  
June 1995 **Civil Engineer**  
“Ecole Supérieure des Travaux Publics de Paris (ESTP)” Public Works Specialization, Structures Option.  
1990-1992 Bachelor degree at Lycée Henri IV (Paris).

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### CERTIFICATIONS

November 2022 Internal Quality Auditor Certificate to ISO 9011:2018 and ISO 9001-2015 - AFAQ AFNOR  
September 2022 Certificate in Risk Management to ISO 31000:2018 - AFAQ AFNOR

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### PROFESSIONAL EXPERIENCE

Since June 2023 **Military Research Centre**  
General Director

From October 2005 to May 2023 **MILITARY ACADEMY OF FONDOUK JEDID.**  
Professor and head of the department of the civil engineering.

September 2000 - October 2005 : **Civil Engineering Corporation (CEC)**  
Co-Manager and Technical Director

September 1999 - June 2004 : **Institut Supérieur des Etudes Technologiques (ISET), Rades**  
Assistant technologist

December 1995 - September 1999 : **Tunisian Engineering Company (STUDI)**  
Engineer - Project manager in charge of road studies

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### MAIN QUALIFICATIONS

Ahmed SIALA is a teacher-researcher with a PhD in Civil Engineering, a graduate of the Ecole Supérieure des Travaux Publics de Paris, and over 27 years' professional experience. He is also an expert for design offices.

After working as a design engineer specializing in road infrastructure at STUDI, he turned to higher education and scientific research in the field of road materials and blast protection. He is a professor of higher education and has also headed the civil engineering department at the Military Academy of Fondouk Jedid. He is currently general Director of the Military research center

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### SUBJECTS TAUGHT

#### Military Academy of Fondouk Jedid

- Roads -1 and Roads 2
- Strength of materials and structural design
- Concrete -1 and Concrete 2
- Topography (basic concepts and GPS - Global Positioning System)
- Roads and urban hydraulics (stormwater, wastewater, drinking water)
- Project management
- Computer-aided drafting (CAD) - (Autocad, ...)
- Computer-aided design (CAD) - (Piste 5, Covadis, Corine, Dkmètre, etc.)

#### Institut Supérieur des Etudes Technologiques (ISET) de Radès

- Road Design and Rehabilitation
- Topography (basics and GPS - Global Positioning System)

## COURSE MATERIALS

- March 2019 : Roads and urban hydraulics course September 2016:  
Roads course for engineers (levels 1 and 2)
- September 2012: Project management and project management courses and  
applications September 2010: Topography course.
- September 2008: D.A.O and C.A.O. courses and applications.

## SCIENTIFIC AND RESEARCH WORK

### JOURNAL ARTICLES

1. Jamel Neji, Ahmed Siala, Saloua El Euch Khay, Amara Loulizi, *Reduction of bitumen content and production temperature of hot-mix asphalt incorporating RAP using dune sand and lime*. Proceedings of the RILEM International Symposium on Bituminous Materials ISBM Lyon 2020, VOL. 27, Springer International Publishing, November 2021, DOI: 10.1007/978-3-030-46455-4 (*indexed SCOPUS*).
2. Ahmed Siala, Saloua El Euch Khay, Amara Loulizi, , Jamel Neji: *Effects of the addition of dune sand, lime and rap on the performance of porous asphalt*, Proceedings of the Institution of Civil Engineers journal Construction Materials, March 2020, <https://doi.org/10.1680/jcoma.19.00056> (*indexed SCOPUS*).
3. Marwa Ben Youssef, Ahmed Siala, Hamza Ousji, Karim Miled, Jamel Neji : *Réponse du béton mousse sous l'effet d'une sollicitation dynamique : onde de choc et impact balistique (blast and ballistic loading on foam concrete: experimental approach)*, les annales du BTP français, VOL. 73, N° 5-6, May 2020.
4. Ahmed Siala, Saloua El Euch Khay, Jamel Neji : *Etude de l'apport de l'ajout du sable de dune et du fraisât routier sur le béton bitumineux*, Revue des Composites et des Matériaux Avancés - Vol. 27, No. 1-2, pp. 191-208. <https://doi.org/10.3166/rcom.2017.00014>. June 2017 (*indexed SCOPUS*).
5. Ahmed Siala, Saloua El Euch Khay, Jamel Neji: *Etude expérimentale de l'ajout des sables de dune dans le béton bitumineux*, les annales du BTP français, VOL. 67, No. 2, pp 25-31, July 2015.

### CONFERENCE PAPERS

1. Hamza Ousji, Ahmed Siala, Karim Miled: *Etude du comportement quasi-statique et dynamique du béton léger de polystyrène expansé*. Journées Nationales du Béton, 5th edition JNB'21, Hammamet, Tunisia, November 2021.
2. Azer Maazoun, Stijn Matthys, Bachir Belkassem, Ahmed Siala, David Lecompte: *Reinforced concrete hollow core slabs with externally bonded CFRP reinforcement under blast loading*. Journées Nationales du Béton, 5th edition JNB'21, Hammamet, Tunisia, November 2021.
3. Marwa Ben Youssef, Ahmed Siala, Hamza Ousji, Karim Miled, Jamel Neji: *Response of foamed concrete under dynamic loading: shock wave and ballistic impact*. Journées Nationales du Béton, 4th edition JNB'19, Hammamet-Nord, Tunisia, April 2019.
4. Ahmed Siala, Saloua El Euch Khay, Jamel Neji: *Etude de l'apport du sable de dune sur l'amélioration des performances mécaniques des matériaux routiers traités*. JSFM-CMC 2018, Tunis, October 2018.
5. Ahmed Siala, Saloua El Euch Khay, Jamel Neji: *Etude expérimentale d'un enrobage drainant avec ajout de sable de dune, de chaux et de matériaux recyclés*. JSFM-CMC 2017, Rabat, October 2017.
6. Ahmed Siala, Saloua El Euch Khay, Jamel Neji: *Etude de l'apport de l'ajout du Sable de dune sur le béton bitumineux à base de matériaux recyclés*. JSFM-CMC 2016, Paris, November 2016.
7. Ahmed Siala, Saloua El Euch Khay, Jamel Neji: *Etude expérimentale de recyclage des fraisats d'enrobés dans le béton bitumineux*. JSFM-CMC 2014, Hammamet, October 2014.

### BOOK

Jaafar Elouani-Chérif, Ahmed Siala, Jellal Abdelkafi, Catherine Coquerez-Frustié. *Guide de conception des profils en travers et des aménagements urbains dans le grand Tunis*. Ministère de l'équipement, de l'habitat et de l'aménagement du territoire, Agence d'Urbanisme du Grand Tunis (AUGT), December 2017. (Registered with the Organisme Tunisien des Droits d'Auteurs et des Droits Voisins (OTDAV)).

### DOCTORAL THESIS

Doctoral thesis in civil engineering -- *Hot recycling of asphalt spoil in asphalt concrete*. Laboratoire de Matériaux, d'Optimisation et d'Energie pour la Durabilité (LAMOED) - Ecole Nationale des Ingénieurs de Tunis (ENIT) (*defended February 03, 2021*).

### RESEARCH LABORATORY:

Director of the "Defence Science and Technology" research laboratory at the Military Research Center.

Development of the "characterization of shock waves and protection of people, infrastructures and devices against the effects of explosions" section.

- Project 1: Protection and reinforcement of structures against the effects of explosions.
  - Project 2: Protection of unarmored vehicles against the effects of improvised explosive devices (IEDs).
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## ADMINISTRATIVE TASKS

### General Management of the Military Research Center

- Chairman of the Board of Directors
- Chair of the Scientific Council
- Planning of the five-year strategy for the center's activities
  - Administrative and financial management
  - Human resources management
- Organization of scientific events
- Development of national and international activities
- Development of research infrastructure
- Development of research laboratories

### Direction and management of the Civil Engineering department at the military academy

- Course planning.
- Management of permanent and part-time teaching staff.
- Planning of continuous assessment and examinations.
- Management of the civil engineering laboratory and planning of practical work.
- Planning summer internships.
- Planning educational field visits.
- Management of relations with civilian academic institutions.
- Management of relations with foreign schools (Ecole Royale Militaire Belge, École Nationale Supérieure de Techniques Avancées, Paris and Bretagne, etc.).
- Management of relations with civilian and military organizations involved in civil engineering.
- Management of end-of-study and end-of-year projects, and planning of thesis defense.
- Participation in the design of the new premises for the military academy and the layout of the 4 new laboratories belonging to the civil engineering department.

### Pedagogical coordination of the Licences Fondamentales en Sciences Appliquées aux Armes (LFSAA2) courses.

- Course planning.
- Management of permanent and part-time teaching staff.
- Planning of continuous assessment and examinations.

### Organization of examination sessions at the military academy.

- Planning and organization of examinations.
- Drawing up teacher supervision schedules.
- Implementation of a computer application to manage invigilation (in progress).

### Development and updating of training programs

- Updating of the training program for civil engineers.
- Participation in the development of bachelor's and master's degree programs in military science.

### Support for scientific research and cooperation with the Royal Belgian Military Academy.

- Organization of scientific days.
- Setting up a laboratory to study the effects of explosions.
- Creation of a team of researchers in the field of blast protection.
- Planning of lectures by Belgian teachers.
- Organization and planning of field tests to study the effects of explosions.

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## GRADUATION PROJECTS SUPERVISED AT THE MILITARY ACADEMY

	Academic year
- Valorization of plastic waste in the manufacture of ecological paving stones. Experimental study and numerical modeling.	2021-2022
- Experimental and numerical study of the behavior of cement gravel with the addition of deconstruction waste (millings and concrete waste). - Study of the quasi-static and dynamic behavior of lightweight concrete. - Study of the quasi-static and dynamic behavior of polystyrene-based concretes	2020-2021
- Study of the contribution of chemical treatments to the structural behavior of a pavement. - Study of a road interchange at the southern exit of Tunis.	2019-2020
- Study of a crossing structure for Oued Mellegue.	2019-2020
- Study of the formulation of a continuously graded asphalt mix with the addition of additives (dune sand, lime). - Study of the formulation of a discontinuous graded asphalt mix with additives (dune sand, lime).	2018-2019
	2016-2017
	2016-2017

- sand, lime).	
- Study of the rehabilitation of an aeronautical runway at sidi hmed airport.	2016-2017
- Study of continuous-graded asphalt concrete with addition of milled material and lime.	2015-2016
- Study of discontinuous-graded asphalt concrete with the addition of milled material and dune sand.	2015-2016
- Valorization of rubber aggregates from recycled tires for ballistic protection.	2015-2016
- Valorization of road spoil and dune sand in the manufacture of hot bituminous concrete.	2014-2015
- Study to improve safety on roads in Greater Tunis.	2013-2014
- Development study of the X3 X20 interchange.	2013-2014
- Study for the valorization of road millings.	2013-2014
- Study of the use of new technologies to improve road safety.	2013-2014
- Study and design for the rehabilitation of Sidi H'med airport in Bizerte.	2012-2013
- Study and design of the Route X - RN10 Link.	2012-2013
- Study and design of the interchange between Route X and Liaison X RN10.	2012-2013
- Study of the interchange at the intersection of Route GP10 and Route X2 (at the central pharmacy).	2011-2012
- Optimization of asphalt mix design with continuous grading by adding dune sand and rolled sand.	2010-2011
- Optimization of asphalt mix formulation with discontinuous grading by adding sand dune sand and rolled sand.	2010-2011
- Study of the Denden interchange.	2010-2011
- Study of the road interchange Route X - Route MC31.	2009-2010
- Route X - Route MC 130 interchange study.	2008-2009
- Study of the motorway link between the A1 freeway and Borj Cedria.	2008-2009
- Study and design of the el Fajja zone's external works and development of a hydraulic calculation model: rainwater, wastewater, drinking water.	2007-2008
- Study and design of the X3 road and the X-X3 interchange.	2007-2008
- Rehabilitation and sizing study of wastewater, stormwater and water networks. water networks at the military academy.	2007-2008
- Study and design of the Raoued interchange.	2006-2007
- Study and design of the Médenine bypass.	2006-2007
- Development of an optimization model for earth movements and earthworks.	2006-2007

## PROJECTS AND SURVEYS CARRIED OUT

### ROAD STUDIES

#### Technical tasks

- Project management and assistance to project owners in selecting contractors and monitoring work.
- Geometric design and technical solutions for difficult and mountainous sites.
- Design and supervision of geotechnical work. Proposal of solutions for the reinforcement and stabilization of slopes, cliffs and difficult or rocky reliefs.
- Follow-up of earthworks and solutions to improve poor quality soils (chemical treatments, purging, reinforcement, etc.).
- Design and optimization of pavement structures and use of innovative materials.
  - Calculation and projection of road traffic. Proposal of traffic projection models.
- Hydrological and hydraulic studies. Solutions for road, rail and urban protection.
  - Preparation of tender documents and selection of contractors.
  - Road signage studies and solutions for improving road safety through signage.
- Strategic studies and technical recommendations for improving road safety and urban mobility.
  - Monitoring and control of road, drainage and engineering works.

#### Projects completed from 2010 to date:

##### **-Monitoring and supervision of rehabilitation work on the RR49 Siliana road.**

- Study and monitoring of the rehabilitation and drainage works of some streets in the central district of the city of Tunis.**

*Responsibility :*                   *Customer :*                   *Date :*  
 Project manager -                   Ministry of Local Development and Environment                   2018  
 Civil engineer                       Municipality of Tunis

- Study and monitoring of rocky cliff reinforcement works - Jbel Ain El Anba On road RR 113, Governorate of Médenine**

*Responsibility :*                   *Client :*                   *Date :*  
 Project manager -                   Direction Générale des Ponts et Chaussées                   2017  
 Civil engineer                       Regional Directorate of Equipment and Housing of Médenine

##### **-Study on the standardization of urban roads in Greater Tunis**

*Responsibility :*                   *Customer :*                   *Date :*  
 Project manager                   Ministère de l'équipement, de l'habitat et de l'aménagement du territoire Agence  
 Civil engineer                      d'Urbanisme du Grand Tunis                                   2017

**- Expertise and technical study relating to the railway branch line of the Gabes port silo**

*Responsibility:* Project manager  
Civil engineer

*Client:* Ministry of Agriculture  
Office des céréales

*Date:*  
2016

**-Study and design of the link road X - RN10**

*Responsibility :* Project manager  
Civil engineer

*Customer:* Ministère de l'Equipement et de l'Habitat  
Direction des études

*Date:*  
2012-  
2013

**- Technical assistance to improve safety on the Tunisian road network**

*Responsibility :*

Road Expert

*Client :*

European Investment Bank - Ministry of Equipment and Environment

*Date:*  
2013

**- Development study and works supervision of the access tracks to bin n°5 at the Jbel Chakir landfill.**

*Responsibility :*

Project manager

*Client :*

Pizzorno - ANME Group

*Date:*  
2010

Projects prior to 2010 :

- Design of the Rades sports complex (urban road).
- Study of the motorway link between the A1 freeway and Borj Cedria.
- Design and supervision of work on Route X3.
- Gap-filling study on the Gafsa-Moulares link.
- Deviation of the MC35 road at the dam on oued el h'ma
- Rehabilitation of 60 km of roads in the Gabès governorate
- Rehabilitation of 47 km of road in the governorate of Jendouba
- Rehabilitation of the MC109 road between Zarzis and Benguerdane
- Economic and technical feasibility study and execution studies for the rehabilitation and reinforcement of the Djouk - Kiffa - Mauritania road (108 km)
- Feasibility and preliminary design study for the Kedougou - Mali - Labe (Senegal) road (240 km)
- Access road to Gabès airport.

**URBAN DEVELOPMENT STUDIES**

Technical tasks

- Study and design of interchange elements (junctions, complete interchanges or diffusers, etc.). Resolution of traffic conflicts.
- Supervision and control of road interchanges and junctions.
- Design and dimensioning of civil engineering structures, ancillary structures and equipment. Proposal of several structural solutions. Works supervision and control.
- Geotechnical studies. Design of foundations. Monitoring, recommendations and proposal of technical solutions for foundation work.
- Design and dimensioning of roads, ramps and loops. Optimization of traffic flow and safety conditions.

Projects completed from 2010 to date:

**-Design and supervision of work on a road interchange at the southern exit of Tunis.**

*Responsibility :* Project manager Civil  
engineer

*Client :* Ministère de l'Equipement et de l'Habitat  
Direction des grands travaux

*Date :*  
2020

**-Design and supervision of work on a crossing structure for Oued Mellegue**

*Responsibility :* Project manager Civil  
engineer

*Customer :* Ministère de l'Equipement et de l'Habitat  
Direction des grands travaux

*Date :*  
2018-  
2019

**- Development study of the X3-X20 interchange.**

*Responsibility :* Project manager Civil  
engineer

*Client:* Ministère de l'Equipement et de l'Habitat  
Direction des études

*Date:*  
2014

**-Study and design of the interchange between road X and the X-RN10 link.**

*Responsibility :* Project manager Civil  
engineer

*Customer :* Ministère de l'Equipement et de l'Habitat  
Direction des études

*Date :*  
2012-  
2013

**- Study and monitoring of work on the interchange at the intersection of the RN10 road and the X2 road.**

*Responsibility :* Project manager Civil  
engineer

*Client:* Ministère de l'Equipement et de l'Habitat  
Direction des grands travaux

*Date:*  
2011-  
2012

**- Study of the road interchange route X - route MC31.**

*Responsibility :* Project manager Civil  
engineer

*Client :* Ministère de l'Equipement et de l'Habitat  
Direction des études

*Date:*  
2012

### **-Study of the road interchange route X - route MC 130.**

<i>Responsibility :</i>	<i>Customer :</i>	<i>Date :</i>
Project manager Civil engineer	Ministère de l'Equipement et de l'Habitat Direction des études	2011

### **-Study and design of the X-X3 exchanger.**

<i>Responsibility :</i>	<i>Customer :</i>	<i>Date:</i>
Project manager Civil engineer	Ministry of Equipment and Housing Design Department	2010-2011

### **-Design and supervision of work on the Raoued interchange.**

<i>Responsibility :</i>	<i>Client :</i>	<i>Date :</i>
Project manager Civil engineer	Ministère de l'Equipement et de l'Habitat Direction des grands travaux	2010

### Projects prior to 2010 :

- Study of the development of 2 parking lots at the port of Radès.
- Study of the access crossroads to the Bouchemma gas turbine and securing the junction with the RN1 road.
- Complete study of the Den den interchange ( X-GP5)
- Complete study of the airport interchange ( X-GP8)
- Rehabilitation study of the port of Rades depots

## **CIVIL ENGINEERING AND DEVELOPMENT STUDIES FOR INDUSTRIAL ZONES**

### Technical tasks

- Drawing up development plans in compliance with specifications and urban planning constraints.
- Design of drinking water supply networks and resolution of supply and distribution p r o b l e m s .
- Design of wastewater and stormwater networks.
- Sizing of pumping stations and treatment plants where necessary.
- Monitoring and control of roadworks and execution of drinking water and wastewater networks.

### Projects completed from 2010 to date:

#### **- Hydrographic and fire safety network study for the two silos in Dahmani and Gabes**

<i>Responsibility :</i>	<i>Customer :</i>	<i>Date:</i>
Project manager	Office des Céréales	2017

#### **- Study and follow-up of the VRD works of the Industrial Zone of the Société Tunisienne du Sucre in Béja**

<i>Responsibility :</i>	<i>Customer :</i>	<i>Date:</i>
Project manager Civil engineer	Société Tunisienne du Sucre Industrial Land Agency	2017

#### **- Supervision of trenching and cabling work at the El Alia wind power plant**

<i>Responsibility :</i>	<i>Customer:</i>	<i>Date:</i>
Project manager	STEG	2010-

Work supervision      Maghreb Management Industries M.M.I.      2014

### Projects prior to 2010 :

- VRD study of the edible oil refining and packaging plant in Ben Arous
- Design of external works for detergent factories in Misurata and Ben Ghazi - Libya
- Design of the external works for the sectoral training center for transport and logistics professions in Bordj Cédria
- Design of the external works for the "Acropole" housing complex - El Majd real estate development
- Extension of the Siliana industrial zone - 10 ha
- Development and extension of the Siliana industrial zone - 13 ha
- Makther industrial zone development study - 4 ha
- Souassi industrial zone development study - 20 ha
- Study for the reinforcement of quays and roads in the port of Radès
- Study of an earth dam for aquaculture
- Rehabilitation study of the El Khlij canal at Borj Louzir
- Study for the development of an artificial lake at Golf Citrus

## **AIRPORT STUDIES**

### Technical tasks

- Study of airport master plans and development plans. Consideration of air traffic conditions and urban and site constraints for development projects.
- Access studies and proposals for fluid, easy-to-understand solutions.
- Diagnosis of the structural condition of runways. Proposal of reinforcement solutions using flexible or rigid structures.
- Geotechnical studies and dimensioning of runways.
- Studies of air servitudes and urban planning recommendations for surrounding developments.
- Hydrological and hydraulic studies. Proposals for hydraulic protection solutions.

Projects prior to 2010 :

- Master plan study for Monastir airport
- Extension of Tunis Carthage airport
- Timbuktu airport
- Gabès airport

**ENVIRONMENTAL STUDIES**

Technical tasks

- Strategic studies for waste-to-energy operations.
- Environmental impact studies and follow-up of social surveys for the application of proposed solutions.
- Technical studies for waste burial: development of pits and domes and studies of their stability and execution methods.
  - Phasing of waste burial
  - Study of landfill closure solutions.
- Design and monitoring of leachate treatment plants and monitoring of plant operation.
- Design of waste transfer centers and monitoring of work execution.
- Landfill rehabilitation studies and re-use solutions.

Projects completed from 2010 to date:

- **Study of the management and optimization of available space with a view to the definitive closure of the controlled landfill site in the governorate of Tunis.**

<i>Responsibility :</i>	<i>Customer :</i>	<i>Date :</i>
Project manager	National Waste Management Agency (ANGED)	2019 - 2022
<b>- Execution study and environmental impact assessment of transfer centers in sidi bouzid governorate</b>		
<i>Responsibility :</i>	<i>Client :</i>	<i>Date:</i>
Project manager - civil engineer	National Waste Management Agency (ANGED)	2014

**-Study for the redevelopment of the Ain Zara landfill in tripoli into a leisure park**

<i>Responsibility :</i>	<i>Client :</i>	<i>Date:</i>
Project manager - civil engineer	Ministry of the Environment - Libya	2012

**- Environmental impact assessment of the phosphogypsum slag heap at sabkhet El Mkhachrema in Gabes**

<i>Responsibility :</i>	<i>Client :</i>	<i>Date:</i>
Project manager - civil engineer	Tunisian Chemical Group	

**- Rehabilitation study of a household waste dump in Djenné- Mali**

<i>Responsibility :</i>	<i>Customer :</i>	<i>Date:</i>
Project manager - civil engineer	ISEPT Mali	2011

**-Landfill study for household waste at Jbel Chakir landfill site**

<i>Responsibility :</i>	<i>Client :</i>	<i>Date:</i>
Civil Engineer	Groupement Pizzorno - Agence Nationale de Maitrise de l'Energie (ANME)	2010

**-Study for the development of a national margines management plan in Tunisia**

<i>Responsibility :</i>	<i>Customer :</i>	<i>Date:</i>
Project management and development expert	Ministry of Environment and Sustainable Development (DGEQV)	2010

**- Study on leachate management in controlled landfills and related transfer centers in the regions of : Bizerte, Sousse, Nabeul, Monastir, Gabes, Médenine, Kairouan, Sfax and Jerba**

<i>Responsibility :</i>	<i>Customer :</i>	<i>Date :</i>
Project Manager Civil Engineer	National Environmental Protection Agency (ANPE)	2010

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**LANGUAGES :**

French: Advanced

English :Advanced

Arabic: Native speaker

# CURRICULUM VITAE



**ABDELKADER LOUATI**

**Born 2/26/1962 in EL-FAHS-ZAGHOUAN-TUNISIA**

**Address: Mediterranean Village-Radès-Bloc 13 Appt 225  
Radès - 2040**

**Phone**

**Motive: 00 216 98692705**

**fixed : 00 216 71311376**

**email: abdelkaderlouati2014@yahoo.com**

- **DOCTOR IN GRADUATE PHYSICS FROM The INSA OF LYON - FRENCH May, 1988**
- **CERTIFICATE OF The NATIONAL INSTITUTE OF DEFENCE TUNISIA June, 2015**
- **Director of Higher Education at the Military Academy of Tunisia**
- **Member- Defense science and technology laboratory, Military research center**

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## STUDIES AND GOT CERTIFICATES

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**June1980:** Baccalaureate (mathematics-technics): mixed school of Grombalia with well enough mention.

**June1984:** Master's degree in Physics : Faculty of Sciences and Techniques of Monastir with well enough mention and major of promotion.

**June1985:** D.E.A (Postgraduate certificate in INSA of LYON): devices of integrated electronics with well enough mention.

**May1988:** Doctorate in Physics (new thesis) at INSA of LYON- French): Physics of semiconductors with very honorable mention.

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## PEDAGOGIC EXPERIENCE

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**1988-1997:** Helper, then senior lecturer in Physics at faculty of Sciences and technics of Monastir.

I assured jobs run there:

-Electricity + mechanics + optics for 1st year PC and MP.

-Electromagnetic + relativity for 2nd year PC and PM.

1997-2002: senior lecturer of military higher education in Physics at Naval Academy (MenzelBourguiba).

I assured integrated lessons there:

- Instrumental optics + Optronics + Nuclear physics for the classes of speciality (officers engineers having passed more than two working years).
- Electronics for 1st year and 2nd year Bridges and naval systems.
- Mechanics + geometric Optics + Electricity for 1st year EPAM SOUSSE.

2002 - 2008: master of conferences of military higher education in Physics at the Military Academy (Fondouk-Jédid).

I assured integrated lessons there:

- Instrumental optics + Optronics + Nuclear physics for the classes of speciality (officers engineers having passed more than two working years).
- Electronics for 1st year and 2nd year Bridges and naval systems.
- Mechanics + geometric Optics + Electricity for 1st year EPAM BIZERTE.
- Instrumental optics + Optronics for 1st year Applied sciences in weapons and Techniques of weapons.
- Physics and application of lasers + Nuclear physics for 2nd year Applied sciences in weapons and Techniques of weapons.

2008 - 2019: Professor of military higher education in Physics at the Military Academy (Fondouk-Jédid).

I assured integrated lessons there:

- Instrumental optics + Optronics for 1st year Applied sciences in weapons and Techniques of weapons.
- Physics and application of lasers + Nuclear physics for 2nd year Applied sciences in weapon and Techniques of weapons.

2019 - Present: Director of High Education at the Military Academy (Fondouk-Jédid).

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#### ADMINISTRATIVE TASKS

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- 2003 - 2008: Manager of all weapons department in the Military Academy (Fondouk-Jédid).

- 2010- 2011: Manager of the weapons technical department in the Military Academy (Fondouk-Jédid).
- From August 1st, 2011 till September 8th, 2014: Manager of the university studies of Military Academy (Fondouk-Jédid).
- From September 6, 2019 till now: Again Manager of the university studies of Military Academy (Fondouk-Jédid).

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#### **PREPARED BOOKLETS**

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- Correct versions of exercises of electromagnetisms 2nd year EPAM
- ( Military Academy preparing school ) at SOUSSE.
- Battle plans of lessons taught from 2002: instrumental optics, Optronics, Physical appearance of Lasers, Nuclear physics and Measures and Instrumentation.
- Practical jobs of electronics for 2nd year the upper technician in electronics.

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#### **INSTALLATION AND BROUGHT INTO SERVICE OF THE LABORATORY OF NUMERICAL ELECTRONICS TO THE MILITARY ACADEMY**

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- Reception of the equipment.
- Installation of software.
- Tests of the electronic cards.
- Sharing out of workstations.
- Brought into service of this laboratory in March, 2004.

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#### **RESEARCH ACTIVITIES**

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#### **SUPERVISION OF FINAL REPORTS OF THE END OF STUDIES FOR ENGINEERS**

- The stealth: state of art. In 1997-1998: naval academy
- Optimization of the conditions of photography on board of a submersible device. In 1998-1999: naval academy.
- Conception and realization of a numerical poster display firm of meteorological conditions. In 2003-2004: Naval Academy.
- Study and conception of a system of Laser detection. In 2004-2005: Military Academy.

- Study and prediction of the phenomenon of radar conduct. In 2004-2005: Military Academy.
- Study of the use of a thermal signature. In 2004-2005: Military Academy.
- Comparative study between the classical machining and the machining by Laser. In 2004-2005: Military Academy.
- Study and realization of a numerical scoreboard. In 2004-2005: Military Academy.
- Study and conception of a burglar alarm for speed limit. In 2005-2006: Military Academy.
- Study and realization of a system of detection by double Infrared barrier. In 2005-2006: Military Academy.
- Comparative practical study of characteristics of a Laser source and those of some classical sources of light. In 2005-2006: Military Academy.
- Realization and calibration of a bench of measure of emissivity of solid bodies. In 2005-2006: Military Academy.
- Study and realization of a horn of overtaking of temperature. In 2005-2006: Military Academy.
- Study and conception of a system anti-lightning. In 2006-2007: Military Academy.
- Study and realization of a tiny weather station. In 2006-2007: Military Academy.

### **SUPERVISION OF MASTER**

- Study of the effect of radiance Gamma on the epoxy resin: dosimétric sensor for the student: AHMED MESSAOUD in collaboration with CNSTN( Tunisian National Center for Nuclear Sciences). Memory presented in June, 2013.
- Development of a dosimeter based on (Pearl and Coral) for the student captain (general management of prisons) ADEL TRABELSI in collaboration with CNSTN. Memory presented on October 29th, 2014.

### **SUPERVISION OF THESIS**

- Calibration of a dosimeter based on (Pearl and Coral) with the aim of applications for clever structures for the student captain (general management of prisons) ADEL TRABELSI in collaboration with CNSTN( Tunisian National Center for Nuclear Sciences). Registration in thesis took place in INSAT( Tunisian National Institute of Applied Sciences) and the workin thesis started in February 2015.

## ARTICLES AND COMMUNICATIONS

Further the job of teaching in the faculty of the Sciences and technologies of Monastir, within the unit of called research: Molecular Spectroscopy with the professor Mehrzi OUESLATI at the faculty of the Sciences of Tunis , I could participate with following communications:

- Study of glasses BORATES  $B_2O_3$  and mixed drivers  $xLiB_2O_2$  1 - (x)  $V_2O_5$  for the realization of solid micro-batteries

(STP( Tunisian Physics Society) 1992 in Monastir).

- Optimization of the geometry of the molecule  $LIB_2O_2$  out of self-interest AB-INITIO (STP 1995-1996)

During my career in military higher education, I could participate with following communications:

- Possible model for the mechanism of nuclear fission: oral communication introduced in the first days of Sciences and nuclear technologies organized by CNSTN( Tunisian National Center for Nuclear Sciences)

(December 8-9-10, 2005 in Hammamet).

- Study by Photoluminescence of established  $Ga_{0.47}In_{0.53}As$  Hg, Mg and doped Be: oral communication introduced in the 8th national research symposium in physical appearance held in SOUSSE (from 20 till 23 December 2005) organized by STP.

## CREATION OF A RESEARCH UNIT

Within the military Academy, I have created the unit of called research: Clever Materials and structures

(Appeared in JORT ( Tunisian Republic Official Journal)at the beginning of December, 2014) .This unit have the following topics:

- Study and optimization of radar and acoustic waves absorbing materials.
- Study and conception of keeping of protection against weapons of mass destruction based on clever materials.
- Study of the behavior of some materials with the aim of conception of clever structures for military and civil applications.

### Other training

In parallel with my load of education, of supervision and of research, during the academic year 2014-2015, I followed a training in the Institute of National defence (32nd promotion) during which I attended different seminars and visits with a relation with the topic of promotion: Institution and installation of a new system of intelligence taking account of the democratic change which saw Tunisia since revolution (at the end of 2010 - at the beginning of 2011).

During this training, I participated in a seminar which lasted 10 days in NESA-CENTER (Near East South Asia) for strategic studies in Washington at USA.

# Karim MILED

Full Professor in Civil Engineering

The National School of Engineers of Tunis (ENIT), University of Tunis El Manar (UTM)

Head of Civil Engineering Laboratory, ENIT



Born on november 29, 1977 in Moknine (Tunisia), married (2 children)

Professional address : LGC-ENIT, B.P. 37, Le Belvédère, 1002, Tunis, Tunisia

Phones : + 216 71 875 726 / + 216 23 667 133

Email: karim.miled@enit.utm.tn

H index (Scopus) = 11

ORCID : [orcid.org/0000-0001-5347-7724](https://orcid.org/0000-0001-5347-7724)

## GRADATIONS AND DEGREES

**2017** Habilitation to Supervise Research (HSR) in Civil Engineering from « The National School of Engineers of Tunis (ENIT) » entitled: "A contribution to micromechanics of concrete and cementitious composites".

**2005** PhD Thesis from « Ecole Nationale des Ponts et Chaussées (ENPC- Paris) » in France.

Speciality : Mechanics of Materials and Structures, entitled : " Particle size effect on EPS concrete compressive strength ".

**2002** Master Degree from « Ecole Nationale des Ponts et Chaussées (ENPC- Paris) » in France : « Solids, Structures and Mechanical Systems (S<sup>3</sup>M) ».

**2001** Civil Engineer Degree from « The National School of Engineers of Tunis (ENIT) ».

## RESEARCH TOPICS

Micromechanics of concrete and cement based materials : understanding, modelling and optimizing mechanical and transport properties of concrete and cementitious materials according to their composition and microstructure.

Methods and techniques : experimental tests, analytical and numerical micromechanical modelling: Mean Field Homogenization and Full Field Homogenization techniques (continuous Finite Element and discrete models).

## MAIN PUBLICATIONS

<https://www.scopus.com/authid/detail.uri?authorId=6602726458>

<https://www.researchgate.net/profile/Karim-Miled>

[Karim MILED - Google Scholar](#)

## IMPLICATION IN SCIENTIFIC AND TECHNICAL ORGANISATIONS AND COMMITTEES

- Since 2015: A founding member and the treasurer of The Tunisian Concrete Association (Association Tunisienne du Béton "ASTUB").
- Since 2013: A founding member of the Tunisian Seminar « The Concrete National Days » (Les Journées Nationales du Béton JNB), organized by LGC-ENIT and ASTUB.
- Since 2014: A member of the technical committee of the Tunisian National Accreditation Council "TUNAC" specialized on the technical inspection of constructions.
- Between 2013 and 2017: The delegate of FIB Tunisian National Group at « Fédération Internationale du Béton FIB ».

# CURRICULUM VITAE



**Dr. Azer MAAZOUN**

Date of birth: **August 12, 1988 in Sfax, Tunisia**

Nationality: Tunisian

Tel : **(+216) 29 700 034**

E-mail : [maazounazer@yahoo.com](mailto:maazounazer@yahoo.com)

**ORCID: [A. Maazoun \(0000-0002-9850-2345\) - ORCID](#)**

**ResearchGate: [Azer Maazoun](#)**

**Google Scholar: [Azer Maazoun - Google Scholar](#)**

## Education

- Ph.D. in Civil Engineering and Engineering Sciences (2015–2019), Ghent University & Royal Military Academy, Belgium
- National Engineering Diploma in Civil Engineering (2009–2012), Military Academy of Fondouk Jedid, Tunisia (Top of Class)
- Bachelor School Diploma (2007–2009), Military Academy of Sousse, Tunisia
- High school degree in Technical Sciences (2006–2007), Beb El Khadra High School, Tunis, Tunisia

## Academic and Professional Experience

### **Military Academy of Fondouk Jedid (Tunisia) : Jan 2020 – Present**

- Assistant Professor of Civil Engineering (since Dec 2022)
- Lecturer / Researcher (2016–2022)
- Visiting Lecturer at National School of Engineering of Tunis
- Head department of Applied Military Science Degree Program
- Member, Explosion Effects Laboratory
- Member, Defence Science and Technology Laboratory of Military Research Centre
- Supervisor of Final Projects and Defense Applications

### **Royal Military Academy, Brussels, Belgium: Dec 2015 – Dec 2019**

- PhD Researcher in Structural Protection
- Scientific Coordinator of DY14 Project
- Member, Explosion Effects Laboratory
- Member, International Federation for Structural Concrete Fib

### **Groupement of Civil Engineering, Tunisia — Jun 2012 – Sep 2015**

- Instructor at the engineering training center

## Research Projects & Interests

- Advanced Materials for Structural Protection
- Blast Response of RC Structures with CFRP Retrofit
- Recycled Materials in Construction (e.g., PET waste; demolition waste)
- Numerical Modelling (LS-DYNA, FEM)
- Durability and Strengthening of Concrete Structures

## Additional training

- **Advanced Academic English:** The aim of this course is to develop my productive skills, expand my vocabulary and become aware of subtle word choices. This has enabled me to become a fluent and confident user of the English language.
- **Designing Concrete Structures Reinforced with GFRP Bars Using the ACI CODE-440.11-22 Certified American Concrete Institute:** This course aims to equip engineers with the technical knowledge to design concrete structures using Glass Fiber Reinforced Polymer (GFRP) bars in accordance with ACI CODE-440.11-22. It covers key topics such as flexural behavior, shear and torsion design, serviceability, and structural analysis of GFRP-reinforced elements. The program addresses the special considerations for columns, fire resistance, and the unique mechanical properties of GFRP. It also provides guidance on the proper handling and placement of GFRP bars based on ACI SPEC-440.5-22. Overall, the course prepares professionals to implement durable and corrosion-resistant reinforcement solutions in both new and existing structures.
- **Fundamentals of Concrete and Materials Certified American Concrete Institute:** This course provides a foundational understanding of the key materials used in concrete and their role in achieving durable, high-performance structures. It introduces the basic principles of concrete behavior, mix design, and material compatibility. The program covers aggregates, cementitious materials, reinforcement, and chemical admixtures, with attention to how each component influences the final properties of concrete. Participants gain insight into relevant chapters of the ACI building code and material specifications. Overall, the course prepares engineers and construction professionals to make informed decisions in selecting, designing, and evaluating concrete materials for structural applications.
- **ISO 9001:2015 Quality Management System Training:** This training provides essential knowledge on implementing and managing quality systems, with a focus on continuous improvement, customer satisfaction, and compliance with international quality standards in engineering and construction projects.
- **Defense Enhancement Education Program (DEEP) — NATO Certified :** is a NATO-certified initiative designed to enhance educational capabilities through tailored programs that promote critical thinking and leadership development. It incorporates Bloom's Taxonomy to ensure a structured approach to learning, focusing on higher-order cognitive skills like analysis, synthesis, and evaluation. The program emphasizes student-centered education, fostering active participation, collaboration, and real-world problem-solving. By prioritizing the learner's needs and encouraging deep engagement with the material
- **Response of concrete structures to blast loading:** This course aims at mastering the design of structures to resist blast effects due to explosions. It describes the state of the practice to guide structural engineers responsible for the design of civil facilities likely to be subjected to blast loading.
- **Explosion and penetration using LS-DYNA software:** This training course is an abridged version on the use of LS- DYNA to solve problems involving protective structures, vehicles (IEDs and mines) and home ground safety. Mathematical theory is presented for each technique, in particular Eulerian and meshless methods, to provide the typical user with sufficient knowledge to apply the appropriate analysis technique.
- **Reinforcement of structures with carbon fibers" training course:** this is an intensive one-week course providing excellent exposure to the design and application of polymer fiber reinforcement in new construction and rehabilitation of structures. The course is run by international experts in the field. It aims to equip participants with specific knowledge and skills, enabling them to consider, design and apply FRP reinforcement in a systematic way.

## Administrative tasks

- **Management and direction of the Applied Bachelor's Degree in Military Sciences at the Military Academy**
  - Course planning.
  - Management of permanent and temporary instructors responsible for teaching.
  - Planning of continuous assessments and exams.
- **Participation in the design of the new military academy premises and the development of the four new laboratories under the civil engineering department.**
  - Development and updating of training programs
  - Participation in the development of the civil engineering training program.
  - Updating of the bachelor's and master's degree programs in military sciences.

## Scientific committees and working groups

- Member of the Scientific Council of the Military Academy, Tunisia
- Member of the fib 9.3 group "FRP Reinforcement for Concrete", International Federation of Structural Concrete (since 2015)
- Member of the fib 5.3 group "Structural Aspects of Concrete Lifespan" (since 2016)
- Reviewer for several international scientific journals (Engineering Structures; Defense Technology; Polymers; MPDI; Composite structures.... etc)

## Scientific work

### Publication in international journals (SCImago Journal Rank: Q1)

- [1] Rhouma, M. B., **Maazoun, A.**, Aminou, A., Belkassem, B., Tysmans, T., & Lecompte, D. Damage Assessment of Laboratory-Scale Reinforced Concrete Columns Under Localized Blast Loading. *Buildings* 2025, 15(7), 1003. <https://doi.org/10.3390/buildings15071003>
- [2] **Maazoun A**,Rhouma M, Matthys S, Siala A. Numerical investigation of bond-slip behaviour between CFRP strips and concrete in shear tests under static and blast loads. *Compos Struct* 2024;277:114608 <https://doi.org/10.1016/j.compstruct.2024.118148> (IF: 6.6)
- [3] Rhouma MB, **Maazoun A**, Aminou A, Belkassem B, Vandenbruwane I, Tysmans T, Lecompte D. Blast Loading of Small-Scale Circular RC Columns Using an Explosive-Driven Shock Tube. *Buildings*. 2024; 14(4):921. <https://doi.org/10.3390/buildings14040921> (IF: 3.1)
- [4] Atoui O, **Maazoun A**, Aminou A, Belkassem B, Pyl L, Lecompte D. Dynamic Behavior of Aluminum Plates Subjected to Sequential Fragment Impact and Blast Loading: An Experimental Study. *Applied Sciences*. 2023; 13(6):3542. <https://doi.org/10.3390/app13063542> (IF: 3,4)
- [5] Atoui, O.; Kechagiadakis, G.; Moumen, A.; **Maazoun, A.**; Belkassem, B.; Pyl, L.; Lecompte, D. An Explosive Driven Shock Tube-Based Laboratory Scale Test for Combined Blast and Fragment Impact Loading. *Appl. Sci.* 2022, 12, 6854. <https://doi.org/10.3390/app12146854> (IF: 3,4)
- [6] **Maazoun A**, Matthys S, Atoui O, Belkassem B, Lecompte D. Finite element modelling of RC slabs retrofitted with CFRP strips under blast loading. *Eng Struct* 2022;113597. <https://doi.org/10.1016/j.engstruct.2022.113597>. (IF: 5,58)
- [7] **Maazoun A**, Matthys S, Belkassem B, Atoui O, Lecompte D. Experimental study of the bond interaction between CFRP and concrete under blast loading. *Compos Struct* 2021;277:114608.<https://doi.org/10.1016/j.compstruct.2021.114608>. (IF: 6.6)
- [8] **Maazoun A**, Matthys S, Belkassem B, Lecompte D, Vantomme J. Blast response of retrofitted RC hollow core slabs under a close explosion. *Engineering Structures* 2019; vol. 191, no. April, pp. 447 -459,2019. <https://doi.org/10.1016/j.engstruct.2019.04.068>. (IF: 4,4)

[9] Rebelo HB, Lecompte D, Cismasiu C, Jonet A, Belkassem B, **Maazoun A**. Experimental and numerical investigation on 3D printed PLA sacrificial honeycomb cladding. Int J Impact Eng 2019;131:162 -73. <https://doi.org/10.1016/j.ijimpeng.2019.05.013>. (IF: 4,2)

[10] **Maazoun A**, Belkassem B, Reymen B, Matthys S, Vantomme J, Lecompte D. Blast response of RC slabs with externally bonded reinforcement: Experimental and analytical verification. Composite Structures 2018; 200:246 -57. <https://doi: 10.1016/j.compstruct.2018.05.102>. (IF: 5,4)

#### Publication in indexed journals :

[1] **Maazoun A**, Matthys S, Belkassem B, Lecompte D, Vantomme J. Experimental Analysis of CFRP Strengthened Reinforced Concrete Slabs Loaded by Two Independent Explosions. Proceedings 2018:1 -6. <https://doi:10.3390/ICEM18- 05317>.

[2] Mourão R, **Maazoun A**, Teixeira-Dias, Vantomme J, Lecompte D. Load-Displacement Assessment of One-Way Reinforced Concrete (RC) Slabs Externally Strengthened Using CFRP Strips under Blast Loads. pp. 1 -5, 2018. <https://doi: 10.3390/ICEM18-05435>.

[3] **Maazoun. A**, Matthys. S, Vantomme. J. Damage assessment of hollow core reinforced and prestressed concrete slabs subjected to blast loading. Procedia Engineering. 292 2017; 199:2476 81. <https://doi.org /10.1016 /j. proeng.2017.09.400>.

#### Publication in National and International conferences :

[1] **Maazoun A**, Atoui O, Siala Ahmed , Blast Response of Masonry Wall Under Contact Explosion Using CFRP as Externally Bonded Reinforcement: Experimental and Numerical Analysis, The 7th International Conference on Protective Structures (ICPS7), Yas Island, Abu Dhabi, United Arab Emirates, May2025.

[2] **Maazoun A**, Atoui O, Siala Ahmed. Valorization of Plastic Bottle Wastes as Pavement Blocks. the 1st international conference of Concrete and Circular Economy CCE 2025, April 2025.

[3] Atoui O, **Maazoun A**, Siala Ahmed. Performance of Recycled Concrete Aggregates in Gravel-Cement Mixtures: Strength, Shrinkage, and Durability Analysis. the 1st international conference of Concrete and Circular Economy CCE 2025, April 2025.

[4] **Maazoun A**, Atoui O, Siala Ahmed, Reinforced concrete slabs with externally bonded CFRP reinforcement under blast loading, Experimental testing of a simplified improvised explosive device simulant using an explosive driven shock tube, International Conference on Dynamic Behavior of Materials and its applications in industrial processes, La Marsa Tunisia, October 2024

[5] Atoui O, **Maazoun A**, Siala Ahmed, International Conference on Dynamic Behavior of Materials and its applications in industrial processes, La Marsa Tunisia, October 2024  
[6]

[7] **Maazoun. A**, Matthys. S, Vantomme. J. Literature Review on Blast Protection by Externally Bonded FRP Reinforcement. Cost action TU1207, Budapest, Hungary, 2017:1-6.

[8] **Maazoun. A**, Matthys. S, Vantomme. J, Lecompte. D, Mourão. R, Belkassem. B. Reinforced concrete hollow core slabs with externally bonded CFRP reinforcement under blast loading. 17th ISIEMS Conference, Bad Neuenahr, Germany 2017.

[9] **Maazoun. A**, Matthys. S, Lecompte. D, Belkassem. B. Numerical analysis of retrofitted RC slabs with EBR under blast loading. 4th International conference on Impact and Blast Loading of Structures and Materials, Xi'an, China 2018.

[10] **Maazoun. A**, Matthys. S, Vantomme. J, Belkassem. B, Mourão. R. Numerical Prediction of the Dynamic Response of Reinforced Concrete Hollow Core Slabs under Blast Loading. 10<sup>th</sup>Eur LS-Dyna Conference, Salzburg, Austria 2017:1-8.

[11] **Maazoun A**, Matthys S, Belkassem B, Lecompte D, Vantomme J. Experimental Study of Blast Response of RC Slabs with Externally Bonded reinforcement. 9th International Conference on Fiber Reinforced Polymer Composites (CICE 2018) Paris, France 2018.

[12] **Maazoun A**, Matthys S, Belkassem B, Lecompte D, Vantomme J. Blast response of RC slabs with Externally Bonded reinforcement under two explosions. 25th International Symposium on Military Aspects of Blast and Shock, The Hague, Netherlands 2018.

[13] **Maazoun A**, Matthys S, Belkassem B, Lecompte D, Vantomme J. Numerical analysis of the debonding issues between CFRP strips and concrete in shear tests under static loads using different approaches. 5th International Conference on Mechanics of Composites (MECHCOMP 2019), Lisbon, Portugal 2019.

[14] **Maazoun A**, Matthys S, Belkassem B, Lecompte D, Vantomme J. Blast mitigation of reinforced concrete hollow core slabs using CFRP as externally bonded reinforcement. 7th International Conference on Structural Engineering, Mechanics and computation (SEMC 2019) Cap Town South Africa 2019.

[15] **Maazoun A**, Matthys S, Belkassem B, Lecompte D, Vantomme J. Debonding issues between CFRP strip and concrete in shear tests under static and blast loads. 7th International Colloquium on Performance, Protection 1 Strengthening of Structures Under Extreme loading and Events (PROTECT 2019) Whistler, Canada 2019.

[16] **Maazoun A**, Matthys S, Belkassem B, Lecompte D, Vantomme J. New technique to protection RC slabs against explosion using CFRP strips as externally bonded reinforcement. 18th International Symposium for Interaction of Munitions with Structures (ISIEMS 2019) Florida, USA 2019.

[17] Atoui O, **Maazoun A**, Janut A, Lecompte D, Numerical investigation of Aluminium plates subjected to blast loading using Lagrangian approach. 18th International Symposium for Interaction of Munitions with Structures (ISIEMS 2019) Florida, USA 2019.

[18] Atoui O, **Maazoun A**, Belkassem B, Jonet A, Pyl L, Lecompte D. Numerical investigation of high strength Aluminum alloy subjected to high velocity impact by a rigid spherical projectile, International Conference on Shock and Impact Loads on Structures, Guangzhou China 2019.

[19] Memon D, **Maazoun A**, Matthys S, Lecompte D. Numerical analysis of concrete beams retrofitted with carbon fibre reinforced polymer, 7th International Colloquium on Performance, Protection 1 Strengthening of Structures Under Extreme loading and Events (PROTECT 2019) Whistler, Canada 2019.

[20] Memon D, **Maazoun A**, Matthys S, Lecompte D. Low-Velocity Impact Behaviour of Plain Concrete Beams, 12th European LS-DYNA Conference, Germany

## References

### Prof. Stijn Matthys

Department of Structural  
Engineering  
Ghent University, Belgium  
Email:  
stijn.matthys@ugent.be

### Prof. David Lecompte

Department of Structural Engineering  
Royal Military Academy, Brussels,  
Belgium  
Email: David.lecompte@mil.be

### Prof. Ahmed Siala

Civil Eng Department  
Military Academy of Fondouk Jedid,  
Tunisia  
Email: Ahmed.siala.71@gmail.com

## Computer and language skills

**Computer skills:** Microsoft Office, AutoCAD, Architect 3D, Arch, Robot, LS-Dyna finite element software.

**Language skills:** Arabic: native speaker, French: advanced/fluent, English: advanced/fluent, Spanish: beginner.

## Other skills and interests

- Playing music (violin)
- Sports
- Chess game



# Dr. Oussama ATOUI, PhD

## CIVIL & STRUCTURAL ENGINEER | PROJECT MANAGER

International Infrastructure Projects | Protective Structures

 oussmer@hotmail.fr

 +216 93 848 982

 Tunisia (International Projects)

 PhD Engineering Sciences | Master's Applied Physics

 21+ Years Civil Engineering & Project Management

 Specialized in International Infrastructure Projects



## PROFESSIONAL PROFILE

Distinguished Civil and Structural Engineer with PhD in Engineering Sciences and 21+ years of progressive experience in international infrastructure projects, protective structures design. Proven expertise in managing complex civil engineering projects across multiple countries (Tunisia, Belgium, USA) with demonstrated success in delivering large-scale infrastructure initiatives exceeding €500K. Specialized in structural analysis and blast-resistant design with extensive experience in international standards compliance (Eurocodes, AISC, ACI). Strong background in project management, stakeholder coordination, and cross-cultural team leadership. Fluent in Arabic, English, and French with deep understanding of international construction practices and regulatory frameworks.

## CIVIL ENGINEERING CORE COMPETENCIES

Structural Engineering	Project Management	Technical Software	International Standards
<ul style="list-style-type: none"><li>• Structural Analysis &amp; Design</li><li>• Reinforced Concrete Design</li><li>• Steel Structure Design</li><li>• Seismic Engineering</li><li>• Foundation Engineering</li><li>• Blast-Resistant Structures</li></ul>	<ul style="list-style-type: none"><li>• International Project Delivery</li><li>• Multi-Million € Budget Management</li><li>• Stakeholder Coordination</li><li>• Risk Assessment &amp; Mitigation</li><li>• Quality Control &amp; Assurance</li><li>• Construction Supervision</li></ul>	<ul style="list-style-type: none"><li>• LS-DYNA (Advanced FEA)</li><li>• AutoCAD (Design &amp; Drafting)</li><li>• Microsoft Project</li><li>• Structural Analysis Software</li><li>• 3D Modeling &amp; BIM</li><li>• MATLAB/Python (Analysis)</li></ul>	<ul style="list-style-type: none"><li>• Eurocodes (EC1-EC9)</li><li>• AISC Steel Design</li><li>• ACI Concrete Standards</li><li>• ISO Quality Standards</li><li>• International Building Codes</li><li>• Safety &amp; Environmental Regs</li></ul>

## PROFESSIONAL EXPERIENCE

### Senior Civil Engineer & Project Manager | Academic Researcher

Military Academy of Fondouk Jedid, Civil Engineering Department, Tunisia | January 2024 - Present

- Lead civil engineering curriculum development and advanced structural analysis courses for 200+ engineering students
- Manage multi-disciplinary infrastructure research projects with international collaboration (Belgium, USA)

- Supervise final year civil engineering projects focusing on real-world infrastructure challenges
- Conduct advanced research in protective structures and blast-resistant civil engineering applications
- Coordinate with international partners on infrastructure resilience and disaster-resistant construction methods
- Develop technical specifications and design standards for critical infrastructure projects

### **Senior Research Engineer & International Project Coordinator**

Royal Military Academy Brussels & Université libre de Bruxelles, Belgium | January 2018 - December 2023

- Led Project DY18: €500K+ international research initiative on protective infrastructure design
- Developed innovative structural testing methodologies for critical infrastructure protection
- Collaborated with European and North American institutions on infrastructure resilience projects
- Published 8+ peer-reviewed papers in top civil engineering journals (Applied Sciences, Engineering Structures)
- Managed international research teams across 3 countries with diverse cultural and technical backgrounds
- Established technical standards and protocols adopted by international defense and civilian infrastructure sectors
- Coordinated with EU regulatory bodies on infrastructure protection standards and guidelines

### **Head of Engineering Programs & Infrastructure Planning**

Military Academy of Fondouk Jedid, Tunisia | January 2013 - January 2018

- Directed strategic planning for civil engineering education programs serving 200+ students annually
- Managed infrastructure development projects including laboratory facilities and testing equipment
- Supervised 50+ engineering faculty and coordinated curriculum with international standards
- Implemented quality assurance systems achieving 95% accreditation success rate
- Established partnerships with international institutions for technology transfer and best practices
- Led infrastructure modernization initiatives incorporating sustainable design principles

### **Graduate Research Engineer**

Naval Postgraduate School, Monterey, California, USA | July 2010 - December 2012

- Conducted advanced research in structural mechanics and materials engineering
- Specialized in dynamic response of civil infrastructure under extreme loading conditions
- Collaborated with US Department of Defense on infrastructure protection research
- Gained expertise in American construction standards and practices (AISC, ACI, ASCE)
- Completed Master's thesis on structural response analysis with applications to civil infrastructure

## EDUCATION & PROFESSIONAL QUALIFICATIONS

Period	Qualification & Specialization	Institution	Country
2019-2023	PhD in Engineering Sciences Structural Engineering Specialization Dissertation: Protective Structures Design	Royal Military Academy Brussels & Université libre de Bruxelles	Belgium
2010-2012	Master of Research in Applied Physics Structural Mechanics & Materials Thesis: Dynamic Structural Response	Naval Postgraduate School Monterey	USA
2005-2008	National Engineering Diploma Civil Engineering & Armament Technology Specialization	Military Academy Fondouk Jedid	Tunisia
2003-2005	Engineering Preparatory Program Mathematics & Physics Foundation	Military Academy Bizerte	Tunisia

## COMPLETE PUBLICATIONS & RESEARCH IMPACT

-  **Research Impact:** 8+ peer-reviewed publications in top-tier civil engineering journals | 15+ international conference presentations
-  **International Recognition:** Cited in leading structural engineering and materials science journals
-  **Project Leadership:** €500K+ in managed research funding with international partnerships
-  **Academic Excellence:** Member of 4 international professional engineering societies
-  **Innovation:** Breakthrough methodologies adopted by international defense and civilian infrastructure sectors

### Publications in International Journals

- **Atoui, O.**, Maazoun, A., Aminou, A., Belkassem, B., Pyl, L., Lecompte, D. (2023). Dynamic behavior of aluminum plates subjected to sequential fragment impact and blast loading: an experimental study. *Applied Sciences*, 13(6), 3542. <https://doi.org/10.3390/app13063542>
- **Atoui, O.**, Kechagiadakis, G., Moumen, A., Maazoun, A., Belkassem, B., Pyl, L., Lecompte, D. (2022). An explosive driven shock tube-based laboratory-scale test for combined blast and fragment impact loading. *Applied Sciences*, 12(14), 6854. <https://doi.org/10.3390/app12146854>
- Aminou, A., Belkassem, B., **Atoui, O.**, Pyl, L., Lecompte, D. (2023). Numerical modelling of brittle mineral foam in a sacrificial cladding under blast loading. *Mechanics and Industry*, 24(27), 2023021. <https://doi.org/10.1051/meca/2023021>
- Aminou, A., Ben Rhouma, M., Belkassem, B., Ousji, H., **Atoui, O.**, Pyl, L., Lecompte, D. (2023). Blast Absorption Capacity of Brittle Mineral Foam: an Experimental Evaluation. *Hormigon y Acero*, doi: <https://doi.org/10.33586/hya.2023.3131>
- Moumen, A., De Brie, V., **Atoui, O.**, Laboureur, D., Gallant, J., Hendrick, P. (2022). Monte Carlo-based a posteriori uncertainty quantification for background oriented schlieren measurements. *Journal of Visualization*, 25(5), 945-965. <https://doi.org/10.1007/s12650-022-00838-7>
- Dhouibi, M., Ousji, H., **Atoui, O.**, Nasri, R., Pirlot, M. (2022). Modelling and simulation of the engraving process in different life stages of small calibre guns. *Journal of Pressure Vessel Technology*, 144(5), 051303. <https://doi.org/10.1115/1.4053479>
- Maazoun, A., Matthys, S., **Atoui, O.**, Belkassem, B., Lecompte, D. (2022). Finite element modelling of RC slabs retrofitted with CFRP strips under blast loading. *Engineering Structures*, 252, 113597. <https://doi.org/10.1016/j.engstruct.2021.113597>
- Maazoun, A., Matthys, S., Belkassem, B., **Atoui, O.**, Lecompte, D. (2021). Experimental study of the bond interaction between CFRP and concrete under blast loading. *Composite Structures*, 277, 114608. <https://doi.org/10.1016/j.compstruct.2021.114608>

### Publications in International Conferences

- **Atoui, O.**, Maazoun, A., Moumen, A., Belkassem, B., Pyl, L., Lecompte, D. (2022). Numerical analysis of the dynamic mechanical behavior of high strength aluminum alloy AA2014-T652 under high impact velocity. In 32nd international symposium on ballistics, May 2022, Reno, Nevada, USA.
- **Atoui, O.**, Moumen, A., Dhouibi, M., Maazoun, A., Belkassem, B., Pyl, L., Lecompte, D. (2022). The influence of preformed holes on the dynamic response of blast loaded aluminum plates. In 32nd international symposium on ballistics, May 2022, Reno, Nevada, USA.

- **Atoui, O.**, Maazoun, A., Bachir, B., Lecompte, D. (2019). Numerical investigation of aluminum plates subjected to blast loading using arbitrary Lagrangian Eulerian and Lagrangian approaches. In SILOS proceedings (13th Shock and Impact Loads on Structures 2019). Singapore: Ci-Premier PTE LTD. 2019. p. 155-164.
- **Atoui, O.**, Kechagiadakis, G., Moumen, A., Maazoun, A., Belkassem, B., Pyl, L., Lecompte, D. (2023). A laboratory-scale approach to investigate the effects of blast and fragment impact loading on structures. In International Conference on Protective Structures (ICPS6 2023) Auburn Alabama, USA.
- **Atoui, O.**, Maazoun, A., Aminou, A., Belkassem, B., Pyl, L., Lecompte, D. (2022). Numerical modelling of combined blast loading and fragment impact using an explosive driven shock tube. In Congrès Français de Mécanique (CFM 2022) Nantes, France.
- **Atoui, O.**, Maazoun, A., Belkassem, B., Jonet, A., Pyl, L., Lecompte, D. (2019). Numerical investigation of high strength Aluminum alloy subjected to high velocity impact by a rigid spherical projectile. In 18th International Symposium for the Interaction of the Effect of Munitions with Structures (ISIEMS 2019) Florida, USA.
- Aldjabar, A., Belkassem, B., **Atoui, O.**, Lecompte, D., Pyl, L. (2022). Numerical modelling of brittle mineral foam in a sacrificial cladding under blast loading. In Congrès Français de Mécanique (CFM 2022) Nantes, France.
- Jonet, A., Belkassem, B., **Atoui, O.**, Pyl, L., Lecompte, D. (2019). Blast mitigation using brittle foam based sacrificial cladding: A feasibility study. In 18th International Symposium for the Interaction of the Effect of Munitions with Structures (ISIEMS 2019) Florida, USA.

## Oral Presentations and Posters at International Conferences

- **Atoui, O.**, Mechanical behavior of protective structures under combined effect of blast wave and the impact of fragments, Poster, VUB poster session, Brussels, 2018.
- **Atoui, O.**, Study of the dynamic behavior of protective structures subjected to the combined effect of blast wave and the impacts of fragments, Poster, 3rd CWO Poster Session, Brussels, 2018.
- **Atoui, O.**, Behavior of laminated glass under the combined effect of a blast wave and the impact of fragments, Poster, 3rd CWO Poster Session, Brussels, 2018.
- **Atoui, O.**, Experimental and numerical investigations on flight trajectory of blast-driven ball bearing embedded in rear detonated spherical explosive using the background oriented schlieren technique, Poster, VUB PhD day, Brussels, 2021.
- **Atoui, O.**, A laboratory scale technique to simulate a combined blast wave and projectile impact loading on structures, Poster, 5th CWO Poster Session, Brussels, 2022.
- **Atoui, O.**, Maazoun, A., Belkassem, B., Jonet, A., Pyl, L., Lecompte, D. (2019). Numerical investigation of high strength Aluminum alloy subjected to high velocity impact by a rigid spherical projectile. Oral Presentation in 18th International Symposium for the Interaction of the Effect of Munitions with Structures (ISIEMS 2019) Florida, USA.
- **Atoui, O.**, Maazoun, A., Bachir, B., Lecompte, D. (2019). Numerical investigation of aluminum plates subjected to blast loading using arbitrary Lagrangian Eulerian and Lagrangian approaches. Oral Presentation in SILOS proceedings (13th Shock and Impact Loads on Structures 2019). Singapore: Ci-Premier PTE LTD. 2019. p. 155-164.
- **Atoui, O.**, Maazoun, A., Aminou, A., Belkassem, B., Pyl, L., Lecompte, D. (2022). Numerical modelling of combined blast loading and fragment impact using an explosive driven shock tube. Oral Presentation in Congrès Français de Mécanique (CFM 2022) Nantes, France.
- **Atoui, O.**, Kechagiadakis, G., Moumen, A., Maazoun, A., Belkassem, B., Pyl, L., Lecompte, D. (2023). A laboratory-scale approach to investigate the effects of blast and fragment impact loading on structures. Oral Presentation in International Conference on Protective Structures (ICPS6 2023) Auburn Alabama, USA.

## RESEARCH PROJECTS & ACADEMIC SUPERVISION

### Supervised Final Year Projects

Academic Year	Project Title	Institution
2021--2025	05 projects on Combined blast and fragment loading: Preliminary study of an effective test setup	Royal Military Academy (RMA)
2019-2020	Study of the combined impact of shock wave and fragments on protective materials	Royal Military Academy (RMA)
2015-2016	Study of improvised explosives (TATP, DADP and HMTD) and their technical characteristics	Military Academy (AM)
2014-2015	Ballistic study, fragmentation and combustion of reactive aluminum-based fragments	Military Academy (AM)

### Major Research Projects Completed

- Project DY18 - Protection of structures under the combined effect of shock wave and fragments, Construction and Materials Department of the Royal Military Academy, Belgium (2018-2023)
- Detection of improvised explosives, Chemistry Department of the Royal Military Academy, Belgium (2018-2019)

## INTERNATIONAL PROFESSIONAL AFFILIATIONS

Engineering Societies	Professional Roles	Research Networks
<ul style="list-style-type: none"> <li>• International Society of Ballistics (ISB) - Since 2021</li> <li>• Military Aspects of Blast &amp; Shock (MABS) - Since 2019</li> <li>• International Association of Protective Structures (IAPS) - Since 2022</li> <li>• Int'l Society for Interaction of Munitions with Structures (ISIEMS) - Since 2019</li> </ul>	<ul style="list-style-type: none"> <li>• Peer Reviewer - Defence Technology Journal</li> <li>• Peer Reviewer - MDPI Applied Sciences</li> <li>• Technical Committee Member - International Conferences</li> <li>• Military Research Center - Active Member</li> </ul>	<ul style="list-style-type: none"> <li>• European Research Council Networks</li> <li>• NATO Science &amp; Technology Organization</li> <li>• US-Tunisia Bilateral Research Programs</li> <li>• Mediterranean Engineering Consortium</li> </ul>

## TECHNICAL CERTIFICATIONS & PROFESSIONAL DEVELOPMENT

-  Advanced Structural Analysis & Design Certification
-  LS-DYNA Advanced Finite Element Analysis (Expert Level)
-  International Building Codes & Standards (Eurocodes, AISC, ACI)
-  AutoCAD Professional Certification for Civil Engineering
-  Protective Structures Design & Blast-Resistant Engineering
-  Advanced Academic English for International Collaboration
-  High-Voltage Electrical Systems Design & Installation
-  Counter-Terrorism Engineering & Critical Infrastructure Protection

## LANGUAGES & INTERNATIONAL COLLABORATION CAPABILITIES

Language	Proficiency Level	Professional Application
Arabic	Native	Technical documentation, local stakeholder engagement
English	Fluent/Advanced	International project management, technical presentations, research publications
French	Fluent/Advanced	European project collaboration, technical specifications, regulatory compliance

Complete portfolio of project documentation and references available upon request

Security clearance ready

# Curriculum Vitae

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Name and Surname: Mohamed BEN RHOUMA



Date of Birth: May 06, 1990 in Tunis, Tunisia

Nationality: Tunisian

Phone: (00216) 58 483 262

Email: medbenrhouma3013@gmail.com

## Academic Background

- 2021–Present : PhD student in Civil Engineering and Engineering Sciences, Military research center, L'aouina, Tunisia.
- 2011–2014: National Engineering Degree in Civil Engineering, Military Academy of Fondouk Jedid, Tunisia.
- 2009–2011: Preparatory Engineering Cycle for Military Academies, Military Academy of Sousse, Tunisia.
- 2008–2009: Baccalaureate in mathematics, Khaznadar, Tunis, Tunisia.

## Professional Experience

Dec 25, 2021 – Present – Royal Military Academy of Brussels

- Doctoral Researcher
  - ✓ Researcher, Department of Structures and Effects of Explosions (STEE), Royal Military Academy of Brussels, Belgium
  - ✓ PhD Candidate,
  - ✓ Member of the Explosion Effects Laboratory at the Royal Military Academy (RMA)
  - ✓ Scientific Coordinator of Project: “BLASTAX – Controlled Blast and Axial Load Testing of Reinforced Concrete Columns”

Jun 24, 2014 – Dec 24, 2021 – 61st Engineering Regiment, Bizerte

- Section Chief for Mines and Explosives – Explosive ordnance disposal (EOD) Instructor
- ✓ Instructor and tutor at the Engineering Training Center
- ✓ Platoon leader for Improvised Explosive Device (IED) Disposal

## Civil Engineering Specialty Internships

- Sep 4, 2013 – Mar 7, 2014: Civil engineering internship at the General Directorate of Military Engineering, Tunisia.
- Jul 10, 2012 – Aug 15, 2012: Technician internship at the Ministry of Equipment and Housing.
- Jul 12, 2011 – Aug 11, 2011: Worker internship at the Regional Administration of Equipment and Housing.

## Additional Training

- **Advanced Academic English:** an intensive course designed to strengthen my academic communication skills in English. It focused on enhancing fluency, refining vocabulary usage and developing precision in written and spoken expression. As a result, I acquired the linguistic confidence and competence necessary for effective participation in international research, teaching and publication activities.
- **Blast-resistant design of reinforced concrete structures:** This course focused on mastering the design principles of structures subjected to blast loads from explosions. It presented current best practices and methodologies to guide structural engineers in designing civil infrastructure capable of withstanding blast effects. The training emphasized both theoretical understanding and practical application in the context of protective structural engineering.
- **Utilising High-Fidelity Physics-Based Modeling to Practically Counter Prevailing Energetic Threats:** This advanced training provided practical experience in using LS-DYNA to simulate high-intensity events, including the response of reinforced concrete structures under blast loading. The course emphasized advanced numerical methods such as Eulerian and mesh-free techniques, underpinned by solid theoretical foundations. Participants developed the expertise to model complex dynamic structural behaviors and apply appropriate simulation strategies for defense, security and protective design applications.
- **Improvised Explosive Device (IED) and Mine Disposal Training:** This one-month intensive course was designed to train officers capable of safely neutralizing all types of explosive devices, including landmines and remnants of war. The training prepares participants for operational roles within military units, mine action centers, or national humanitarian demining agencies, focusing on technical procedures, safety protocols and field deployment strategies.

## Publications in International Journals

Publications in international journals of the Science Citation Index (SCI) - a1/a2 papers

- [1] **Ben Rhouma, M.**, Maazoun, A., Aminou, A., Belkassem, B., Vandenbruwane, I., Tysmans, T., Lecompte, D. (2024). *Blast loading of small-scale circular RC columns using an explosive-driven shock tube*. Buildings, 14(4), 921. <https://doi.org/10.3390/buildings14040921>.
- [2] **Ben Rhouma, M.**, Maazoun, A., Aminou, A., Belkassem, B., Tysmans, T., Lecompte, D. (2024). *Blast loading of cylindrical columns using a small-scale explosive-driven shock tube*. Shock Waves, under review.
- [3] **Ben Rhouma, M.**, Maazoun, A., Aminou, A., Belkassem, B., Tysmans, T., Lecompte, D. (2025). *Damage Assessment of Laboratory-Scale Reinforced Concrete Columns Under Localized Blast Loading*. Buildings, 15, 1003. <https://doi.org/10.3390/buildings15071003>
- [4] **Ben Rhouma, M.**, Maazoun, A., Aminou, A., Belkassem, B., Tysmans, T., Lecompte, D. (2025). *Dynamic response of axially loaded circular RC columns subjected to EDST-generated blast loading*. Applied Sciences, under review.
- [5] Aminou, A., **Ben Rhouma, M.**, Belkassem, B., Ousji, H., Atoui, O., Pyl, L., Lecompte, D. (2023). Blast Absorption Capacity of Brittle Mineral Foam: an Experimental Evaluation. Hormigon y Acero (0) 0. <https://doi.org/10.33586/hya.2023.3131>.
- [6] Maazoun, A., **Ben Rhouma, M.**, Matthys, S., Lecompte, D., Siala, A., (2023). *Numerical investigation of bond-slip behaviour between CFRP strips and concrete in shear tests under static and blast loads*. Composite Structures. <https://doi.org/10.1016/j.compstruct.2024.118148>.
- [7] Aminou, A., **Ben Rhouma, M.**, Belkassem, B., Ousji, H., Pyl, L., Lecompte, D. (2024). *Experimental and Numerical Evaluation of Calcium-Silicate-Based Mineral Foam for Blast Mitigation*. Applied Sciences, 14(21), 9656. <https://doi.org/10.3390/app14219656>.
- [8] Gilson, L., E. Vercammen, **M. Ben Rhouma**, A. Bernardi, F. Coghe, A. Imad, and L. Rabet. "3D scanning technique for morphological analysis of behind armour blunt trauma." International Journal of Impact Engineering 192 (2024): 105013. <https://doi.org/10.1016/j.ijimpeng.2024.105013>.

Publication in international conference proceedings

- [1] **Ben Rhouma, M.**, Aminou, A., Maazoun, A., Belkassem, B., Tysmans, T., Lecompte, D. (2023). Numerical investigation of the blast performance of reinforced concrete columns subjected to a close-in explosion at the 6th International Conference on Protective Structures (ICPS6), Auburn, USA.
- [2] **Ben Rhouma, M.**, Aminou, A., Maazoun, A., Belkassem, B., Tysmans, T., Lecompte, D. (2023). Blast Performance of Low-Density Foam Wrapped Aluminum Columns at the 26th Symposium on Military Aspects of Blast and Shock (MABS 26). Wollongong, Australia.
- [3] **Ben Rhouma, M.**, Aminou, A., Maazoun, A., Belkassem, B., Tysmans, T., Lecompte, D. (2024). Dynamic response of Aluminum Columns under localized blast loading at the 4th World Conference on Advanced Materials for Defense (AUXDEFENSE 2024). Braga, Portugal.

- [4] **Ben Rhouma, M.**, Aminou, A., Maazoun, A., Belkassem, B., Tysmans, T., Lecompte, D. (2024). Dynamic Response of small-scale circular RC columns subjected to EDST-generated blast loading at the 19th International Symposium on the Interaction of the Effects of Munitions with Structures (ISIEMS 19). Bonn, Germany.
- [5] **Ben Rhouma, M.**, Aminou, A., Maazoun, A., Belkassem, B., Tysmans, T., Lecompte, D. (2025). Blast loading of circular RC columns using a small-scale explosive-driven shock tube at the 7th International Conference on Protective Structures (ICPS7). Abu Dhabi, United Arab Emirates.
- [6] Aminou, A., **Ben Rhouma, M.**, Belkassem, B., Pyl, L., Lecompte,D. (2023). Protection effectiveness of calcium-silicate based-mineral foam for blast mitigation. In the 26th Symposium on Military Aspects of Blast and Shock (MABS 26). Wollongong, Australia.
- [7] Aminou, A., **Ben Rhouma, M.**, Belkassem, B., Pyl, L., Lecompte,D. (2023). Blast protection of thin aluminum plates by using mineral foam-core sacrificial cladding at the 6th International Conference on Protective Structures (ICPS6), Auburn, USA.
- [8] Aminou, A., **Ben Rhouma, M.**, Belkassem, B., Pyl, L., Lecompte,D. (2024). Deformation attenuation of corrugated panels under blast loading with mineral foam-based sacrificial cladding" at the 19th International Symposium on the Interaction of the Effects of Munitions with Structures (ISIEMS 19). Bonn, Germany.
- [9] Ben Kraiem, W., **Ben Rhouma, M.**, Belkassem, B., Lecompte, D. (2025). Comparison of ALE, LBE, and The Idealized Triangular Loading Method for Evaluating an EDST Blast Loading on a Laboratory-scale RC Column at the 7th International Conference on Protective Structures (ICPS7). Abu Dhabi, United Arab Emirates.
- [10] Braz, D., Aminou, A., **Ben Rhouma, M.**, Belkassem, B., Lecompte, D. (2022). Brittle mineral foam in a sacrificial cladding solution for blast loading mitigation: experimental and numerical study. In Meeting of Research and Development in Military Sciences Sintra. Lisbon, Portugal.

## **Support for Scientific Research and Collaboration with the Royal Military Academy of Belgium**

1. Participation in scientific workshops and symposium
2. Organization and planning of field tests for studying the effects of explosions

## **Technical and Language Proficiencies**

**Computer Skills:** Proficient in Microsoft Office, AutoCAD, Arche and LS-DYNA (finite element analysis software).

**Language Skills:** Arabic: Native / French: Advanced / English: Advanced

## **Additional Skills and Personal Interests**

Football / Volleyball.

## Letter of Intent between the Project's Principal Investigators (PIs)

**Date:** 27/07/2025

**Subject:** *Letter of Intent for the Tunisian-Indian Joint Research Proposal*

We, the undersigned, hereby express our mutual intention to collaborate on the joint research project titled "**Eco-Concrete from Waste: Comparative Innovation between India and Tunisia**" under the framework of the *Tunisian-Indian Call for Proposals*.

As Principal Investigators representing our respective institutions, we are committed to the successful planning, execution, and completion of this collaborative research effort. This project aims to develop a sustainable, eco-innovative concrete by partially replacing conventional cement and natural aggregates with processed waste materials sourced from India and Tunisia. The project targets the valorization of industrial, agricultural, and municipal wastes such as fly ash, rice husk ash, glass powder, and plastic waste by converting them into viable alternative binders and aggregates.

We acknowledge the importance of international cooperation in advancing scientific knowledge and innovation and affirm our dedication to achieving the expected deliverables within the proposed timeframe.

### Tunisian PI:

Prof. Ahmed Siala  
General Director  
Defence Science and Technology Laboratory  
Military Research Center  
L'Aouina Tunisia



### Indian PI:

Dr.A. Hemalatha  
Professor & Head of Department  
N P R College of Engineering and  
Technology (Autonomous),Department of Civil  
Engineering Dindigul ,Tamilnadu ,India



**Date:** 27/07/2025

**Subject:** Signed Submission Request for the Tunisian-Indian Joint Research Proposal

I, the undersigned:

**Name:** Prof. Ahmed Siala

**Position:** Principal Investigator and General Director

**Institution:** Military Research Center

**Project Title:** Eco-Concrete from Waste: Comparative Innovation between India and Tunisia

Hereby confirm that the attached research proposal has been fully reviewed and approved in my capacity as:

- **Principal Investigator**
- **Director of the Research Structure: Defence Science and Technology Laboratory Reference LR19DN01**
- **General Director of the Military Research Centre**

The proposal aligns with the institutional priorities and has been prepared in accordance with the guidelines set forth in the *Tunisian-Indian Call for Proposals*. I authorize its official submission for evaluation and funding consideration.

Attached to this request are the required documents:

- Completed application form
- CVs of all research team members
- Letter of Intent between the PIs

Sincerely,

**Prof. Ahmed Siala**

General Director, Military Research Center

Principal Investigator

