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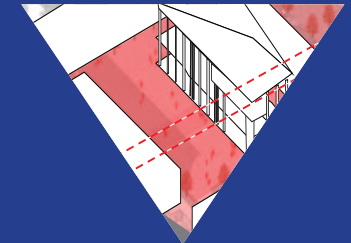
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Architecture Research Agenda





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Syllabus presents experiences and research made inside formative courses at different levels: bachelor, master, doctorate.
The goal is to offer these results, provisional and incomplete as they can be, to the scientific community, enhancing dialogues and exchanges.

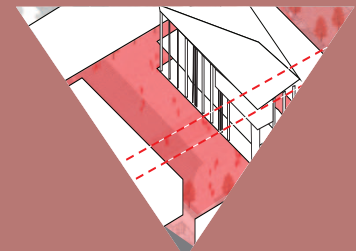
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Architecture Research Agenda



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Carla Bulone's academic education was born on a classical basis, around books on Latin, Greek, and Art History. In 2015, she obtained her Master's Degree in Architecture at the Mediterranean University of Reggio Calabria, with a thesis in Technology for Architecture. In the same department, she also obtained the professional license. In 2016, she moved to Tuscany for work, and she continued to increase her professional skills with training courses. In 2017, she specialized in marketing and digital tools for business by completing a "Digitization for companies" course. Today, she works for Branding S.r.l. as a marketing manager, with whom she started a Ph.D. Executive at the Politecnico of Milan.

The research topic revolves around the experimentation of a newly discovered material, graphene, which promises to revolutionize the scientific world, passing between different sciences and disciplines. From a global perspective, the research focuses on the descriptive and critical study of graphene as a highly technological, performing, versatile material with interesting potential to deepen its scientific knowledge at an academic level. In detail, the study of the neo-material investigates its implications in the building construction and the plausible effects on architectural design. The theoretical context in which the research moves addresses the complex debate of the relationship between materiality and technology in the current ever-evolving architectural panorama, in which technological-digital progress emerges with more preponderance every day.

Carla Bulone

Graphene in building construction

Position Project

For elaborating the first assignment, titled Position Project, I selected my Master's Thesis as the reference project that best embodies the spirit of doctoral research to frame and set the conditions necessary for carrying out the research topic. The master's thesis, entitled "Innovative technologies for a housing module of Solar Decathlon Europe", operates in the discipline of technologies for architecture with a strong vocation for sustainability, energy efficiency, prefabrication, temporariness, and architectural flexibility. The idea of the thesis project arises from the competition rules and then develops independently as a model of essential, adaptable, and temporary architecture.

The research project reworks the theoretical framework outlined by the master's thesis project, drawing inspiration from the topics covered in technological innovation for architecture. Therefore, theoretical speculation on innovation and technologies in architecture was crucial in the introductory phase of the research topic.

Working on the first assignment allowed me to develop a first reference framework for the preliminary phase of doctoral research, clearly establishing the underlying disciplinary area to set up the research activity and the generic boundaries of the topic. Thanks to the Position Project, I affirmed the

research object, the motivations behind the theme and the causes, the fundamental objectives to be achieved, and finally expressed the method in summary.

In practical terms, in parallel with the writing of the thesis, I began to collect and select the most relevant texts and articles on the subject to configure an adequate state of the art through a literature review.



"Innovative technologies for a housing module of Solar Decathlon Europe".
Master's degree thesis, a.y. 2014/2015. Mediterranean University of Reggio Calabria.

Position Project

WHAT

From a global perspective, the research focuses on the descriptive and critical study of graphene as a highly technological, performing, versatile material with interesting potential. In detail, the study of the new material investigates its implications in the building construction sector and the plausible effects on architectural design.

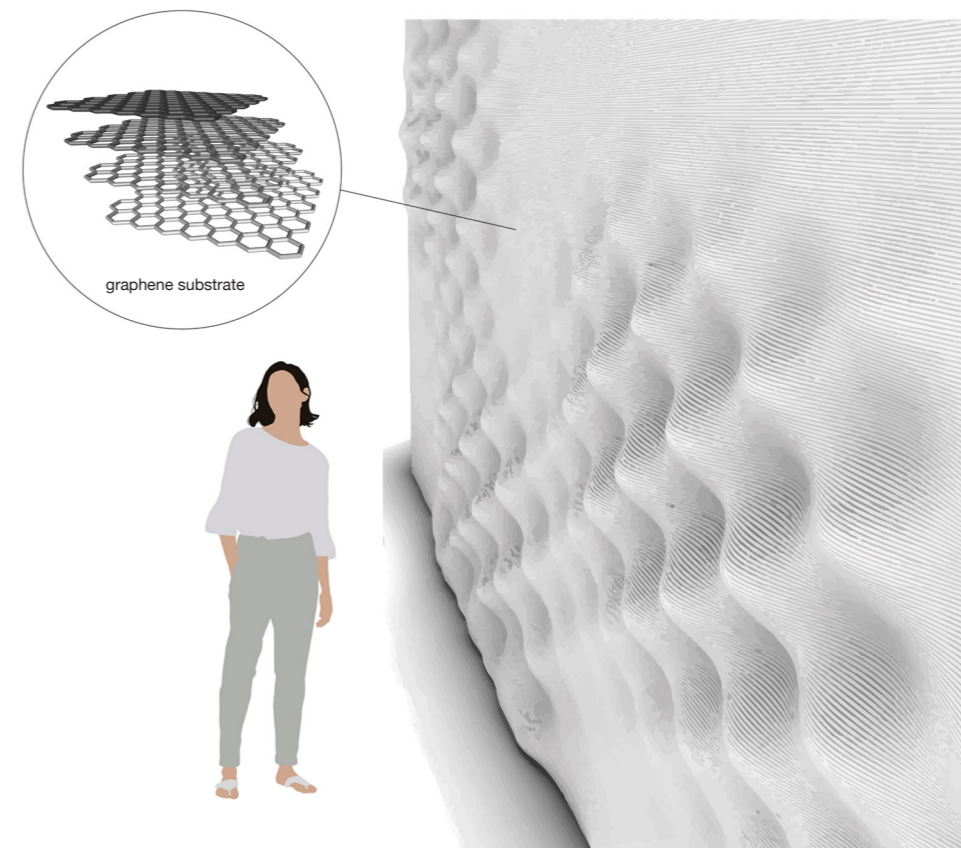
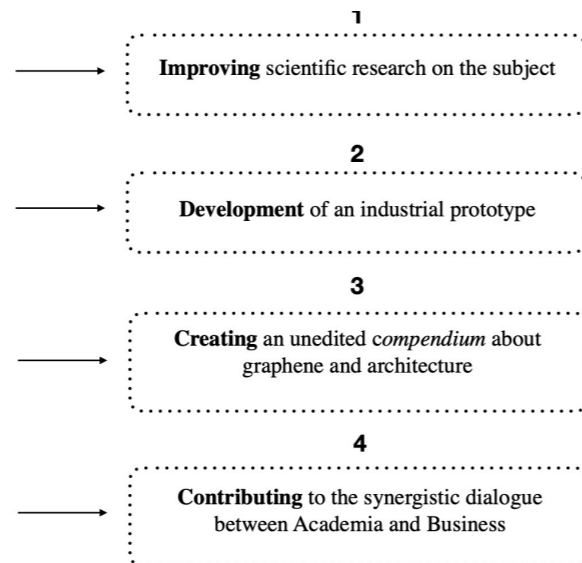
WHY

The study of graphene could be an interesting challenge for scientific research regarding new materials, new design solutions, and innovative approaches in contemporary architecture, joining the current international research on graphene in Europe and worldwide.

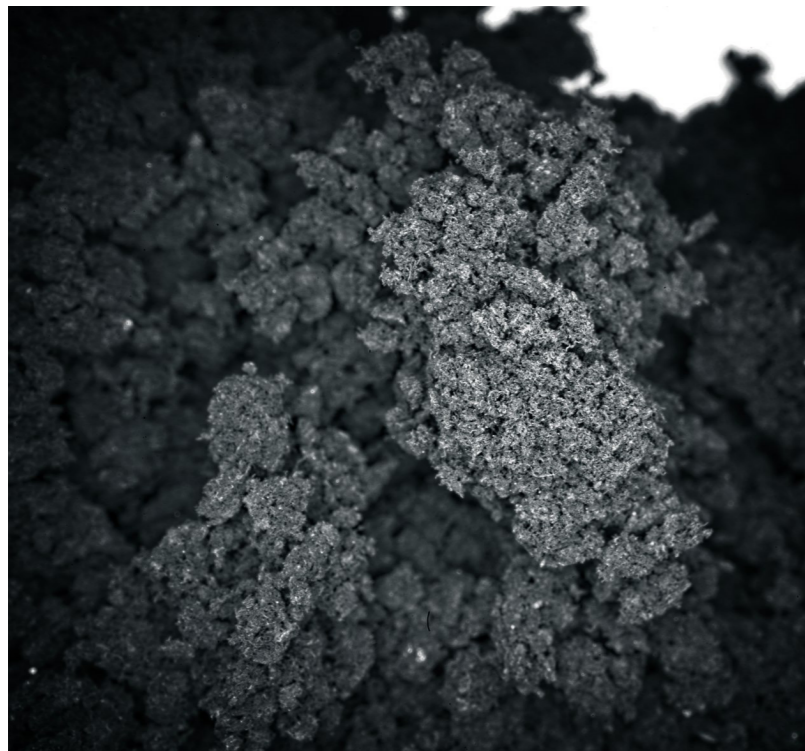
HOW

The research will be improved through a scientific investigation on a theoretical level, made of literature review, case studies, interviews and data collection, and by means of experimental research consisting of drawings and an architectural design approach, with the help of partners's company.

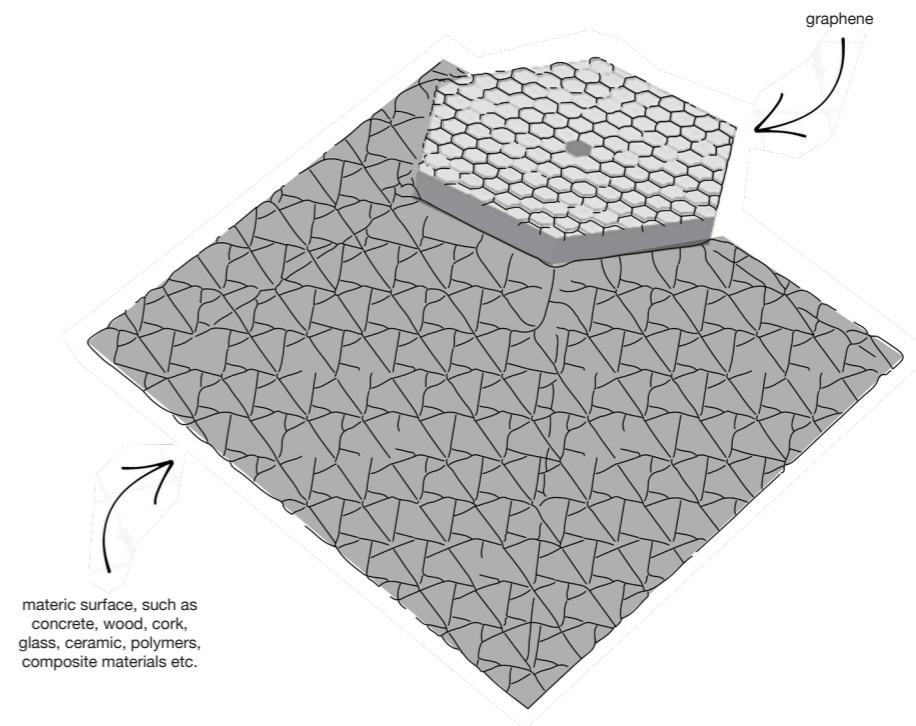
OBJECTIVES



Interpretation of the research topic.



Graphene Flakes. It is one of the most popular forms of graphene, can be used for many applications such as conductive inks, nanofluids, supercapacitors, composites, etc.
Photo by Branding S.r.l.



References

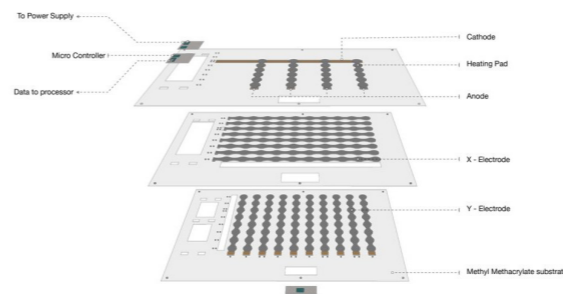
In order to draw up the second assignment, References, I chose an experimental project by the Institute for Advanced Architecture of Catalonia called Synapse as a case study because I guess it represents an interesting integration between graphene and architectural design. The new material is not only used for its properties but, above all, it is integrated into the materiality of the architectural elements.

Synapse is an interactive medium for spatiotemporal behavioural data collection and analysis. It can be a constitutional part of a variety of architecture interfaces like floors, walls, facade systems, furniture and even warped on a curved surface. Graphene is being used as a key constituent for its extreme conductive properties. As a system, this material together with its application is without precedence in architecture and related industries. Regarding the prediction of architectural application, Synapse can be used for indoor spaces to predict spatial performance through diverse behavioural data of similar spaces; for dynamic space configuration to map occupancy and behavioural patterns of inhabitants in a space; finally, in the matter of urban vision to provide accurate, anonymous, large-scale spatiotemporal information.

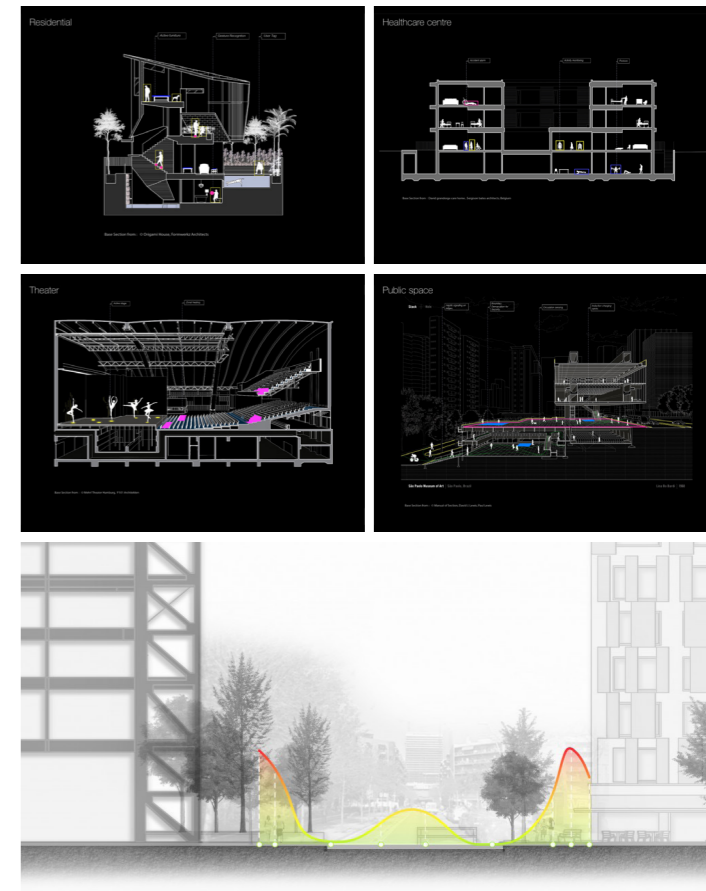
This interesting experimentation aim to provide designers and decision-makers with an information-gathering tool for users' spatial behavioural patterns towards a better evidence-based, contextual, data-driven process and behavioural research.

Instead, concerning the choice of twelve references, I selected texts, books, and articles to map a wide-ranging state of the art on the research subject and then go down in scale in the next steps. The twelve references concern some texts that frame the topic from a general theoretical perspective on technologies for architecture, for instance, the book by Guido Nardi "Tecnologie dell'architettura. Teorie e storia", and on nanotechnologies in building construction. Besides, articles dealing with topics such as "smart materials", "reactive solutions", "responsive facades", etc., to evaluate plausible graphene application scenarios in the current architectural context. Then again, among the twelve references, there are the most recent texts on this new material, such as the book by Kostya Novoselov and Albená Yaneva "New Architecture of Science, The: Learning From Graphene", the annual reports by the Graphene Flagship project and, finally, the articles of the scholars of the Institute for Advanced Architecture of Catalonia (IaaC), which are more focused on the practical aspect of experimenting with graphene in an architectural design application.

Thanks to the elaboration of the second assignment, I defined the boundaries of the search, placing the topic within a well-defined context. Through this first process of literature review, the research activity lays the foundations for a temporal and theoretical positioning in the reference architectural scenario.



SYNAPSE (2018). An interactive medium for spatiotemporal behavioural Data collection and Analysis. Images by official project webpage on IaaC website. <http://www.iaacblog.com/programs/synapse/>.



Key words - Key projects

By identifying keywords and key projects, the research activity matures and develops in its theoretical structure. The four keywords - graphene, technological innovation, performance of materials, nanotechnology - summarize the core research, which in turn give life to an archipelago or a constellation of inspirational keywords. The selection of key projects that opened the comparison with the research topic was fundamental. Therefore, the research further re-elaborated the theoretical framework of reference, placing itself more specifically.

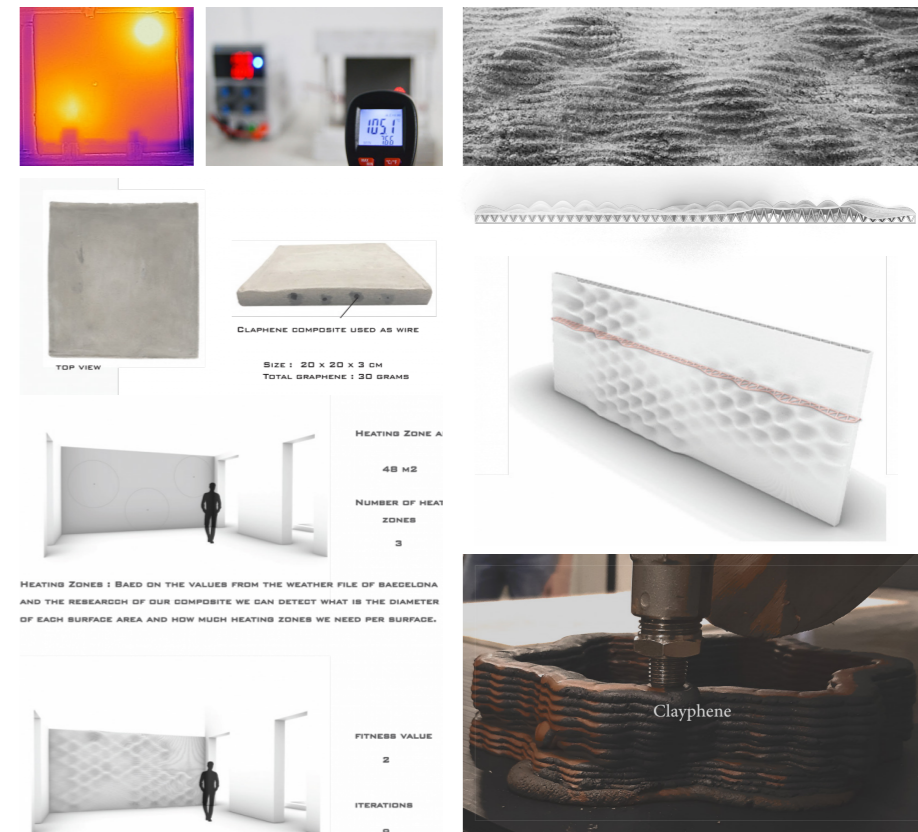
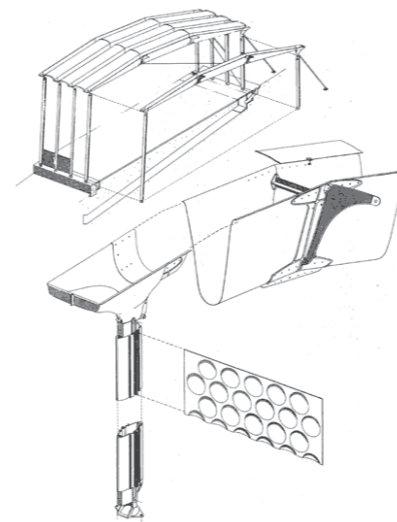
In particular, two key projects have been chosen for the comparison: one represents an architectural project of the past, figuring itself as a theoretical model from which to draw, the other symbolizes contemporaneity and the progress of architectural design nowadays. The comparison served as a link between a very recent theme such as graphene research and the historicized experience of the past, as a fundamental guide for looking to the future of architectural design.

Jean Prouvé's work was chosen because he contributes enormously to spreading the concept of accessibility of art and creating links between art and industry, as well as between art and social consciousness. Jean Prouvé combines craftsmanship and entrepreneurship, design and architecture, creating a new style. A style in which the purely formal aspect of design

takes on a secondary role, giving way to the usefulness of objects, their cost-effectiveness, and the conscious use of materials. His main theoretical contribution and design result was transferring the production technique from industry to architecture without compromising the aesthetic quality. J. Prouvé embodies the best theoretical reference for this doctoral work in executive mode between academia and the corporate world for all these aspects. On the other hand, the second key project concerns architectural experimentation by the IaaC Institute, called Clayphene. Finding a common thread with Prouvé's pragmatism, the Spanish institute's studies look to the future

of architectural design, such as digital parametric architecture and computational design. The project (on the right) concerns the creation of a composite material by mixing graphene with clay that can replace existing heating systems. By combining graphene with clay, it is possible to transform clay into an electrically conductive material and heat-generating material. This composite is capable of converting electricity into heat with a low resistance value. Thus, such a design system can replace existing heating systems by combining electrical conductivity and the heat generation properties of these composites. In addition, graphene and clay composite can transfer electronic data to replace the existing cable system for data transfer.

J. Prouvé. The Aluminium Pavilion. 1952



Clayphene (2019). Images by official project webpage on IaaC website. Available at: <http://www.iaacblog.com/programs/clayphene-3/>.

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