NATIONAL TECHNICAL UNIVERSITY OF ATHENS
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«Infrastructure and Construction Project Management»

Postgraduate Diploma Thesis

Energy-Efficient and Cost-Effective Design Methods for Electrical/Mechanical Installations. Case Study: 2000m² Multi-Use Building

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Abstract

This master's thesis presents a comprehensive study of energy-efficient and cost-effective design methodologies for electrical and mechanical installations in multi-use buildings. The research focuses on a 2000m² case study building located in Crete, Greece, demonstrating how modern building technologies can be effectively integrated within the Greek regulatory framework while addressing Mediterranean climate challenges and advancing sustainable construction practices. The case study building is strategically organized across five levels: basement (300m²) housing electromechanical equipment, ground floor (550m²) featuring museum space and reception areas, second floor (550m²) containing multipurpose rooms and gathering rooms, third floor (550m²) with six gathering rooms, and roof level (50m²) with auxiliary facilities. This architectural arrangement optimizes both functional efficiency and energy performance through careful spatial planning. The high-performance building envelope significantly exceeds Greek regulatory minimums for Climate Zone A. Air sealing measures limit building envelope leakage to 0.6 ACH at 50 Pa pressure differential, substantially reducing uncontrolled air infiltration. The enhanced envelope performance creates optimal balance between heat loss reduction and solar control, particularly beneficial in Crete's mild winter design temperature of +7°C and hot summer conditions. The study implements a Variable Refrigerant Flow (VRF) system with exceptional efficiency for multi-zone applications. Heat recovery ventilation systems capture 75% of sensible and 65% of total energy from exhaust airstreams, reducing annual HVAC energy consumption by approximately 35%. These mechanical systems incorporate smart controls and monitoring capabilities for optimal performance. Economic analysis validates the high-performance design with compelling returns: VRF system demonstrates 6.7-year simple payback compared to conventional systems. The comprehensive economic benefits encompass immediate cost reductions through energy efficiency, medium-term value creation through enhanced property performance, and long-term benefits through risk mitigation and increased asset value. This comprehensive study demonstrates that modern building technology integration can achieve exceptional performance improvements while providing compelling economic returns. The 2000m² multi-use building successfully combines advanced building envelope

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design, high-efficiency mechanical systems, renewable energy integration, and intelligent building controls to exceed Greek NZEB requirements by significant margins.