

DETOX TECHNOLOGY IN NEW ARCHITECTURE BUILDINGS

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Abstract: Application of new eco-friendly materials and technologies in construction indicate new tendencies in biomorphic creation of physical structures in the cities. In this paper, the author focuses attention on organic-metabolic, continuous visionary development of micro and macro physical spaces or areas in which new cultural forms of life and communication among users are created. Newly built, multi-storey towers having dynamic, non-stereotypic forms were emphasized as they established a very close relationship with the natural resources and materials, and where the designers based their specific design-engineering ideas on the creation of flexible vertical socio-cultural communities. The examples in this paper represent homomorphic concepts of sustainable construction innovated with geometric shapes in which the volume of structural assemblies provide new intelligent standpoint with very prominent vegetation facade membranes-multilayer membrane skins. In addition to the esthetic, they have a microclimate-energy and an important space-regulatory detoxifying function. Smart ecourbarchitectonic thinking directed to different city building characteristics of engineering processes and activities that where the artifact materials will not have a dominant share, but a creative synthesis-interpolation of new sustainable technologies with natural, organic materials as integral component parts. In general, a different philosophy of building a new house, as early as tomorrow will be based on a significantly increased presence of bionic and biomimetic Eco-Technology.

Keywords: eco-materials, eco-technologies, detoxification towers, ecourb architecture, bionic structure.

1. INTRODUCTION

The increasing presence of vegetative materials in conceptual town planning-architectonic designs of new structures, in all parts of the world, with different functional volumes, raises considerations about necessity of inclusion of eco-friendly materials in physical structures. The Belgian architect Vincent Callebaut, inspired by natural materials and forms, continues to cause admiration of the world with his new, ostensibly futuristic designs of the structures in which the synthetic relation of artifact and natural materials is inevitable. In his words, we are dealing with archibiotical structures having a detoxifying character. A new city building strategy is arising, and a new urban design of physical structures in a space which changes the history evaluation of areas in cities, redefines identity of microambient spatial entities. In addition, it changes microclimatic conditions in the environment, so that the environment would be truly better and healthier. The phenomenon of fusing of natural and industrial materials in construction of buildings, brings about a radically more creative artistic-visual appearances in the structure of the cities

[1]. In the process, each user of such buildings is provided with a small area of soil, where he could grow his own food, reduce the energy consumption or by implementation of renewable energy sources make their homes neutral in terms of carbon dioxide emission. The examples in this paper confirm such considerations.

2. TEXT

Too many artifact physical structures in urban agglomerations in the world inspired town planners to consider the integration of the urban design with nature. The example of the vertical part, "living façade" in Barcelona, confirms such attitude in which the vegetative material – "vegetecture", on a 21 meter high wall at the narrow end of the housing block corner, apart from creating an exquisite artistic and esthetic impression also possesses detoxifying properties. The vertical garden on the scaffolding of galvanized metal piping visually „moves" the alignment line and creates a new „green-coloration", variable sensibility in macroambient space, and creates

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potential for generation of more oxygen and for reduction of carbon dioxide by absorption from the air [2]. The hybrid detox ecourbarchitectonic form of the structures with „green lungs” and the Vertical Garden Tarradellas, as a natural fragment, opens a new chapter in the further, organic conceptualization of exterior and interior space and recovery of the natural environment.

It changes the designing and planning perception and understanding of strategic formation of urban structural extensions using „intelligent membranes” and potentials for application of interpolation of contemporary materials with new spatial arrangements in the urban fabric.



Figure 1. „Vegetecture.” The 69-foot wall is green grows where Galvanized steel scaffolding Garden Tarradellas. Mediatrix Green vertical garden. Capella Garcia Arquitectura Rather queasily call this project in Barcelona, [16–18].



Figure 2. Vertical forest Mountain Hotel will clean the air in Guizhou, China, [19–20].

The creation of Stefan Boeri, the architect of (SPP) Mountain Hotel, having capacity of 250 rooms in Guizhou, China, with a popular vertical forest on the façade plane, is very inspiring and directed on the new conceptualization of ecourbarchitectonic space. The contemporary way of thinking and recognizability of the hybrid physical structure dominated by the natural, vegetative, detoxifying green material, indicates creation of a new, synthetic identity of structures in space and different building standards. The quality and composition of air in the immediate surrounding was considerably improved, with the emphasis on the metabolic integral design and new culture of house building. The proposal for a different understanding of façade appearance, and then a new esthetic-memorial and thermal-acoustic properties realized by using materials from the immediate environment brought about a strategically innovated, sustainable materialization vision in which the environmental factor becomes indispensable [3]. The imaginative introduction of key natural, detoxifying material, to such an extent when it prevails over artifact-synthetic materials, changes formal and building philosophy, changes the practice in which the places of urban

environment acquire prominently better quality and attraction for the users.

In the visionary archibiotic conceptual town planning designs for Paris in 2050, we may observe important innovations in which the concept of future urban space is focused on the natural, green materials from the immediate environment. The designs are dominated by the emphasis on verticality of non-orthogonal, challenging materials archisculptural forms with facades and roofs whose design is based on high-quality greenery with multiple functions. The urban space will be improved, and environmentally and culturally transformed with new hybrid structures and materials, which will, mostly in structural terms, allow sculptural – esthetic forms and spatially different visual-communication flows. The detox component of interpolated materials will improve the lives of people, their social contacts and everyday culture, especially at the ground level. The designers, which will in the near future use contemporary building materials in spatial design, will have an imperatively indispensable need for integration with environmental materials, so that ambient identity of the entities would be even more creative, with new and more cultural characteristics [4, 5].



Figure 3. Paris Smart City 2050 - Vincent Callebaut, [21–22].



Figure 4. Futuristic Paris Smart City, [23–24].

„Smart cities” of tomorrow will use contemporary building materials of innovative characters. The tower skins will react to sunlight and regulate climatic conditions in an interior space. They will range between temperature and air humidity and the overall acoustic and energy properties. „Photosynthesis Towers” will have facilities where electrochemical generators will produce electric energy and biofuel. Bio-façade surfaces will produce oxygen and reduce carbon dioxide emission. They will operate actively in detoxication terms, and they will stimulate creation of healthy microclimate in the immediate environment. Smart City, through implementation of new technologies and contemporary materials in ecourbarchitecture will facilitate expansion of city territory with significant changes in their matrix and urban identity. Revolutionary city building transformations with new ideas in formation and cultural differences of spatial forms are in store [6]. A better understanding of urban context and a new strategy of development of city frameworks from which we expect a healthier future are on the horizon.

One of the conceptually most spectacular city building designs was produced by the architectonic

group MAD¹, by envisioning a densely populated city of Beijing in 2050. Their futuristic designs proposed linking of the existing structures using new physical communication structures with dominant natural vegetative materials on the interpolated platforms of amoeboid volumes, which are significantly elevated from the ground level. The concept of construction of very tall structures, as considered by this team, is not needed, and the process of establishing a new organization of urban space with the material-urbanologic ideology is necessary. In addition, it is necessary to leave the rigid-angled forms and interpolate archisculptural forms which mimic and support nature [7, 8]. Identity of a place must be changed in non-globalization terms, through new understanding of urban design and new cultural expression. The orientation to horizontal linking of structures in

¹ Add: West Tower, No.7, Banqiao Nanxiang, Beixinqiao, Beijing, China 100007. Enquiry: office@i-mad.com. Media: press@i-mad.com. Recruitment: hr@i-mad.com. MAD is an architectural design firm based in Beijing, China, with offices in Los Angeles and New York City. MAD first gained international attention in 2006 when it was commissioned to design the Absolute Towers in Mississauga, Canada. Founder: Ma Yansong. Founded: 2004

space, with plenty of vegetative material indicates a general tendency of adequate propositions for a

different ecourbarchitectonic interventions which are integrative in character.



Figure 5. MAD's proposal for the future development of Beijing CBD area. Project was named *Beijing 2050*, [25–26].



Figure 6. Courtesy of Vincent Callebaut's Architecture, *Hyperions Eco-Neighborhood Produces Energy in India*, [27–28].

Vincent Callebaut, the architect, designed Hyperion Eco-Neighborhood, in India, which will produce energy with the aim to protect the environment and renew „urban renaturalization”. The design unifies low-tech and high-tech structural elements with the goal of energy decentralization and stimulation of deindustrialization, through the concept of six tower gardens made of timber, a natural material. The urban identity of this structure is recognizable for utilization of timber material instead of steel or concrete. Emission of 1,1 tons of CO₂ per cubic meter can be avoided for the most part, which indicates one of the conceptually most detoxifying ecourbarchitectonic structures [9, 10]. The reinforcement of structural elements at the joints will be made of steel in order to provide static-mechanical stability of the structure. The towers are designed on radial, ring-like volumes in order to facilitate vortex air flow inside them, similar to chimney air circulation effect, which results from the wind gusts, which provides creation of their own energy generation which would provide lighting, water heating, air conditioning of housing units etc.

The vision of smart, coherent city dominated by contemporary and natural vegetative materials in an organic fusion will be encountered in the design of a futuristic, sculptural city of Shenzhen in China. The futuristic vision of this design by Belgian architect Vincent Callebaut contains vertical towers with very different functions, of urban and rural character, with a goal of freeing space at the ground level and protecting the natural environment. The stationary traffic was designed underground, while the upper floors saw implementation of agricultural stations, halls, commercial facilities, housing, gardens, etc. the dominating feature are vegetative structures intended for the purification of air and provision of a good quality micro-climate. The buildings were designed with special wind turbines and solar panels for a long term supply of cheap energy and with the vegetation, which, in addition to esthetic-artistic effects, provides detoxifying of air, and considerable reduction of carbon dioxide. It was predicted that such rational, hybrid complexes will provide a more cultivated future, with more energy than the users will be able to consume in their lifetime [11].



Figure 7. Eco-friendly Asian Cairns Concept, Innovative Farmscraper Concept to Benefit Shenzhen, China, [29].



Figure 8. Limestone Skyscrapers, [34,35].



Figure 9. Landscape balconies. Image Courtesy of Vincent Callebaut Architecture. Garden towers, [36,37].



Figure 10. Oxygen Eco Tower², [38,39].

² Mipim Awards 2015 - People's Choice Award - Winner project

The designs for conceptual town planning-architectonic designs of limestone towers, whose sculptural forms follow the symbiotic, hilly and mountainous localities with the lush vegetation, were obtained at „e-volo” competition³ in 2015. New conceptualization of settlements was conceived in such a way, that the backbone of the composition is the river flow profile, with the trained riverbank area. Geometrical-structural composition follows specific contour conditions with its coherent and consequent design, which advocates a new building and designing cultural strategy in the interactive formation of settlements and natural environment. The detoxifying context and new materialization in the direct contact with the intact natural space are important characteristics of this idea. The environmental method of research in the designing creation of new identity of living environment exhibits a new cultural strategy and a sensitive understanding of local, material context [12]. Interaction of contemporary artifact construction materials and natural materials in the environment produced a new creative, transformed spatial framework. An image of a different evaluation of living space in general.

Four environmental towers with a garden character, with intensive vegetation in a façade envelope, support the conceptual detoxification of microambient living environment. New material identity of structures in the urban space allows the users to encounter a new culture in the urban design and to introduce a healthier living environment. The floor volumes are discreetly rotated in order to provide a better insolation of large terraced volumes. This created a potential for establishment of new forms of life in interior and exterior space, a new scenery which supports and endorses dynamical building interventions. The use of green natural material created specific, historically significant changes for the existence of the community. A monotony and repetition of ecourbarchitectonic globalistic volumes of structures is avoided, and instead, a diversity in ideology and materialization of urban design was established [13]. A different generation of residential-office buildings is heralded, with an increased presence of oxygen in the living environment.

Human identity of the new production of ecourbarchitectonic space can be viewed through the design of 20 storey high luxurious tower, having an organic-floral form, by a group of Italian architects from „Progetto CIM”⁴ in cooperation with „Timberplan”⁵,

produced for the tropical conditions of the city of Jakarta. It has 75 levels with villas and various forms of large garden areas and swimming pools in the façade envelope. A new ideology of complex urban design with the structures which will create oxygen and application of contemporary building materials brought about a challenging pattern of futuristic characters. Orthogonal matrices in floor volumes were abandoned, and the physical artifact was directed to the archisculptural form as a model for strategic planning [14, 15]. The spectacular oxygen tower won a number of awards in 2015. The most important is the prestigious „MIPIM Awards 2015” awarded in Cannes, France. The tower is conceived as a vertical tower, it integrates elegance, comfort, high technology in housing sector. It utilizes renewable energy sources, reduces emission of carbon dioxide and contains solar panels. Energy from the lift facilities will be renewable. Heating and cooling are obtained from the contemporary geothermal facility. The designers conceived good air circulation, so air is filtered and adjusted to the natural microclimate in the environment, in order to reduce pollution.

3. CONCLUSION

An advancement in construction of new ecourbarchitectonic structures can be viewed in the presented examples of prominently vertical, multi-storey buildings through the implemented innovative technologies where artifact and natural structures achieved equilibrium. In addition, climate change in the world affected the change of city-building designing opinions in transformation of the forms of façade skins whose multi-layer detoxifying composition with filters made from algae and lichen contributes to a better comfort of the users and a quality regulation of microclimatic and energy processes in urban structures. This considerably reduced pressure on the eco-system structure in the environment of the buildings and resulted in global benefits in exterior and interior space. By interpolation of these natural, eco-vegetative materials in building compositions, the historical-cultural-social image of ambient entities are

³ Honorable Mention. 2015 Skyscraper Competition. Jethro Koi Lik Wai, Quah Zheng Wei, Malaysia

⁴ <http://www.plbusinessgroup.com/40-best-new-real-estate-developments-in-the-world/>. Architect: Progetto CMR

Engineering Integrated Services S.r.l. Developer/Client: Bimantra Citra. Other: Tecnimont Civil Construction & Permasteelisa Group (project management), Cimolai (construction company). Description: “‘Oxygen Eco-tower, your villa in the sky.’ The design strategy aims at upgrading the traditional concept of villas, through a new residential tower reflecting a sustainable vision that develops upwards, to minimize the use of the soil in high-density cities. ‘Oxygen Eco-tower’ is a residential building of 75 floors, with 161 villas.”

⁵ C/ Arzobispo Marcelo González, 24. Bajo, 47007 Valladolid +34 983 157 700. Contact email hola@timberplan.es

transformed and the biomorphic facades brought about new possibilities in a more sophisticated esthetic-artistic designing of the streets, plazas and squares.

New generation of „archibiotic“ structures in the cities will have an indispensable relation to the natural materials from the environment, and their different designing conceptualization. They will have a new culture in designing the house physiognomy. It is certain that the energy efficient, environmental houses have a tight correlation with the materials and environmental technologies in the field, which will affect the character of architectonic compositions and their typology. We are living the time of serious, innovative environmental-material-technological, very rapid, city building, complex engineering and revolutionary changes whose contribution is visible in environmentally conceptualized buildings which will, with new technologies and materials, partially independently produce energy and oxygen and reduce emissions of carbon dioxide. Detox buildings, in the near future, will reduce pressure on the environmental resource structures.

4. REFERENCES

- [1] A. Wood, S. Henry, *Best Tall Buildings: A Global Overview of 2015 Skyscrapers*; CTBUH Awards Hardcover, Images Publishing Dist Ac, 2016, 21–34.
- [2] C. Aiello, *eVolo 01: Housing for the 21st Century*, eVolo, 2009, 72–85.
- [3] C. Aiello, *eVolo 02: Skyscrapers of the future*, eVolo, 2010, 62–64.
- [4] C. Aiello, *eVolo Skyscrapers: 150 New Projects Redefine Building High: 2*, Abridged, Audiobook, Box set, Evolo, 2014, 41–50.
- [5] G. Iannaccone, M. Imperadori, G. Masera, *Smart-ECO Buildings towards 2020/2030: Innovative Technologies for Resource Efficient Buildings*, SpringerBriefs in Applied Sciences and Technology, 2014, 67–80.
- [6] J. Hou, B. Spencer, T. Way, K. Yocom, *Now Urbanism: The Future City is Here*, Routledge, Publication, 2015 82–86.
- [7] L. Leifer, H. Plattner, *Design Thinking Research: Building Innovation Eco-Systems (Understanding Innovation)*, Springer, 2013, 41–56
- [8] M. F. Ashby, *Materials and Sustainable Development*, 1st Edition, Butterworth-Heinemann, 2015, 76–79.

- [9] M. Mostafavi, G. Doherty, *Ecological Urbanism*, Lars Muller; 4th Revised ed. Edition, 2016, 60–64.
- [10] N. Clear, *Architectures of the Near Future (Architectural Design)*, John Wiley&Sons; 1 edition, 2009, 89–92.
- [11] S. Lieb, C. Klein, *Futuristic: Visions of Future Living*, DAAB Media; Bilingual edition, 2013, 104–109.
- [12] S. Hagan, *Ecological Urbanism: The Nature of the City*, Routledge; 1 edition, 2014, 78–89.
- [13] V. Callebaut, *Archibiotic*, Huazhong University of Science and Technology Press, 2008, 62–87.
- [14] V. Callebaut, C. Andrieu-Millagou, *Paris 2050: Les cités fertiles face aux enjeux du XXIe siècle*, Michel Lafon, 2015, 44–61.
- [15] V. Callebaut, *Fertile Cities*, Design Media Publishing Limited, 2014, 35–49.

5. WEB SOURCES

- [16]
http://www.arquitectes.cat/iframes/mostra_new/visor.php/obra/996?&lang=#
- [17] <http://www.urbangardensweb.com/wp-content/uploads/2013/07/jardi-tarradellas-green-side-wall-urbangardensweb-private-visit-barcelona.jpg>
- [18]
<http://www.citylab.com/design/2012/06/barcelona-63-foot-vertical-park/2421/>
- [19]
<http://www.domusweb.it/en/news/2012/06/20/capella-garcia-green-side-wall.html>
- [20] <http://inhabitat.com/vertical-forest-mountain-hotel-will-clean-the-air-in-guizhou-china/>
- [21] <http://2.bp.blogspot.com/-kPjwipNPapk/VQigBmlj5FI/AAAAAAAAA7eY/l5PNcX-m-Xg/s1600/14.jpg>
- [22]
<http://www.archdaily.com/585254/vincent-callebaut-s-2050-parisian-vision-of-a-smart-city/>
- [23]
<http://www.geo.fr/var/geo/storage/images/media/le-projet-des-jardins-suspendus-des-tours-massena-de-l-architecte-belge-vincent-callebaut-dans-le-xiii-e-arrondissement-de-paris2/1962854-1-fre-FR/le-projet-des-jardins-suspendus-des-tours-massena-de-l-architecte-belge-vincent-callebaut-dans-le-xiii-e-arrondissement-de-paris.jpg>

- [24] <http://www.2luxury2.com/wp-content/uploads/Mangrove-Towers-futuristic-green-towers-paris-2050-vincent-callebaut.jpg>
- [25] http://58.96.177.128/wp-content/uploads/2014/09/20111025171453_2968.jpg
- [26] http://images.adsttc.com/media/images/56cc/ed73/e58e/ce8f/8100/0349/large_jpg/25_SKY_FOOTBRIDGE.jpg?1456270680
- [27] http://images.adsttc.com/media/images/56cc/ed73/e58e/ce8f/8100/0349/large_jpg/25_SKY_FOOTBRIDGE.jpg?1456270680
- [28] http://images.adsttc.com/media/images/56cc/ee3a/e58e/cefa/9100/0308/large_jpg/35_AXONOMETRIC_VIEW.jpg?1456270879
- [29] <http://fullinsight.com/blog/2013/04/farmscrapers>
- [30] <http://acdn.architizer.com/thumbnails/PRODUCTION/ab/5b/ab5b1cff1670c8656fd4a74ca4873388.jpg>
- [31] <http://architizer.com/blog/head-in-the-clouds-unbuilt-skyscrapers/media/1416933/>
- [32] <http://fullinsight.com/blog/2013/04/farmscrapers>
- [33] <http://www.evolo.us/wp-content/uploads/2015/03/0351-0.jpg>
- [34] http://portalkomunalny.pl/wp-content/uploads/2015/04/fot.-www.evolo.com_.jpg
- [35] <http://www.evolo.us/category/2015/>
- [36] http://www.arquitetorio.com.br/files/uploads/ARQUITETURA/Vincent%20Callebaut/5508a811e58ece68db00001f_vincent-callebaut-masterplan-predicts-future-of-self-sustaining-cities_16_garden_towers_-_aerial_view.jpg
- [37] http://images.adsttc.com/media/images/5508/a840/e58e/ced0/1a00/0023/large_jpg/18_GARDEN_TOWERS_-_HOTEL.jpg?1426630690
- [38] http://timberplan.es/timberplan/2015/03/Oxygen-Eco-Tower-2400x1300_c.jpg
- [39] <http://www.archilovers.com/projects/146961/oxygen-eco-tower.html>



ДЕТОКСИКАЦИОНА ТЕХНОЛОГИЈА У НОВОЈ АРХИТЕКТУРИ ЗГРАДА

Сажетак: Примјена нових еколошких материјала и технологија у изградњи објеката указује на нове тенденције стварања биоморфних физичких структура у градовима. У овом раду пажња аутора се фокусира на органско-метаболички, континуирано-визионарски развој микро и макро просторних амбијенталних цјелина у којима се стварају нови културолошки облици живљења и комуникације међу корисницима. Акцентоване су новоизграђене, вишеетажне куле динамичних, нестереотипних форми код којих је успостављена врло тијесна веза са природним ресурсима и материјалима и гдје су пројектанти своје специфичне дизајнерско-инжењерске идеје заснивали на стварању флексибилних вертикалних социјално-културних заједница. Примјери у раду заступају хомоморфичне концепте одрживе градње са иновираним геометријским облицима волумена у којима конструкцијски склопови доносе нова интелигентна становишта са јако наглашеним вегетационим фасадним опнама – вишеслојним мембранским омотачима. Осим естетске, они имају микроклиматско-енергетску и важну просторно-регулаторну детоксикациону функцију. Смарт еко-урбархитектонска размишљања усмјеравају на другачије градоградитељске карактеристике инжењерских процеса и активности у којима неће бити доминантно учешће артефактних материјала већ синтезно-креативно интерполовање нових одрживих технологија са природним, еколошким материјалима као нераскидивим саставним дијеловима. Уопште, различито нова философија грађења кућа, колико сутра, биће темељена на значајно увећаном присуству бионичких и биомиметријских еко-технологичких.

Кључне речи: еко-материјали, еко-технологичка, детоксикационе куле, еко-урбархитектура, бионичке структуре.

