

# Global and local in the housing of the future

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## Abstract

Changes and progress are an inseparable part of modern living, and they reflect a growing degree of education, the ever-rising living standards and wealth. We are witnessing a growing influence of globalization and individualization based on new information and communication technologies - ICT. The growing awareness of human impact on the Earth became a vital contemporary issue. Every age has produced a particular way of dwelling as a reflection of technological developments as well as specific social, economic and cultural conditions. What is being sought is a more flexible and dynamic architecture, where the conventions of the past are changed by some new conventions of the digital time in which we live. We see the fusion of sustainability and ICT (Information and communication technology) as a right way to future development, and we call it **Smart architecture**. With our students we work on experimental projects and research of new housing concepts. We shall here present the experience from our work.

## 1 Introduction

Huge changes are taking place in modern living: with an ever-increasing role of new information and communication technologies (ICT), which bring about changes in the way of life, there is also growing influence of globalization and individualization based on new ICT. The growing awareness of human impact on the Earth became a vital contemporary issue.

At Faculty of Architecture in Zagreb, we teach three courses on housing: Single family housing, Multy family housing and an optional course, Virtuality in Housing Architecture. Through our knowledge of development, we are trying to foresee what architectural future will be like. Is the future a concept of 'intelligent' environment, 'a smart dwelling of the future', which comprise a number of achievements of modern ICT, or does the future lie in experimental projects in which housing space represents continuing dynamic surfaces that change in accordance with inhabitants' needs and thus become active interfaces between the physical and the virtual?

We are researching new concepts of housing in which flexibility, ecology (sustainable development) and virtuality are of crucial importance. The concepts of “intelligent” environment, “a smart dwelling of the future”, which contain all achievements of contemporary IT, new intelligent materials, there emerge “intelligent” dynamic membranes, LED and LCD screens instead of walls, VR systems become an integral part of both professional and private life... Living in parallel worlds—virtual and real worlds must reflect on the concept of contemporary housing.

The widespread adoption of digital technologies is leading to profound changes on the way we live today. New media are reshaping contemporary experience from the ways people think about home and community to how they work, learn, and participate in public life.

Digital technologies are transforming nature and the aims of architectural thinking and creativity, erasing the relation between substance and data, between real and virtual, between organic and inorganic, and they lead us into a volatile territory from which rich innovative forms are born. Information and communication technology –ICT, offers new possibilities in communication through exchange of data and information between different persons, between people and computer, between different machines. ICT therefore has a potential to enlarge and improve human communication. It makes possible the creation of a global market for services and applications and supports cooperation in research, development and education.

## 2 Architecture and its influence on environment

“Current global development trends are incompatible with sustainable development and ability to build the future. Sustainable development is the most important political concept at the start of the 21<sup>st</sup> century”. Franz Josef Radermacher [1]

The growing awareness of **ECOLOGICAL DEPENDENCE** between man and the environment in which he lives is increasingly present on the global level, on the level of striking a dynamic balance between natural and man-made effects on the planet’s whole system.

Human impact on the Earth is a vital contemporary issue. Ecological dependence strikes at the very root of man’s existence in space, of his expansion. The global population has increased tenfold over the last hundred years due to scientific developments and technological innovations. There are six billion people in the world today and the number keeps growing to an eventual 10 billion people, creating more pressure on our decreasing resources.

One of the key issues for future development is the potential of man’s influence on natural environment, which is in a state of dynamic balance. Dynamic balance is a precarious balance. Ecological dependence and sustainable development are the basis for our efforts to create a dynamic balance of the environment.

The awareness of economic dependence of man and environment is of utmost importance. All human activities, including architecture, take part in disturbing the natural balance. Man’s existence is related to that balance, along with all events like war, destruction, climatic disasters etc.

A small portion of the world population consumes nearly 80% of the planet's resources and produces 80% of its environmental pollution. Buildings are responsible for a large portion of the world's total energy use and raw material consumption and are also responsible for around 25 % of timber harvest and 16 % of fresh water withdrawal. Urbanized areas produce 40 % of the solid waste destined for local landfills.

Housing makes up for as much as 80 percent of the urban tissue, so the way we live our life at home is an environmental issue of global importance.

One of the most important trends can be found in Europe’s demographics. According to EEA - European Environment Agency, by 1995 the average European household contained 2.5 people.

This is expected to decrease further. At the same time the number of one-person household increases from 30% in 2000 to 36% by 2015.

While Europe's population is growing slowly, at the same time an increasing number of people live alone, so the number of households is growing much faster. Europe's population increased by 5% between 1980 and 1995, the same period saw the number of households increase by 19%.

Smaller households have a higher consumption per capita than large ones. Even if the environmental impact of each household was reduced, the sector's overall impact could remain at today's levels.

Besides that, the average size of dwellings, however, did not decrease in tandem, growing from 83 to 87 square meters between 1985 and 1997. Higher living standards tend to add to the pressures on the environment by households: emission of greenhouse gases and air pollutants, the use of water and energy, the discharge of wastewater, the production of a wide variety of waste, the production of other pollutants, such as chemicals harmful to the ozone layer, etc.

Higher energy standards for houses and the introduction of more efficient electrical appliances have not led to a decrease in total energy and electricity consumption by households. Furthermore, Europeans use more energy efficient appliances and heating installations in their homes, but as whole their homes consume more energy than they did before. The household sector is one of the largest users of energy in the EEA, consuming 29% of final energy consumption (excluding energy used for transport). Between 1985 and 1998, the actual amount of energy consumed per household remained nearly constant, but the growing number of households increased energy use by 4%. [2]

Today in Europe, half of our energy consumption derives from imported fossil fuels and, on current trends, by 2030 we will have to import more than two thirds of our total energy consumed.

In U.S., they have a similar situation. Residential and commercial building operations account for almost half of U.S. energy consumption, and over three-quarters of U.S. electricity consumption - largely because of building design. According to architect Edward Mazria, residential and commercial buildings are conventionally thought of as consuming 38 percent of energy in the United States. But when he adds in industrial building operation consumption and the embodied energy of building materials, he calculates that architecture's share is actually closer to *half* the country's total energy consumption. Similarly, architecture is responsible for 46 percent of U.S. carbon dioxide (CO<sub>2</sub>) emissions.

When architects design buildings and specify construction materials, they are responsible for that building's energy consumption pattern for its lifetime. Rather than depending solely on technology to bring down building energy use, Mazria believes design strategies concerned with siting, fenestration, and material selection can go a long way toward energy efficiency. [3]

Europe has committed itself in the Kyoto Protocol to reduce the greenhouse gas emissions which come from burning fossil fuels, mainly coal, oil and gas. To fight climate change, greenhouse gas emissions should – by 2012 – be reduced by 8 % compared with 1990 levels. However, present trends point to an increase of over 5 %.

In its 2000 Green Paper on security of energy supply, the European Commission set out a strategy to improve energy efficiency and to encourage greater use of new, renewable sources of energy (wind, PV, solar thermal, hydro power, geothermal) – largely available within Europe. [4]

Ground-breaking targets along the way towards sustainability are important both for renewable energy and end-use efficiency. The targets set out in the EC White Paper of 1997 foresee a 12% share of renewable energy in total energy consumption by the year 2010 (a doubling of 1997 share) and 20% by the year 2020. [5]

## **3 Changing's**

### **3.1 Sustainability**

The production of buildings and their use are important factors in the problem of the environment, and can therefore play an important part in its solution. Globalism of ecology and homeland directly affects the future that is related to the overall balance of the world. These problems could be reduced through changing systems and peoples' habits and lifestyles.

The problems of overcoming climatic problems are related to environmental issues and directed into the definition of justice factors: sustainable development as satisfaction of humanity's needs without burdening the future generation's possibilities to satisfy their own needs.

The environmental impact of building materials, construction techniques, and building operations and maintenance can be reduced. Sustainable building practices attempt to consider the environmental, economic, and social effects of a built project in a holistic way.

Sustainable architecture celebrates the connection between our build and natural environments, enhances communities, minimizes the impact of design and construction on finite natural resources, and fosters our physical and emotional well-being. Sustainability or "green" design in housing refers to an architecture that does not harm to natural environment, preserves it for future generations, giving a special emphasis to the use of autochthonous materials, to recycling of various resources, depending upon natural forms of energy. The sustainable building movement emerged from solar, energy efficiency, water conservation, land conservation, and indoor air quality interest groups working together to develop a whole systems approach to building. Cooperation from environmental organizations and academic disciplines has become requisite to lead the way toward a sustainable future. Sustainability (Nachhaltigkeit) as postulated in Germany "requires the inextricable linkage of ecology, economy and social security. Sustainable development requires that improvements in economic and social living conditions accord with the long-term process of securing the natural foundations of life".

### **3.2 Homeland – genius loci**

Time, in which we live, "the digital era", is time of constant and big changes. Space is the only limiting factor in possible changes in the future. In that respect, research of genius loci as an overall notion of environment (ambient, ecological, and cultural) inhabited by people should be the base of investigation.

The Earth's global system consists of a series of homelands that is a starting point in our thinking.

Natural features of the homeland are related to geographical features. Natural and man-made manifests itself through human presence. Homeland without human presence is the natural environment, while the homeland is part of the mental system.

"*Genius loci* is plurality, existing simultaneously on different levels. It moves through the land, the air, and water as well as through history. These streams are constantly colliding and converging..." Tadao Ando, [6]

Milan Prelog teach us that revitalization of the homeland is not just a problem of building industry, not just historical and artistic, urban,, not even architectural, but most of all anthropological problem, and as such, the most sophisticated. [7]

"By studying every individual urban form we are simultaneously studying, planning and developing/simulating the content and form of a city. We are developing/simulating possibilities of changing its mental image. It is therefore important to realize the relation of spatial constituent elements of a city, i.e. streets, squares, parks and promenades..., all social (common, collective) spaces of a city, spaces of sociability and social activities. Architectural forms (buildings etc) are constituent elements of a typology through which we are discovering morphological sequences of

building, all of which helps us discover and comprehend the idea of a city and a built space. By researching in this way the history of a city's architecture, we are preserving and developing the concept of the city while carefully forming its most precious parts, linking tradition and creativeness into a permanent continuity.”[8]

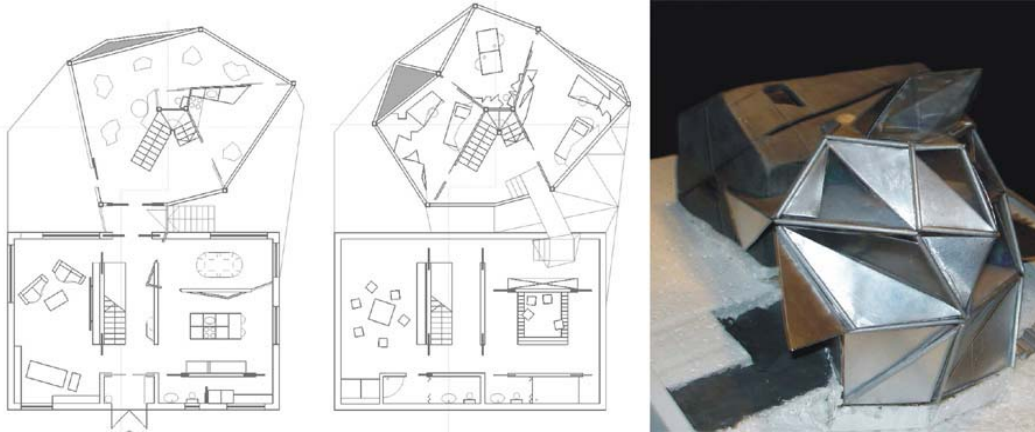


Figure 1: Zivcnjak Ivana - Family house, Zagreb, Architectural design IV  
Host house (The parents house) – The parasite house (The children house)

Digital revolution changes not only the nature of architectural output, but also the location and that causes a re-definition of architectural output's link with cultures of particular regions. Population migrations towards better conditions lead to a loss of homeland, abandonment of a cultural environment, while also prompting the need to create a new homeland. Dynamic balance is the development of the homeland.

**Local conditions must be made to equate global conditions as the general framework.**

Balance on the global level, affected by a number of minor human activities that converge into environmental factors. We can monitor, balance and establish methods of control and balance only through the use of ICT, that is the only existence of today. In that sense, the architect emerges as one of those on the team that studies the phenomenon of preserving life on Earth. Today's trend of development in housing should be stopped.

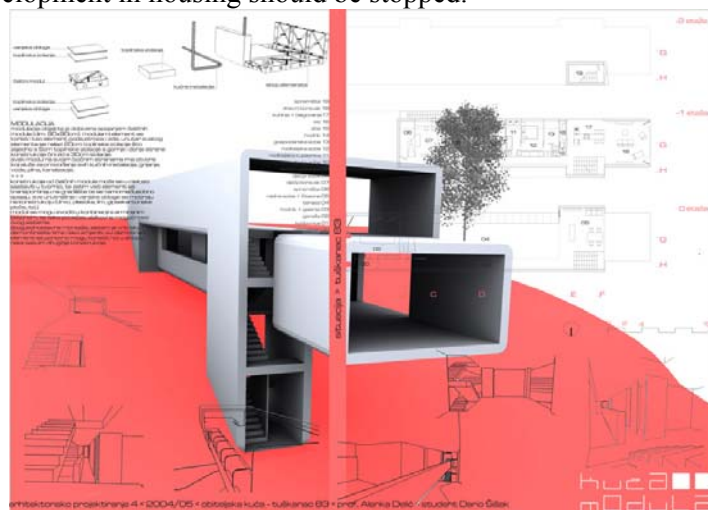


Figure 3: Sisak Dario - Family house, Zagreb, Architectural design IV  
Module House (steel modules 90x90 cm) - prefabrication and flexibility

### 3.3 Smart architecture

On the other side, there is little doubt that “intelligent homes” are the future of architecture.

We see the fusion of sustainability and ICT (Information and communication technology) as a right way to future development, and we call it **Smart architecture**.

**Smart architecture** is dealing with a variety of design challenges: the environmental problem, the optimal use of space and other resources, a functional utilization of materials and technology, and aesthetics. Smart is contextual, it responds to its surroundings. And not just the physical environment – but to the social environment as well, for the political and historical context. **Smart architecture** is intelligent, in the sense of design, and in the way intelligent building, or space, interacts with its environment and adapts to the user's wishes. **Smart architecture** is techno-logical. It uses advanced engineering and materials. Smart buildings are designed to react to use and movement, but do not interfere with the users' real life demands. Smart homes are more interactive from do-it-yourself installations where a clever user can connect all the household appliances, entertainment and security systems to the computer control center.

All that makes architecture smart.

### 3.4 New concepts of housing

Changes and progress are an inseparable part of modern living, and they reflect a higher level of education, higher living standards and wealth. Research by EEA - European Environment Agency shows that consumer spending per capita has increased by 46% since 1980, shifting from basic needs (food, housing) towards less basic needs (transport, fuel, recreation). [2]

Family is being transformed – childless couples, singles, etc – with independence within the family growing and individual needs changing.

Changes demand a high degree of changeability. Private spaces are substituted with diffuse usage spaces (work from home), which leads to the conversion of housing space, multi-functionality. Constant fluctuation of workforce related to economic instability is also present and that causes changes in relation to private property, people accept the idea of mobility as a way of life. Evolution in social behavior demands changes in the concept of designing modern housing, but also calls for new concepts in relations between housing and environment. Heterogeneity, multi-functionality, are the features of the new housing, difference openness, flexibility, industrialization and individuality are replacing homogeneity, specialization, manufacture work and collectivity.

Architecture is marked by constant changes, by people who know what they want and make decisions. People want their own home, not only to satisfy their primary needs, such as basic protection, but a ‘home’ which will express their identity, a space with which they can identify. When a family moves into a flat, they fit it out according to their tastes and practical needs.

In that sense, flexibility, adaptability and variability are the first and necessary step in creating adequate housing space.

Experiments in housing are rare, but **research of new (experimental) spatial systems** in accordance with the needs and wishes of their inhabitants must be the architect's obligation. Living in parallel worlds – virtual and real – reflect on the concept of modern housing.

New concepts or housing are emerged, in which flexibility, ecology (sustainable development) and virtuality play a crucial role, demonstrating a new way of thinking about urban living, and offering a new way of life for the start of the 21<sup>st</sup> century.

The new concept is marked by multi-functionality in usage, implementation of ICT, contemporary design, with the use of state-of-the-art technologies. Disposition in place of composition, reactive spaces, evolving, artificial, global and local spaces, which can respond to the needs of modern man.

The possibility of choice becomes a parameter of value. Large offer of good possibilities is a condition for realizing individual demands. Therefore, offering as large a choice as possible is essential, it is the result of assessment. Quality is the quantitative offer of quality solutions.

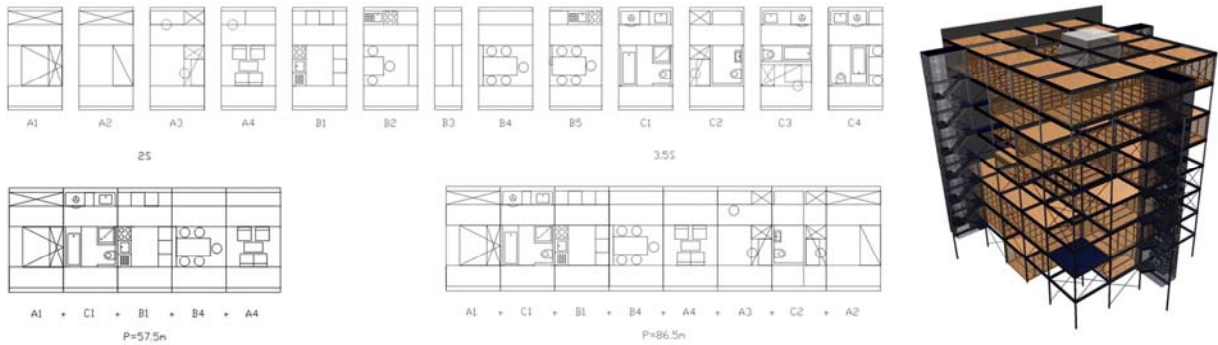


Figure 4: Ana Vuckovic – Apartment building, Spansko, Zagreb – student project  
 “...house with fixed construction and limited numbers of different modules 2.4x4.2 m – plug in system with great flexibility”

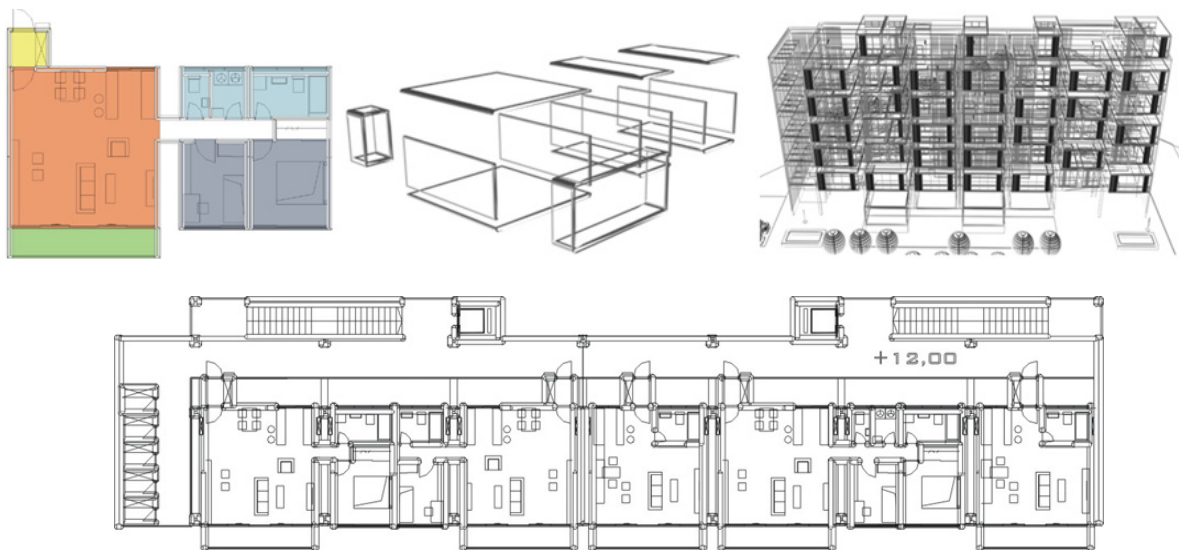


Figure 3: Opalic Bosko: Multy family house, Vrbani, Zagreb, student project  
 Prefabricated flexible apartments

### Instead of conclusion – The next step?

Sustainable architecture teaches us that when creative processes are used in conjunction with social, cultural, and environmental systems, architecture can meet the aesthetic and practical requirements of today without compromising the needs of future generations.

Experience of the smart architecture became basic knowledge for constant controll of the global environment. That is begining of a cyclic transformation process which has to be in harmony with civilization needs and culture. Technology is advancing so rapidly that what now counts as a highly efficient building is likely to be regarded as wasteful in the future. The use of a building and the



associated life cycle must guide decisions on materials and on energy concepts. Smart architecture has to be reusable, adaptable and transformable. In many cases, sustainability then comes down to designing buildings to have a short life span.

Modern housing incorporates most advanced contemporary technologies and social standards. All those parameters change rapidly, and that calls for continuing research and application of modern knowledge, materials, development programs and most recent information technologies, with a strategy of sustainable development. The entire process must be a part of the ecological system of balancing life on Earth. Building structure and virtual structure are the basis in the process of shaping the housing environment.

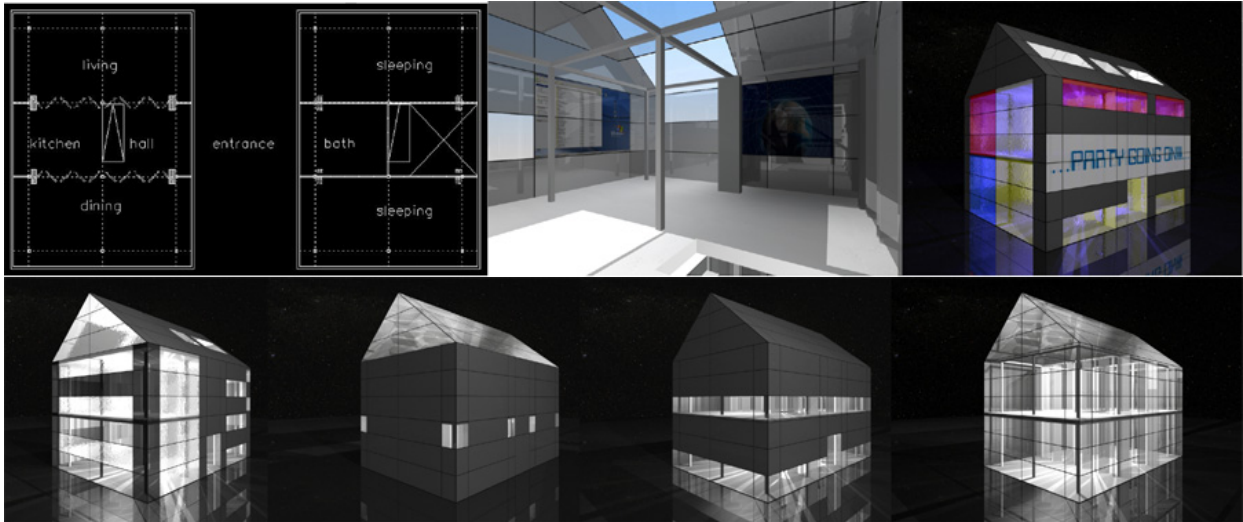


Figure 5: Niskota Dean, Starcevic Ivan & Zuparic Hrvoje: Virtuality in housing architecture  
International Velux competition, 2<sup>nd</sup> prize  
Contemporary intelligent house based on new SAS (Smart Architectural Surface) prototype

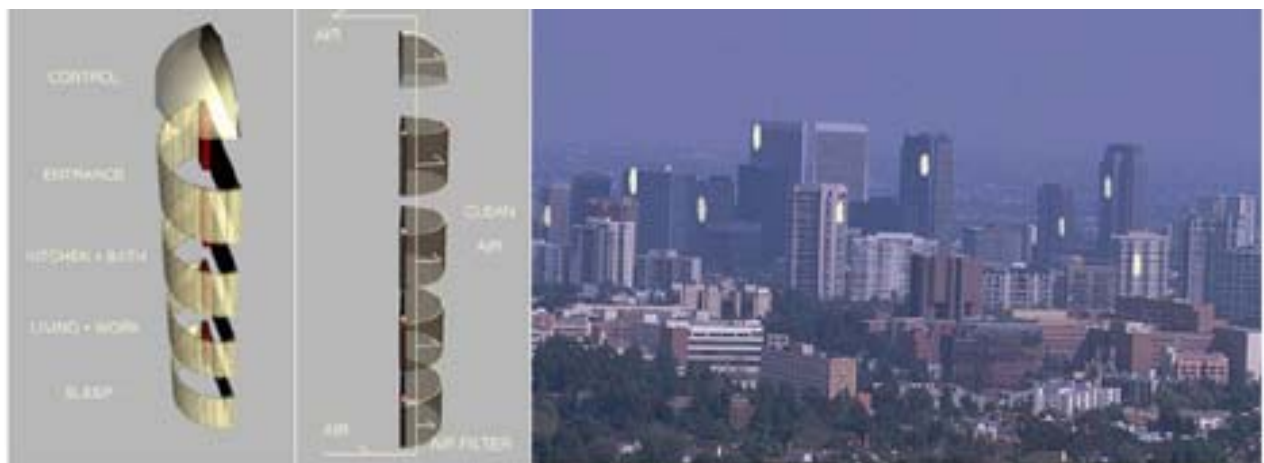


Figure 6: Pavlovic Ivana & Pejic Iva: Virtuality in housing architecture  
Bubble 02 – Temporary shelter for two - a private protected ecosphere



The next step in the near future is to interpret the whole building as a system that adapts to external conditions. Buildings were always meant to be as steady as a rock, but such new living systems are not static products any more. They can take various configurations according to the season and the use of the building. Dynamism, mobility and interaction are leading to the development of architecture as a transport-dwelling shell, easily dismantled dwellings, disposable industrial buildings, compostable garden huts, movable and reusable buildings...

Housing thus becomes a research lab of the new architecture. We lack enough experience from the past that could help us consider the new digital future and way of life. Predicting changes is an utterly thankless task. However, the current findings, experience and the pace of changes that have taken place in the last 50 years, are heralding ever-faster changes.

With our students, within the courses we focus to practice responsible architecture in a contemporary context. Through experimental projects and research of new housing concepts, students create a basis for discussions on theoretical and practical solutions for the housing of the future, create new ways of presentation and open new fields of research.

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