



**Politecnico  
di Torino**

## **Honors Thesis**

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**Master's Degree Architecture for Sustainability.**

**Abstract**

**Title**

**The impact of shading systems on indoor comfort and energy-efficiency for offices:  
Comparative analysis of fabric roller blinds and electrochromic glazing under  
automated and manual controls**

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High-performance façades are expected to reduce operational energy while safeguarding occupants' comfort, yet comparing dynamic shading technologies under realistic control were not widely discussed in previous research. This thesis therefore benchmarks comparison of electrochromic (EC) glazing against fabric roller blinds—mounted either inside or outside—when both are driven by similar sensor-based algorithm with manual override (simulation-based). A south-facing, two-desk office was modelled for three representative European climates—Northern European (Stockholm), Central European (Frankfurt), and Southern European (Rome). Annual heating, cooling, and interior lighting loads, spatial daylight autonomy (sDA), 95th-percentile Daylight Glare Probability (DGP), and melanopic daylight autonomy (mel-DA, the percentage of daytime hours which melanopic EDI  $\geq 250$  lux) were computed and compared. Overall, the differences between the various configurations in terms of overall performance are small. All seven façade variants occupied a narrow energy band: the sum of heating, cooling, and lighting never differed by more than 10 kWh m<sup>-2</sup> yr<sup>-1</sup>. Lighting loads remained modest: the worst fabric raised annual lighting by only  $\approx 1$  kWh m<sup>-2</sup> yr<sup>-1</sup> versus the best. Daylight-related metrics showed similarly subtle spreads. Exterior blinds boosted sDA by 4–11% in Stockholm and Frankfurt but reduced it in Rome; EC glazing stayed within the top performer in every city regarding daylight provision. All fabric options kept DGP in the "imperceptible glare" EN-17037 band, whereas EC raised that value by 0.01—just enough to shift the rating to "perceptible glare". Mel-DA exceeded 70% for every configuration in the two cooler climates and ranged from 65% to 88% in Rome, where exterior and light-coloured fabrics excelled. A sensitivity analysis of activation thresholds and signals revealed that revising the glare-avoidance and solar-gain triggers influenced the shading performance significantly, in terms of both energy demand and occupant comfort. The study therefore concludes that, within today's high-performance envelope, an optimised, occupant-centred control strategy is more decisive than the choice between the shading technologies. Architects and practitioners are advised to prioritise calibrating control logic based on local climate and perceptual metrics to create buildings which are sustainable, energy-efficient, and occupant-friendly.

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