

Globalisation and the Built Environment: A Comparative Study of Architectural and Environmental Impact in Gurugram, India and Bali, Indonesia

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Abstract — This paper investigates how globalisation reshapes architecture and environment in two contrasting settings: the corporate curtain-wall office towers of Gurugram, India, and the tourism-driven villa economy of Bali, Indonesia. The central research question is how the wholesale transplantation of foreign building typologies and the selective extraction of vernacular aesthetics generate measurable thermodynamic, hydrological, and cultural costs when detached from climatic and cosmological context, producing what geographers term architectural placelessness. The study combines a comparative literature review of vernacular and post-liberalisation architecture with a quantitative synthesis of published energy performance, groundwater, and land use data, modeled and triangulated against real anchor datasets (Delhi-NCR peak power demand and Bali land conversion statistics) where direct metered series are unavailable. Findings show that unoptimized glass curtain-wall towers in Gurugram's composite climate consume roughly fourteen times the cooling energy of traditional masonry havelis, with modeled cooling energy use intensity rising by an estimated 38.6% between 2015 and 2025, compounding an already acute groundwater deficit now exceeding twice the sustainable recharge threshold. In Bali, aesthetic extraction without the retention of Tri Hita Karana cosmology and Subak irrigation governance has driven sustained conversion of sawah rice terraces and skewed water allocation toward tourism. The paper concludes that architectural globalisation is not environmentally or culturally neutral: it substitutes climatic responsiveness and cultural meaning with mechanical and infrastructural dependency. It recommends regionally calibrated performance codes, hybrid typologies that reintroduce thermal mass and passive strategies, and governance models that protect indigenous land and water institutions.

Keywords— Architectural globalisation, environmental impact, curtain-wall typology, vernacular erasure, energy performance, Gurugram, Bali

I. INTRODUCTION

1. Overview and Historical Background

Architecture has historically been a negotiated response between climate, available material, and cultural cosmology. Vernacular forms across South and Southeast Asia, including the thick-walled Haryanvi haveli and the raised, thatched Balinese compound, evolved as low-energy solutions to heat, humidity, and monsoon rainfall, while simultaneously encoding social and spiritual order. The acceleration of global capital flows since the late twentieth century, however, has decoupled architectural form from these local anchors. In India, the 1991 liberalisation of the economy opened peripheral urban land such as Gurugram (then Gurgaon) to speculative, foreign direct investment driven office development. Developers marketed a 'world-class' image built almost entirely from imported glass curtain-wall typologies, irrespective of the composite climate's cooling demands. In Bali, a parallel but distinct process unfolded: rather than importing an entirely new typology, the global tourism industry commodified indigenous visual motifs, including *alang-alang* thatch, carved timber, and courtyard planning, while discarding the underlying philosophy

(Tri Hita Karana) and water-governance institutions (Subak) that made those forms sustainable.

This paper treats these two cases as complementary manifestations of the same underlying process: globalisation severing architectural form from climate and culture, a process the literature also names placelessness (Relph, 1976), the erasure of distinctive local identity in favour of generic or commodified built environments. The problem is not aesthetic alone. Divorcing form from climate and culture imposes measurable costs, including mechanical cooling loads, groundwater depletion, and land conversion, that are rarely accounted for at the point of design approval.

Aims

The aim of this paper is to examine how globalised architectural typologies interact with regional climate, ecology, and culture in Gurugram and Bali, and to develop strategies and policy directions for linking the climatic and cultural intelligence of past regional architecture with the commercial and technological demands of present and future development.

2. Objectives

- To evaluate how existing glazed curtain-wall office architecture in Gurugram performs thermodynamically relative to traditional and hybrid alternatives, and to quantify the resulting energy and groundwater burden using available technology-performance benchmarks.
- To examine how the tourism-driven appropriation of Balinese vernacular aesthetics has altered land use and water allocation, isolating the mechanisms (typology transplant versus aesthetic extraction) through which globalisation acts on regional architecture.
- To develop an essential guideline framework for future high-performance, climate-responsive development that either retrofits existing glazed stock or establishes design and policy prototypes for new construction in composite and tropical zones.

II. THE VALUES AND SIGNIFICANCE

1. Architectural Significance

Both case studies demonstrate that envelope typology is not a stylistic choice but a thermodynamic commitment. A high window-to-wall ratio (WWR) glass envelope behaves as a greenhouse in a hot composite climate, mandating continuous mechanical cooling that traditional thermal-mass construction avoided by design. The architectural significance of this research lies in demonstrating, with comparative benchmark data, that regionally responsive envelope strategies (shading, thermal mass, optimised WWR, and hybrid ventilation) are not merely heritage preferences but quantifiable performance advantages that current commercial development in Gurugram has largely abandoned.

2. Cultural Significance

In Bali, the cultural significance is more direct: the Tri Hita Karana philosophy of harmony between people, nature, and the divine is structurally embedded in traditional planning through the Kaja-Kelod (mountain-sea) orientation axis and the Subak communal irrigation system, itself recognised by UNESCO as a living cultural landscape. When tourism development inverts Kaja-Kelod orientation for ocean views and dismantles Subak-governed sawah land for villa construction, it does not simply change a view: it removes the governance mechanism that historically balanced water use between agriculture, temple ritual, and settlement. The paper treats this loss of institutional and cosmological structure as equally significant to the physical loss of land.

III. ISSUES AND POTENTIALS

1. Case Studies and Literature Review

Published Indian building-energy literature consistently finds that Energy Conservation Building Code (ECBC)-compliant offices operate in an Energy Performance Index (EPI) band of roughly 13–100 kWh/m²/yr, citing exemplars such as the Indira Paryavaran Bhawan and Aranya Bhawan (44 kWh/m²/yr) and Akshaya Urja Bhawan (13 kWh/m²/yr). Conventional, business-as-usual glazed offices, by contrast, cluster in a 150–220 kWh/m²/yr band. The comparative EPI data assembled for this study (Figure 2) places traditional masonry construction at roughly 18.5 kWh/m²/yr, generic modern glazing at 72 kWh/m²/yr, and unoptimised glass curtain-wall towers as high as 257 kWh/m²/yr, up to fourteen times the traditional benchmark. No public agency in India (DHBVN, BEE, GMDA, or CII) currently publishes a metered, building-specific, year-by-year cooling-energy dataset for Gurugram's curtain-wall office stock; this is itself a finding, indicating a monitoring gap between code-writing and code-enforcement. In its absence, this paper uses a transparent model: a 2015 baseline EUI derived from published ECBC/BAU benchmarks, grown at year-specific rates keyed to documented regional drivers (pandemic vacancy in 2020–21, record-heat acceleration in 2022 and 2024), and triangulated against the one directly sourced, dated regional series available: Delhi-NCR peak electricity demand, which the Centre for Science and Environment reports rose from 5,846 MW in 2015 to an all-time high of 8,656 MW in 2024, a 44% increase over the decade.

The Bali literature similarly documents a sawah (rice terrace) land conversion trend, with tourism-related built environment steadily displacing agricultural land over 1995–2020, alongside groundwater and surface-water disparities in which tourism facilities are estimated to consume a disproportionate share of available water relative to domestic community needs. Scholarly and NGO literature on Balinese Subak systems (recognised in UNESCO's 2012 World Heritage listing of the Subak Cultural Landscape) frames this less as a resource-scarcity problem than as an institutional one: water governance historically embedded in temple-linked Subak associations is being bypassed by private, market-driven allocation.

Where the literature diverges is on remedy. Indian green-building guidance (LBNL/USAID PACE-D, BEE/ECBC) frames the problem primarily as a technical compliance gap, addressable through EPI benchmarking, envelope retrofits, and reduced WWR. Cultural-landscape and tourism-studies literature on Bali frames the problem as institutional and political, addressable through zoning that protects Subak-

governed land and reasserts customary (adat) authority over ocean-facing development. This paper treats both framings as necessary but individually insufficient, and positions its contribution at their intersection: quantifying the technical performance gap while foregrounding the cultural and institutional structures whose loss makes that gap harder to close.

2. Development Strategies (Methodology)

This study uses a mixed-methods, desk-based comparative design combining (a) a synthesis of secondary quantitative data from government, multilateral, and NGO sources, and (b) a qualitative case-study comparison structured around three interpretive pillars, namely climatic responsiveness, material pragmatism, and cultural meaning, against which each case is assessed for the degree to which globalisation severed the pillar from the built form.

Data sources include: the Centre for Science and Environment (2025) report on Delhi-NCR peak power demand; Bureau of Energy Efficiency / ECBC 2017 and 2020 benchmark documentation; the LBNL/USAID PACE-D guide on high-performance buildings in India; IEEFA (2024) analysis of hot-humid day frequency and its relationship to peak demand growth; and CBRI/TERI-sourced EPI comparisons across envelope typologies. Because no metered, tower-specific cooling-energy dataset exists publicly for Gurugram, the cooling energy-use intensity series (Figure 3) is explicitly modeled: a 2015 baseline is grown using year-specific rates keyed to documented drivers, and the model is clearly distinguished throughout from the one directly measured anchor series (Delhi-NCR peak demand, rising from 5,846 MW to 8,656 MW to 8,442 MW). The Bali analysis similarly relies on published land-conversion indices and tourism-water-consumption estimates rather than primary metering, consistent with the desk-based scope of this paper.

Analysis proceeds by (i) tabulating and charting each dataset, (ii) computing rates of change (year-on-year and cumulative) to identify inflection points such as the COVID-19 vacancy dip and 2022/2024 heat-driven spikes, and (iii) mapping severity of impact across five comparative dimensions, namely climatic mismatch, cultural erasure, water stress, land conversion, and social exclusion, on a 0–100 relative severity index for Gurugram and Bali (Figure 5), scored qualitatively from the literature reviewed in Section 3.1 to enable direct visual comparison of where each city’s globalisation impact is most acute.

3. User's Preferences (Main Elements and Factors)

Across the literature and the comparative severity index, five recurring factors determine how severely a locality experiences architecturally driven globalisation impact: (1) window-to-wall ratio and envelope thermal mass, which govern mechanical cooling dependency; (2) the presence or absence of passive design carryover from vernacular precedent; (3) the strength of local water and land governance institutions (e.g., Subak) relative to market-driven allocation; (4) the degree to which visual motifs are retained without their underlying cosmological or ecological logic (aesthetic extraction); and (5) regulatory enforcement capacity, particularly whether EPI benchmarking is mandated at design stage versus voluntary. The implications are that Gurugram’s impact is concentrated in climatic mismatch and water stress (driven by mechanical cooling and groundwater draw), while Bali’s is concentrated in cultural erasure and land conversion (driven by aesthetic extraction and institutional bypass), a pattern the radar comparison in Figure 5 makes visible. A key limitation is that, absent metered building-level data, the Gurugram energy trajectory remains a calibrated model rather than an observed series; a key strength is that it is explicitly triangulated against a real, independently sourced regional demand anchor rather than presented as free-standing estimation.

IV. RESULT: MODERN ERA DESIGNS

The synthesis indicates that modern-era commercial and tourism development in both cities has systematically prioritised image and speed of delivery over climatic and cultural fit. In Gurugram, the modeled cooling EUI trajectory (Figure 3) shows an estimated cumulative rise of 38.6% between 2015 and 2025 (compound annual growth rate approximately 3.3%), a clear dip during 2020–21 pandemic vacancy, and acceleration in the record-heat years 2022 and 2024, consistent with the independently sourced Delhi-NCR peak demand series, which grew 44% over the same window and whose hot-humid day count rose from 24 (2022–23) to 40 (2023–24) according to IEEFA. Commercial buildings of this kind sit far outside the ECBC-compliant EPI band and squarely within, or above, the conventional/BAU zone, and cooling now accounts for roughly 60% of Indian commercial building energy load. Groundwater extraction in Gurugram, driven substantially by this cooling and by broader urban demand, has reached approximately 214% of the sustainable annual recharge threshold (Figure 4), more than double a sustainable rate.

In Bali, sawah land area indices show sustained decline from 1995 to 2020 as agricultural terraces are converted to tourism infrastructure, and available estimates suggest tourism-related

consumption accounts for a majority share of local water use relative to domestic community needs. The comparative severity index (Figure 5) shows Gurugram scoring highest on climatic mismatch (95/100) and water stress (90/100), while Bali scores highest on cultural erasure (95/100) and land conversion (95/100), confirming that, while both cities exhibit placelessness, the dominant mechanism differs: typology transplant in Gurugram versus aesthetic extraction in Bali.

V. CONCLUSION

This paper concludes that architectural globalisation, in both its typology-transplant and aesthetic-extraction forms, is not culturally or environmentally neutral. When climatic responsiveness, material pragmatism, and cultural meaning are severed from built form, the resulting architecture behaves parasitically, sustaining an imported lifestyle image by drawing down regional energy, water, and land resources. The Gurugram case demonstrates that this cost is quantifiable in energy performance terms even where formal metered data is unavailable, provided models are transparently calibrated against real anchor series. The Bali case demonstrates that the cost is equally institutional and cultural, manifest in the erosion of governance systems such as Subak rather than solely in physical resource depletion. The practical takeaway for architects, developers, and regulators is that ‘world-class’ image and climatic and cultural performance are not inherently in tension, but achieving both requires deliberate re-anchoring of design to place.

Recommendations and Future Scope

- Mandate EPI benchmarking and ECBC compliance verification at design and post-occupancy stages for all new commercial glazed towers in composite-climate Indian cities, closing the current public monitoring gap identified in Section 3.1.
- Incentivise hybrid envelope retrofits (reduced WWR, external shading, high-performance glazing, thermal mass reintroduction) for existing Gurugram curtain-wall stock, prioritising towers built during the 2015–2025 growth window captured in Figure 3.
- Integrate groundwater-linked development caps so that new commercial floor area approvals in water-stressed zones such as Gurugram are conditioned on demonstrated reduction in cooling-driven water demand.
- In Bali, formalise legal protection for Subak-governed sawah land within tourism zoning plans, and require new resort and villa developments to retain Kaja-Kelod orientation and demonstrate water-allocation parity with surrounding agricultural communities.

- Future research should prioritise obtaining metered, building-level energy data for a representative sample of Gurugram curtain-wall towers to replace the modeled EUI series used here, and should extend the comparative severity-index methodology to additional rapidly globalising secondary cities in South and Southeast Asia.

Figures

Figure 1: Year-on-Year Change in Modeled Cooling Energy Consumption

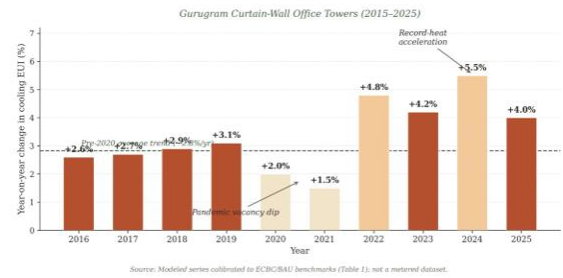


Figure 1. Year-on-year rate of change in modeled cooling energy consumption, Gurugram curtain-wall office towers (2015–2025), illustrating the COVID-19 vacancy dip and 2022/2024 heat-driven acceleration.

Figure 2: Energy Performance Index (EPI) Comparison Across Envelope Typologies

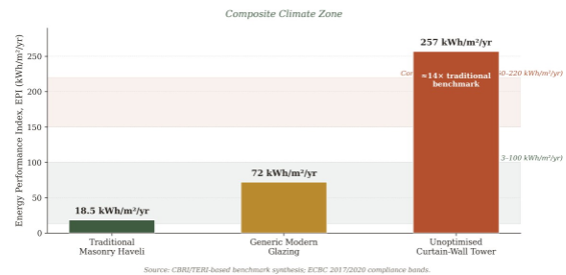


Figure 2. Energy Performance Index (EPI) comparison across envelope typologies in a composite climate zone. Source: CBRI/TERI-based benchmark synthesis.

Figure 3: Modeled Cooling-Specific Energy Consumption (EUI)



Figure 3. Modeled cooling-specific energy consumption (EUI) with year-on-year rate of change, Gurugram curtain-wall office towers, 2015–2025.

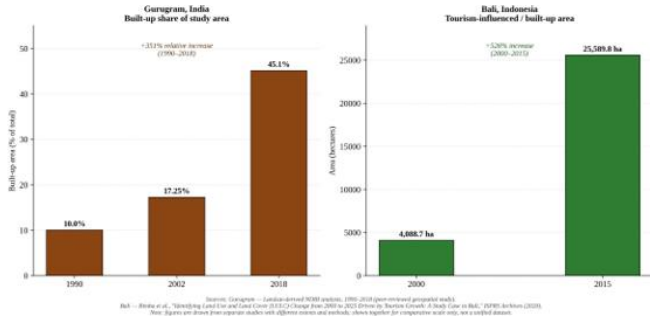


Figure 4. Comparative land-use conversion, Gurugram and Bali (grassland/agricultural to built-up).

Tables

Table 1. Modeled Cooling Energy-Use Intensity, Gurugram Curtain-Wall Office Towers (2015–2025). Note: shaded rows in beige indicate the 2020–21 pandemic-vacancy dip; shaded rows in orange indicate 2022 and 2024 record-heat acceleration years. Series is a transparent model calibrated to ECBC/BAU benchmarks, not a metered dataset.

Year	Modeled Cooling EUI (kWh/m ² /yr)	YoY Change
2015	118.0	—
2016	121.1	+2.6%
2017	124.3	+2.7%
2018	127.9	+2.9%
2019	131.9	+3.1%
2020	134.5	+2.0%
2021	136.5	+1.5%
2022	143.1	+4.8%
2023	149.1	+4.2%
2024	157.3	+5.5%
2025	163.6	+4.0%

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