



**Politecnico
di Torino**

Honors Thesis

Master of Science in Sustainable Architecture

Abstract

**ANALYSIS OF CIRCADIAN LIGHTING IN
CLASSROOMS OF THE POLITECNICO DI TORINO
Experimental and simulation results.**

Tutor/Correlator

Valerio Roberto Maria Lo Verso

Candidate

Isabella Turati

July 2023

The thesis examines the theme of circadian lighting in spaces inside the Politecnico di Torino.

The work comes from a reflection matured over the years about the time each student spends inside university spaces.

Classrooms should encourage students' learning and concentration, and on the contrary not reduce their performance and productivity. The spaces we live in are not just a shell to shelter us from the changing seasons, but also places that allow us to learn and discuss positively with other people.

The human being is constantly in connection with natural events: the transition from day to night is one of the main ones. In fact, it regulates our organism giving a fundamental rhythm to our life, regulating the passing of the hours in psycho-physical terms.

The implicit question is if the spaces daily lived by each student can be best utilised through the integration of natural and electric light.

The aim is to observe the results given by the integrative lighting (photopic and melanopic illuminances) and to check if the circadian values are aligned with current standards: the circadian stimulus (CS), the equivalent melanopic lux (EML) and the melanopic daylight equivalent illuminance (m-EDI).

The thesis is divided into three different parts.

The first part is an introduction to the relationship that exists between light, man and architecture.

An analysis includes the essence of light, starting from its ethereal perception through human studies to its physical and architectural conception.

The second part of the thesis focuses on changing learning spaces, starting from the studies conducted in the 19th century by Horace Mann to the more recent studies conducted in the early 2000s on circadian rhythm by Mark S. Rea and Mariana G. Figueiro.

The latter studies have demonstrated the importance of exposure to natural light, which intensely influences biological rhythms, regulating the secretion and suppression of melatonin, but also human behaviour.

The current standards and protocols are very wide-ranging and divisive, the one referring to learning spaces was analysed by dividing it according to the different requirements for daylight, electric light and melanopic light.

The third part of the thesis contains studies referring to real cases.

In this work, the results obtained from two different approaches, then combined, will be presented.

The first method concerns the characterisation of electrical lighting by field measurements, necessary to define the photopic and melanopic illuminance impact of the lighting system.

The second, on the other hand, concerns daylighting at representative times of the year; it was developed through simulations using models with the calculation programmes available on Rhinoceros by Solemma: Climate Studio and Alfa.

The objective is to verify that, in each classroom, the contribution of daylight and electricity meets the daily WELL (m-EDI) requirements for all the days and sky conditions considered.
