

Textile architecture

Membrane structures for new architecture expression

Between atopic and ethics

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Text presentation

ATOPIC ARCHITECTURE AND MEMBRANE STRUCTURES

Sign and signs of the new building archetype between ethics and form

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Abstract

Textile architecture is a new architectural expression negotiating the 'atopic' space in the constructed world between ethics and form.

The presentation of the edited work "Atopic architecture and membrane structures" on the use of tensile membrane structures in construction aims to illustrate the contemporary place of these structures in architecture. It is a new structural archetype of the twentieth century, involving textiles and fabrics from the shell outside to the interiors within, and has defined an architecture of lightness, brightness and versatility, amounting to a new language of contemporary architecture with its own architectural repertory.

Keywords: atopic, ethics, expression

1. Introduction

As an adjunct to the text itself, further details regarding the origins and assumptions that lie at the basis of textile architecture as well as some of its features are provided.

Textile architecture derives from the use of tensile membrane structures as opposed to other building techniques which make use of heavy or variously light technology. Thus, the structural and morphological aspects are inseparable but versatile. In this way these peculiarities allow for multiple solutions both in terms of function and form, with the added benefit of a finished work which is both reversible and recyclable.

This introduction sets out the ways in which textile architecture has been illustrated and described before going on to define what textile architecture actually is.

The aim of this text (and this paper) is to illustrate through the works of national and international philosophers, historians, scholars and designers, sketches, drawings, designs and photos of works completed or proposed in order to:

- **describe** the landscape of tensile membrane structures in architecture worldwide over the last 70 years and recall some of the most significant episodes relating to the evolution of this technology;
- **reaffirm** the environmental and technological advantages achieved with the use of this new structural archetype of the 20th century;
- **hold** that this light technology has brought about a new architectural expression: *textile architecture*;

- **define**, above all, the architectural legitimacy of the works which make use of tensile membrane structures and at the same time define it as 'atopic' architecture which may find its place in a variety of urban contexts, consequent to its widespread use;
- **confirm** its ethicality, through the concept of lightness, with a *philosophical and structural-morphological* reading. From this point of view, tensile membrane technology allows for the construction of works significant not only for their reduced mass but above all for the unavoidable structural rigour that determines the relationship between morphology and creativity and, thus, an innovative vision which goes beyond traditional architectural practices;
- **affirm** that textile architecture may contribute to tackling the issue of sustainability and that this technology, aside from its specificity, is *one of the inventive components of design thought*.



Figure 1: Cover book

2. Textile architecture from illustrating to affirming

The idea of **illustrating** the test prevalently with sketches, drawings, graphics and some photos was based on the consideration that nowadays most works are widely available on websites and in countless books and journals, so that it was decided to use a sign-type format with the purpose of stimulating the curiosity of the reader but principally to show how an initial "sketch" is transformed into a tangible reality. In addition, though not all initial sketches of each work present in the text could be easily obtained, those published are designed to represent (if they are indeed capable of being cultural "replicators") the "meme"¹ of the work in question, in other words the message and idea behind the design. In some ways the sketch constitutes the most interesting and fascinating stage in the process. (*Frei Otto, Eduardo Vittoria, Aldo Capasso, Renzo Piano, Nicholas Goldsmith, Horst Berger and Felix Escrig*).

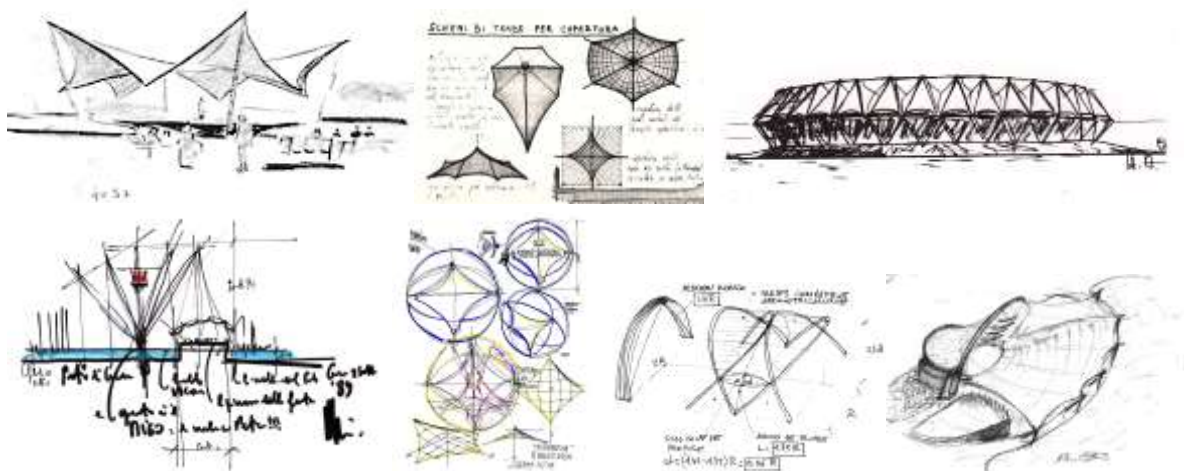


Figure 2: Sketches by Frei Otto(1957), Eduardo Vittoria(1973)), Horst Berger(1985) Renzo Piano(1989), Aldo Capasso(1993), Felix Escrig (1999) and Nicholas Goldsmith (2008)**

At the same time, where the architect's sketches are missing, a graphic reading of the work was adopted, in line with the illustrative purpose of this text: a new representation of the work, no longer *meme* but a graphic recording of its realisation.

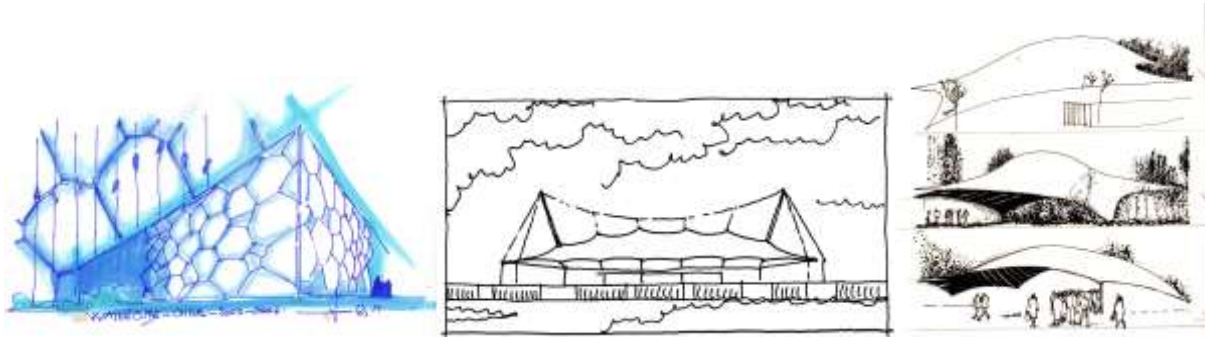


Figura 3: Drawings by Aldo Capasso, Vincenzo Pinto and Ugo Ciminelli**

The main purpose was to **describe** the implications for design and the environment arising from this new structural archetype of the 20th century over the last 70 years, regardless of the quality of the works of the architects who made use of this technology. The aim was also to recall certain significant periods of the evolution of this technology: the early experiments with models and analogies with the natural world according to Frei Otto; the first interactive software to control form by Massimo Majowiecki and the first international symposium on tensile membrane structures *Architettura e leggerezza*- Naples, 1993.



Figura 4: Frei Otto experimentations, years'50, Form finding Massimo Majowiecki, years'70, International symposium *Architecture and lightness*, (Aldo Capasso 1993)**

The story is told by an international multi-disciplinary scientific community, from philosopher Aldo Masullo to architecture historian Renato De Fusco, from tensile membrane pioneer Frei Otto to designers, structural engineers and scholars who have made use of this technology such as Renzo Piano, Michael Hopkins, Massimo Majowiecki, Nicholas Goldsmith, Ruy Marcelo Pauletti, Eduardo Vittoria, Gerry D'Anza, Horst Berger, Kazuo Ishii, Roberto Santomauro, Carlos H. Hernández and Felix Escrig.

**ARCHITETTURA ATOPICA
 E TENSOSTRUTTURE
 A MEMBRANA/
 ATOPIC ARCHITECTURE
 AND MEMBRANE
 STRUCTURES**

Seguono i nomi dei relatori, con le loro rispettive istituzioni, tra molti a fronte. Segue una lista di autori, con le loro rispettive istituzioni, tra molti a fronte.

A CURA DI ALDO CAPASSO

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Figura 5: Interior cover book and drawings of auto**

The text aims to **reaffirm**, in the light of experience, how the use of textiles in construction has led to the realisation of small, simple designs for shade (*brise soleil*, gazeboes, parasols, etc.) or larger scale protection from the elements (stadiums, conference centres and even façades) as well as interior fittings. The brightness, transparency and multiple functional potential of these designs have brought about the widespread popularity of membrane technology. At the same time its structural lightness integrates organically with other building systems and the possibility to dismantle and store these structures means that they may be permanent or temporary and even recyclable, environmental and technological benefits which have led to its widespread use.

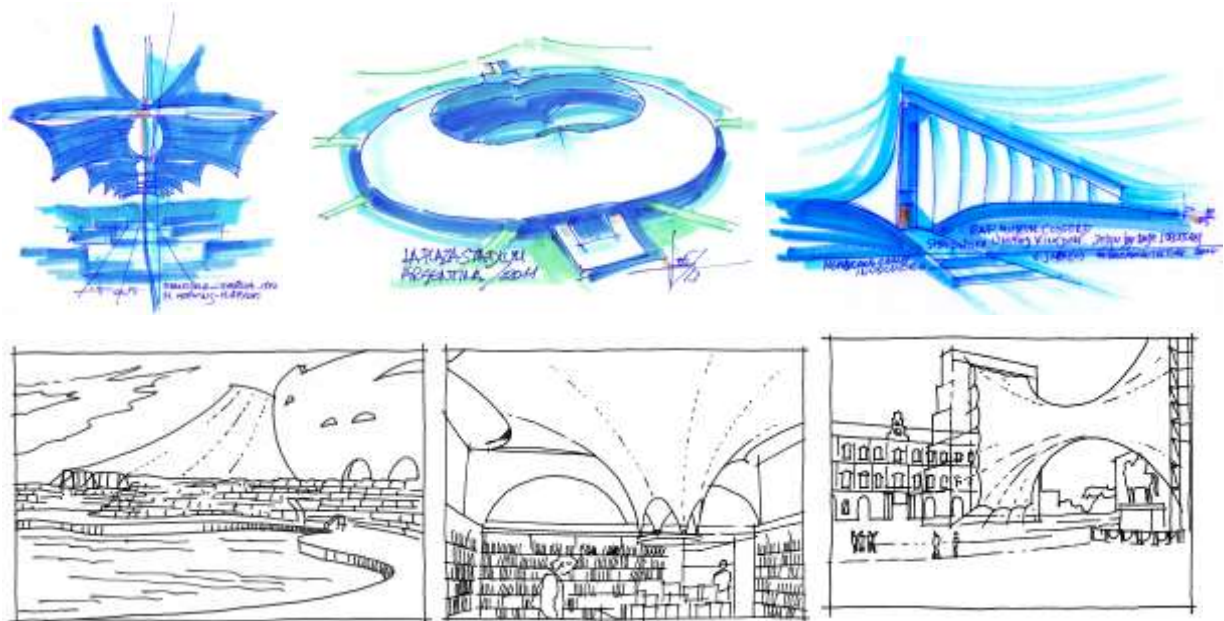
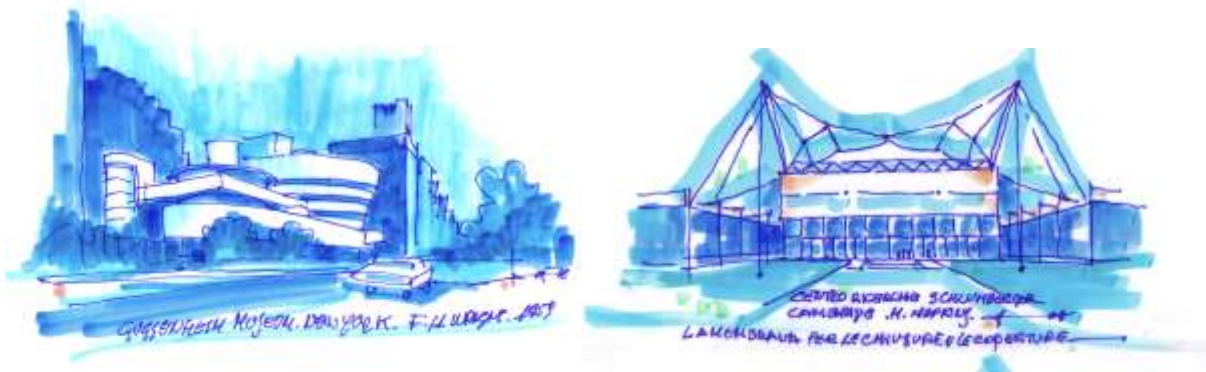


Figura 6: *Shading facade*, Golf Club, UK M. Hopkins (1982). *Membrane coverage*, La plaza stadium, Argentina, R Ferreira(2011). *Textile envelope*, RAF Museum, Cosford UK(2002). *Integration between textile envelope and massive building* , Dyplomatic Club Riyadh, S.A, F.Otto (1988). *Membrane interiors*, Vesuvio libri, Napoli, A. Capasso (2002). *Tensoart*, Tarantara, Napoli, A. Kapoor (2000)**

It is also **to hold** that *textile architecture* may be considered as a new architectural expression stemming from the ways it is constructed and also its environmental and morphological characteristics. In other words, its structural volumetric plasticity, its brightness by day and night and all the transparencies and variations in colour are part of an architectural and figurative repertory (an architectural poem) typical of advanced technologies and contemporary functional and ecologic/environmental designs and thus place textile architecture firmly within the many and varied expressions of the architectural landscape.

The text underlines the central fact that textile architecture is *architecture*, since it creates a living space, and further **defines** it as 'atopic', to be integrated into widely different urban contexts as a consequence of the widespread use of tensile membrane technology. More specifically, as regards the debate, at times overshadowed, surrounding the architectural legitimacy of the designs that incorporate this technology, architecture historian Renato De Fusco holds that: "...made up of a tent-shell that covers and shapes an interior

ARCHITECTURAL LEGITIMACY



*The tensile structures..... Made up of a tent-shell that covers and shapes an interior space, they are in all respects real and true architecture. (Renato De Fusco)***

space, they are in all respects real and true architecture".² And at the same time it is also 'atopic', continues De Fusco: "First, a tensile structure can be erected almost anywhere, and as such is atopic, it is indifferent to the site where it is located ...", though adding "...it is right to argue that many other architectures of the past - from Greek temples (which displayed similar characteristics both in their homeland and in Magna Graecia), to Gothic cathedrals, from Brunelleschi to Palladio's Rotonda, from some works of Ledoux to Le Corbusier's Villa Savoye (an object resting on the lawn according to its author), etc. - are, or appear to be totally indifferent to the place where they stand, the problems of adaptation or the genius loci."³

"ATOPICITY"

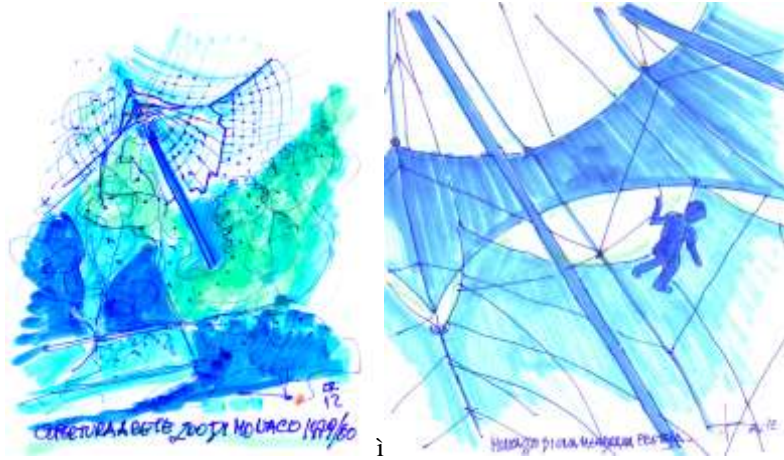


*First, a tensile structure can be erected almost anywhere, and as such is atopic, it is indifferent to the site where it is located...(Renato De Fusco)***

Obviously it depends on the quality of the work. Just as Greek temples, Gothic cathedrals and even modern architecture have characterised the architecture of the most diverse of countries with their own language and technology, so tensile membranes are capable of harmonising with the most varied expressions of architecture enriching the urban heritage.

To **confirm** the ethicality of textile architecture the starting point is the concept of lightness as seen from various viewpoints, such as *philosophical lightness* to quote Italo Calvino. He holds that lightness is "... a value rather than a defect...."⁴, substantially overturning its negative meaning. Observing the architecture of the "vele", Aldo Masullo, identifies a structural lightness and thus an ethic vision "... Here the architecture - he observes - that seems to be the science of heaviness, because on it rests the stability of buildings, is transformed into the art and technique of lightness...", and continues "... It seems to me that the architecture of lightness is able to identify with such a state, made immediately noticeable by the extraordinary speed of change induced by technology, but at the same time exercising the ancient virtues of ἦθος as courage to venture into the open space, where we can realise ourselves in an authentic freedom..."⁵. Lightness, then, as innovation-ethics compared to the heaviness normally associated to morality, in other words, to *customary design practices*.

LIGHTNESS ETHICS

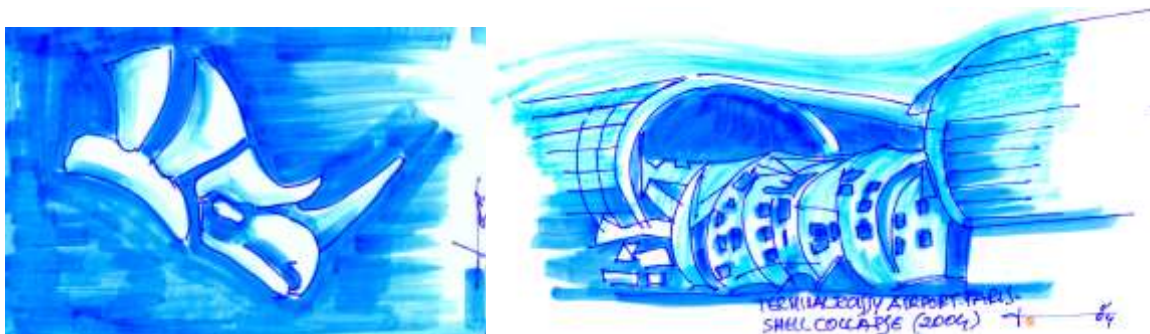


*Here the architecture that seems to be the science of heaviness, because on it rests the stability of buildings, is transformed into the art and technique of lightness. (Aldo Masullo)***

But lightness is not just about reducing mass, but rather represents a design approach committed to safeguarding resources and the environment; it is a cultural vision of the ideas and things around us, which goes beyond the weight of habit, through the force of a delicate invention capable of creating a suitable space for man in the present as well as suggesting an architectural approach for the future.

Structural lightness derives from the scientific and technological development of our time, which, in the case of tensile structures (thanks to the tensile state of the membrane), has meant that the actual mass of the building itself is less than the load it has to bear (external load). What is more, the lightness of these designs is further emphasised by the translucence and luminosity of the membrane, which allows natural or artificial light to create an architecture in which the inner space becomes indefinable, where the glare of the light blurs the line between roof and wall; an architectural shell which brightens the interior by day and diffuses artificial light to the outside by night.

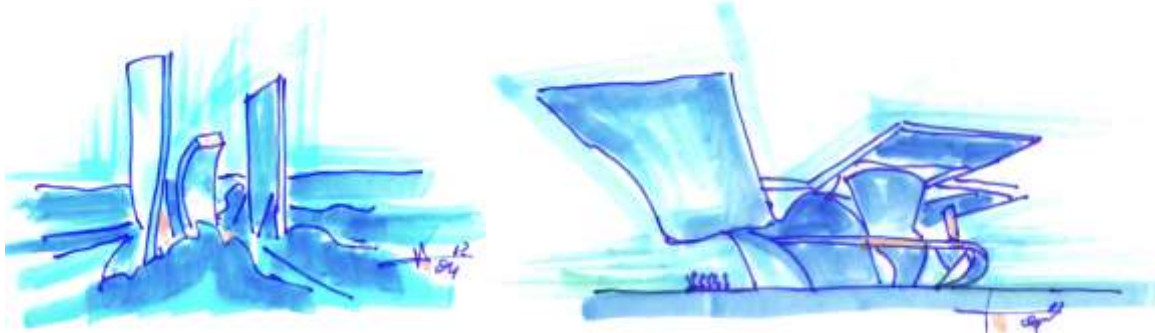
STRUCTURAL ETHICS



*"On the other hand, the structural challenge associated with the formal revolution evidently increases the uncertainties in reliability assessment and, therefore, makes architecture's need for a responsibility (sustainability) ethic even more impelling: the so-called "Archethic (Massimo Majowiecki)***

On the concept of ethics, to the structural ethic must be added the morphological ethic, as Majowiecki notes "... the structural challenge associated with the formal revolution evidently increases the uncertainties in reliability assessment and, therefore, makes architecture's need for a responsibility (sustainability) ethic even more impelling; the so-called "Archethic".⁶ Frei Otto adds "The comprehension of membrane tensile structures lies in the concept of minimum surface and in dealing with the search of forms in an appropriate way. In the case of pre-tensed structures, this means to process form and structure at the same time, avoiding the mistake to put form before structure and then verify it, since this would lead, as a matter of fact, to unnatural and disharmonious results."⁷

MORPHOLOGICAL ETHICS



*The comprehension of membrane tensile structures lies in the concept of minimum surface and in dealing with the search of forms in an appropriate way. In the case of pre-tensed structures, this means to process form and structure at the same time, avoiding the mistake to put form before structure and then verify it, since this would lead, as a matter of fact, to unnatural and disharmonious results. (Frei Otto)***

The text concludes by **affirming** that textile architecture may contribute to tackling the issue of sustainability in design and that technological research provides added value to architecture.

Regarding sustainability, Frei Otto notes *"In recent times the concept of sustainability has become popular. It entails to administer the present wisely in order to preserve future generations. Sustainability makes the convenience of constructing an issue of the first importance and outlines building methods without renouncing harmony and beauty. This is a responsible behaviour, but it also represents a "light" ideological approach to balance the relationship between man and nature."*⁸

Sustainability of this type of architecture is guaranteed by reduced mass, by method of assembly, by its versatile employment, flexibility and, thus, its capacity to be adapted to diverse environmental and functional contexts. It also allows the structure to be removed or modified, to be integrated with other building designs and biodegradable materials such as steel, wood, and now recyclable textiles to be used.

More specifically Mario Losasso notes *"The technology of tensile membrane structures is clearly placed in this line of sustainable technological culture, oriented to the transformation processes of general dematerialization. Taking advantage of innovation, it takes the least amount of material with the highest possible output."*⁹

In the light of what has been described and illustrated as regards the architectural outcomes of the use of tensile membrane structures, the text also **affirms** once again that this technology, regardless of its specificity, is one of the *inventive components of design thinking*

SUSTAINABILITY



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Finally, the text is dedicated to three scholars who have crossed my own path of knowledge and use of textile architecture: Frei Otto, Eduardo Vittoria and Massimo Majowiecki.

To Frei Otto, who pioneered tensile membrane structures, but more importantly, because he is the master of lightness in building, or rather of non-building.

*"We do not build for the next millennium, but for the man of today. Therefore we have to accept that our buildings, in one or two generations, will no longer exist. But perhaps some of our ideas are so important that we will make them survive: so the heritage is spiritual. Only principles and ideas are the sign of our civilisation, not the bricks and mortar of our history."*¹⁰

To Eduardo Vittoria, who "saw" in this technology a potential change which goes beyond the custom of permanent design to adapt to new environmental needs, highlighting how a technology goes beyond its own specificity (wood, steel, concrete or whatever) to represent "... one of the inventive components of design thinking".¹¹

And lastly to Massimo Majowiecki, who, was not only the forerunner in terms of programmes designed to make structural calculations for tensile structures, but, significantly, placed the emphasis on the ethics of design. Referring to current sophisticated design programmes, with a mind to architecture's tendency to provoke wonder through 'special effects', he notes: "... *Free-Form-Design is a challenge for architects and engineers, but after the first impressive accomplishments, the ethical and aesthetical repercussions of the imposing 'fashion' of FFB on the social context must be considered carefully. It is opportune not to encourage the tendency to see innovation, whatever form it may take, as a positive thing for the single fact of being innovative, regardless of its effective merits or its contribution to knowledge.*"¹²

These thoughts mirror those of Nobel laureate Rita Levi Montalcini, who reasoned that "Not everything that science discovers must necessarily be used"¹³

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¹⁰ Otto F., op.cit

¹¹ Vittoria E., "Leggerezza maestra della tecnologia", in (a cura di Capasso A.) *Architettura Atopica e tensostrutture a membrana*, Clean edizioni, Napoli 2013

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¹³ Montalcini R., website

**Photos and pictures appeared in "Atopic architecture and membrane structures" whose authors have authorised publication