

# *Bioclimatic behaviour of small healthcare facilities*

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## *keywords*

*bioclimatic*

buildings for healthcare

small healthy facilities

bioregionalism

environment

## **Abstract**

The study carried out lately by an international research team, composed by Italian, Greek, Romanian and British experts, was aimed at creating a soft methodology for designing very simple healthcare facilities, which will enhance the sustainable character of the choices and focus on the social rather than on the therapeutic actions run within these peculiar spaces.

In particular this chapter's specific goal is that of defining the importance of the bioclimatic and bioregionalist design approach to the healthcare social structures within an urban district. In fact it is well known that today «[...] the economic centre of the city is no

longer the agriculture and not even the industry [...] at the core of our economy there are the services: transportation, education, health, judging system, legal business»<sup>1</sup>.

## **Introduction**

The topic of designing buildings for healthcare has been for long time accessible only to few very expert professionals, with great knowledge of the hospital procedures and techniques. Choices of size, paths, spaces, volumes, as well as materials, light and appliances requirements - not talking about the unnumbered complex systems which actually nowadays make an hospital a very high level machine working perfectly - is really

a challenge for architects, engineers, designers and builders. In fact it is well known that «[...] the design of hospitals draws up both general design skills and highly specialized sector-specific knowledge; maintaining a careful balance between achieving quantitative objectives and creating an environment that enriches the lives of all those who use the building is fundamental: hospitals are places of care and care cannot be defined in purely technical terms»<sup>2</sup>.

The World Health Organization defined *health* as «A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity»<sup>3</sup>.

But lately some new kind of structures have been promoted, which cannot be considered as a proper hospital facility, but in which still a number of therapeutic actions can be run, and few patients are welcome together with some not-ill people who claim to be disposed to those investigations aimed at prevention rather than therapy. The concept of *comprehensive health centre* has been defined as a place «[...] providing a wide range of health and social services, often linked to other community facilities»<sup>4</sup> and was «[...] used in the late 1940s to describe the type of centre [...] intended to provide a comprehensive range of primary community and social care services»<sup>5</sup>, but lately the term comprehensive health centre is utilized «[...] to distinguish this recent generation of buildings from the more modest local authority and NHS<sup>6</sup> health centres built in

the last century»<sup>7</sup>, and its role is that of «[...] co-locating services that have traditionally been provided by different agencies in different buildings»<sup>8</sup> such as for example GP<sup>9</sup>, dentists, opticians, pharmacists, but also some specialist services and some local social services. One of the reason of the creation of these centres is that of moving «[...] as many services as possible out of high-cost hospital care into community facilities»<sup>10</sup> or that of providing care in the patients' local community or at home, but mainly in order to «[...] put more emphasis on preventative healthcare»<sup>11</sup>. Finally the comprehensive health centre has also the «[...] potential to promote a sense of community. Because community services are a local resource, the centre from which these services are delivered should help foster a sense of belonging and citizenship»<sup>12</sup>. The latest can happen if some other community facilities other than healthcare ones are put together in the mix.

In fact as declared by Lefebvre «[...] a city includes the security as well as opening need, the guarantee and the adventure need, the need of organization of working and of playing, the need of unpredictability and that of the unexpected one, of unity and of difference, of isolation and meeting, of exchange and of investments, of independence (or solitude) and of communication, of immediacy and of long term perspective [...] the specifically urban needs are qualified needs, places of simultaneity and encounters»<sup>13</sup>.

Additional community facilities can in fact serve «[...] to open up the centre to a greater range of users and a bigger footfall»<sup>14</sup>. We know actually that lately «[...] new forms of societal and bonding welfare based on sociality and care, the change of demographic profile and the welfare crisis drive towards new solutions which will provide value to relational dimensions, beyond purely monetary and individual aspects. Both for elderly and children, which constitute two groups of population particularly important, the purely performing as well as private-driving logic cannot stand the next-years demand [...] what is needed - and that the convivial society can be capable of providing - is the framing of relational shapes able to aid»<sup>15</sup>. These structures, which in this book are explained in deeply terms by other authors, are simple to be designed and do not require a full expertise in the field, as it happened with big hospitals. Now it can be briefly remembered how the situation of health structures in Europe is developing: «[...] nowadays health facilities are becoming apparent in the health care field mainly under two trends: the first trend is towards concentration, reinforcing the creation of hyper modern hospitals marked by the leaps and bounds of progress in the medical science, technology and the organization and management techniques. The second trend is towards forms of care “outside” the hospital, with services and facilities situated in the community»<sup>16</sup>.

A good and well working hospital architecture’s «[...] full potential will only be realized where design intent and practice coincide»<sup>17</sup>. And it is also evident that a design team, before starting an hospital project, should visit an existing healthcare building «[...] seeing it in action and talking to people who use it»<sup>18</sup>. It is in fact obvious that «[...] good architects with the help of well processing programs can produce hospitals which can be both beautiful and effective»<sup>19</sup>. But also when designing a small healthcare facility some similarities can be found with planning big hospitals, «[...] not only in terms of functions but also in terms of their spatial organization and the way in which key design issues such as circulation, flexibility and sustainability are addressed»<sup>20</sup>. Therefore an architect or an engineer can actually take the task of designing such a structure, and can also improve the quality and the architectural value of the place, because one of the main characters of these healthcare structures is that of resulting as part of the community. Therefore the integration of these buildings into the city and the social life of the district in which it has to be completed should need the sensitivity and the creative predisposition of an attentive designer. In fact these structures are actually part of the social and community life of a place, and in there also some common activities can be run, such as children playground, sport actions, entertainment, and so on.

Therefore often they can be located in an existing building where the physical and urban integration already exists, and where other activities are run, besides the healthcare ones, such as commercial, working, sporting, leisure, residential and many others. Where in fact the city is really social, the mixed use of a district is desirable, and within this kind of places, social and psychological health is usually superior<sup>21</sup>. Therefore the knowledge of the existing site, of its characters, of its eventual history, of its social diversity becomes one of the core items to be focused before starting with the possible integration of the healthcare structure within the context. If the building has to be constructed from the beginning, and thus it will be all new, then the adaptation and the appropriateness should be carefully studied, mainly if the area has an historical value.

If, instead, the healthcare facility will be located within an existing building, then the question addressed mainly to the interiors and the external facades, and the complexity of the project could be superior. In fact «[...] there are [...] relevant transformations which do not require a radical change of structures but that preview internal modifications [...] even meaningful; those are transformations that can be compared to the beavers' activity: they work from the inside modifying even substantially old structures, but they do not destroy them»<sup>22</sup>.

Sometimes the building can be listed by the

Protection Institutions, leading to some restrictions as far as changes in the existing shape and materials of the building are concerned, and very often the apertures on the facades cannot be modified or enlarged. But, as we know, the Windows are the eyes and the ears of a building, and from there the external environmental events can actually enter, so defining the microclimatic as well as the healthy levels of the interiors.

### **1. No longer all sealed buildings**

And here it comes the bigger question that in these notes I want to focus on: the comfort conditions. In fact one of the difference between a very traditional hospital and the healthcare facilities we are speaking about, is the fact that most of the rooms of an hospital should be sealed and cannot get air, light and any other intrusion from outdoor, so creating very artificial climatic conditions, which in some cases are necessary, but in some others can be superfluous if not actually dangerous. As far as environmental factors are concerned, there is in fact already a development in designing healthcare facilities, for «[...] natural light [...] has been demonstrated to improve recovery rates in intensive care units, to maintain circadian rhythms in both patients and staff, and to promote production of vitamin D; [...] views of nature and/or human activity have been shown to increase speed of recovery; [...] incorporation of acoustical absorptive surfaces appropriate for infection

control will promote rest and sleep in an increasingly noisy technological healthcare environment»<sup>23</sup> but also integrating «[...] natural and artificial lighting needs to address not only technical aspects (sustainability, life cycle cost, light levels and colour rendering required for clinical processes) but also the therapeutic agenda. This includes appropriate user control and variation in light levels over time to support circadian rhythms»<sup>24</sup>. If in fact it is true that parasites, bacteria, virus and any other harmful living being do not survive under certain conditions, which actually help to eradicate them from the internal milieu, it is also true that these circumstances can be sometimes unhealthy also for humans. As we know from a number of studies about health and buildings<sup>25</sup>, a few illnesses can derive from the absence of natural conditions, air and light in particular, such as for example the SAD, and others can arise from the air conditioning systems, such as for example the Legionella<sup>26</sup>. The same effects which some hazard substances provide to an house can be actually found in hospitals, and not always the pure white and smooth surfaces can actually mitigate those hazards. But conversely «[...] a curious parallel evolved between the architecture of the clinic and the domestic, a hygiene fetishism which led to some of the key monuments of early modernism adopting the white-tiled, white enamel, chrome and glass aesthetic of the hospital»<sup>27</sup>.

Lately the approach starts to be different; even in USA, «[...] the emphasis on environmental quality that has characterized American hospitals over the last couple of decades can be traced back to the foundation of Rudolf Steiner's Anthroposophical Society in 1912. The idea that the environment can perform a healing function [...] was revived in 1970s. New ideas are born which create the need of taking some natural occurring force from outdoor into the internal spaces; it can be proposed that [...] individuals control the lighting, ventilation and temperature of the spaces they occupy»<sup>28</sup>.

This idea came firstly from «[...] the so-called patient-centered philosophy [...] research carried out by Roger Ulrich (which) confirms that patients enjoying a pleasant view from their bed, recover more quickly, stimulation of five senses is desirable»<sup>29</sup>, but can also be applied to the need of preventing some air-conditioning-affected disease as aforesaid. «It has long been asserted that *the quality of the environment* has an impact on the physical and mental well-being of both patients and staff, and that this leads to improved clinical outcomes. Recent research has shown quantitative measurable outcomes such as reduced uptake of pain medication due to qualitative improvements in the environment encompassed by an holistic and integrated approach to therapeutic design including: way finding, interior design, lighting design, art, landscape design»<sup>30</sup>.

Being these healthcare structures instead very different from hospitals, they can actually be provided with natural light and natural air changes. Therefore another big question arises - together with the comfort - the bioclimatic performance of the building itself. If light and air are important for life, mainly when they are not artificially created, it can also be pointed out that direct solar radiation affects greatly both the physiological and the psychological conditions of users. Moreover the sun can actually contribute to improve microclimatic comfort and thus on one hand heating up the rooms in winter and on the other hand providing an aid to energy saving, due to the fact that the sun is a natural renewable power source. Therefore in an healthcare facility, such as the ones we are talking about in these notes, the input of solar light directly hitting indoor is highly appreciated for users' health, comfort and psychological happiness.

## **2. Bioclimatic and bioregionalist approach**

One of the solutions which can increase solar incoming in the premises is designing the building with a bioclimatic approach. Either will the healthcare structure be located within an existing building or realized as a new architecture, the importance and care for the bioclimatic parameters - such as orientation of facades and windows, thickness of the envelope, eventual sun collection systems, and any devise useful for summer cooling - should be taken into account in the design stage.

With this approach the selection of materials, the shape of the buildings, as well as any other decision taken during the design procedure will allow the final architecture to behave as a comfort machine, and at the same time to perform at very high level as a system which can supply any kind of benefits to users in terms of various satisfaction factors; first of all it can provide direct solar radiation indoor, so creating - as aforesaid - a very happy milieu, besides warm, dry and well-naturally lighted spaces.

In order to allow a building to be bioclimatic, and even farther, sustainable, the connection with external environmental conditions is mandatory. In fact for the already explained reasons, when a building is not completely sealed and thus tight, the internal milieu is more healthy, in particular when the spaces are destined to such activities as those aimed at avoiding or mitigating the illness and its eventual hazard.

Another important aspect which can affect the safety within internal rooms of an healthcare facility is due to the technical selection of materials. As it is known, the life cycle of a building system, as well as any other furniture, can provide various effects on the resulted final product which is present within the living spaces.

Different kinds of content in this product are to be considered, as well as procedure, since any of the stages of the life cycle dispenses various effects; the indicators usually

employed for assessing the level of sustainability of a process, together with the level of naturalness of a final product can be widely found in literature<sup>31</sup>.

«Specification of materials for the interior of an hospital need to reflect a balance between factors such as robustness, frequency and cost of maintenance, sustainability and infection control. While the infection control tends towards the selection of hard, smooth surfaces products with few or sealed joints, this needs to be balanced with therapeutic, other safety, and maintenance considerations including: acoustics, [...] heating and ventilation, [...] artificial light design, [...] safety, [...] maintenance»<sup>32</sup>.

Talking about materials the role of the surface quality can be specified: as far as safety is concerned «[...] smoother floors are generally easier to clean but are more slippery, so careful risk assessment is needed to select appropriate material for different areas»<sup>33</sup>: but it can be remembered that non smooth surfaces, otherwise than on the floors, can also increase the welcome and friendliness of rooms, for they create shadows and warm sensations, rather than the cold one that a reflective very smooth surface usually provides to people.

But another specific aspect which is not very often considered, even though one of the indicators were actually the distance between the construction yard and the preproduction site as well as the availability of the prime

matters within a ray of a certain number of kilometers, is the parameter of the bioregionalism.

This approach to design procedure, known since the beginning of the 60s, has now become very popular, since it can solve a great number of environmental questions, such as for example the waste problem, the transportation pollution and energy consumption, and so on. And it has been often compared with the well known idiomatic sentence "at Zero-Km". But this approach is actually more complex and involved some other fields of human action and sensitivity, rather than only the logistical issue of finding prime matters in a very close site. In fact, as literature demonstrates<sup>34</sup> the bioregionalism is a thought current, an holistic approach and a way of living and working in a place, which involves a great number of different issues, both of material/physical and spiritual/physiological nature. Designing with the *Bioregionalist Spirit of the Place* means to try to get in harmony with the bioregion itself, to collaborate rather than to transform and brutalize the landscape, to improve social, sensitive and natural milieu, trying to save the feeling of belonging.

Carrying this approach to the design of health facilities means therefore to strengthen the link between the users and the place, either they were patients with some illness, or only people who come for check up, or even part of the medical staff.

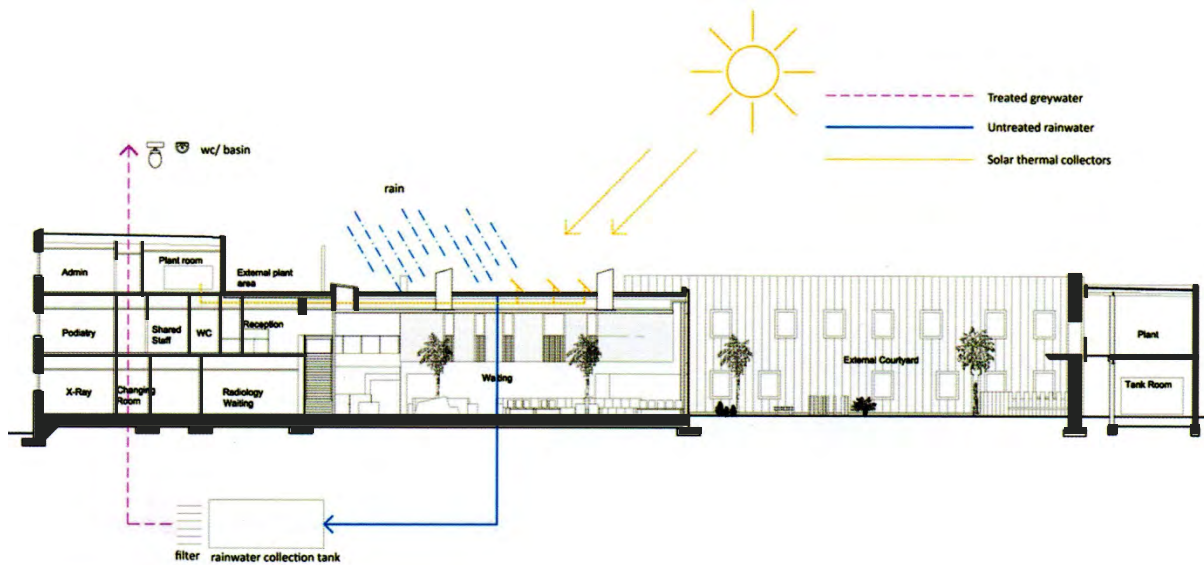


fig01 - Environmental strategy for renewable technology (up) and External view (down) of the South Liverpool NHS Treatment Centre, designed by Buttress studio [source: De Syllas J. (2018) Integrating Care, Routledge, London].



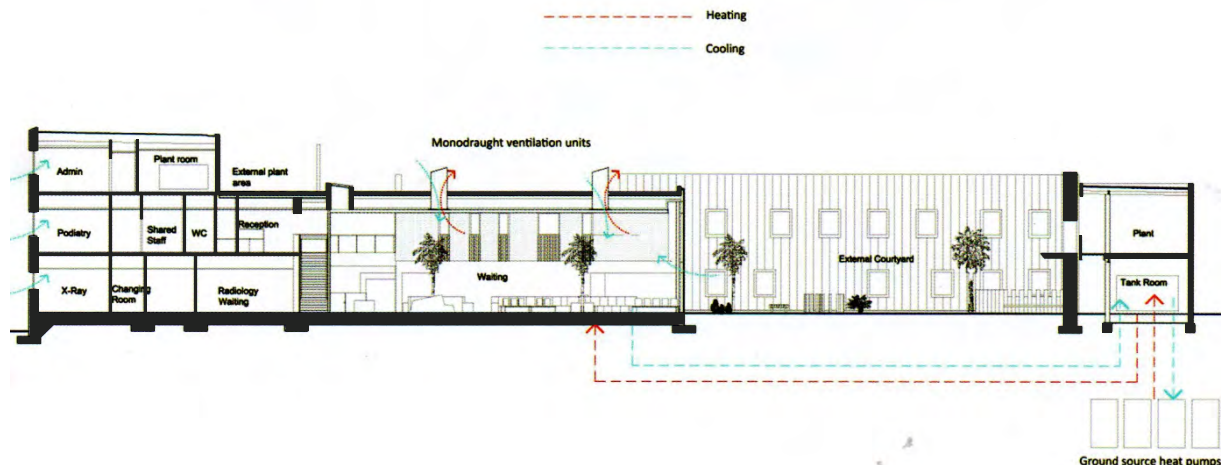


fig02 - Heating and Cooling strategy (up) and The internal Courtyard as a social space (down) in the South Liverpool NHS Treatment Centre, designed by Buttress studio [source: De Syllas J. (2018) Integrating Care, Routledge, London].

Therefore also the interior should remind people of the external milieu, about the existing cultural as well as natural city-scape. This can be applied by means of certain careful decisions taken during the design procedure, such as for example the shape of the building, the materials, the orientation of the windows, all the technological systems of the building as well as any environmental device. For example the thermal, acoustic and lighting configuration of the internal spaces should be appropriate to both the users' requirements and any eventual social and psychological need. But mainly any choice should be accurately compared with the site's essences and characteristics, so as to reflect the "spirit of the place". In this way, not only the users would feel one thing with the environment, but also the place would not be decayed and greatly transformed and instead will be respected and its characters and performances will be preserved and remembered so as to save the bioregional identity.

### **3. Factors affecting safety, security and health**

According to Patrick Geddes' declaration, the urban context can be conceived as «[...] an organism, as a living being in continuous transformation, enlightening the need of identifying interactions, links, relationships between the various components - the physical and material actuality, made up with urban texture and infrastructural system and with the

greenery as well as the immaterial one, linked to human activities - which regard and merge into the places of living and into men's spaces [...] a blended idea which recalls of all the complexity and heterogeneity of human settlements on land [...] a city which is never unique but always plural»<sup>35</sup>. And so the characteristics of the local environment - in this case the city - can become part of the design, mainly when the use destination of the building - either it is new or it consists in the recovery of an existing one - is that of an healthy facility. This approach can then apply a classification and specification of the number of factors affecting the final behaviour of the internal spaces as well as the correct performances of the technological systems. The aim of such a classification is that of defining what actually contributes to provide health and comfort to users, and what, on the other hand, could instead create discomfort, unease, annoyance and even some kind of illness.

The first classification can be done according to the location of the factors, i.e. whether they are inside the building or outside, or even in filtered spaces between indoor and outdoor, such as for example the entrances, the corridors, the balconies and so on.

The second criterion is that of the environmental performances, so it can be possible to identify thermal, acoustic, lighting, safety and security factors, according to the comparative needs which users should always get satisfied.

In order to identify other factors, in the class of Health for direct effects on man, some can be mentioned such as Safety, Ergonomics, Psycho-social qualities, whose indicators are actually the following: Localization, Intensity, Effect on target, Duration, both for materials and other sources of pollution or unhealthy affecting the internal spaces of a place for therapy<sup>36</sup>.

The final and most important class of factors which greatly affect the bioregionalist behaviour of the whole built environment is then that of the place identity, which can actually create a specific feeling among the people but also help to be part of the place so providing security, welcome and belonging sense. How can a place be identified? Of course with some sensations arising within the users of the place itself which bind a place to another, but mainly is due to concrete and physical characters, aspects which define the area. For example the colour and the smoothness of the external surfaces, but also the materials employed with their properties and performances, and the spaces' dimension and shape, the building configuration, the windows' size and orientation, the kind of external envelope, the structural system, the technological plant systems (artificial heating, lighting and conditioning, electrical and telecommunication and so on), the connections with outdoor systems, entrances, roads, squares, eventual green areas, traffic potential, any other polluting or sound providing source.

## **Conclusion**

It has been focused on the importance of a bioclimatic approach within a building which is aimed at caring for users' health, mainly when the therapeutic actions are not highly invasive or strongly indispensable, but the principal goals of the building itself are those of providing a social as well as preventative services, that is the House of health, as it has been defined lately, rather than the house of illness. It has also been tried to briefly clarify that basic health conditions are linked to the thermal and general environmental comfort, due to the amount of energy systems, to the pollution essences coming from oil-derived materials and to the ventilation occurrence; the latest is strictly connected to the air conditioning plant systems (HVAC) and to the potential of using the natural ventilation. Finally a social connection between these healthcare peculiar architectures and urban performances as well as requirements could enhance the importance of promoting within the territory such structures, because the city is in the end exactly an organic and plural system, with a great number of various natural as well as anthropical structures interacting each others'. Even the Brazilian Constitution reports that «[...] the policy of urban development [...] has the goal of arranging the whole development of social functions of the city and of guaranteeing its inhabitants' comfort»<sup>37</sup>, then city and health should walk joined as well as the new trends in urban planning declare.

We can eventually remember that «[...] health care can be defined as all the activities, behaviour and experiences in an environment that guarantee the security and the integrity of the people who are users of healthcare buildings [and that] [...] over the last twenty years a nursing philosophy has developed where a person is viewed as a whole. It is the patient that should be the centre of attention and his needs should govern the hospital work»<sup>38</sup>. Unfortunately the sharing economy «[...] pushes towards a step beyond the idea that it will be possible to live without link and dependence from more and more prompt and personalized services which it can offer. But all this at the cost of an increasing dependence on the social organization as a whole»<sup>39</sup>.

We can conclude declaring that if it is true that a modern (and smart) city should provide high level - and great amount of - services and should ease as much as possible the chance of satisfying needs and jobs from home, thanking to digital tools and processes, then it can also be added that a city is a social place and nothing can substitute the interchange between people, as well as provision of health services. It is not possible to be cared for via an information tool; even if now the *IoT* business<sup>40</sup> has also improved the robotics and digital means for remote control of everything, lately even the surgery: if a human being needs a therapy, he/she needs also comprehension, care and psychological help, together with therapy; therefore going to a

very close and small sized healthcare and social facility will improve the quality of her/his life.

If these small community and healthcare structures and buildings are provided with very high level of comfort the chance of healing increases.



*fig05 - How the green can interact with healthcare facilities in the courtyard garden of the Carlisle Wellbeing and treatment Centre, Belfast, designed by Penoyre & Prasad LLP. [source: De Syllas J. (2018) Integrating Care, Routledge, London].*

## Notes

- 01 - MAGATTI, M. (2018), *La città convivio*, in: Giuliani, I., Piscitelli, P. (ed.), *Città, sostantivo plurale*, Fondazione G. Feltrinelli, Milano, pag. 60.
- 02 - ANDERS, C., BLOOM, C. et Al. (2018), *Part 19 Hospitals*, in AAVV, "Planning and design data. Metric handbook", edited by Pamela Buxton, Routledge London, page 19-1.
- 03 - WHO Constitution 1948.
- 04 - DE SYLLAS, J. (2018), *Integrating Care*, Routledge, page I.
- 05 - *Ivi*, page X.
- 06 - NHS = National Health Service.
- 07 - DE SYLLAS, J. (2018), *Integrating Care*, Routledge, page X.
- 08 - *Ivi*, page XI.
- 09 - GP = General Practitioner.
- 10 - DE SYLLAS, J. (2018), *Integrating Care*, Routledge, page XI.
- 11 - *Ivi*, page XI.
- 12 - *Ivi*, page XII.
- 13 - SETTIS, S. (2018), *Il diritto alla città*, in GIULIANI I., PISCITELLI P. (edited by), "Città, sostantivo plurale", Fondazione G. Feltrinelli, Milano, pag. 24.
- 14 - DE SYLLAS J. (2018), *Integrating Care*, Routledge, page XIII.
- 15 - MAGATTI M. (2018), *La città convivio*, in Giuliani, I., Piscitelli, P. (ed.), "Città, sostantivo plurale", Fondazione G. Feltrinelli, Milano, pag. 66.
- 16 - CHRYSAFIDIS, E. (2019), *Primary Health Centres in the 21st century - Cells of Health and Health Culture*, in the present book, page 133.
- 17 - DE SYLLAS, J. (2018), *Integrating Care*, Routledge, page XIII.
- 18 - *Ivi*, page XIV.
- 19 - VAVILI, F. (1998), *Health care Facilities. Reality and expectations*, in AAVV, "Hospital design at the beginning of the 21st century", University studio press, Thessaloniki, Greece, page 23.
- 20 - DE SYLLAS, J. (2018), *Integrating Care*, Routledge, page XIV.
- 21 - For the concept and practice of "Mixed use" in the city see: ZEIDLER, E. (1985), *Multi-use Architecture in the Urban Context*, New York: Van Nostrand Reinhold; EVANS, G. (2014), *Living in the City: Mixed Use and Quality of Life*, in: "Wellbeing and the Environment: Wellbeing: A Complete Reference Guide". John Wiley & Sons, Oxford.
- 22 - BALDUCCI, A. (2018), *La città mutevole*, in Giuliani, I., Piscitelli, P. (ed.), "Città, sostantivo plurale", Fondazione G. Feltrinelli, Milano, pag. 85.
- 23 - ANDERS, C., BLOOM, C. et Al. (2018), *Part 19 Hospitals*, in AAVV, "Planning and design data. Metric handbook", edited by Pamela Buxton: /Routledge 2018, pages 19-29.
- 24 - *Ibidem*.
- 25 - IGE, J., PILKINGTON, P., ORME, J., WILLIAMS, B., PRESTWOOD, E., BLACK, D., CARMICHAEL, L., SCALLY, G. (2018), *The relationship between buildings and health: a systematic review*, in "Journal of Public Health, Volume 41, Issue 2, June 2019", Pages e121-e132.
- 26 - «The main pollutants emitted by building materials are the Volatile Organic Compounds (VOCs), belonging to the category of chemical nature pollutants and made up with a great amount of substances, among which the aromatic and chlorinate hydrocarbons prevail as well as terpenes and aldehydes. Among the latest, the most diffused indoor are formaldehyde and toluene. VOCs are released by the almost totality of building products, but mainly by the finishing (cladding, paintings, sealers, primers, glazing) and by the intermediate ones for the installation, such as for example, the adhesives, [...] the fillings» (Oberti, I. (2005), *Materiali edilizi e qualità dell'aria*, in: Grosso, M., Peretti, G., Piardi, S., Scudo, G. (edited by), "Progettazione ecocompatibile dell'architettura.

- Concetti e metodi, strumenti di analisi e valutazione, esempi applicativi." vol. 1 Napoli: Esselibri-Simone, page 444).
- 27 - HEATHCOTE, W. (2019), *The architecture of health: how buildings are designed for wellbeing*, in "Living with Buildings", wellcomecollection.org, [on-line] available at: <https://www.ft.com/content/0249c3be-bce0-11e8-8dfd-2f1cbc7ee27c>.
- 28 - VAVILI, F. (1998), *Health care Facilities. Reality and expectations*, in AAVV, "Hospital design at the beginning of the 21st century", University studio press, Thessaloniki, Greece, page 24
- 29 - *Ivi*, pages 24.
- 30 - ANDERS, C., BLOOM, C. et Al. (2018), *Part 19 Hospitals*, in AAVV, "Planning and design data. Metric handbook" edited by Pamela Buxton: Routledge 2018, page 19-29.
- 31 - «In sustainable design, the verification phase aims to know the building quality of the building, and mainly to satisfy the classes of need for well-being and environmental protection. [...] Product life cycle methods [...] assess the environmental impacts of production processes according to life cycle indications, [...] multicriteria methods [...] are based on a protocol articulated in the following phases: establish a set of requirements to be met; set criteria to satisfy the requirements, such as indicators and threshold values; evaluate the scores to be attributed to the satisfaction of the requirements and the weights; perform the evaluation and the sum of the various scores obtained. [...] Some are: [...] Eco label, DerBlau Engel, Nordic Swan, Nature Plus, ANAB/ICEA, PEFC, FSC, Ciclo di Moebius, Pannello Ecologico, ICMQ, Inbar, LEED, Green Star, Klima Haus, Breeam Eco Homes, Protocollo Itaca, SB 100» (DE JOANNA, P., BUONINCONTI, L. (2010), *From Meta-design to evaluation: Guidelines for sustainable design of buildings*, in AAVV "Sustainable Technologies for the enhancement of the natural landscape and the built environment", Luciano ed., Napoli, pages 317-318).
- 32 - ANDERS, C., BLOOM, C. et Al. (2018) *Part 19 Hospitals*, in AAVV, "Planning and design data. Metric handbook" edited by Pamela Buxton: /Routledge 2018, page 9-30.
- 33 - *Ibidem*.
- 34 - Some useful text for the concept of Bioregionalism: ALEXANDER, D. (1996), *Bioregionalism: The Need For a Firmer Theoretical Foundation*, Journal of Ecosophy, Vol 3/ n° 3, Trumpeter ed.; BAUMAN, Z. (2001), *Voglia di comunità*, LaTerza, Bari; BERG, P. (1984), *Welcome speech from the First Bioregional Congress of North America*; BERG, P., DASMANN, R. (1977), *Reinhabiting California*, in "The Ecologist, Volume 7 n. 10", December; CARSON, R. (2000), *Silent spring*, Penguin books, London; COBB, J.B. Jr. (2001), *Deep Ecology and Process Thought*, in "Process Studies, Vol.30, Number 1", Spring-Summer, Claremont, CA; DEVALL, W., SESSIONS, G. (1985), *Deep Ecology: Living As if Nature Mattered*, Gibbs M. Smith, Inc., Salt Lake City; FRANCESE, D. (2016) *Technologies for Sustainable Urban Design and Bioregionalist Regeneration*, Routledge, London; REES, W.E. (1992), *Ecological footprints and appropriated carrying capacity*, in Environment and urbanization, n. 4; STEVENSON, F. (2013), *A bioregional approach to climate change design*, in "ARC 307, 327, 377, Environment and Technology 5"; VAN NEWKIRK, A. (2009), *Bioregions: towards Bio regional Strategy for Human Cultures*, in Environmental Conservation, Cambridge Journals on line, Volume 2, Issue 02; WWF (2018) The Living Planet Report, [on-line] available at:

[https://wwf.panda.org/knowledge\\_hub/all\\_publications/living\\_planet\\_report\\_2018/](https://wwf.panda.org/knowledge_hub/all_publications/living_planet_report_2018/).

- 35 - GIULIANI, I., PISCITELLI, P. (2018), *Premessa - La città montaggio*, in Giuliani, I., Piscitelli, P. (ed.), "Città, sostantivo plurale, Fondazione G. Feltrinelli, Milano, pages. 8-9.
- 36 - See the VAdE Methodology in: FRANCESE, D. (2007) *Architettura e vivibilità*, FrancoAngeli, Milano.
- 37 - Art. 182, a new integration of the original Brazilian Constitution of 1988.
- 38 - DILANI, A. (1998), *Healthcare buildings as supportive environments*, in: AAVV, "Hospital design at the beginning of the 21st century", University studio press, Thessaloniki, Greece, page 90.
- 39 - MAGATTI, M. (2018) *La città convivio*, in Giuliani, I., Piscitelli, P. (ed.), "Città, sostantivo plurale", Fondazione G. Feltrinelli, Milano, page 64.
- 40 - For "IoT" see for example: MUDASSAR YAMIN, M., KATT, B., TORSETH, E., GKIOULOS, V., KOWALSKI, S.J. (2018), *Make it and Break it: An IoT Smart Home Testbed Case Study*, in "Proceedings of the 2nd International Symposium on Computer Science and Intelligent Control", ACM New York, NY, USA.