



# Towards a post-naturalist architecture: a systematic review of nature-culture relationship in ecological architecture

## Hacia una arquitectura posnaturalista: una revisión sistemática de la relación naturaleza-cultura en la arquitectura ecológica

**SEDA ZAFER KÜÇÜK**

Yıldız Technical University, Turkey  
zaferseda@gmail.com

**AYŞEN CIRAVOĞLU**

Yıldız Technical University, Turkey  
aysenc@yildiz.edu.tr

**ABSTRACT** Studies on nature-culture relations emphasize the intertwined cultural relationship between the natural world and human culture. In recent years, there has been an increase in practices that include non-human entities, expanding the scope of architectural design. This review explores current approaches that examine the relationship between nature and culture in the context of ecology in architectural design. The data were collected from the Scopus and Web of Science databases guided by PRISMA The Preferred Reporting Items for Systematic Reviews and Meta-Analyses. Information regarding the post-naturalist perspective in architecture was derived from an analysis of contemporary studies that address the nature-culture discourse and expand the relationship between ecological principles and architectural design. The findings demonstrate that the domain of architectural design can be expanded through the incorporation of alternatives that are frequently perceived as threatening, overlooked, marginalized, or defective, particularly in relation to ecological considerations. This review promotes alternative ecological practices by highlighting innovative architectural design concepts and strategies.

**RESUMEN** Los estudios sobre las relaciones naturaleza-cultura enfatizan la entrelazada relación entre el mundo natural y la cultura humana. En arquitectura, esta perspectiva cuestiona el diseño de entornos basados en normas racionales, separados de mundos externos aparentemente dañinos. Sopesa el valor atribuido a la naturaleza y busca diseños alternativos. Esta revisión explora los enfoques que examinan la relación entre naturaleza y cultura en el contexto de la ecología en el diseño arquitectónico. Los datos se recogieron de las bases de datos Scopus y Web of Science siguiendo el método PRISMA. La información sobre la perspectiva postnaturalista en arquitectura se derivó del análisis de estudios contemporáneos que abordan el discurso naturaleza-cultura y amplían la relación entre principios ecológicos y diseño arquitectónico. Los resultados demuestran que el dominio del diseño arquitectónico puede ampliarse incorporando alternativas percibidas como amenazadoras, pasadas por alto, marginadas o defectuosas, en particular en relación con consideraciones ecológicas. Esta revisión promueve prácticas sostenibles alternativas destacando conceptos y estrategias de diseño arquitectónico innovadores.

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## 1. Introduction

In architectural design, ecological discourse often unfolds within predetermined frameworks shaped by technological, material, or climatic standards. Terms such as environmental, green, natural, organic, and sustainable are frequently used interchangeably, reflecting a generalized ecological vocabulary. Within this discourse, nature is typically treated as an environment, resource, or model, yielding a limited ecological perspective. The idea of nature that is not evaluated with technical, economic, and political dependencies and ignoring the critical flaws in production and consumption systems leads to unsustainability (Dilnot, 2011). In contrast, the political ecology approach questions the power relations and socio-environmental inequalities embedded in these definitions, urging a more critical and situated engagement with ecological design. Political ecology requires a new understanding of how the 'habitats, 'natural environments, places, or shelters' that constitute architectural ecologies emerge from material, spatial, social, political, and economic concerns (Rawes, 2013).

Discussions on global warming, disasters, epidemics, and environmental collapse, as well as the spread of ecological theory and material practice, have led to the loss of influence of architecture as an independent object and the emergence of an imperfect ontological framework that encounters challenges with environmental instability (Gannon et al., 2015). Post-naturalism, which seeks to resolve the nature-culture dichotomy of the past two decades through variable and interconnected worlds, proposes a more nuanced conceptualization of nature. It posits that nature is inextricably linked with human history and that it cannot be the environment or an ideal reference for architectural form (Gissen, 2019).

The primary objective of this article is to develop a comprehensive overview of studies that examine an architecture-oriented inquiry into post-natural relations with nature through a systematic literature review. The article explores alternative architectural approaches in relation to nature and the inclusion of previously ignored or non-homogenized entities that are typically challenging to incorporate into design concepts. The theoretical foundation of this study is rooted in post-naturalism, a critical ecological perspective that challenges the pursuit of stability and conservation of nature. Furthermore, it accommodates experimental, imperfect, and temporary possibilities that challenge the dominant conception that 'good architecture' must be timeless and permanent.

The existing literature lacks comprehensive study focusing on the nature-culture relationship and the post-naturalist perspective in architecture. To

address this gap, the systematic literature review analyzed articles published in the past decade that discuss non-sterile, threatening, ignored, marginalized, or flawed aspects of nature that transcend conventional design approaches. The study, combined with an analysis of the collected data, provides a model of the information revealed in various articles within the context of post-naturalist architectural design. This article weighs a priori value attributed to nature and searches for alternative ecological practices by highlighting current and radical architectural design concepts and strategies with a systematic review.

### 1.1. Radical reframing of nature-culture relations: theoretical ground for post-natural practices

The tendency to view "the Earth as a container" in which life is fixed or embedded has shaped dominant ecological thought for many years (Van Wyck, 1997, p. 53). The perception of nature as an inexhaustible resource, treated as a discrete entity that solely fulfills human needs, has resulted in a neglect of the environment that humans affect and transform. Efforts to make unusual and undesirable natural forms attractive, popular demands focused on green, and landscape ecology of picturesque traditions have led to the definition of 'nature' through the neat and well-maintained appearance of the relationship between humans and the ecosystem (Nassauer, 1995). The romantic and picturesque view of nature, nurtured by capitalism and the ideology of the means of production, has given rise to the production of nature as urban regulations have domesticated wild nature (Smith, 2008). When examined from a Western perspective, nature is frequently perceived as an impassive backdrop to human activities and has been positioned in a sterile and passive manner through the hygienic design approach of the modern era (Latour, 2012). The concept of the environment has not been seen as a living space in which humanity is immersed to the same extent as all other living beings but rather as a complex community that must be analyzed to quantify it (Clement, 2013).

According to Gandy (2008), the "concept of nature" is central to a new interdisciplinary approach that critically addresses the shortcomings of broad or universal scientific explanations. He also argues that "the boundaries between different bodies of knowledge" have become increasingly fluid (Gandy, 2008, p. 562). With the emergence of new materialism, a contemporary philosophical movement, a more dynamic and relational view of the world has emerged, emphasizing the interconnectedness of all beings (human, non-human, and material) (De Landa, 1997). Scientist

and feminist theorist Donna Haraway (2016) emphasized *Staying with the Trouble*. She critically examined so-called natural hierarchies, suggesting that science and technology are neutral tools of human understanding, arguing these perspectives often marginalize those not conforming to standardized norms of individuality. The conceptualization of the ignored and non-sterile, as articulated in Timothy Morton's (2016) dark ecology, transcends the confines of conventional visual and aesthetic considerations. It encompasses a nuanced understanding of nature that acknowledges the presence of negative attributes, including tragedy, ugliness, and melancholy. In contrast to the tendency to reduce the natural world to the concept of ecology, there is a need for radical intimacy that engages with the intrinsic ecological and material qualities of spaces (Morton, 2010; Grosz, 2011). The questioning of architectural and human-centric thought, which is based on the domestication of wild nature, is becoming increasingly important.

At the same time, in examining architecture's relationship with nature, the past tendency to view nature as a sublime source of aesthetic inspiration, formal models, proportions, and rationality is losing influence, while interest in self-organizing systems, genetic algorithms, and biological morphogenesis is increasing (Ruy, 2012). Contemporary conceptualizations of nature, such as preserving the environment for humanity's benefit, aesthetic nature into a cultural spectacle, and industrialization governing organisms based on their impact on human productivity, are being superseded by new paradigms (Joachim, 2016). The scope of architecture is expanding to include different living species and radical practices such as mycelium, silkworm, and algae, and it is confronted with non-disciplinary concerns such as living species, decay and rust, etc. (Lally, 2014; Armstrong, 2020).

These emerging philosophical and ecological positions—such as dark ecology, new materialism, and post-humanism—not only redefine how architecture conceptualizes nature but also inspire a range of radical design practices that challenge anthropocentric aesthetics, sterile material use, and disciplinary boundaries. This paradigmatic shift is reflected in experiments with living organisms, decaying materials, and performative systems that resist traditional architectural classifications. These conceptual reframings lay the groundwork for new design strategies that engage with dynamic material processes, non-human actors, and ecological indeterminacy—core aspects of the post-natural condition explored in this review.

## 1.2. Post-natural perspective in architecture

Following the 1980s, "a relational ontology understanding of the nature-culture togetherness has

emerged, as evidenced by the work of Haraway and Latour and Science and Technology Studies (STS) theories of the independent agency of non-human nature" (Frichot, 2018, p. 40). In his analysis of the post-human characterization of the global ecological crisis, he encompasses extreme climatic events like floods, ice melt, tropical eruptions, and droughts, Latour (2011) posits that ecology has emerged as an alternative definition to modernization. This shift is attributed to ecology's ability to define a post-natural era and position humanity within a network of shared concerns, rather than a system based on common values, perspectives, and principles (Yaneva, 2017). Furthermore, post-naturalism challenges naturalist approaches in architecture that attempt to bridge society and nature through concepts such as balance and mimesis (Gissen, 2015). This illustrates that nature and culture are engaged in a process of mutual displacement and argues against the notion of the environment as a self-organizing entity.

In the post-naturalist perspective, ecological practices that address the marginalized dimensions of nature informed by concerns regarding pollution, non-human species, the motivation to produce solutions to global issues such as climate change or disasters, social, creative actions, and stance against established norms. The paradigm shift in architecture from its conventional focus on design to an emphasis on matter and ecosystems, accompanied by an awareness of dynamic environmental conditions such as soil, waste materials, straw, and atmospheric phenomena, has been increasingly evident over the past two decades (Till and Wigglesworth, 2001; Rawes, 2013). In this context, concepts have emerged as sub-nature, techno-nature, socio-nature, hyper-nature, which align with the post-naturalist perspective, point to an architectural imagination that deviates from traditional definitions of nature and encompasses new architectural organisms, new environments and new natures (Harrison, 2013).

As a post-naturalist architectural example, Gissen (2009) conceptualized subnatures as natures that have had a direct or indirect effect on people in the historical process of architecture, which cannot be expressed or controlled naturally (e.g., dust, smoke, gas, weeds, crowds) and are therefore kept hidden, seen as dirty or frightening. For example, weeds clinging to a wall are not included in the building system because they are useless, dust continues to surround the structures as one tries to control it, and the increased sweat and humidity of crowds affects the atmosphere of the spaces. While human activities "in industry and technology profoundly alter the natural world and create new states of nature, subnaturalist understanding draws attention to the fact that new, deviant natures can emerge from existing polluted conditions" (Kallipoliti, 2018, p. 32). The post-naturalist perspective resonates

with Yaneva's notion of *cosmopolitical ecology*, which "cover[s] all the objects of human and non-human collective life bearing on complicated forms of association between beings" and requires "a new form of political activity" to account for their uncertain relations (Yaneva, 2017, p. 4). Cosmopolitical ecology, which calls for a more reflexive and sensitive approach to design—as seen at the building scale in examples like the High Line and the Blur Building—emphasizes that the natural world no longer offers a unified framework to serve as a grounding model for human experience, as it must now account for the impact of all actors, including materials, technologies, and environmental factors.

The post-naturalist viewpoint establishes a common framework against the modification of undesirable and threatening elements of nature to meet vital expectations. In architecture, this perspective questions the design of environments based on rational standards, separated from seemingly harmful external worlds.

## 2. Methods

Literature reviews synthesize themes in the literature, requiring evaluation and critique of existing perspectives while offering new ideas (Groat and Wang, 2013, p.143). Using a systematic literature review, this study critically examines the relationship between nature and culture and identifies the studies that extend the relationship between architectural design and ecology to post-natural areas. This study combines a PRISMA-based literature selection process with a qualitative thematic analysis structured around three analytical questions, enabling the identification of conceptual patterns and design strategies related to post-natural ecological thinking in architecture.

Journals and proceedings articles on the topic were searched according to the PRISMA guidelines (Page et al., 2021) which were developed to facilitate the transparent and complete reporting of systematic reviews. It recommends steps to screen records (titles and abstracts) for eligibility and efficiently filter out irrelevant studies. Scopus and Web of Science, which are the most comprehensive databases, were selected for the search. A preliminary scan was conducted on the areas where the research is concentrated in the context of the main subjects examined and on which subjects the architectural context of post-naturalism may intersect.

As discussed in Section 1.2., the concept of post-naturalism in architecture is theoretically grounded in ecological, post-human, and STS that challenge traditional nature-culture binaries. Post-naturalism is an emerging, diffuse term that is not widely or explicitly used in architecture yet. It is conceptually embedded in terms like subnatures, non-human species, cosmopolitical ecologies etc. Since the term is not yet widely formalized in architectural literature, the keyword strategy was developed to reflect related themes identified in the theoretical framework. Given the interdisciplinary and evolving nature of the topic, we anticipated that key terms like "post-naturalism" might not appear explicitly. Therefore, we used a broad and exploratory search strategy, combining conceptual terms ("post-nature", "dark ecology") with disciplinary anchors ("architecture", "ecological design"). Boolean operators and iterative trial searches helped refine the query for relevance and specificity.

The investigation yielded a relationship map in which the subject is included in the literature through the research fields. In Figure 1, the mapping shows the relationship of common topics in literature based on the preliminary scan. Figure 1 presents a

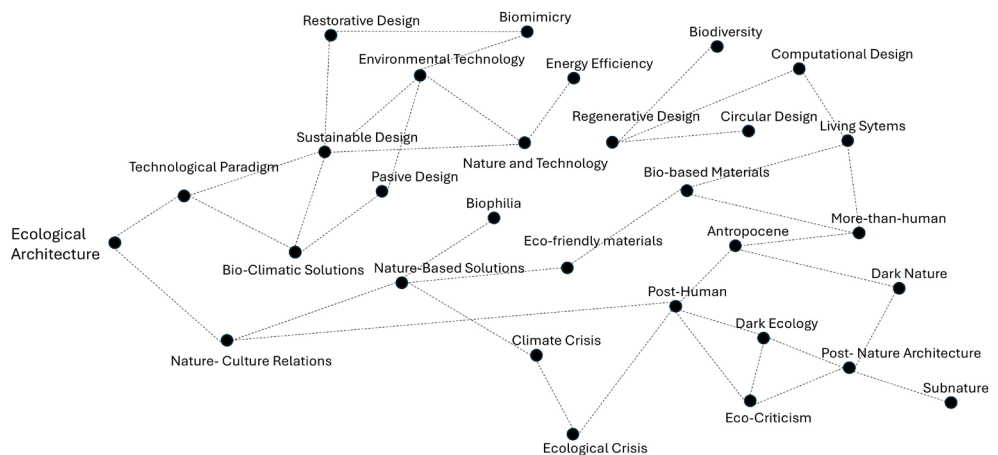


Figure 1: Preliminary Conceptual Map from Scoping Review. (2025)

conceptual relationship map developed through an initial scoping review of approximately 50 articles and abstracts. This map was constructed manually through thematic clustering. It visualizes the conceptual proximities among ecological and post-natural architectural terms encountered during an initial exploratory reading of relevant literature. Keywords and recurring themes were collected, grouped by thematic similarity, and manually mapped to visualize intersections in ecological design discourse. Terms were grouped and linked based on recurring co-occurrences, shared theoretical frameworks, or thematic intersections across the selected articles. The map served as a heuristic tool to inform keyword selection for systematic database search. This qualitative mapping guided the refinement of search strings and inclusion criteria for the systematic review. Rather than being the result of quantitative text-mining, this map reflects a qualitative synthesis

of emerging themes, which served to shape the search string and define the conceptual boundaries of the review.

## 2.1. Identification of relevant publications

The studies on nature-culture relations in architecture are concentrated on themes such as ecology, the Anthropocene, post-humanism, and new materialism. In the identification process, the possibility of not directly expressing the concepts of nature-culture or post-naturalism in the title, keywords, and abstract sections is considered. There are no architectural publications that explicitly and directly use the concept of 'post-naturalism' in the determined databases. For this reason, in order to find studies on the subject with implicit meanings, the same databases were searched using T1-TLE-ABS-KEY ("post nature" OR post-nature OR "nature-culture" OR posthuman

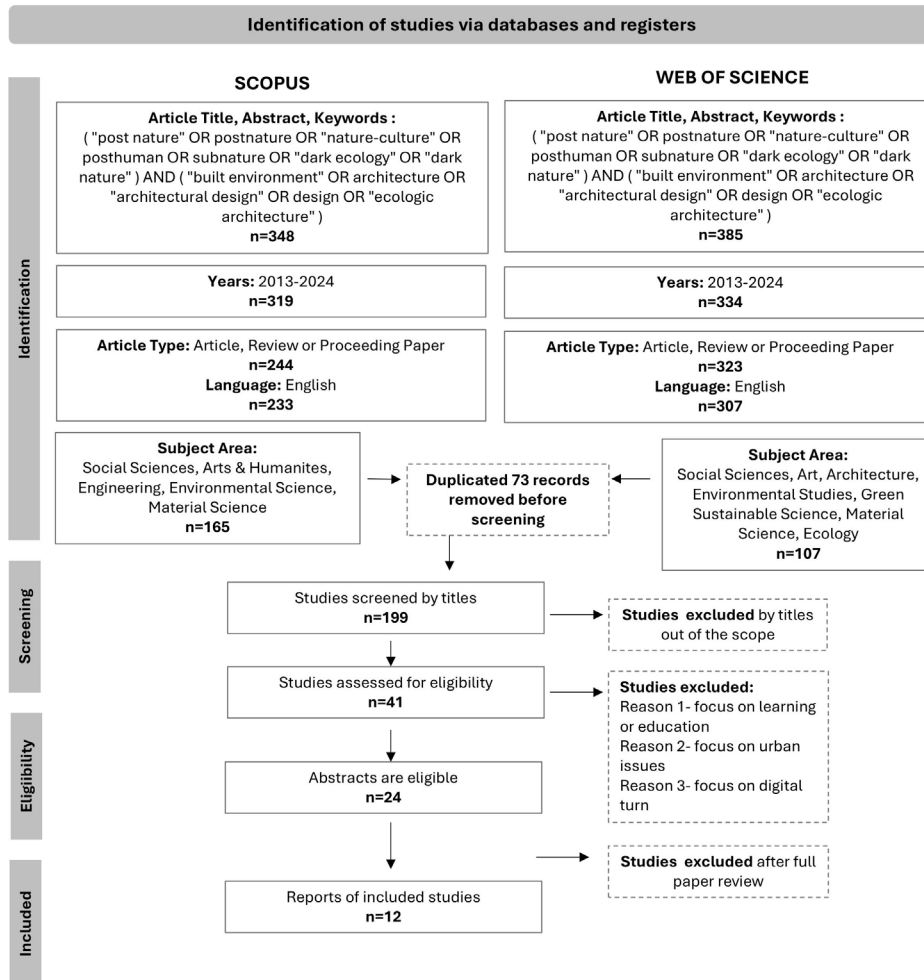


Figure 2: The process of selecting the studies to be reviewed. Based on the PRISMA 2020 flow diagram. Page et al, (2021)

OR post-human OR subnature OR “dark ecology” OR “dark nature”) AND (“built environment” OR architecture OR “architectural design” OR design OR “ecological architecture”). Filters were applied for peer-reviewed English-language articles, reviews, and conference papers published between 2013–2024.

The search returned a total of 733 results. After removing 73 duplicates and refining by subject areas (Ecology, Social Sciences, Arts and Humanities, Engineering, Environmental Science, Material Science, Environmental Studies, and Green Sustainable Science), 199 studies remained for title screening. At this step, studies were excluded only if the title clearly indicated an unrelated disciplinary focus, in alignment with the subject areas selected. Specifically, records were excluded if they pertained to topics such as artificial intelligence without ecological relevance, computer science, cybernetics, general education, digital performance art, or other learning-based studies unrelated to architectural or ecological discourse. This ensured that only those publications with thematic potential within architecture, ecological design, or nature-culture relations were retained for abstract screening. Ambiguous titles were kept for abstract review in the next phase.

Then, the studies were assessed for eligibility by excluding those with different focuses in the abstracts. In terms of the appropriateness of the topic, it was considered important that the studies addressing the nature-culture relationship within

the context of architecture should have content that goes beyond defined design approaches and includes non-sterile, threatening, ignored, marginalized, or natural contexts (discussed as post-naturalism in the previous section).

We applied the following inclusion criteria:

- A general focus on nature–culture relationality within architectural discourse (including post-humanism, the Anthropocene, or ecological design).
- A critical stance toward dominant sustainability narratives, nature, or ecology.
- Engagement with radical, speculative, or marginal ecological themes, including materials, species, or processes often excluded from conventional ecological or architectural approaches (e.g., dirt, decay, algae, insects, etc.).

Exclusion criteria during abstract and full-text reviews were:

- A primary focus on architectural education or learning methods (e.g., curriculum studies, pedagogical models).
- Studies centered on urban transformation, smart cities, or urban sustainability frameworks, where architectural design itself was not the focus.
- Research with a technological or digital emphasis unrelated to ecological or post-natural perspectives (e.g., parametricism, digital twins, smart materials without environmental framing).

Article	Year	Authors	Title	3 Keyword
1	2024	Harrison, AL	Feral Surfaces: Building Envelopes as Intelligent Multi-species Habitats	Biodiversity; More-than-Human; Multi-species work
2	2024	Saha, T., Nusem, E.	Ecologies Otherwise: Mapping Ontological, Speculative, and Transition Design Discourses	Ontology; Speculative; Sustainability
3	2024	Hutt, S.	Flying Feral: Posthuman Architectures, Enclosures and Open-Loop Interface Designs	Feral; Post-Human; Subculture
4	2024	Bühler, M., Hollenbach, P., Köhler, L. & Armstrong, R. .	Unlocking Resilience and Sustainability with Earth-Based Materials: a Principled Framework For Urban Transformation	Microbes; New Materialism; Regenerative Design
5	2024	Leveratto, J.	More-Than-Post: A Five-Step Recipe for Decentring Design	More-Than-Human; David Gissen; Donna Haraway
6	2024	Chayaamor-Heil, N., Houette, T., Demirci, Ö. & Badamah, L.	The Potential of Co-Designing with Living Organisms: Towards a New Ecological Paradigm in Architecture	Algae; Biofabrication; Living materials
7	2021	Akyurek, B. K., Mohammadi, M., Ciravoglu, A. & Yegenoglu, H.	Technological Transition in Building Design at the Intersection of Living and Manufactured	Technological Transition; Bio-building Components; Living Organisms
8	2020	Bar, T.	Rethinking the Individual-Collective Divide with Bio-digital Architecture	Bio-digital; Generative Architecture; Posthumanism
9	2020	Mestre, N.	Over-Designed Ecologies	Sustainability Fix; Nature-Based-Solutions; Ecology
10	2018	Panagiotopoulou, V., Yang, Z., Li, X.	Depraved Urban Scapes: Inhabiting Subnature in the Hybrid City	Hybrid; Subnature; Toxicity
11	2018	McGaw, J.	Dark Matter	Bio-actant; Materials; Mycelium
12	2013	Moreno.D., Grinda, E.G.	Third Natures: Incubators of Public Space	Involuntary Parks; AMID.cero9; Ghettos as Positive Spatial Models

Table 1: Information of included studies. (2025)



Criterion	Description	Scoring (0-2)
Relevance to post-naturalism	Does the study clearly address post-natural or related concepts (e.g., subnature, dark ecology, more-than-human agency)?	0 = not addressed, 1 = partial, 2 = strong
Conceptual clarity	Are key terms and frameworks well-defined and used consistently?	0 = unclear, 1 = somewhat clear, 2 = very clear
Architectural contextualization	Does the paper directly connect to architectural design, theory, or spatial discourse?	0 = not architectural, 1 = indirect, 2 = direct
Theoretical contribution	Does it contribute to new insights or reframing in post-natural discourse or ecological design?	0 = little, 1 = moderate, 2 = strong
Documentation of examples	Are architectural cases or design practices clearly described and analyzed?	0 = no examples, 1 = unclear, 2 = well described
Scholarly rigor	Is the argument well-supported with references, logic, and critical analysis?	0 = weak, 1 = average, 2 = strong

Table 2: Quality assessment rubric for evaluation. (2025)

Article	Relevance to post-naturalism	Conceptual clarity	Architectural contextualization	Theoretical contribution	Documentation of examples	Scholarly rigor	Total
Feral surfaces: building envelopes as intelligent multi-species habitats	2	2	2	2	2	2	12
Ecologies otherwise: mapping ontological, speculative, and transition design discourses	2	2	2	2	1	1	10
Flying feral: posthuman architectures, enclosures and open-loop interface designs	2	1	2	1	2	1	9
Unlocking resilience and sustainability with earth-based materials: a principled framework for urban transformation	1	2	2	2	2	2	11
More-than-post: a five-step recipe for decentering design	2	2	2	1	2	2	11
The potential of co-designing with living organisms: towards a new ecological paradigm in architecture	2	2	2	1	2	1	10
Technological transition in building design at the intersection of living and manufactured	2	2	2	2	2	2	12
Rethinking the individual–collective divide with biodigital architecture	2	2	2	2	2	2	12
Over-designed ecologies	2	2	2	2	2	1	11
Depraved urban scapes: inhabiting subnature in the hybrid city	2	1	2	1	2	2	10
Dark matter	2	2	2	2	2	2	12
Third natures: incubators of public space	2	1	2	2	2	1	10

Table 3: Quality assessment of articles. (2025)

After applying these filters, 24 articles were deemed eligible by abstract review, and 12 were included following full-text assessment. Of these, 8 appeared in both databases, and 4 were unique to SCOPUS. Figure 2 illustrates the systematic screening and selection process using a PRISMA-style flow. Table 1 shows the list of 12 papers.

2.2. Analysis & Synthesis

All research is reductionist to some extent; a study must be structured around precisely defined variables and reduced to categorized information (Groat and Wang, 2013). Thematic analysis is a widely used methodology for identifying core patterns—or themes—that underlie a particular

concept (Braun and Clarke, 2006). In this study, a synthesis approach is adopted, integrating both deductive coding guided by analytic questions and inductive identification of emergent themes.

To evaluate the methodological and conceptual quality of the included studies, a bespoke quality assessment rubric was developed, considering the interdisciplinary and theoretical nature of literature (Table 2). Each article was assessed based on relevance to post-naturalism, conceptual clarity, architectural contextualization, theoretical contribution, documentation of design examples, and scholarly rigor. A score out of 12 was assigned. Studies were not excluded based on quality, but this assessment helped contextualize the strength

and depth of the evidence. Studies were classified according to their quality level according to the total score obtained from these criteria: those with 10–12 points were considered high quality, those with 7–9 points were considered medium quality, and those with 6 and below were considered low quality (Table 3).

This assessment helped ensure that the selected studies were conceptually aligned with post-naturalist ecological thinking and demonstrated sufficient depth for inclusion in the thematic analysis (Table 3). The high scores in categories like post-natural relevance and theoretical contribution suggest that the included studies strongly engage with the conceptual shift beyond conventional ecological design. However, a few studies scored lower on use of architectural examples or disciplinary specificity, highlighting the still-developing intersection between theory and design application in this domain. This pattern reflects the emerging and often speculative nature of post-naturalist design research, where theoretical innovation may take precedence over conventional academic formalism. The quality assessment thus provided not a basis for exclusion, but a tool to contextualize the strengths, emphases, and gaps across the selected body of literature. While the final number of studies (n=12) is limited, our quality assessment confirms that the majority are high-quality, theoretically rigorous contributions that are directly relevant to post-natural ecological design in architecture. This supports our claim that the dataset, though small, is appropriate for this emerging, interdisciplinary topic.

Article	Approach	Referred concepts of nature (Q1)	Potential design concepts (Q2)	Perspective to design (Q3)	Architectural case examples & applications
1	Design	posthuman	"feral" "habitats for nonhuman species" "multi-species design"	radical empathy; interdisciplinarity	experimental multispecies façade prototypes and speculative living building envelopes
2	Theoretical	non-human socio-nature social-ecologies	"speculative" "ontological" "transitional"	redirective; relational; practice-based; social	speculative design studios, pedagogical and design practices that challenge dominant paradigms
3	Analytical	post-human nature-culture	"feral" "rewilding" "sympoietic"	speculative; territorial; co-habitative; multi-species systems; biologic	multispecies architectural interfaces, facilitating and containing feral agency
4	Analytical	non-human	"regenerative design" "microbial metabolisms" "bio-based materials"	interdisciplinary; technological; new materialist; biological	experimental earth-based material prototypes; urban-scale regenerative material systems
5	Theoretical	post-human	"more-than-human" "possibility of failure" "disturbance" "sympoietic"	accepting failure; objection; cohabitation; radical inclusion	speculative, situated design studio experiments engaging more-than-human ecologies
6	Analytical	subnature socio-ecological	"living organisms" "engineered living materials" "bio-fabrication"	disruptive technology; co-design; biological	bio-integrated prototypes and co-design experiments with fungi, algae, and other living organisms
7	Analytical	subnature next nature pure nature	"bio-derived concepts" "bio-building components" "living organisms"	biological; technological; living	experimental biohybrid design prototypes combining living systems with manufactured technologies
8	Theoretical	posthuman	"nomadic science" "biodigital" "robotic production"	non-dualistic; new materialist; performative	digitally grown pavilions, emergent collective forms through digital-biological systems
9	Theoretical	without-nature	"against' nature domestication" "rewilding" "living organisms" 'intricate choreography'	rewilding; biotic; morphogenetic; metabolic	open-ended, messy, or feral ecologies in speculative studio projects; urban wetlands, controlled biodiversity corridors, or techno-ecological landscapes
10	Design	subnature anxious landscape	human-computer interaction; material transformation	data-oriented; algorithmic; bio-receptive materials	data-driven urban mapping and interventions in subnatural, neglected urban zones
11	Theoretical	subnature dark nature	"bio-actant" "living matter" "gaia" "dark matter"	rethinking materials; co-creative with earthly habitats; compost thinking	ecological material experiments on mycelium-based architecture
12	Design	subcultural	"biotic materials" "third natures"	collective; non-conventional cultural forms;	landscape-integrated pavilion, community-driven public space transformation

Table 4: Analytical summary of the included studies. (2025)



In addition to the tailored quality assessment, a qualitative thematic analysis was employed to analyze the 12 selected studies. This method involves coding textual data, grouping codes into descriptive categories, and generating higher-level analytical themes. Recent studies across disciplines have demonstrated the value of thematic analysis in analyzing conceptual and design-oriented literature (Warner et al. 2020; Huang et al. 2025). The coding process aligned with thematic analysis yet incorporated grounded, comparative strategies influenced by Charmaz's (2008) constructivist grounded theory approach.

In this study, the analysis was structured around three analytical questions that served as the coding framework:

- Q1. Which alternative conceptions of nature are examined?
- Q2. What critical questions do they raise about the nature–culture relationship from an architectural perspective?
- Q3. What approaches do they emphasize in terms of architectural design strategy?

A summary of each article's responses to these questions was recorded in a comparative review table (Table 4), which enabled cross-analysis

and supported the development of overarching thematic categories. The full analysis procedure is detailed in Section 3.2.

### 3. Results

#### 3.1. Overview of included studies

Among the studies reviewed, those with an analytical approach [3, 4, 6, 7] provided a critical review supported by data. Hutt (2024) discussed challenging spatial narratives intended to be kept sterile and control-oriented by integrating wildlife into architecture. Bühler et al. (2024) proposed a resilience framework that provides practical ways to create built environments that self-organize as living metabolisms. Chayaamor-Heil et al. (2024) explored alternative materials and ecological models for designing living organisms, such as bacteria, algae, and fungi. Akyurek et al., (2021) drew attention to the critical role of small scale in understanding the technological transition from building components to bio-building components.

Studies using a theoretical approach [2, 5, 8, 9, 11] point to a conceptual shift. Bar (2020), drawing on current post-humanist and nomadic theories, focused on alternative material-oriented processes,

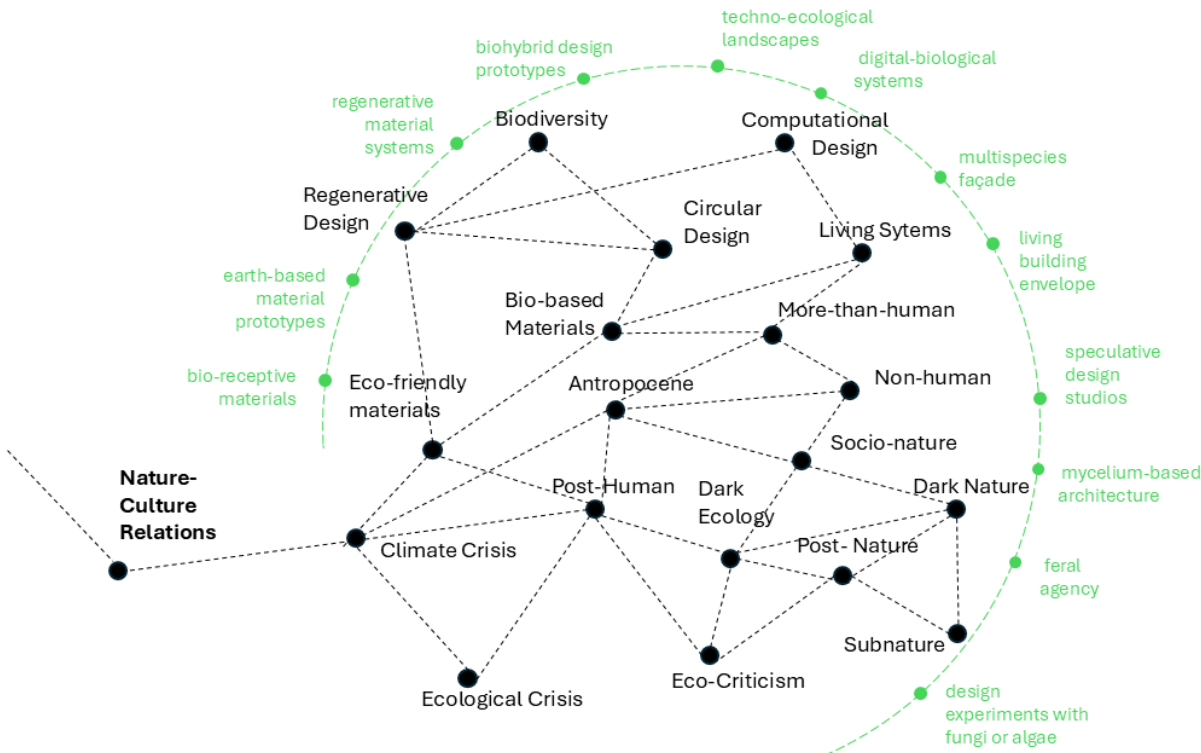


Figure 3: Conceptual Map from Reviewed Studies. (2025)

such as morphogenetics and reconceptualizations, moving away from binary relational models. Saha and Nusem (2024) proposed ontological, speculative, and transitional design theories to contribute to ecological thinking that emphasizes interdependent forms of existence. Leveratto (2024) referred to the concept of the post-human, which is often mentioned in many studies, proposing more than humans, and focused on architectural design that views the world as a place of interspecies coexistence and cooperation. While emphasizing the changes in ecological relationships, Mestre (2020) drew attention to new ways of designing the environment, far from romanticized aesthetics, such as rewilding. McGaw (2018), in a work titled *Dark Matter*, referenced Haraway's idea of compost to emphasize radical and social-ecological thought, which focuses on materials outside the architect's typical ecosystem, which can be uncanny or dirty.

Studies on the design approach [1, 10, 12] have focused on different design practices. Harrison (2024) who studied how to create potential habitats for nonhuman species, focused on urban facades and wild systems. Emphasizing the use of digital tools, Panagiotopoulou et al. (2018) drew attention to the interactions of post-industrial urban areas characterized by seemingly inhuman living conditions, attempting to address London's atmospheric toxicity with urban hybrid interventions organized by digital algorithms. Moreno and Grinda (2013) emphasized that urban space is a dirty, smelly, and noisy place against sanitization, proposing speculative practices through "third natures".

These examples provide concrete evidence of how post-naturalist thinking translates into architectural experimentation. For instance, Harrison's (2024) speculative multispecies façades are not only symbolic of cohabitation but also challenge modernist ideals of cleanliness and enclosure by inviting ecological overgrowth into the building envelope. Hutt's (2024) feral interface experiments similarly reject human-centric spatial control and instead design for the agency of other species, fostering post-human co-existence through spatial openness.

In theoretical works, speculative pedagogical settings such as Saha and Nusem's (2024) design studios embody more-than-human ecologies through transitional and ontological design practices. Leveratto's (2024) situated studio practices allow for messy, adaptive, and multispecies design outcomes, reflecting the instability central to post-naturalist critique.

From a material and biological perspective, Chayaamor-Heil et al., (2024) and Bühler et al. (2024) explore regenerative, co-designed prototypes, where mycelium, algae, and earth-based materials become design agents. These experimental

material systems not only introduce bio-agency but also question architectural boundaries and permanence.

Design-oriented contributions such as Bar (2020) and Akyurek et al., (2021) demonstrate the hybridization of biological and digital systems, where morphogenetic and biohybrid structures disrupt anthropocentric design logic. Across these cases, we observe a shared concern: architecture is reframed not as an inert object but as a living, co-produced ecology, where instability, decay, and symbiosis become key design principles. These examples deepen the thematic reading by anchoring abstract concepts into embodied and speculative practice, thereby operationalizing the post-naturalist lens through situated material engagements. Figure 3 presents an expanded version of the conceptual map, enriched with architectural examples derived from the systematic analysis to illustrate how theoretical concepts are grounded in design practice.

### 3.2. Thematic analysis of studies

A thematic analysis of post-naturalist design perspectives was conducted using a qualitative approach guided by the three analytical questions (Q1–Q3). The analysis was performed manually, while data extraction templates and code–theme mappings were documented digitally and iteratively reviewed to ensure consistency. A sample data extraction form and code–theme correspondence are included in Appendix A.

Each article was examined using a structured data extraction template, which systematically captured theoretical frameworks, key concepts, critical perspectives, architectural examples, and relevant page references. The coding process followed a predominantly deductive approach based on Q1–Q3, with inductive flexibility allowing for the inclusion of emergent subthemes.

In the initial coding phase, open codes were derived from each article's responses to the analytical questions. These codes were then grouped by conceptual affinity and refined through comparative cross-case analysis. Similar code clusters were synthesized into higher-level thematic categories, with boundaries defined by the conceptual frameworks they reflected.

This analysis resulted in the identification of three main thematic categories:

- Biological -Speculative Design Perspective
- Relational -New Materialist Design Perspective
- Innovative- Technologic Design Perspective.

Theme naming was based on the conceptual correspondence that best reflected the content of the theme. These themes were created by clustering the open codes obtained through

Q1–Q3 at the theoretical and practical levels, and each was supported by representative examples representing different aspects of ecological thinking in architecture.

### 3.2.1. Biological-speculative design perspective

The design concepts presented in the studies, such as *microbial metabolism*, *bio-based materials* [4], *bio-fabrication*, *engineered living materials*, *living organisms* [6], *bio-derived materials*, *bio-building*, *biotic materials*, *morphogenetic processes*, *metabolic processes* [9], *bio-actants*, and *compost* [11], pave the way for radical experiments with non-human organisms. Self-organizing built environments from an ecological perspective using microbial organisms allow the development of collective life based on different subnatures (Bühler et al., 2024). In this context, it is emphasized that microbiology and architecture are not separate disciplines, that alternative biological formations related to nature can disrupt capitalist hierarchies, and that the boundaries between the inside and outside can be blurred. Biomaterial advancements improve construction and reduce environmental impact, but most remain experimental and lack practical application (Córdova Alborec and Ríos Llamas, 2024). From an architectural perspective, a transformation from “a relationship in which architecture is seen as a means of separation from a completely harmful external environment to one based on interaction” (Gissen, 2010) is encouraged. In this context, the strategy of designing the regenerative capacity of the design itself rather than the strategy of designing objects that use living organisms is prominent. These perspectives challenge traditional models of architectural permanence and instead embrace processes like decay, growth, and metabolic transformation.

### 3.2.2. Relational-new materialist design perspective

The design concepts emphasized in these studies are *feral*, *habitats for nonhuman species*, *multi-species design* [1], *ontological*, *relational*, *practice-based* [2], *rewilding*, *sympoietic* [3], *more-than-human*, *cohabitation* [5], *choreography* [9], *human-computer interaction*, *material transformation* [10], and *collective* [12]. They have attempted to create a relational perspective beyond isolated architectural objects. With reference to current discussions in the field of New Materialism regarding the duality between nature and the built environment, it is emphasized that beings in the world have a reality independent of the human mind, that all objects are equally real and existent, and that none has an ontologically different status from the other. In this relational understanding, human and non-human agents and dynamics exist within different temporal cycles that can overlap, coexist, and intersect, all of which bring together living materiality. These new ways of thinking, nourished by the

ontological field, reject Cartesian dualism as the subject/object duality that has persisted since the Enlightenment and argue that objects exist and not merely as a homogeneous background for human representations.

### 3.2.3. Innovative-technologic design perspective

The design concepts emphasized in these studies are *regenerative design* [4], *engineered living materials*, *bio-fabrication*, *disruptive technology* [6], *nomadic science*, *bio-digital*, *robotic production* [8], and *non-conventional cultural forms* [12]. These support the perspective of innovation-oriented materials and the performative participation of different living beings in design. The reconceptualization of the architect as a digital craftsman who monitors imperceptible data that has been silenced and marginalized the creation of practical ways to create biotechnologies and self-organizing built environments, and the role of catalysts for unforeseen developments stand out (Bar, 2020; Bühler et al., 2024). In recent years, lightweight, durable, and biodegradable mycelium-based materials and concrete applications that repair their own cracks due to the bacteria they contain have shown innovative approaches in biotechnology. In this sense, the relationship with technology is changing.

Some studies engage with multiple themes, reflecting the interdisciplinary nature of post-natural design approaches. For instance, Bühler et al. (2024) contribute to both the biological-speculative and technologic-innovative perspectives through their integration of microbial systems and responsive technologies. Likewise, Bar (2020) engages both relational ontologies and technological reconfigurations. These three themes are discussed in the following section, corresponding to the conceptual foundations, critical design practices, and operational strategies identified in literature. They directly inform the structure of the discussion under the categories: Post-Naturalism in Architecture, Radical Practices, and Design Strategies.

## 4. Discussion and conclusions

The concept of post-naturalism, which was emphasized in the introduction of Latour's article as a philosophical thinker and Gissen as an architect, provides a conceptual framework for the biologic-speculative, relational-new materialist, and innovative-technological design perspectives presented in our thematic analysis. Concepts such as post-human, non-human, and more-than-human, which question the position of humans, are widely adopted, while nature-culture duality is expressed through concepts such as socio-nature, socio-ecological, subnature, and subculture. The articles examined using design and analytical

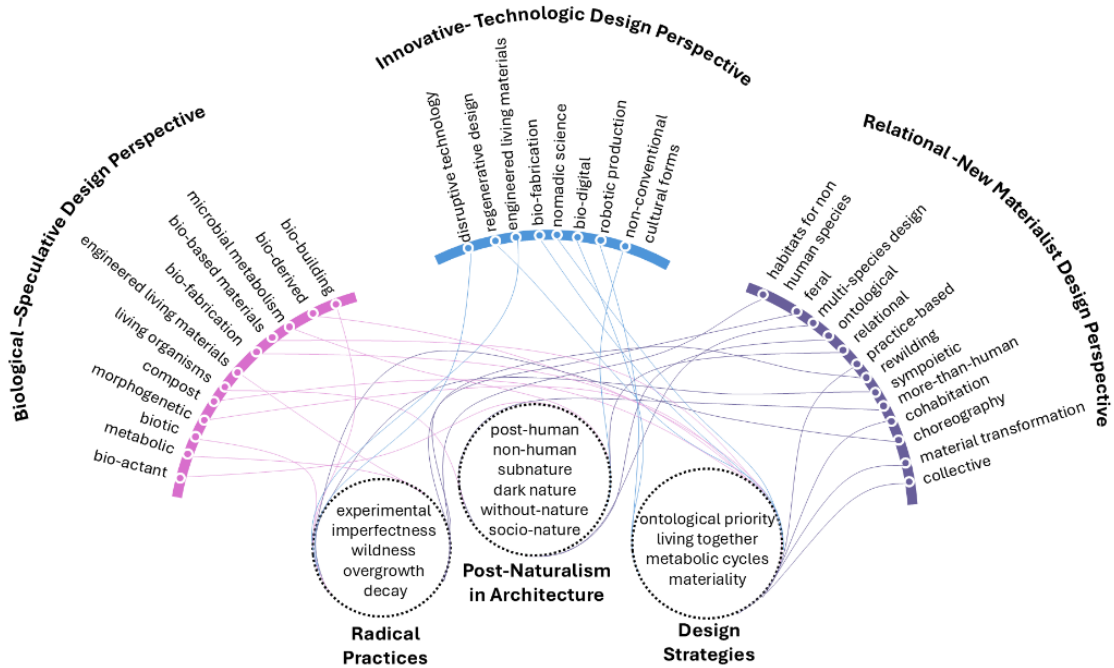


Figure 4: Analytical diagram of results. (2025)

approaches highlight radical or alternative practices. In all studies, it is common to search for conceptual shifts in nature in ecological design. In this section, the critical points of the results are discussed based on three themes:

### Post-naturalism in architecture

In the studies examined, the approach of architecture beyond the understanding of nature developed with standardized design models is evident. It posits the relationship with nature has historically changed according to social systems, and that this has shaped the relationship with the environment. These studies emphasize the instability and constant change of daily life and the environment by developing a critical perspective against defined expectations and isolated and static environments. The tendency to reject the idea of pre-human wild nature, resist efforts to reduce nature to a self-organizing field of existence, and understand and manage the dynamic interactions between human and non-human elements of the environment overlaps with the concept of post-naturalism. Nature and society are not separate spheres but co-produced through political, scientific, and material negotiations—a view that underpins the architectural approaches reviewed here (Latour, 2004). Although the studies use different conceptual terms—such as post-human, non-human, subnature, dark nature, without-nature, and socio-nature—they often converge in highlighting similar critiques of anthropocentric and binary understandings of nature.

### Radical practices

The examples given in each of the studies show that architects see subnatures such as algae, bacteria, mycelium, decay, wild ecologies, and dirty materials as endemic materials, and turn neglected ecological conditions into a reflection in design. There is a tendency to use buildings to draw attention to a variety of environments and alternative modes of architectural engagement so that go beyond architectural understanding. Harrison (2024), for example, proposed to apply the qualities of wildness, overgrowth, decay, and the metabolic cycle of elements that accompany

organic processes to building facades. Instances that integrate ecological principles beyond conventional natural design elements suggest that several traditional and rigid architectural notions (such as composition, plan, insulation, sustainability, control, and order) give way to innovative conceptual approaches. These new perspectives include ideas like more-than-human, bio-actant, and radical empathy, which offer new ways of conceptualizing architectural design. Such approaches foster radical empathy and experimental forms that embrace impermanence and ecological interdependence (Puig de la Bellacasa, 2017). The case studies given in the articles are radical in their forms, disrupting the idea that good architecture should be timeless and permanent, and offering opportunities for experimental, imperfect, and temporary possibilities.

## Design strategies

Studies show that widespread design strategies are experimental, control is left to different living beings or shared, and they proceed with a movement that requires interdisciplinarity (e.g., biology). Instead of integrating nature into design in a representative way, there is a tendency towards the ontological priority of the environment, while at the same time emphasizing socio-cultural conditions, such as living together. This ontological priority pushes us to rethink architecture's humanistic dependence on "projection, notation, and formal paradigms and to change the centuries-old tradition of architectural construction that separates materiality from thought" (Bar, 2020, p. 453). For example, designs with different living organisms such as insects or mycelium require a relationship between their physiological, chemical and other properties. In this sense, what is materiality, for whom is a habitat created, and how can the metabolic cycles of buildings be improved, which are accepted as valid parameters in the design process, begin to be questioned. On the other hand, speculative design, critical design, and design fiction come to the fore in various ways (Saha and Nusem, 2024). The search for alternatives to provide different responses to ecological problems and to go beyond the boundaries of design is evident in the design strategies.

These thematic patterns resonate with broader shifts in ecological and architectural theory over the past decade. As outlined by theorists such as Jane Bennett (2010), Timothy Ingold (2011), and Rosi Braidotti (2013), architectural discourse has increasingly moved beyond representational models of nature toward relational ontologies, material agency, and more-than-human entanglements. The emphasis on compost, fertility, microbial design, and multispecies interaction seen in the reviewed studies extends this discourse into spatial practice, suggesting that ecological architecture is undergoing a fundamental philosophical transformation.

In summary, the reviewed studies show that a way of thinking is developing through experimentation and/or discourse, challenging established interpretations and proposing novel conceptual frameworks. These three thematic perspectives do not operate in isolation but are interconnected through overlapping conceptual frameworks and design logics. As shown in Figure 4, post-naturalist architecture is characterized by a constellation of radical practices and strategic approaches that cut across speculative biological experimentation, relational material thinking, and technologic innovation. This way of thinking is not only concerned with representations of nature but also points to a design approach and architectural practice that does not separate designers and designed beings from the entities that have been covered up until now. At the same time, what is not included in the scope of architecture becomes questionable. In this context, practices that question the nature of matter and materials, temporary installations, and speculative projects can be widely adopted because they are experimental. Post-natural practices, which transform basic knowledge about design and offer opportunities for experimental, imperfect, and temporary possibilities, show that trends that intertwine architecture and nature, other than green, sustainable, or other environmentalisms, are diversifying.

By proposing this review, which analyzes the trends and patterns identified in the literature on ecology and architecture, the evolving design approaches to marginalized materialities that are not included in the scope of architectural design were evaluated within a post-naturalist framework. Discussing the existence of nature is not a new

topic in the field of architectural design, but studies on the cooperation between different living and non-living species and the design understanding of alternative biological formations through innovative design approaches are relatively new.

The evaluation showed that design approaches and biotechnological strategies related to different living species have increased in the last decade, especially regarding the concept of the post-human. However, to fully understand relational design regarding nature and radical architectural approaches, it is not enough to evaluate them only under the concept of a post-human. In light of these considerations, we sought to establish a “post-naturalist” framework to facilitate a comprehensive understanding of the evolution of architectural design, encompassing not only the incorporation of diverse living organisms, such as mycelium, insects, bacteria, and algae, into the built environment, but also the necessity of addressing non-disciplinary concerns, including transpiration, decay, and rust.

The concept of post-naturalism has been relatively understudied in architectural research, which emphasizes the interrelationship between nature and culture. The studies included in the review indicate that areas such as innovative materials, materiality, coexistence with different species, and design practice with other disciplines are evaluated to a greater extent than optimal. Furthermore, these studies concur with the identification of a sociocultural paradigm shift. Evidently, the concept of sustainability has received minimal attention in ecological and environment-related articles. One reason for this is that the selected studies place significant emphasis on a deep and critical perspective on ecology through materiality, which is marginalized and perceived as unsightly, unaesthetic, or peripheral in architectural discourse.

## 5. Recommendations

In a world in which everything is in flux and all material entities are interconnected, it is crucial to examine the relationship between nature and cultural forces. The entities marginalized against nature, which are enabled by being objectified within the processes of subjectification in architectural design—that is, the creation of entities in a desired form or their suppression—present an alternative potential for innovative and ecological design approaches. This potential has given rise to new imaginations of the object of architecture, ecological design actions, and new design strategies.

Concurrently, the architectural actions proposed in the studies are evaluated in alternative, experimental, or radical contexts, as ‘sustainability’ in architectural design creates a clear boundary between nature and a green-focused system approach. These approaches encompass dark and non-sterile aspects, together with current environmental concerns that are exacerbated by the objectification of nature. From the review of the studies examined, it is evident that there is a lack of research on several key issues. These include the discussion of non-sterile or unhygienic design strategies, questioning of the origins of architecture and its ecological aesthetic perception, and the generation of discussions on the subject and object of architecture. Based on the review presented in this study, our objective was to encourage further research into radical and innovative areas that are not sufficiently visible for future ecological design approaches.

The scope of this study was limited to 12 articles, a relatively limited dataset, due to the interdisciplinary nature of post-naturalist approaches in architecture.

Question area	Subsection	Content (e.g. Article: Harrison, 2024)
Q1. Alternative conceptions of nature	Conceptual terms	e.g., post-human, feral, multi-species
	Theoretical framework	e.g., post-naturalism, Gaia theory
	Representative quotes / page no	e.g., ‘Architecture must include nonhuman desires’ (p.12)
	Open codes	e.g., posthuman nature, multi-species design
	Critical focus	e.g., instrumentalization of nature
Q2. Critical questions from architectural perspective	Questioned concepts	e.g., anthropocentrism
	Representative quotes / page no	e.g., ‘The binary view of nature and culture collapses...’ (p.5)
	Open codes	e.g., critique of nature-culture dualism
	Architectural strategies	e.g., bio fabrication, feral design
Q3. Design strategies	Application examples	e.g., microorganism-based façades
	Representative quotes / page no	e.g., ‘Architecture as a co-design act...’ (p.18)
	Open codes	e.g., symbiotic strategies, material experimentation
Code → theme mapping	Code	e.g., posthuman nature
	Theme	Biological–Speculative
	Explanation	Redefining the boundaries of nature



However, it is important to acknowledge that the small sample size may affect the generalizability of the findings. The diversity of concepts and the speculative nature of many reviewed studies indicate a field still in formation, where theoretical richness often exceeds practical application. In this context, the trends and themes revealed in this study should not be considered definitive statements, indicative tendencies that point toward shifting paradigms in ecological design. Future studies with broader datasets could expand and refine the framework proposed here and test it in different contexts. Furthermore, due to the scope of this study, regional or cultural differences were not examined in detail; this offers new avenues for future comparative research.

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