Sustainable Architectural Design Projects – A Semiotic Understanding

Sherif Goubran a\*

a Individualized Program, Concordia University, Montreal, Canada

\*sherif.goubran@mail.concordia.ca

Sherif Goubran is an architect and PhD candidate in the Individualized Program (INDI) at Concordia University. He is a Vanier Scholar (SSHRC) and a Concordia Public Scholar. His research is focused on sustainable building practices and their intersection with international development agendas. Sherif has an MASc in building engineering from Concordia University and a BS in architecture from the American University in Cairo - Egypt.

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# Abstract

The potential of semiotics to theorize and analyze the field of sustainable architecture is still largely unexplored. This paper uses a triadic structure for defining sustainable design signs and distinguishes two separate modes of sustainable design reasoning: namely deductive and abductive sustainable design reasoning. This theoretical framework is used to analyze two architectural projects submitted for an international design competition in Montreal, Canada. The architectural texts, considered in this paper the representamen of the signs, prove to be indicative of the mode of reasoning deployed. The analysis also reveals that the mode of reasoning used dictates the types of signs produced, the role designed-objects have in the signs, as well as the functional possibilities design elements perform in the project. The paper proposes that deductive sustainable design reasoning brings to a halt the process of semiosis – presenting a status-quo approach – and that abductive sustainable design reasoning allows semiosis ad infinitum – presenting a future driven outlook. Additionally, a gap appeared between the open form of critical judgement proposed for competitions and the conceptual fixation inherit in deductive sustainable design reasoning. This paper presents a theoretical contribution that provides new possibilities for researches to model and analyze sustainability in design projects.

**Keywords:** Reasoning; sustainability; architecture; design competition; Green buildings; Sustainable design visions

# Introduction

Buildings are historic, cultural, social, and technological artifacts (Gieryn 2002; Goss 1988; Doyle 1991). In an effort to understand buildings, previous research has attempted to assimilate the built environment in social theory (Lawrence and Low 1990; Gieryn 2002; Leach 1997). On the other hand, wide cultural, technical, and natural principles govern architecture[[1]](#footnote-1) as a social, economic and practical activity (Nelson and Stolterman 2012). One can argue that the designing buildings[[2]](#footnote-2), in all their complexity, requires both critical and reflective practice; borrowing some features from the artistic process (Schön 1983; O‘toole 1992). What has been made certain by previous research is architecture’s ability to convey meaning (Krampen 2013; Eco 1981; Doyle 1991).

There have been many attempts to propose parallels between language and architecture – where both can be understood as systems of communications (Cucuzzella et al. 2019). This notion of the built environment as an indefinite code waiting to be ‘decoded’ by the urban navigator has become progressively common. However, if we use Barthes’ recommendation, decoding the built environment requires a person who is a geographer, urbanist, architect, historian, and psychoanalyst (Barthes, 1985 - p 9). Others scholars proposed to see architecture as a language in itself and used theories of semiotics and semiology to understand it and to expose its visible or concealed meanings (Klee 2018; Gieryn 2002; Abd. Manan and Smith 2014; Lazutina et al. 2016; Wang and Heath 2011; Doyle 1991). However, less focus has been placed on using these theories to understand the architectural project (i.e. the process of architectural design itself) and specifically to understand the phenomenon of sustainable architecture as manifested in architectural design.

Projects have been theorized as a social and anthropological phenomenon (Lang 1987; Boutinet 2005). Sustainability, on the other hand, is understood as a complex socially constructed philosophy[[3]](#footnote-3) – made of multi-layered and interconnected natural, social, ethical and ideological characteristics (Walker 2006; World Commission on Environment and Development 1987; Fry 2009). The definition, constituents and breadth of the philosophy of sustainability have experienced many developments and changes since its emergence (United Nations 2016; Robert, Parris, and Leiserowitz 2005; Liodakis 2010; Moe 1984; Hajer 1995; United Nations 2015; Pawłowski 2008). However, the application of sustainability in the field of architecture has resulted in the creation of new approaches, shifts in practice as well as the establishment of different standards and norms (Vandevyvere and Heynen 2014; Scardigno 2014; Keitsch 2012). Today, several questions are still being debated such as (1) what sustainability means in architecture, (2) how does sustainable design manifest and differentiate in building projects, and (3) how sustainability is communicated in architectural design projects. In other fields, semiotics is used to theorize and model multidisciplinary practice (Li 2017; Barley and Tolbert 1997). However, the potential of semiotics to theorize and analyze the field of sustainable architecture – specifically relating to the production of meaning in design – is still largely unexplored.

This paper explores how semiotics can provide the theoretical basis for examining and modelling the dynamic processes involved in sustainable architecture design. Previous research has shown that two rationalities of sustainable design are present - the technical rationality and problem setting rationality (Cucuzzella 2016). The paper develops on this view and defines the technical and problem setting rationalities as two distinct modes of reasoning: defining them as deductive and abductive sustainable design reasoning respectively. By studying the signs of sustainability in design projects, the paper proposes a methodology for differentiating between these modes of reasoning, to investigate their styles of signification, and their consequences on architectural projects and their analysis. The hypothesis of the paper is that deductive sustainable design reasoning brings to a halt the process of semiosis and abductive sustainable design reasoning allows semiosis *ad infinitum.*

“[T]o say that a hypothesis is plausible is itself a plausible hypothesis, and so it goes ad infinitum: we have a logical circle that can never reach its own point of departure.” (Fisette 1997 - p 73).

In order to study the proposed hypothesis, the paper uses a corpus of documents extracted from the international competition for new Montreal Planetarium (Le Projet du Nouveau Planétarium de Montréal)[[4]](#footnote-4) launched in 2008 and concluded in mid-2009. This two-step competition is considered important in the context of Montreal for a number of reasons: 1) it was an international competition, 2) it received very high visibility and the built project became an important icon for tourism in the city’s Olympic complex, 3) it was one of the first projects to require Leadership in Energy and Environmental Design (LEED®) platinum certification - the highest level possible (Cucuzzella 2015a), and 4) as highlighted in the jury report and the second stage competition brief, the environmental approach of the submitted projects – their innovation and the quality of integrating LEED© credits – constituted the highest percentage (20%) in the judgment criteria. The selection of projects within the framework of a competition is critical since competitions have been theorized as a democratic method for the production of knowledge and architectural quality with a long tradition in the field (Rönn, Kazemian, and Andersson 2011; Turner et al. 2015; Andersson, Zettersten, and Rönn 2013; Chupin, Cucuzzella, and Helal 2015).

Two projects will be used in this analysis: the winning project by Cardin + Ædifica, Ædifica, SNC Lavalin, Dupras Ledoux, and Fauteux et associés (referred to as Cardin + Ædifica) as well as a runner-up project by Atelier Big City & L'Oeuf (referred to as Big City + L'Oeuf). The main texts which will be used are the architectural texts of the second step of the competition – which are required as part of the submission folders for the projects – as well as the design panels. In accordance with the competition requirements, the original architectural texts were provided in French. In this paper, the statements are translated to English by the author and the original French statements are provided for reference in the footnotes. Discourse analysis will be used to analyze the statements that appear in the text in order to identify the reasoning modes deployed (van Dijk 2008a; van Dijk 2008b; Michel Foucault 1993). Additionally, critical discourse analysis approaches will be used to highlight and relate the specific arguments presented with the broader situation of the project including information presented in the jury report (Michel Foucault 1993; Hodge and Kress 1995b; Hodge and Kress 1995a).

# The application of semiotic theory in architecture design projects

The theoretical ground of this paper is founded on the semiotics of C.S. Peirce. The Essential Peirce Volume 2 (EP2) edited by the Peirce Edition Project (Houser et al. 1998), The Philosophical Writings of Peirce (Buchler 1955) and The second volume of the Collected Papers (CP2) (Hartshorne, Weiss, and Burks 1994) are used as primary sources. The works of Deledalle (2000), Fisette (1997), and Hoopes (1991)[[5]](#footnote-5) are used as secondary print sources. This paper views sustainability cues in architectural design projects as triadic signs which can be reproduced or created. For consistency, the general terminology adopted is that the sign has a representamen, an object and an interpretant (Figure 1)[[6]](#footnote-6).

In order to establish the triad of sustainable design signs, each of the 3 members[[7]](#footnote-7) (namely the representamen, object and interpretant) have to understood and defined. Peirce articulates the definition of the triad’s members as well as the general relation between them:

“A Representamen is the First Correlate of a triadic relation, the Second Correlate being termed its Object, and the possible Third Correlate being termed its Interpretant, by which triadic relation the possible Interpretant is determined to be the First Correlate of the same triadic relation to the same Object, and for some Possible Interpretant.” (EP2.290)

“A Sign, or Representamen, is a First which stands in such a genuine triadic relation to a Second, called its Object, as to be capable of determining a Third, called its Interpretant, to assume the same triadic relation to its Object in which it stands itself to the same Object. The triadic relation is genuine, that is its three members are bound together by it in a way that does not consist in any complexus of dyadic relations. That is the reason the Interpretant, or Third, cannot stand in a mere dyadic relation to the Object, but must stand in such a relation to it as the Representamen itself does.” (Buchler 1955 - p100)

As understood in the previous passages, the relation between each of the 3 members is equivalent and cannot be reduced to any number of dichotomies. However, he does not refute the possibility of more complex relations but rather indicates that simplifying signs further than a triad would only distort their reality. Instead, he proposes that “four can be analyzed into threes” (Deledalle 2000).

Peirce gives the interpretant a clear definition

“[..] the idea in the mind that the sign excites, which is a mental sign of the same object, is called an interpretant of the sign.” (EP2.13)

While Deledalle (2000) uses the Sir W. Hamilton’s definition of the word representamen found in the Century Dictionary[[8]](#footnote-8), Peirce defined the term more broadly:

“[Representamen is an] object serving to represent something to the mind.” (Sir W. Hamilton 1887)

He also distinguishes between the first sign and the subsequent signs as well as between the representamen and its ground. Additionally, he makes specific how the representamen relates its object[[9]](#footnote-9) and creates new signs.

“A sign, or representamen, is something which stands to somebody for something in some respect or capacity. It addresses somebody, that is, creates in the mind of that person an equivalent sign, or perhaps a more developed sign. That sign which it creates I call the interpretant of the first sign. The sign stands for something, its object. It stands for that object, not in all respects, but in reference to a sort of idea, which I have sometimes called the ground of the representamen.” (Buchler 1955 - p99)

Peirce elaborates further on the specific relation between a representamen and its object.

“The object represented is supposed not to be affected by the representation. That is essential to the idea of representation. The Representamen is affected by [the] Object but is not otherwise modified in the operation of representation. It is either qualitatively the double of the object in the Icon, or it is a patient on which the object really acts, in the Index; or it is intellectually linked to the object in such a way as to be mentally excited by that object, in the Symbol.” (EP2.171)

“But a Representamen mediates between its Interpretant and its Object, and that which cannot be the Object of the Representamen cannot be the Object of the Interpretant.” (EP2.276)

Throughout his writing, Peirce highlights the fundamental role the representamen plays in the triadic relation. As seen in the previous quotes, Peirce clarifies that the representamen is a “first”. Deledalle (2000) clarifies that the process of semiosis can only be set-off through a representamen and that, in semiosis, the interpretant of one sign becomes representamen in another (Deledalle 2000). In fact, the process of semiosis can only continue infinitely as long as the interpretant becomes the representamen in a different sign.

 “[A sign (or representamen) is] anything which determines something else (its interpretant) to refer to an object to which itself refers (its object) in the same way, the interpretant becoming in turn a sign, and so on ad infinitum” (CP2.303).

In this paper, the representamen is the linguistic – or textual - form of the sign (referred to as *text*), the object is that which stands for the representamen (referred to as *designed-object*), and the interpretant is the meaning and it exists in the realm of ideas, concepts and thoughts[[10]](#footnote-10). Objects can be dynamical (i.e. the real object) or immediate (i.e. as represented by the sign). On the other hand, the process of semiosis could be potentially short-circuited when arriving at a final interpretant by force of habit – in turn bringing the process of semiosis to an end (Fisette 1997).

[Insert Figure 1 here]

In the context of architectural design projects, a linguistic representamen, as presented in the reports and descriptive texts, corresponds to what the designers (or design team) have to “say”. Li proposes that “saying” could be taken as the representamen since it is naturally distinct from “doing” – which in the case of architectural design would correspond to the designed-object (i.e. the object that designers create) (Li 2017). In fact, Peirce elaborates on the linguistic forms of a representamen in *The Categories Defended*. He clarifies that “any general word, [or] sentence […]” are from a class of representamen that will fulfil its function “solely and simply because it will be interpreted to be a representamen” (EP2.163). He then clarifies further in *The Three Normative Sciences:*

“A representamen is either a rhema, a proposition, or an argument. An argument is a representamen which separately shows what interpretant it is intended to determine. A proposition is a representamen which is not an argument, but which separately indicates what object it is intended to represent. A rhema is a simple representation without such separate part.” (EP2.204)

Sheriff argues in the *Fate of Meaning* that literary text could be considered rhematic (Sheriff 1989). So, while the text is itself is a sign (made of terms, propositions and arguments), its interpretant is not restricted to arguments and could take the form of “a rhema, a proposition, or an argument” (EP2.204). Through semiosis, this interpretant becomes the representamen that determines a new interpretant - another rheme, proposition or argument – and so on to infinity (Deledalle 2000; Fisette 1997).

In architecture design projects, texts are used to describe, clarify and specify the design. Andersson, Zettersten and Rön offer a description of the texts’ role in architecture projects in their preface of *Architectural Competitions – Histories and Practice:*

“[…] the descriptive text has no value in itself, but is intended only to clarify the knowledge that is already deposited in the images and being conveyed through visual impressions. It is an already formed environment which is being revealed to the observer as design. The pictures transmit experience. The text on the other hand is intellectual in character, appealing to reason. Consequently, text and image represent two very different understandings of knowledge which are both to be found in architectural competitions, and which are made manifest in the mode of communication and visualization of knowledge to the observer.” (Andersson, Zettersten, and Rönn 2013 - p10-11)

While Andersson, Zettersten and Rön do not specifically articulate the relation between text and images (considered in this paper the designed-objects), 4 important observations could be extracted: 1) that descriptive texts and images are distinct elements of the project, 2) that each element conveys a different dimension of the project – text appealing to reason the images transmitting experiences, 3) that descriptive texts do not affect the images but that the texts are affected by the images, and 4) that the knowledge indented to be conveyed (which could be understood as the design’s meaning) has a simultaneous relation to both texts and images. These observations reveal the triadic relation of – *texts-images-meaning* – in architectural projects that cannot be reduced to dichotomies. Additionally, Peirce’s indication that “the object is supposed not to be affected the representation and the representamen is affected by the object” (EP2.171) stands in parallel to observation 3 taken from Andersson, Zettersten and Rön’s text (i.e. the descriptive text is affected by the designed-object, but doesn’t affect it).. Since the descriptive texts of architectural design projects ought to represent designed-objects, it could be considered a representamen within the context of a specific design problem or design element.

There is a needed distinction between the designed-object and the design documents on one hand and the real project on the other. This distinction can be understood based on Perkins-Buzo’s proposal that the design documents present the object that is intended to be built (Perkins-Buzo 2017). These intentions surely embody certain real-life limitations (such as codes, costs, time and resources) and goals (such as needs and market demands) as proposed by Lang (1987 - p38). In real-life situations, building designs change continuously until the last phases of the construction (changes which might include removal of features or changes in specifications) (Lang 1987). Thus, we can propose that in design documents, where the project first becomes a physical object that exists in the environment beyond the mind of the planner (Perkins-Buzo 2017), foreground the intentions of the designer. Thus, the paper proposes that sustainable design reasoning can be best understood from these early design documents.

The concept of the three irreducible categories of being[[11]](#footnote-11) (namely firstness, secondness and thirdness) plays a key role in the semiotic understanding of signs – including sustainable architectural signs (Fisette 1997; EP2.196).

“Philosophy has three grand divisions. The first is Phenomenology, which simply contemplates the Universal Phenomenon, and discerns its ubiquitous elements, Firstness, Secondness, and Thirdness, together perhaps with other series of categories. The second grand division is Normative Science, which investigates the universal and necessary laws of the relation of Phenomena to Ends, that is, perhaps, to Truth, Right, and Beauty. The third grand division is Metaphysics, which endeavors to comprehend the Reality of Phenomena. Now Reality is an affair of Thirdness as Thirdness, that is, in its mediation between Secondness and Firstness.” (EP2.196)

This trichotomy presents the distinction between phenomena and their occurrences – the *types* and their *tokens* (Fisette 1997 - p 6). Using explorations of semiotics in artistic practice, we can propose to correlate firstness with abductive reasoning as a mode of providing possibilities for meanings to emerge and to correlate thirdness with deduction reasoning as a mode of presenting fixed meanings based on convention and habit.

“An Abduction is a method of forming a general prediction without any positive assurance that it will succeed either in the special case or usually, its justification being that it is the only possible hope of regulating our future conduct rationally, and that Induction from past experience gives us strong encouragement to hope that it will be successful in the future.” (Buchler 1955 - p299)

The interpretation of Boudon (2000) is key for understanding the application of the modes of reasoning to architecture projects.

“[We] dissociated the principle of abduction (which innovates) from that of deduction (which establishes) and induction (which discovers) [...] It is this categorical memory [induced by deduction] which is questioned by abduction in its investigative work” (Boudon 2000 - p 84) [[12]](#footnote-12)

This view allows us to distinguish between abduction which innovates by investigation and deduction which establishes by regulation and habit. When these different modes of reasoning are applied in design, and sustainable architecture in specific, they offer different limitations, possibilities and regularities for the formation meanings, the role of objects and the construction of signs.

# Modes of reasoning and sign trichotomies in architecture design

Cucuzzella (2016) proposes a theoretical model which distinguishes between problem-solving and problem setting approaches in design. She describes discourse in problem-solving approaches as prescriptive and universal while discourse in problem setting approaches as contextual and reflective. Concrete examples can help highlight these approaches and correlate them with deductive (resulting in what could be understood as problem-solving) and abductive (resulting in what could be understood as problem setting) modes of reasoning. The two selected projects in the Planetarium competition present two different approaches to environmental and sustainable design. Each of the two analyzed projects presents a reflection and introduction relating to LEED® requirements and how they fit within the proposed project.

“Beyond the abstract accounting required for the LEED qualification, our understanding of architecture is changing. [...] [H]owever, the tension between juxtaposition and integration is exacerbated today by the LEED requirements and the proliferation of electro-mechanical devices that are involved in the operation of the building (and even in the city itself).” - Big City + L'Oeuf [[13]](#footnote-13)

In this short reflection, *Big City + L'Oeuf* put in question the LEED© system: they indicate that, unless applied critically, this credit scheme can create tensions and juxtapositions that might not be in line with critical ecological approaches. Although the statement does not directly present any concrete innovation (reiterating the concerns voiced by many scholars and practitioners), it signals a reflexive and critical approach to the project LEED® platinum certification requirement. Big City + L'Oeuf question the ability of LEED® - its credits and requirements - to define the sustainability of the project. The reflection directly relates to Boudon’s (2000) description of abductive exploration and its questioning of deductive rules and categories. In *Big City + L'Oeuf*’s project, the topics of ecology and sustainability emerge across all the text and are integrated with and inseparable from the description of the architecture. They focus their discussion on the critical integration and mediation between functions, spaces, quality and technology.

On the other hand, Cardin + Ædifica present the sustainability of their project differently. About 50% of their text is dedicated to the environmental discourse which they organize under sub-titles which are based on the LEED® categories (namely water, energy, materials, etc.) (Cucuzzella 2015b). Unlike Big City + L'Oeuf which integrated the sustainable and ecological with the architectural description,Cardin + Ædifica concentrated all the sustainability-related information at the end of the text – after presenting the spatial and architectural details of the projects. This text, in fact, directly represents the project from the perspective of LEED©, its categories and credits.

“The topics below address the most important elements of the LEED accreditation system that we plan to participate in.” - Cardin + Ædifica [[14]](#footnote-14)

This pragmatic approach does not question the given directives of the certification, instead, it confirms their relevance in defining the project. The main argument presented by the text is that ‘in addition to attaining the spatial and museological design requirements, the project also tackles all the categories and credits required to attain the LEED© Platinum level’.

Cardin + Ædifica’s approach to sustainability remains grounded in the credit and code requirements when describing the specific sustainability features of their project. The case of the ventilation system clearly highlights their approach. The representamen describes this environmental feature based on other higher-order signs – such as laws, best-practice, codes, and guidelines. It establishes the meaning of these signs based on conventions. For this specific ventilation feature, only one figure is presented on the panels (Figure 2).

“The supply of air through the raised floors is geared towards achieving better air quality in the building. [...] A complete air quality management plan will be provided. [...] The thermal comfort expected by the engineers is in accordance with ASHRAE 55-2004.” - Cardin + Ædifica [[15]](#footnote-15)

[Insert Figure 2 here]

By looking at the content of the statement, the representamen can only be understood as a legisign. Thus by considering the signs hierarchy, their interpretants can only be argumentic – and in turn, their objects can only be symbolic (Krampen, 2013 - p 41). Within the triadic structure proposed earlier and based on the ideas of Krampen (2013 - p 44), Figure 2 can be understood as a symbol for the representamen defined by the ASHRAE 55-2004 guideline (as a convention). Thus, the representamen is an argument for achieving the specific ASHRAE guideline (a necessary part of achieving a complete connex) and the figure is symbolic to this achievement (Krampen, 2013 - p 43). Purely deductive design reasoning creates a limitation in the process of signification since it can only allow argumentic-symbolic-legisigns to be created. For these signs, the final interpretant is present and accessible to the reader – which is the specific conventions, rules or codes referenced. Thus, these argumentic-symbolic-legisigns refuse to be further interpreted and lead to short-circuiting the process of semiosis. In the example of the ventilation, the sign cannot be interpreted further than the argument of achieving the guideline. In this context, the argument can be understood as the sign’s final interpretant.

Kaelin argues that a purely aesthetic sign could be a rhematic-iconic-qualisign (Kaelin 1983). However, a representamen describing sustainability features based on the qualities and functions of elements and objects – avoiding references to habits, and codes yet moving beyond the simple sensory or perceptible level – can be understood as a sinsign (Krampen, 2013 - p 45). In fact, and if we take Perkins-Buzo’s approach (2017), the designers’ description aims to communicate an object of “actual existence” ((Buchler 1955 - p101). This can be seen in the case of the solar wall description proposed by *Big City + L'Oeuf.* Figure 3, which depicts the instances the wall appears on the panels – presents the relations indicated in the text and mirrors its description.

“Basic strategies for sustainable development quickly crystallized the geometry of the building and established the importance of a solar wall. This wall, which crosses the interior on three levels, becomes an architectural landmark and a strong scenographic element. It organizes air flows around it and allows pre-conditioning of air within it. The approach to sustainable development is inseparable from architecture; it is part of the scenography.” - Big City + L'Oeuf. [[16]](#footnote-16)

[Insert Figure 3 here]

Within this context, this solar wall – which is a key sustainability feature in the project – presents a new design hypothesis. It is a result of an innovative – abductive - process which combines geometry, technical knowledge, knowledge of the natural sciences, and knowledge of the principles of air movement and its buoyancy. The hypothesis captures a firstness – the possible qualitative existence of such a wall which combines the described features and organizes the spaces as indicated. Most importantly, further interpretation is required in order for meanings specific to the project to fully emerge. This sign builds a connection with a broad concept – that of sustainable development. Since the notion of sustainability mentioned in the text can be considered an open-context[[17]](#footnote-17), the interpretant remains rhematic: open for different interpretations through continuous semiosis (Krampen, 2013 - p 42 & 44). The designed-object depicts the relations and characteristics described in the text making their relation iconic. Thus, in the specific case of the solar wall, a rhematic-iconic-sinsign is constructed. This sign can be taken a representamen, in continuous semiosis, which in turn can create higher-order signs – arriving at a possible final interpretant (Fisette, 1997 - p 15). These cases exemplify Boudon’s (2002) proposal; abductive mode of sustainable design reasoning – where meaning emerges by semiosis - functions in contrast to deductive sustainable design reasoning - which establishes meaning based on guidelines and convention.

Using Li’s (2017) concept of sign coupling, it can be argued that, in the in abductive design reasoning, the representamen (the text) and the object (the designed-object) undergo coupling. In this case, both the text and designed-object become an intrinsic part of the sign that cannot be separated – ideas which have been also proposed by De Biasi & Biasi (2000). Li’s (2017) ideas of institutionalization will be explored further in the discussion on denotative and connotative functions of architecture objects.

# The role of designed-objects and the risks of abductive reasoning

The roles and characteristics of designed-objects are important aspects to analyze in architectural design projects. From the previous examples, it was seen that designed-objects can only exist as symbols in argumentic signs and that they can exist as icons (as well as indexes or symbols) in rhematic signs. These limitations are based on the hierarchy of signs and their trichotomies (Fisette 1997; Krampen 2013). However, in projects, some of the texts and statements refer to objects or elements which are not directly identifiable in the design documents – since not all objects are represented on the panels. By combining this with the ideas relating to dynamical and immediate objects, we can propose that when objects are being referred to in the text, 1) designed-objects can have a dynamical existence when they have a positive qualitative existence in the design documents, or 2) designed-objects only have an immediate possibility when they cannot be identified or isolated in the design documents.

The last passage of the text presented by Cardin + Ædifica, a proposal for an educational program on the environmental features of the building is proposed, legitimized by possible innovation credits which were attained in a previous Montreal project.

“In addition, we also plan to set up an educational program demonstrating the functioning of the building systems using screens, panels and pamphlets. The program will focus specifically on water management, energy performance and any other intervention which proves to be interesting for visitors. This program has already been the subject of an innovation credit for the Tohu project."- Cardin + Ædifica [[18]](#footnote-18)

Despite the museological integration required for achieving the credit[[19]](#footnote-19), this proposal does not appear in the panels of the projects – in drawings or illustrations. Instead, the team establishes the legitimacy of the proposed strategy based on proven ability to generate credits – a previous experience or precedent. This deductive approach, which establishes its legitimacy based on previous experience and convention, presents an incomplete sign with no designed-object. For this sign to be interpreted as an effective environmental strategy in the project, a fictional immediate object is needed - since the “real” object is non-existent.

On the other hand, in Big City + L'Oeuf’s project, an abstract description of the green roof is presented which is coupled with various illustrations in the drawings (Figure 4).

“[T]he Planetarium presents another of its ecological faces through its green roof whose design is inspired by a pixelated image of the Tarantula Nebula." - Big City + L'Oeuf [[20]](#footnote-20)

[Insert Figure 4 here]

The traditional notion of the green roof is challenged in order to provide, by abduction, a new design hypothesis that combines ideas from astronomy and ecology. Although many fictional immediate objects can emerge by reading the textual description, the proposed design (which is significantly detailed in about 8 drawings on the panels) provide a dynamical designed-object that confronts any fictional immediate objects imagined. Said otherwise, any immediate objects that are created by interpretants are eliminated by the designed-object present on the panels. This confrontation between the immediate and dynamical objects can, in fact, be observed through the Jury’s comments. The green roof, when judged by experts and professionals on the jury, resulted in a mismatch between the imagined (fictional immediate objects) and the dynamical designed-object proposed.

“The imagery of the celestial map is broken by the heaviness of the volume; the green roof does not match this image” – Jury [[21]](#footnote-21)

Wilson (2018) provides a meaningful reflection which captures some of the tensions that arise around fictional immediate objects, their interpretation. It also hints to possible conflicts between immediate and dynamical objects.

“[W]e are satisfied with this “cheap truth” in the cases of statements about fictional objects because, in those cases, we disregard their dynamical objects and consider only whether the statement made about the fictional object conforms to the immediate object upon conventional interpretations of the proposition […]. It involves considering how [we believe] the fictional object should be interpreted.” - Wilson (2018)

Understood this way, the case of the educational program proposed by Cardin + Ædifica results in a fictional immediate object. The dynamical object of this feature is disregarded and is instead validated by the design team’s previous experience – its validity is established by convention. On the other hand, in Big City + L’Oeuf’s green roof, the immediate object of the imagined universe and stars is confronted with a dynamical object that has a qualitative existence. In this case, the interpretation of the designers did not conform with the jury’s belief on how it should be interpreted.

# The distinction between denotation and connotation

One of the main questions that arise when discussing architectural objects, including sustainability-related ones, is their *functional* dimension. Umberto Eco (1981 - p 24) proposes that architecture has two functions, namely denotative and connotative. He indicates that the denotative function denotes the uses while the connotative function relates to broader social – or systemic - uses of the object. He proposes that, although we tend to associate more the denotative functions with objects, their connotations (understood as their social and cultural meanings) are as important (Eco 1981 - p 24). Krampen (2013 - p 57) proposes, using Preito’s (1975) logical arguments, that the differentiation between these two functions can be understood in terms of iterations of cognition (what he names *calculus*): where denotative requires at least one cognitive iteration and connotation requires two or more iterations to be understood. These iterations can be correlated with the process of semiosis – as the process of meaning-making.

As proposed earlier, abductive design reasoning produces elementary level signs such as rhematic-iconic-sinsigns. The sinsign’s mode of operation – where the singular and aesthetic forms are realized and where relationships between elements are emphasized – resulting in coupling the text and the designed-object (Krampen 2013; Fisette 1997). Additionally, this link is enforced further by iconic designed-objects since their bear some similarity with the representamen. Thus, we can propose that in architectural rhematic-iconic-sinsigns the denotative function is always present while the connotative function remains open for interpretation – through semiosis. This can be seen in the solar wall and green roof examples which were extracted from Big City + L’Oeuf’s project.

On the other hand, signs which have the potential to halt the process of semiosis – namely argumentic-symbolic-legisigns which are produced as a result of deductive design reasoning – can suspend the *functions* of designed-objects on the connotative level without direct inference to their denotation. This has been also proposed by Li (2017) and defined as connotational Institutionalization[[22]](#footnote-22)[[23]](#footnote-23) and decoupling.

“[connotational Institutionalization and decoupling] empties a sign of its denotative meaning and transitions the sign in its totality to a “mere signifier” in the eyes of adopters. Being a mere signifier means that the denotative meaning […] loses its significance” (Li 2017)

In Cardin + Ædifica’s project, the use of timber clearly exhibits Li’s (2017) connotative institutionalization. The team proposes the use of timber, as an environmental intervention in the project which intersected with a number of LEED© materials and interior air quality credits. The text referencing the wood is highly focused on its environmental characteristics – its connotative function. The only illustration for the wood included in the panels presents an abstracted image of a general structure (Figure 5).

“[N]otably by the strong presence of wood in the building structure [...], all the wood used will be FSC-certified given the importance it has in the project. The use of wood will also reduce the project's impact in relation to greenhouse gases. - Cardin + Ædifica [[24]](#footnote-24)

And the figure was accompanied with the following text: “CO2 sequestration (impact of the cut compensated by replanting and the sequestration it induces) [and] Substitutes for materials that consume a large quantity of fossil fuel to manufacture” - Cardin + Ædifica (extracted from panel) [[25]](#footnote-25)

[Insert Figure 5 here]

The denotative function of the wood, as a structural material with benefits beyond the environmental, has not been addressed in the project’s text nor panels. This has been noticed by the jury as highlighted in their comments.

“The levels of decision and precision in the design leave some things requiring more details: some elements seem contradictory, including the treatment of the wooden structure” – Jury [[26]](#footnote-26)

It is important to note that not all architectural signs that are a result of deductive design reasoning focus on the connotative functions. In some argumentic-symbolic-legisigns, both the denotative and connotative functions of the object could be presented. However, these functions are merged and not necessarily distinguished. Additionally, in these signs, the denotative function does not serve in the process of meaning-making. Cardin + Ædifica’s propose a retention basin for rainwater which they intersect with the LEED© requirements of environmental site design and water efficiency. The only presentation of the strategy is a diagrammatic sketch of the basin and its interaction with the building (Figure 6).

“As for the demand for water, the latter will be controlled by means of the accumulation in the retention basins which, via the filtering marsh, will ensure a continuous and natural purification of the rainwater. This innovative strategy achieves a 55% reduction in water use compared to municipal water.” – Cardin + Ædifica [[27]](#footnote-27)

 “As for the management of rainwater, we propose using a filtering marsh for treating and naturally purifying the rainwater. The water will be redirected in a tank for the use of the mechanical equipment of the Planetarium” – Cardin + Ædifica [[28]](#footnote-28)

[Insert Figure 6 here]

The sign can still be considered an argumentic-symbolic-legisigns. It can be interpreted as a method of application ecological water management structured around the LEED© requirements (specifically for achieving the 55% reduction in water usage required). The designed-object, the sketch, is a symbol of this method. The holistic ecological, human and natural character of the designed-object is clearly highlighted – what can be considered its connotative function. The representamen (i.e. text) also presents the denotative function of the designed-object – namely purifying water, reducing water demand and rainwater use. Both functions are presented in the sign simultaneously with no distinction.

However, the argument presented in the sign can still be valid if the denotative function was absent and even if the designed-object (Figure 6) was not presented. This could be achieved by reformulating the statement to reference directly the credits sought after – ‘To achieve the LEED© platinum credits for rainwater management, water-efficient landscape design, innovative technologies for water management and water use, filtering marches will be added to the landscape and rainwater will be used in sanitary fixtures resulting in the required 55% reduction in use’. This type of criteria driven discursive formation can be seen in other parts of their text: such as the example of the educational program, presented previously, as well as the case of bicycle parking in the same project.

**“[T]he standard for bicycle parking prescribes 5% on the number of full-time employees. We plan to install 30 bike parking facilities which will also allow access to visitors” – Cardin + Ædifica** [[29]](#footnote-29)

Based on these examples, we can argue that in deductive design reasoning, connotative functions of objects become the end goal – they are an intrinsic part of the final interpretant of the sign. The denotative functions only serve and enforce the connotations. This process can be related to Barthes’ idea of mythification (1972). On the other hand, abductive design reasoning focuses on the denotative functions of objects. This focus is critical for communicating the relationship between the elements required for formulating the sign. For the signs created by abductive sustainable design reasoning, the connotative functions of objects emerge through semiosis. In abductive reasoning, an unclear denotative function could contradict the rhematic interpretant – leading to confusion; as seen in the green roof case in Big City + L’Oeuf’s project.

What is also important to note is that the cases of pure deductive sustainable design reasoning, where objects are fictional and immediate and where the connotative functions are foregrounded, might even hint to sustainability as a pure simulacrum – where the notion has no relation to any reality whatsoever and it becomes a simulation of its own (Baudrillard 1995).

“There is a plethora of myths of origin and of signs of reality - a plethora of truth, of secondary objectivity, and authenticity. Escalation of the true, of lived experience, resurrection of the figurative where the object and substance have disappeared.” (Baudrillard 1995 - p5)

# Discussion

## Modes of design reasoning, signs and judgment

Judgement can be considered a tradition in the field of architecture and specifically in architecture competitions. Chupin (2011), through the exploration of the history and practice of judgement, proposes a complex model for judgement – which he calls *judgement by design*. In this model, he proposes an analogy between judgement and design in the way they arrive at decisions. Although there are similarities between the dynamic process of design formulation and judgement, one can question the relevance of innovation within the jury’s mandate for selecting one or a group of winning projects. Not to undermine the complexity of the process of judgment, which in some cases involve reviewing and selecting from more than 500 projects, the end goal is to *discover* the most suited project[[30]](#footnote-30) - ultimately building a conclusion rather than a hypothesis (Collins, 1971; Chupin, 2011). This is clearly indicated within Zeisel’s (2006)[[31]](#footnote-31) spiral model (Figure 7), which Chupin (2011) uses as the basis of his judgement model. What is most important to highlight are the conceptual shifts - the leaps in our the understanding of the vision of process and product – that are required to arrive at *suitable* decision both in design and judgement (Zeisel 2006). We can propose a parallel between these shifts and the levels of semiosis of architecture design signs: the initial images at the entry of the spiral correspond to the immediate objects which are then tested against the presented projects and their dynamical objects (in what is labelled the image-present-test cycles).

[Insert Figure 7 here]

Within the exploration of design reasoning in architecture projects, we can start to see how deductive sustainable design reasoning – and their resultant argumentic-symbolic-legisigns – could potentially resist these forms of open-judgement. These signs create a fixed conceptual ground that oppose the conceptual shifts proposed by Zeisel (2006) and which Chupin (2011) indicated to be crucial for arriving at judgements (i.e. in that context the word is understood as decisions based on judgement). In fact, depending on their occurrence in specific competitions, these argumentic-symbolic-legisigns might dislocate Zeisel’s (2006) “domain of appropriate responses” to include them and exclude other signs which are less established and more experimental. This phenomenon has been explored by Cucuzzella (2015b) in different competitions. Cucuzzella reports that in this specific competition for the Planetarium of Montreal, the universal and technical approach to sustainability adopted by the winning project (**Cardin + Ædifica) put other projects which presented “experimental approaches” at a disadvantage – since they were seen as lacking the technical rigour and direct application of ecological guidelines (Cucuzzella 2015b). She concludes:**

**“[W]e can now wonder if the competition format […] is indeed compatible with the legitimate demand for environmental performance, and if it should not be reformulated by taking into account the space for exploration and innovation and the search for quality” - (Cucuzzella 2015b)**

## Modes of design reasoning and outlook

We have explored how the modes of sustainable design reasoning can affect how sustainable design features are described (textually) and presented (visually) in order to build complex signs. These modes have also been correlated with the shifting and placement of focus on the connotational or denotational meanings of objects, and they have been shown to affect how projects can – or cannot – be judged. One of the unique characteristics of projects is their anticipatory nature – the project has to be understood in fact as a mode of imagining and shaping the future (Boutinet 2005). For sustainability in the built environment in specific, this idea has been explored and defined as design *futuring* – where designs become forward-looking and catered to future scenarios (Fry 2014; Fry 2009).

In deductive reasoning, previous habits and conventions – which have known and predictable outcomes and can be replicated are used to establish design decisions and meanings. In a sense, by replicating an established sustainability feature in a project you are creating a *token*-based on past experience and knowledge. However, the specific application of this approach would require knowledge of the project – a type of minimal present knowledge – in addition to past experience. We can correlate this approach with what has been defined as *Status-Quo*” in other research fields (Henderson 2015). In other cases, where present knowledge of the project was missing, the jury commented on the apparent superposition of sustainability features on projects.

On the other hand, in abductive sustainable design reasoning, more diverse types of past knowledge (beyond the established approaches) are used and combined with present knowledge relating to the project to propose new signs. These new produced signs – new *types* - provides a future outlook that embodies the notions of anticipation and futuring: they provide hypotheses that could be tested and explored in the future (Fry 2009). We can define these approaches as *Futured*. Figure 8 provides a comparison between the two modes of reasoning and their outlooks. With this view, it can be proposed that the future outlook can be further explored since “architectural projects is a practicable method for investigating the future and testing ideas” (Andersson, Zettersten, and Rönn 2013 - p11). These sustainable design visions can be analyzed based on their character (i.e. human vs technological focused) and their inspiration (history vs future driven) (Goubran and Cucuzzella 2019).

[Insert Figure 8 here]

## On the roles of text and objects in architecture design

We have prioritized the analysis of the architectural texts where design teams describe and present their own projects – what was taken to be the representamen of the sustainable design signs. This approach provides the ability to ground the interpretation of the modes of reasoning on the linguistic structure, to compare the modes of reasoning in statements and discourse, and most importantly to understand explore how these statements build or weaken the links between designed-objects and texts[[32]](#footnote-32). However, this method could have three main shortcomings or contradictions.

The first relates to the comprehensiveness of the architectural texts. Like all texts produced in an institutional setting and submitted in a formal setting, the documents analyzed followed requirements related to limits on the number of words, text structure and tone. In Cardin + Ædifica’s project, for instance, the jury report highlights the passive environmental strategies used in the project. These passive strategies, although bundled under categories that relate to LEED® credits, were not explicitly mentioned or articulated in the architects’ description (Figure 7 shows some of these strategies). The reasons for excluding these strategies from the project description cannot be interpreted accurately. However, by exploring these design strategies on the presentation panel, they appear to be new design hypotheses: they present innovations which bridge material, technical and natural sciences with form-making. Thus, although the architects’ texts are critical to building meaning in sustainable design, the complete dependence on texts could present limitations to the analysis. Future work will have to focus on developing means to mediate between the text and objects and to consider accounting for objects which are presented with no descriptive text. This can be achieved by broadening the corpus to include texts generated by the architects outside the competition or in interviewing the design teams regarding the projects.

[Insert Figure 9 here]

The second comment comes in contrast to the first. It relates to the limitations of the design panels on communicating environmental strategies in design projects. Within the same limitations proposed on text, the panels’ format and number are also subject to project-specific requirements and regulations. Although designers, and architects in specific, are able to create technical, illustrative, and descriptive presentations to communicate their design and designed-objects, there still remains a question on how some environmental strategies could be meaningfully presented: strategies such as the use of recycled materials, the placement of windows to create interactions with exterior spaces or even the more abstract concepts such as biodiversity. The possibilities of meaningful representation for environmental strategies are in fact a scope of current architectural research in academia and practice. Although concretely, the project might be deploying some strategies which are described in the text, these objects might not be presented on the panels due to the lack of meaningful representation. Future work needs to focus on understanding this gap and exploring methods to overcome these limitations in the analysis of sustainable design signs.

While the first two limitations could apply to architectural projects in general, scholars of design competitions argue that competitions could be in fact immune from such shortcomings. Researchers propose that the underlying epistemology of competitions includes both text and imagery as tools by which architectural projects provide solutions to specific design problems (Andersson, Zettersten, and Rönn 2013; Andersson, Zettersten, and Rönn 2016; Chupin, Cucuzzella, and Helal 2015; Tostrup 1999).

“Architectural competitions are based on three fundamental presuppositions:

(a) that drawings and visualizations may transmit credible knowledge and (b) that quality in architecture is something that may be seen and transmitted via images. And in a principal view, (c) that architectural projects is a practicable method for investigating the future and testing ideas.” (Andersson, Zettersten, and Rönn 2013 - p11)

The third and final shortcoming relates to the overarching modes of reasoning in projects – namely deductive or abductive design reasoning. In the analysis, examples were used to highlight the polarities being investigated – deductive/abductive, connotative/denotative, and immediate/dynamical. Each of the projects used in the examples exhibited tendencies towards a specific mode of reasoning. However, in both projects, some elements of each mode were present – such as the passive strategies of Cardin + Ædifica shown in Figure 7 or in cases in Big City + L’Oeuf where codes and standards were used to justify ecological design decisions. This raises several questions around whether one project can be said to have an overarching mode of reasoning and how such a mode could be assessed. If one mode of reasoning is selected qualitatively for a project[[33]](#footnote-33), it would disregard instances of other modes. A quantitative comparison, where for example saying that 10 objects are based on deductive reasoning and 5 are based on abductive reasoning to justify its overarching deductive reasoning, disregards the relative importance of these objects to the project[[34]](#footnote-34). Developing combined measures that capture both the qualitative and quantitative occurrences might provide a solution for this limitation.

# Conclusion

In this paper, we have attempted to use Peirce’s (1991) triads to explore and understand sustainable architecture design signs. The paper proposed to correlate the representamen of the sign with the architectural texts of projects, the object of the sign to the designed-objects which are illustrated in design documents, and the interpretant to the meaning generated. Previous literature had proposed two approaches to sustainable design – technical and reflective (Cucuzzella 2016). The paper correlated these approaches, using ideas of Boudon (2000), to the modes of reasoning proposed by Peirce and elaborated by Fisette (1997): where technical approaches are correlated to deductive sustainable design reasoning and reflective approaches are correlated to abductive sustainable design reasoning. By using documents extracted from the international design competition for the new Montreal Planetarium, the distinction between the two modes of reasoning is made clear from the statements and descriptive texts. The paper then used the two projects to highlight the effects these modes of reasoning have on the production of sustainable design signs, and to explore the roles designed-objects occupy in each of these modes of reasoning. Additionally, the paper proposed that in abductive sustainable design reasoning text and designed-objects are coupled to denote while in deductive reasoning the sign is decoupled and focused on connotative meanings. Table 1 presents a summary of the characteristics proposed for the two modes of reasoning.

[Insert Table 1 here]

In the discussion section, the judgement process in architecture was studied based on the ideas of Chupin (2011) and Collins (1971). In regards to sustainability in architectural projects, a gap appeared between the open form of critical judgement proposed for competitions and the conceptual fixation inherit in deductive sustainable design reasoning and their argumentic-symbolic-legisigns. By intersecting some of the characteristics of deductive and abductive sustainable design reasoning, the first was correlated with *Status-quo* definition and the second with the concept of *Futuring*. Futured signs present an opportunity to be further analysed based on the nature and inspiration of their future outlook. Finally, some of the limitations of the approach and pending questions were presented in the final section of the discussion with some ideas for future research directions.

This paper seeks to contribute to the theoretical modelling of sustainability in architectural design projects. The paper proposes a methodological shift in the understanding sustainability features in architectural projects - to be understood as triadic signs composed of text, designed-objects and meaning(s). Additionally, the paper proposes a combination of analysis, based on semiotics and discourse analysis, to extract and define the modes of reasoning around sustainability issues in design. Future work should attempt to use the approach proposed in this paper to study sustainability in architectural projects with a specific focus on the role of abductive design reasoning and the generation of future outlooks.

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Table 1. Summary of semiotic characteristics of deductive and abductive sustainable design reasoning

Figure 1. Triadic structure of sustainability signs in architecture design – the triadic structure is based on C. S. Peirce (1991) and distinction of elements is based on Li (2017).

Figure 2. Elevated floor ventilation as presented by Cardin + Ædifica (“Competition : Planétarium de Montréal”)f

Figure 3. Solar wall as presented by Big City + L'Oeuf – (left) in section view and (right) in an environmental diagram (“Competition : Planétarium de Montréal”)

Figure 4. Presentation of the green roof by Big City + L'Oeuf – (top) in section view, (bottom left) in detail view, and (bottom right) in environmental diagram (“Competition : Planétarium de Montréal”)

Figure 5. Wood structure as presented by Cardin + Ædifica (“Competition : Planétarium de Montréal”)

Figure 6. Diagram of water management on site as presented by Cardin + Ædifica (“Competition : Planétarium de Montréal”)

Figure 7. Zeisel’s (2006) spiral model (p 30) as used by Chupin (2011)

Figure 8. Status-Quo approaches (top) aim at replicating past experiences and knowledge based on habit and Futured approaches (bottom) aims at synthesizing past knowledge with new knowledge to create new design hypotheses with a future outlook

Figure 9. Some of the passive environmental strategies presented by Cardin + Ædifica (“Competition : Planétarium de Montréal”)

1. The term “architecture” is used to indicate the act, art and practice of designing objects that occupy the built environment. [↑](#footnote-ref-1)
2. This is specific to designing building of quality. This notion of quality in architecture has been heavily debated for centuries – and is still an ongoing debate. Vitruvius (1914).proposed a triadic structure composed of beauty, usability and durability. Today the concept is more focused on ideas of responding to and catering to various human needs (Van Wezemael, Silberberger, and Paisiou 2011; Hough and Kratz 1983; Purcaru 2015). [↑](#footnote-ref-2)
3. The word “philosophy” in this case could be substituted with the word “ideology” – understood as a set of ideas, views, and beliefs what determine behaviour and actions (Ponzio 1993; Prishtina 2018). [↑](#footnote-ref-3)
4. All the information and data for this competition is available through the Canadian Competition catalogue (CCC) at ccc.umontreal.ca. (“Canadian Competitions Catalogue (CCC)") [↑](#footnote-ref-4)
5. Specifically Chapter 8: On the Nature of Signs [↑](#footnote-ref-5)
6. The word representamen has been specifically used interchangeably with other words such as sign, vehicle, or sign-vehicle (Buchler 1955; Houser et al. 1998; Hoopes 1991). [↑](#footnote-ref-6)
7. Peirce uses the word “members” to describe the elements of the triad [↑](#footnote-ref-7)
8. The dictionary is now found online at <http://www.global-language.com/CENTURY/> [↑](#footnote-ref-8)
9. Sometimes named sign-object [↑](#footnote-ref-9)
10. A similar distinction and definition is proposed by Li (2017) [↑](#footnote-ref-10)
11. Firstness is “being in terms of positive qualitative possibility”, secondness is “being in terms of actual fact” and thirdness is “being in terms of laws that will govern phenomena in the future” (Fisette 1997 - p 6). [↑](#footnote-ref-11)
12. The original French quote: “[N]ous avons dissocié le principe de l'abduction (qui innove) de celui d'une déduction (qui établit) et d'une induction (qui découvre) […] C'est cette mémoire catégorielle [induite par deduction] qui est questionnée par l'abduction dans son travail d'enquête” [↑](#footnote-ref-12)
13. Original French quote: “Au-delà de la comptabilité somme toutes abstraite requise pour la qualification LEED, notre appréhension de l’architecture se transforme. […] [C]ependant la tension entre la juxtaposition et l’intégration est aujourd’hui exacerbée par les exigences LEED et la prolifération des dispositifs électro-mécaniques que l’on souhaite faire participer au fonctionnement du bâtiment (et même de la ville).” - Big City + L'Oeuf [↑](#footnote-ref-13)
14. Original French quote: “L’ensemble des thèmes ci-dessous traitent des éléments les plus importants prescrits au système d’accréditation LEED et auxquels nous prévoyons participer.” - Cardin + Ædifica [↑](#footnote-ref-14)
15. Original French quote: “L’apport d’air par la conception de planchers surélevés se veut une recherche d’une meilleure qualité d’air dans le bâtiment. […] Un plan de gestion de la qualité de l’air complet sera prévu. […] Le confort thermique prévu par les ingénieurs est conforme à la norme ASHRAE 55-2004.” - Cardin + Ædifica [↑](#footnote-ref-15)
16. Original French quote: “Des stratégies élémentaires de développement durable ont rapidement cristallisé la géométrie de l’édifice et établi l’importance d’un mur solaire qui, en traversant l’intérieur sur trois niveaux, devient, un repère architectural et un élément scénographique fort autour et dans lequel s’organisent la distribution et le pré-conditionnement des flux d’air : L’approche au développement durable est indissociable de l’architecture; elle est partie prenante de la scénographie.” - Big City + L'Oeuf. [↑](#footnote-ref-16)
17. Krampen (2013) uses connex and context interchangeably [↑](#footnote-ref-17)
18. Original French quote: “De plus, nous prévoyons aussi la mise sur pied d’un programme éducatif démontrant le fonctionnement des systèmes relatifs notamment à la gestion de l’eau, la performance énergétique et tout autre intervention dont la démonstration s’avère intéressante pour les visiteurs, ceci à l’aide d’écrans, de panneaux et de pamphlets. Ce programme a déjà fait l’objet d’un crédit d’innovation dans le cadre du projet de la Tohu.” - Cardin + Ædifica [↑](#footnote-ref-18)
19. In the TOHU, the educational program is integrated within all the CESM site and concentrated in the TOHU building. The program at TOHU required different features and spaces to be designed to specifically accommodate tours and visits related to LEED® and environmental design. [↑](#footnote-ref-19)
20. Original French quote: “[L]e Planétarium présente une autre de ses faces écologiques et donne en spectacle son toit végétalisé dont le dessin est inspiré par une image pixellisée de la Nébuleuse de la Tarentule.” – Big City + L’Oeuf [↑](#footnote-ref-20)
21. Original French quote: “L'imagerie de la carte céleste est brisée par la lourdeur du volume; le toit vert ne correspond pas à cette image” – Jury [↑](#footnote-ref-21)
22. More details on institutionalization and structuration (Li 2017; Barley and Tolbert 1997; Giddens 1984). [↑](#footnote-ref-22)
23. Li (2017) presents two kinds of institutionalization: denotational and connotational. In the denotational kind, the sign brings the three components of the sign closer (a coupling process) which could be achieved through typification, objectification, or theorization. In the connotational kind, the sign is emptied from its denotational meaning and is used as a signifier – exemplifying Barthes’ idea of mythification. In this definition, institutions could be understood as “shared rules and typifications that identify categories of social actors and their appropriate activities or relationships” (Barley and Tolbert 1997). [↑](#footnote-ref-23)
24. Orignial French quote: ““[N]otamment par la forte présence du bois dans la structure du bâtiment […], tout le bois utilisé sera certifié FSC compte tenu de l’importance qu’il revêt dans le projet. L’usage du bois permettra aussi de réduire l’impact du projet au niveau des gaz à effet de serre.” - Cardin + Ædifica [↑](#footnote-ref-24)
25. Original French quote: ““Séquestration du C02 (impact de la coupe compensé par la replantation et la séquestration qu’elle induit) [et] Substitue à des matériaux dont la fabrication est fortement consommatrice d’énergie fossile” - Cardin + Ædifica [↑](#footnote-ref-25)
26. Original French quote: “Le niveau de décision et de précision du design laisse à désirer : certains éléments semble contradictoire, dont le traitement de la structure en bois” – Jury [↑](#footnote-ref-26)
27. Original French quote: “Quant à la demande en eau, cette dernière se fera à l’aide de l’accumulation dans les bassins de rétention qui, via le marais filtrant, assurera une épuration continue et naturelle des eaux de pluie. Cette stratégie novatrice permet une réduction de 55% de la consommation d’eau par rapport aux eaux municipales.” – Cardin + Ædifica [↑](#footnote-ref-27)
28. Original French quote: “Quant à la gestion des eaux de pluie, nous proposons un traitement et une purification naturelle des eaux pluviales par la mise en place d’un marais filtrant, l’eau sera réacheminée dans un réservoir pour l’usage des appareils sanitaires du Planétarium” – Cardin + Ædifica [↑](#footnote-ref-28)
29. Original French quote: **“[L]a norme concernant les stationnements de vélos prescrit 5% sur le nombre d’employés à temps plein. Nous prévoyons installer 30 stationnements de vélos ce qui permettra aux visiteurs d’y avoir accès également.” – Cardin + Ædifica** [↑](#footnote-ref-29)
30. This process of judgment as discovery could be correlated with Boudon’s (2000) definition of inductive thinking – that which discovers. [↑](#footnote-ref-30)
31. Originally published in 1981 and revised in 2006 [↑](#footnote-ref-31)
32. Couples or decouples the sign if we use Li’s terms (Li, 2017) [↑](#footnote-ref-32)
33. Qualitatively in this context means based on the qualities of the text and linguistic structure, [↑](#footnote-ref-33)
34. Where one designed-object could be relatively more important in the design – having spatial, functional and structural effects that are more significant than others. Example: the passive design strategies of Cardin + Ædifica which showed a tendency towards abductive reasoning helped shape and refine the cones which cover the theatre – one of the most distinctive feature of the project. [↑](#footnote-ref-34)