Acta Technica Napocensis: Civil Engineering & Architecture Vol. 60 No. 3 (2017)
Journal homepage: http://constructii.utcluj.ro/ActaCivilEng
Special Issue– 6 th International Workshop in Architecture and Urban Planning
The built Environment – between permanent and temporary

Multi-disciplinarity in the local sustainable design of the buildings

Nina-Cristina Ditoiu [*1], Mihaela Ioana Maria Agachi[*2]

[1,2] *Technical University of Cluj-Napoca, Faculty of Architecture and Urbanism, 34-36 Observator Street, Cluj-Napoca, Romania*

(Published online 15 March 2018)

Summary

Nowadays in the international research, trans-disciplinarity is a recurrent topic. In this context, multi-disciplinarity shouldn't be a challenge for the local sustainable design of the buildings. The technical sciences applied in architecture as a humanist science is anyway a multidisciplinary approach. A mono-disciplinarity approach couldn't achieve a local sustainability design. To choose a preferred disciplinarity like the most important or primordial could be a compromise in the final project. A mistake could be to suppose that architecture is just an aesthetic, subjective option which is succeeded anyway. A local case study will be presented with some appropriate answers to the sustainability design, not full "transition design".

Rezumat

În cercetare transdisciplinaritatea este o temă actuala. În acest context, multidisciplinaritatea nu ar reprezenta o provocare in proiectarea cladirilor sustenabile. Științele tehnice aplicate în arhitectura ca si știință umanistă implica multidisciplinarritatea in mod implicit. O abordare monodisciplinară este exclusa. A alege o disciplină ca fiind primordiala ar putea fi un compromis în defavoarea proiectului final, desi necoordonarea interdisciplonara nu este recomandata. O greșeală ar fi de asemenea să consideram arhitectura doar o opțiune estetică, exclusiv subiectivă, deci optionala. Intr-un studiu de caz se vor indica cateva solutii de design sustenabil din practica curenta.

Keywords: local sustainable design, multi-disciplinarity, "transition design"

1. Introduction

Temporality and flexibility are important issues of sustainability. A research team and Professor Cameron Tonkinwise [1] defined "Transition design" as "rethinking sustainability" - "a transformation of high-level systems in the context of digital platforms and digital economy" with the involvement of multi-disciplinarity. The elements of the framework model they achieved for "transition design" were defined as "vision", "theories of change", "mindset/posture" and "new ways of designing". In a changing world of nowadays the fourth Industrial Revolution, the

[1] * e-mail: nina.ditoiu@arch.utcluj.ro
[2] * e-mail: mihaela.ioana.agachi@arch.utcluj.ro

sustainable design can include the loss of essential parts of the humanity. That is the reason why human sciences should never be excluded from a design work. Architecture should remain the human science to compensate the balance for the technical part in the building design. In the technology revolution, we need more than ever the human sciences: history, psychology, sociology, etc. and architecture to link the humanity to many technical sciences involved in the sustainability of the buildings. "The new design ways" of the recent technologies involve objective factors that couldn't be ignored without missing important achievements of a technological system. Robert Muslim said in "The Man Without Qualities", a novel written in the earlier stage of the 20'th century, that "if men ever achieve to fead just energetical pills instead of bread and meat, they would know nothing about landscapes." [2] Could be similar to the valuable things that might be missed after "the fourth industrial revolution" [3].

2. Heading

Rem Koolhaas introduced the term of "junk space" in architecture in 2001 [4]. He considered the invention of the modern architecture of the 20th century a mistake. "Our concern for the masses has blinded us to People's Architecture. Junkspace seems a nonsense, but it is essence, the main thing... product of the encounter between escalator and air conditioning, conceived in an incubator of sheetrock (all three missing from the history books)."[4] After fifteen years, in the Hans Ulrich Obrist's interview he explained that in the same building „some parts of the building die, while others are reborn, some are used while others are still unfinished" involving "the process of transformation".[5] In the same interview of Rem Koolhaas, he explains one of his unbuilt project „La Defence Paris" when his team proposed to eliminate all the buildings older than 25 years old. It was considered a visionary project, but scandalous. He thought the lifetime of the buildings is still a tabu topic in Europe. Maybe in the world of technological revolution and the risks associated with it a conservative approach as the Western European one of the conservative practice, wouldn't be so wrong. Maybe some of the existing buildings should accept new interventions, and exceptions should always be heritage buildings. Or maybe the new building should be built for an unknown future, including flexible spaces from the designing stage. The newness could integrate the heritage by improving, rather than conquering it; in balance not in contrast. The architect introduced the temporality theme in contemporary architecture as a valuable quality. The speed of changing in technology increases the flexibility needed. "Transition design" [1] theory is against the way the sustainable building design is thought as a punctual intervention which solves a certain issue. Actual systems about evaluate sustainable design existent in practice should be reevaluated.

Trying to define the improvements of technology in the sustainable buildings there are a few systems from different countries, like LEED ("Leadership in Energy and Environmental Design" from the United States of America) or DGNB ("German Sustainable Building Council"). In the most known certificate systems for sustainable buildings, the temporary architecture is not a main topic yet. NzEB ("Nearly Zero Energy Buildings") is already part of legislation in the European Union adapted to all the environmental factors of the countries. It's a standard that calculates the energy consumption, CO^2 emissions and sustainability are covered just to use the alternative sources of energy. It could be the most technical from all of standards remembered but excludes important parts in a building life cycle, and the most important, the main issues of existence of the sustainability in the first preliminary design stage. The comparison between this kind of standard and the other of certificate systems is at least strange. The DGNB system is an agreement of good practice in all life cycle of the building and architecture practice. The NzEB standard appears to be included in one of the many chapters of the DGNB standard, the one with the sources and the consumption of energy.

As example, in designing of an office buildings or for administrational use, NzEB [6] system requirements versus DGNB [7] evaluate very different solution.

Exterior envelope of the building limit by the U value - Thermal transmittance (W/mpK) in NzEB [6] - Table II.1 some of them are: Exterior envelope of the building: 0.21 W/mpK; Windows: 1.3 W/mpK; Wall: 0.303 W/mpK (…). For glazed facade NzEB standard limited for the office building the percent of glazed façade to 17,42% [6]-Table II.1, for residential building - 12.53% [6] - table II.5, in the condition of very different needs for the daylight factor. It's not a design decision of an architect or maybe an anthropologist how to use or not the benefits of daylight. It's about calculate percent areas. For the similar system evaluated, glazed façade, DGNB [7] – SHP Table 6, evaluate solar heat protection required. SHP calculated as window to wall ratio calculated with total shading coefficient of window system, glazing and sun protection (Table 6) with in two different situations: SHP smaller than SHP max and SHP smaller than 0.8 of SHP max. It's more technical than NzEB conditions. There are few chapters of DGNB that are relevant criterion to made it a certification of good practices. Thats couldn't be found in a standard that evaluate almost exclusively the energy consumption like NzEB[6]: "Design for all"[7], "Flexibility and Adaptability"[7], "Commercial viability"[7], "Public transport"[7], "Design concept"[7], "Layout quality"[7], "Visual comfort"[7], "Fire safety" "[7], "Sound insulation"[7], "Cleaning and maintenance"[7], etc. Some of them are inputs data that can make the difference between good practice in design of any building and not adequate practice for any building, not just sustainable ones.

To introduce one systems of sustainability (DGNB) or energetically efficiency (NzEB) discussed in the framework of "transition design" is difficult. NzEB is too rigid or maybe too technical to can apply it to a "Vision"[1] from any design work. DGNB could evaluate a "Vision"[1] as a "Design concept"[7] in one of the chapters.

Case study

Framework model for "transition design"[1] include I - "vision", II - "theories of change", III - "mindset/posture", IV - "new ways of designing" and an interchange between them in the redesign process. The elements of the same framework adapted to the local design work can be I – design concept, II - flexibility, III – identity detailed in cultural differences / the culture of using spaces, IV - new technologies included in the new design. It's pretty far to the "Vision" from the framework of "transition design" defined by Professor Cameron Tonkinwise. It's just a target that could be achieved than can support many improvements. I will discuss them from the formal point of view, the functionality, and the essence of the four elements of the model adapted to the building studied.

	"transition design" [1]	**local sustainable design**	**Case study**
I	"vision"	design concept	• Essence: water waves form • Formal: bioclimatic building thinking with vegetation included
II	"theories of change."	flexibility	• Essence: large scale - design stages • Formal: interior flexibility was not a topic
III	"mindset/posture."	identity	• Essence: large scale - the local specificity of the city with interior courtyard on large buildings • Formal: interior lack of flexibility of individual offices

IV	"new ways of designing."	new technologies	• Essence: sustainability • Formal: public administration building – reference representative building, solar architecture with new technologies

The building studied is an administrative building of the Local Public Company of Water Management from Oradea city, Bihor county [8]. The water waves form inspired by the representative function and also the small river named "Peta" from that area of the city. It's an industrial area not closer to the center of the historic city. The identity is preserved in the courtyard form of the building, not in the image of some traditional construction materials.

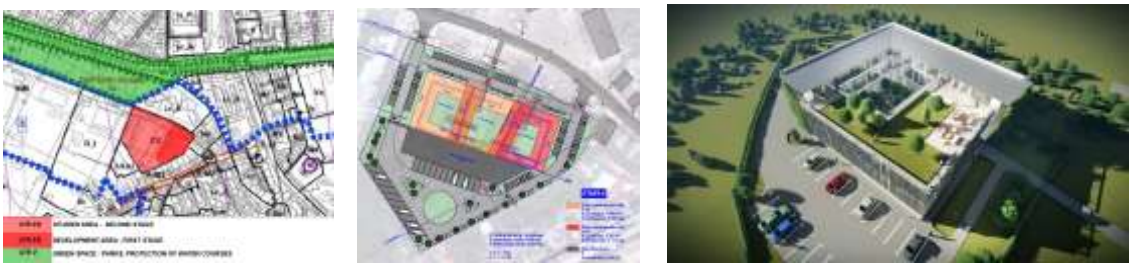

Figure 1. Urban planning regulations: red colored is studied area, green colored water course protection area (1) / Site plan of the second potential stage (2) / Render with the development from the first stage (4)

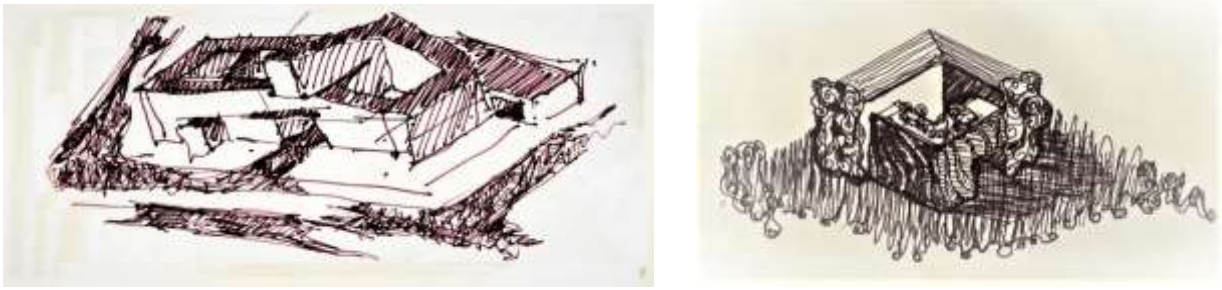

Figure 2. One of the first sketches, with the potential of the second stage on the extended site (3) / One of the last sketches with the actual proposed building (3)

Figure 3. Night render / Day East elevation render: both image include vertical sun shading system from East sides of the building with the water waves form (4)

I will present the essence for every one of the four elements of the Professor Cameron Tonkinwise 's framework adapted to this particular case study.

I. "vision" [1] – water waves

The building design concept essence is represented in the water waves form which feed green areas. The "green" of the vegetation is on the three parts of the "water form" and grow from it: "hedera" type plants are forming two green walls on the exterior sides of the North - East and South - East elevations and green roof terrace. The volumetric of the building starts with "the essential point" of the water waves form. Adopting a bioclimatic building that protects the interior courtyard walls of overheating, the water waves form materialised in a vertical sunshade system, the green walls that also protect against overheating became the secondary part, the water waves concept is important.

II. "theories of change" [1] - flexibility

Flexibility appeared more in the design process than in the final building. The design was made in two different stages that can be seen just in sketches. The first designed building was extended on a larger site with many different function included: administrative and stock place with safety equipment. The second stage is utopic in that moment. The investment is just for the administrative building on a small part of the initial site. The culture of using spaces could explain the lack of flexibility of interior design with many individual offices. That is an issue that might be changed in time from the private area of offices to area of public administration.

III. "mindset/posture" [1] - identity

The site of the investment is in Oradea, a city which "is first mentioned in 1113, under the Latin name "Varadinum" (…) Recent archaeological findings around the city provide evidence of a more or less continuous habitation since the Neolithic".[9] The site is included in an area protected by the code "BH-I-s-B-00944" as an archaeological site. The archaeological research will be done by the phase of the earth excavation stage. Development of historical city of Oradea is on the course of water "Crisul Repede". His smaller affluent "Peta" that flows on the north side of the studied location.

Water is a part of the landscape in the area and a very special element of the archetypal images for any local user from this urban space.

The local specificity of the traditional city are the buildings with interior courtyards, and that was one of the most important input data for the planning work. The location is in the periphery industrial area of the city, the reason that the chosen materials are not the traditional ones.

IV. "new ways of designing" [1] - new technologies in sustainability

Sustainability is an ordinary topic all over the world. The European legislation, like NzEB standard, on the background of a traditional culture, is a starting point. The sustainability of the building and the technological factors that are important for energy efficiency start as bioclimatic building in the first stage, and alternative sources of energy for the second stage are a target. Photovoltaic systems proposed are not feasible in this moment of the budget.

In researches, PV systems appear that will be feasible in some years or some decades. Like a representative function of a public building might deserve to be designed with that target of sustainable design of new technologies. New technologies ask for a new design - solar architecture with the protection against overheating of the interior courtyard, metallic structures designed for solar panels (PV technology) in the second stage and horizontal sunshades in the first stage, "the water waves" form applied to vertical sunshades on West sides of the building.

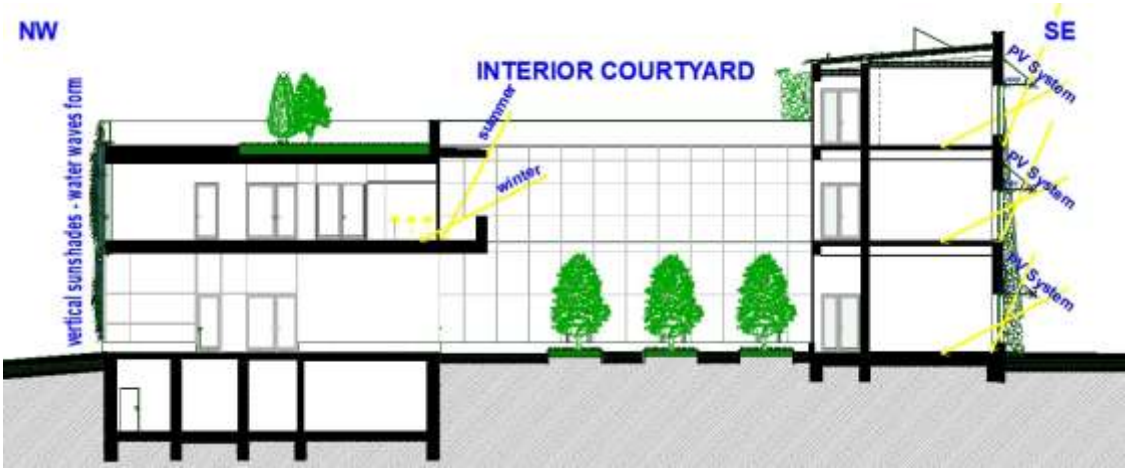

Figure 4. Section with metal structures designed for actual horizontal sunshades and a potential future photovoltaic system on the South-East elevation and vertical sunshades on water waves form on North West elevation (2)

The structure for 55 photovoltaic panel that are designed to be inserted in the next future is done in PVSyst version 6.64 [10] for the preliminary design stage.

Figure 5. result reports of preliminary design stage for choosing optimal tilt angle for Oradea (latitude 27.02 ^{o} N, longitude 21.56 ^{o} E):
Cluj-Napoca the meteorological data bases: tilt angle 39 ^{o} / Timisoara the meteorological data bases: tilt angle 39 ^{o}/ Timisoara the meteorological data bases: tilt angle 40 ^{o}. (5)

39 ^{o} was the chosen tilt angle after this reports of preliminary design.: for the azimuth angle (-19^{o}), surface covered with PV system panels: 107.6 m2, number of 55 panels Bosch PV polycrystalline cells [11] - Module dimensions: 990mmx1976mmx50mm, Module power class 295W (the best value we know at this moment).

The nominal power resulted for 55 Modules power class 295W is 16.2 kWp. The estimated annual power after the reports was: 20788 kWh – Timisoara meteorological data, tilt angle: 40^{o}; 20799 kWh – Timisoara meteorological data tilt angle: 39^{o}, 20734 kWh – Cluj-Napoca meteorological data tilt angle: 39^{o}. After the installation of the PV system with the estimated power in preliminary design phase the building could achieve of energetical independence.

3. Conclusions

Risks of the fourth industrial revolution, technological revolution, are about humanity's values. To preserve them people should pass in the creativity world over the pure sciences. "The Man with no quality" [2] couldn't avoid the loss. In his Journal [12] Andre Gide admits as an infallible advice that we should take over us the most humanity as we can. According to him "the most beautiful things are the ones inspired by madness and written with ration ability. We have to place ourselves between them, closer to madness for dreaming and closer to the rationality for writing." He was a special writer in France in the same times Robert Musil [2] in Austria wrote the novel about the crisis of humanity.

4. References

[1] Tonkinwise, Cameron, https://www.futurelearn.com/courses/designing-futures/2/steps/141985, Lecture of Professor Cameron Tonkinwise at the online course "Designing the Future", conducted by the RMIT School of Media and Communication University, Melbourne, Australia, between 06.02.2017-11.03.2017, visited in 21.06.2017
[2] Musil, Robert, "Omul fara insusiri", Polirom, pp. 79, 2008, Personal translation;
[3] Schwab, Klaus, „The Fourth Industrial Revolution", Crown Business, New York, pp. 6-7, 2017;
[4] Koolhaas, Rem,"Junk space", 2001, http://www.cavvia.net/junkspace/, visited in 21.06.2017
[5] Hans Ulrich Obrist, "Vietile artistilor, vietile arhitectilor – Interviuri cu cei mai mari artisti contemporani", Pandora Publishing, Bucuresti, pp. 461, pp. 470-471, 2016
[6] "Nearly zero energy buildings (nzeb) Romania plan de creştere a numărului de clădiri al căror consum de energie este aproape egal cu zero" - plan reviziut şi actualizat, iulie 2014, pp. 10, table II.1
[7] DGNB Core and scheme sheet, Offices Version 2014, documentation received from dgnb.de in 28.04.2017
[8] http://www.rowater.ro/dacrisuri/Continut%20Site/Acasa/Contact.aspx, Administratia nationala "Apele Romane" Administratia Bazinala de Ape Crisuri
[9] https://en.wikipedia.org/wiki/Oradea , visited in 18.10.2017
[10] http://www.pvsyst.com/en/, PVSyst version 6.64, Photoltaic software dedicated to design of PV systems, visited 18.10.2017
[11]http://www.boschsolarenergy.de/en_us/bosch_se_serviceorganisation/kundendienst_1/produktinformationen_na/produktinfos_crystalline_solar_modules.html , Bosch's 72-cell multi-crystalline modules, visited 18.10.2017
[12] Gide, Andre, Jurnal, Ed. Univers, Bucuresti, 1970, pp. 36, pp.32, Personal translation

Figures sources:

(1) Figure 1: Urban planning regulations in approval procedure as support image for the site plan, http://www.oradea.ro, visited in 12.03.2016
(2) Figure 1, Figure 4: arch. Nina Ditoiu - architecture team coordinator of design in Aquaprociv Proiect company, Cluj-Napoca, Romania;
(3) Figure 2: arch. Nina Ditoiu's sketches;
(4) Figure 1, Figure 4: arch. Virgil Mihut' renders - Etaj 4 company, Cluj-Napoca, Romania;
(5) Figure 5: result reports of preliminary design stage worked by Nina Ditoiu in dedicated software for photovoltaic technology PVSyst version 6.64, License type: premium, student, limited to 12 months.