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Research and Experimentation for Technological Districts

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Abstract
The Technology and Environment Research Unit of DiARC carries out researches on technological and environmental design for ex novo interventions and urban rehabilitation with special reference to technologies, processes and methodologies to improve resilience and adaptability of the built environment, to reduce the energy demand of buildings, to use environmental resources rationally and for product innovation and design experimentation. Among the ongoing researches, particularly significant are those in association with the technological district High Technology Research Center for Sustainable Construction STRESS Scarl, where the Technology of Architecture plays a coordinating role using disciplinary contributions from architecture and non-architectural fields as well as from industrial partners. The main objective is achieving real effects on the territory by means of decision making support platforms, demonstration designs and prototypes in line with the approaches of the third mission that increasingly characterise the results of university research in partnership with Public Administration, Local authorities, Research centres and industries.

Parole chiave:
Sustainable design
Civil engineering, architecture
Sciences for sustainability, environment and resources

Main lines of research of the Technology and Environment R.U. of DiARC

(V. D'Ambrosio)

In the research activities carried out by the Technology and Environment Research Unit of DiARC in the last years, the theme of the technological and environmental design for urban rehabilitation has been studied with special reference to technologies, processes and methodologies to improve resilience and adaptability of the built environment, to reduce the energy demand of buildings, to use environmental resources rationally, to reduce impacts and

for product innovation and design experimentation. The main lines of research developed in the last years refer to:

- technological innovation in building rehabilitation processes[1];
- processes and technologies for the sustainable rehabilitation of the anthropic environment[2];
- environmental design for urban projects[3];
- methodologies and tools for adaptive design in climate change[4];
- innovative technologies of systems and components for the built environment[5];
- technological design to reduce the energy demand of buildings[6];
- design experimentation with digital methodologies for eco-efficiency[7];

The adopted methodologies have constantly followed a systemic, procedural need/performance-related approach in the interpretation of the current changes in the building process as well as in the comprehension of the innovative developments in the industrial production for construction purposes, in the operation approach and implementation testing with reference to the requirement and index systems. Some of the research fields have been approached experimentally sharing knowledge from several disciplinary expertise of different scientific areas and involving industrial partners with an interdisciplinary and interscale approach.
Among the ongoing researches, the activities of applied research by the High Technology Research Center for Sustainable Construction STRESS Scarl are particularly important for their complexity and for the innovation of the issues addressed. The District is the first one in Italy that has ever focused on improving competition and innovation through the synergy among the university, the enterprises and the research centres in the Campania region.
The lines of the research carried out by the District refer to strategic fields confronting with the themes of innovation and technology transfer framed in the more advanced directions of the European and international research such as the strategies for adaptation and mitigation of climate change, resilience in the built environment and construction of zero energy buildings.
These are the research fields where the two researches were developed: METROPOLIS - *Integrated and sustainable methodologies and technologies for the adaptation and safety of urban systems*[8] and SMARTCASE – *Multifunctional innovative solutions for the optimisation of primary energy consumption in the indoor quality of life in the building system*[9], financed by the National Operational Programme for Research and Competitiveness 2007-2013 within the European Union Cohesion Action Plan administered by the Ministry of Education University and Research and the Ministry of Economic Development, where the technology of architecture played a coordination role using several inputs from disciplines inside and outside the field of architecture as well as from various industrial partners with the purpose of having real effects on the territory by means of decision making support Platforms, demonstration designs and prototypes in line with the approaches of the third mission that increasingly characterise the results of the university research in partnership with the Public Administration, Local authorities, Research centres and industries of national significance.

Adaptive design and experimental models for urban systems. The METROPOLIS project

Within the more advanced European lines of research on climate change-related themes there is the adaptive design to combat the hazard caused by heat wave and pluvial flooding in urban areas. The main impacts of climate change affect health and well-being of the inhabitants, peaks of energy demand and the functioning of infrastructures and technological networks[10].

These issues, in an interdisciplinary context, were the main contribution of the research group for Technology and Environment of the DiARC in the METROPOLIS research project[11], whose general aim is the management of seismic, hydrogeological and climate-related risks in urban areas. The project within the High Technology District STRESS dealt with the development of methodologies and tools for the knowledge production of urban systems and the assessment of hazard and vulnerability. The result, which is of an experimental nature, is an integrated decision making support platform that develops scenarios and technical/typological design solutions to reduce vulnerability and environmental risks for a resilient and sustainable urban system. The developed platform and the methodologies had their experimental application on a regional context in Campania, nonetheless the system has been conceived to be transferred and applied to other contexts and operating conditions.
At the international level, the current state of knowledge about the adaptation to climate change has developed approaches based mainly on the wide scale. Both the field of scientific research and the technical policies for the built environment now require experimentation by means of downscaling processes applied to the local scale. Moving from the adaptation plans, guidelines for better targeted design solutions are being developed. The assessment of the actual vulnerability degrees requires more detailed scales of knowledge deepening and their following processing aimed at the comprehension of urban phenomena and at adaptation and mitigation measures. The assessment of vulnerability starts with the acknowledgement that it depends on multiple factors. Some of them belong to the characteristics of the urban system such as the degree of exposure to climate change and the degree of sensitivity that affects the system. Other factors are external such as impacts, i.e. the extent of the effects of climate change. The adaptive capacity, introduced through the intrinsic characteristics of the urban system or through qualities and performances introduced as a result of appropriate design interventions, leads to the reduction of potential damages and, by extension, reduces vulnerability and increases the system's resilience[12] (fig. 1).
The research approach is based on the assumption that the knowledge of vulnerability and the development of guidelines for adaptation should be considered starting at the low scale – districts, complex urban elements, blocks, buildings, open spaces. Buildings and roads were the basic elements for analysis, models and adaptive design options. This approach is exactly the opposite of what it is usually done when using progressive scaling that moves from spatial planning, as only with the results coming from the control at the construction level, you can get results that allow assessing the real degree of vulnerability to climate change in urban areas and the necessary measures to reduce it.
Knowledge and design choices were based on preliminary remarks: for their specific characteristics (type/morphology, function/space, technology and environment, community) urban settlements suffer different impacts in relation to the intrinsic degree of vulnerability of the urban system (related to the exposed elements and their characteristics of sensitivity to climate changes) and to the hazard conditions linked to climate projection scenarios.
The vulnerability degree of the urban system has been assessed through the development of technological, environmental and economic indicators that can quantify and monitor the performance of the physical system (buildings and open spaces) with reference to the characteristics of the population that is more exposed to the studied climate phenomena.
The interpretation of the urban system was carried out at different levels due to the complexity of contents and the convergence of multiple disciplinary approaches[13] moving from the analysis of the physical system associated to the social, economic and environmental

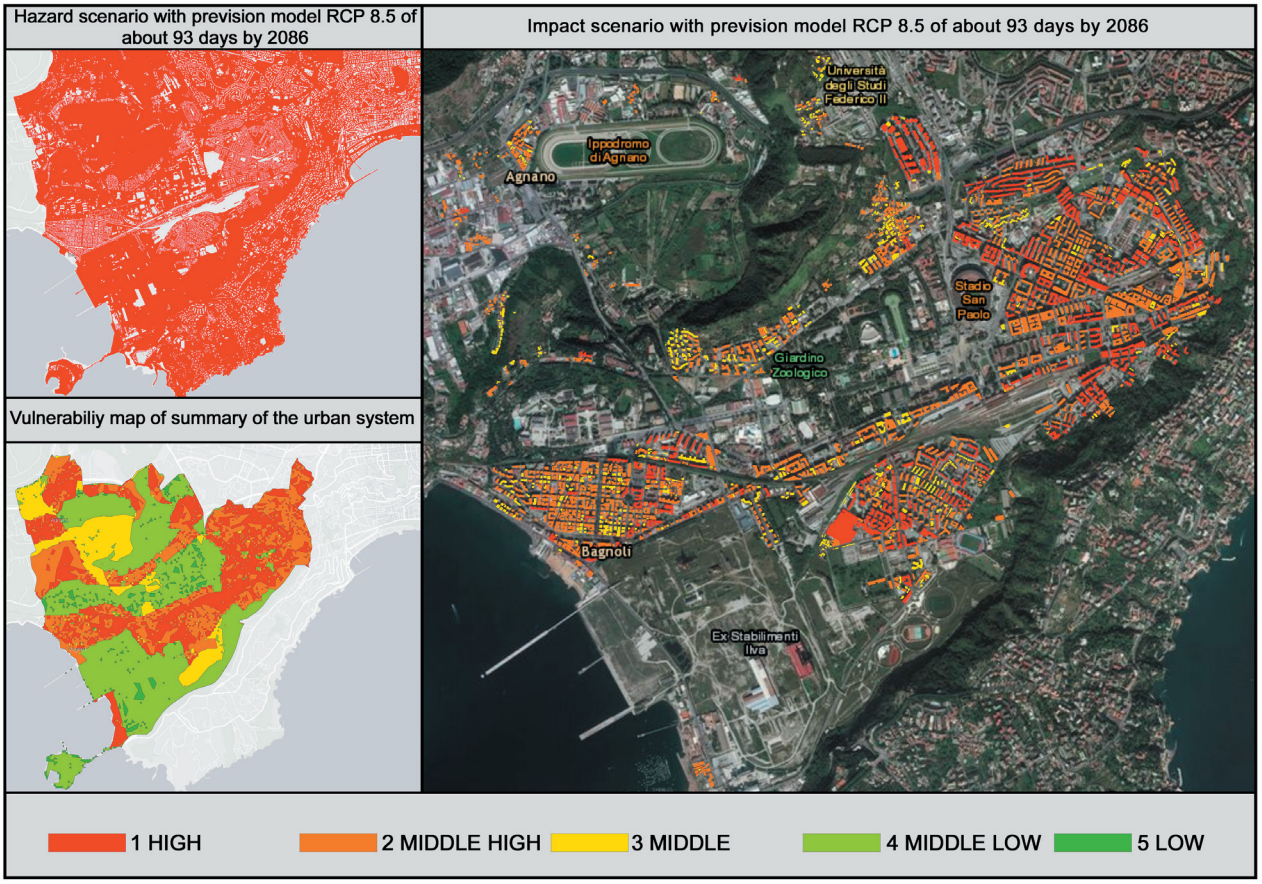

Fig.1. Impact scenario developed as a hazard projection of the heat wave forecasted in 2086 in Naples and extended over 93 days (as model RCP 8.5 Representative Concentration Pathways). The map shows the classification of the impacts on inhabitants and was based on the intrinsic vulnerability of the urban system.

spheres. Among the different disciplinary expertise involved, the contribution of the technological and environmental design was developed both in terms of contents related to their disciplinary specificity and through the capacity of systemic approach and process. Operating on the urban system, technological and environmental design concerned analytic and design aspects involving knowledge processes, simulation and projection of the effects of rehabilitation actions on homogenous urban areas, urban elements, buildings and open spaces (fig. 2).

The main product of the research activity is the development of methodologies and the processing of complex analytic/provisional models. The phase of framing the knowledge production about the urban system provided all the information, the tools and the necessary methodologies to build a model that could gather the multiple data of such a complex system like the urban one, where knowledge and specific expertise merge integrating each other. Detailed investigations were achieved at the level of urban elements, buildings and open spaces in order to collect targeted information that could integrate with general data from institutional databases. The knowledge of standardized and recurring parts and elements of the city allowed to extend performances and physical characteristics to similar elements and contexts by analogy and appropriate verifications. This extension enabled the mapping of the phenomena, bringing heterogeneous data at the level of standardization of acquirable information to get a comprehensive overview for the interpretation of phenomena and use

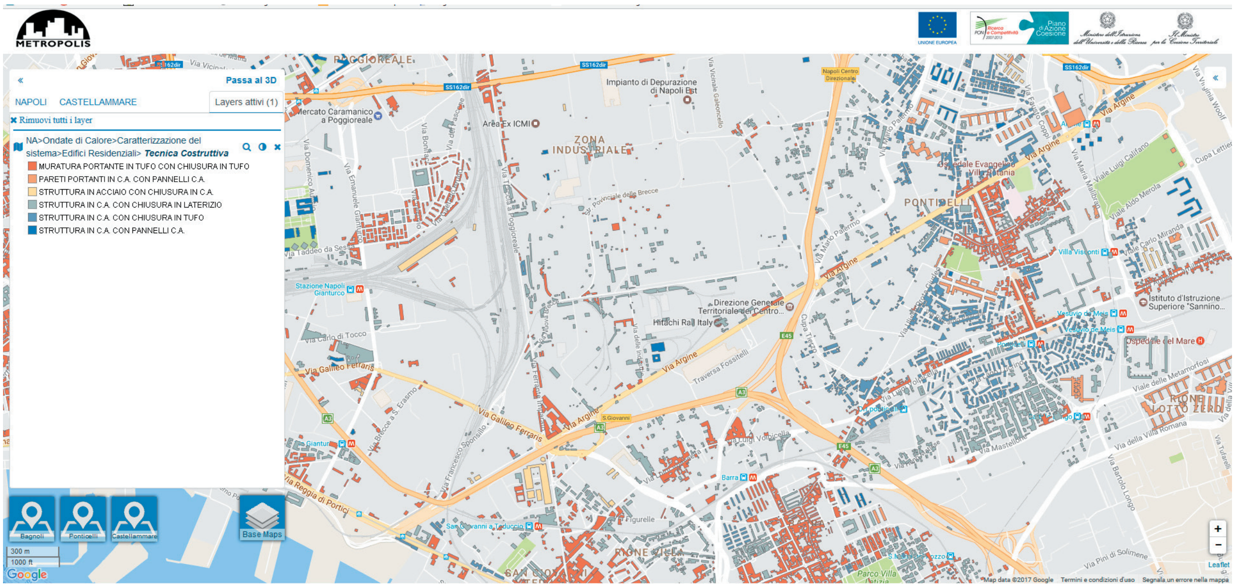

Fig. 2. The demonstrator project of the Metropolis research. Thematic map example in the study area of east Naples, available on the webGIS Platform.

them to simulate actions and options of adaptive deign. The knowledge phase has been the starting point for the development of sensitivity and exposure indexes through which assess the degree of vulnerability of the urban system and its parts, referring them to the building systems, the open spaces and the population.

The methodologies applied to the different research phases are both analytical/deductive and experimental to develop knowledge models, of assessment of vulnerability levels and of simulation of the adaptive capacity of the urban system based on the adoption of adaptive design solutions. Models were structured as a GIS spatial database that makes the system searchable and implementable through data modelling and process. The collaboration with research Centres specialized in climate projections such as the CMCC Euro-Mediterranean Centre on Climate Changes as well as industrial partners such as Geoslab for the remote sensing data processing, led to the experimentation of models to characterize hazard with respect to heat wave and pluvial flooding, defining hazard scenarios and assessing their intensifying over time.

The developed methodologies and models were tested in some urban areas in Naples: in East Naples (from the outskirts of the Old City to the Ponticelli district) and in West Naples (in the districts of Bagnoli, Cavalleggeri d'Aosta and Fuorigrotta), areas that have been considered relevant for the interaction of different geomorphological conditions, urban growth types and for being articulated in parts of consolidated city, 70s and 80s urban expansions and parts of "informal" contemporary city.

The research investigated the theme of technological and environmental design relating it to interscale processes and targeted analysis, that were applied to buildings and to the urban scale. The deepening focused both on the downscaling of the factors related to climate change and predisposing factors that depend on the characteristics of the physical system and the population that contribute to exposure and sensitivity. Data coming from institutional databases are not enough to develop detailed scenarios, therefore it was necessary to de-

velop a model with original characteristics that can put together a massive quantity of data coming from direct survey. Moreover, the research developed connections between tests of applicability of adaptive design in specific areas and potential co-benefits deriving from the system of selected choices, i.e. in terms of cost-effective results.
Further research developments will be able to focus on the deepening of modelling processes to define wider impact scenarios and resilience analysis, assessing the efficacy of adaptation measures and multi-sectorial consequences over time (on well-being and safety of urban areas, environmental quality of buildings and open spaces, use of material and energy resources, social inclusion and education, direct and indirect economic aspects), promoting comparative actions and dissemination in Europe[14]. Another research development can be the experimentation of adaptive design approaches for urban rehabilitation processes in areas that are characterized by critical environmental trends, verifying the applicability of strategic approaches and technological and environmental design solutions with effects on the reduction of the exposure to climate hazards and on the socio-economic sustainability by means of experimental demonstration projects. This theme is the subject of the PRIN 2015 research where, with interscale operating modes, effective correspondences among resource management, process governance and the activation of micro and macro actions for rehabilitation will be defined (by means of ex novo actions or technological retrofit) to reduce the climate vulnerability of the urban system[15].

The architecture-technology-environment system for the SMART CASE Project
(A. Claudi de Saint Mihiel)
The current EU guidelines highlight the need - within the debate on sustainable construction, attentive to environmental, welfare and safety issues - to implement integrated approaches, in order to obtain structurally safe buildings, characterized by reduced environmental impacts, appropriate comfort conditions and low energy consumption in the service life. In this scenario, a strategic role can be identified in the development of Technological Districts[16], which constitute an active network at national and international level for the promotion and dissemination of the innovation culture in the construction sector by promoting the development of scientific research, technology transfer and specialized training.
Within the STRESS District, these issues are addressed in SMART CASE project research activities[17], that deal with the topics related to the definition of multifunctional innovative solutions for the optimization of primary energy consumption and indoor livability, studying design strategies for the building envelope, for the integration of engineering and solar power systems, for the monitoring, control and management of consumptions, to achieve the best energy-efficiency standards (Zero energy Building, Net Zero energy Building, Net Zero Source).
The research related to the Nearly zero energy issue is part of Technological design[18], predominantly in relation to the refurbishment of existing buildings, innovative technologies for the reduction of energy requirements of new buildings, process governance, environmental and energy sustainability protocols. Energy is the privileged field of theoretical and applied investigations, which are carried out by DiARC Technology and Environment Group, whose specific contribution concerns the study of technological and environmental design processes and outcomes for the identification of retrofit strategies for existing buildings. In particular, the research is focused on solutions for the optimization of primary energy consumption and

indoor livability conditions in relation to new buildings, by acting on the building envelope, to increase the efficiency of active systems, energy supply from renewable sources and the management of the building-services system, verifying components integration level in terms of environmental, technological and economic performance.
The research areas of the R.U. are focused on subjects in which some technical inadequacies related to current design and construction practices are critically considered, aiming at the use of new and more efficient technologies for the improvement of performance, not only oriented to the optimization of energy aspects but also of the buildings overall quality. This is possible through integrated design interventions aimed at overcoming a linear conception of the design process, with the ability to anticipate and assess the transformation effectiveness in projects conducted simultaneously on multiple levels and by more actors.
The current state of knowledge concerns the awareness that energy efficiency of buildings is largely determined by the performance of envelope, services and passive control systems for summer and winter comfort. The research has established the goal of developing support and guidance tools and methodologies for the design of new buildings in the Mediterranean area, in relation to the selection of envelope technologies for the best overall building energy, environmental, as well as structural performance, also given the high criticality in terms of seismic risk.
Specifically, SMART CASE Research activities have involved the study of innovative solutions that limit energy needs by acting on opaque and transparent building envelope. In this sense, technological innovation has enabled the development and characterization of materials, technologies and innovative multi-functional components with the purpose of reducing energy consumption and improving indoor quality, as well as performing solutions in terms of reduced energy requirement (morphology, compactness, orientation) and to ensure satisfactory levels of lighting through the control and management of sun and artificial light.
Research activities concerning energy efficiency also focus on the experimentation of new technological solutions, such as smart components and systems, which allow knowing in real-time energy management of buildings through a greater control of building performance, net zero energy consumption-oriented. The research outcomes on net zero impact buildings have involved the integration of endogenous and exogenous factors. The former consist in the properties, characteristics and performance of buildings parts and of building as a whole: thermal transmittance and inertia OF THE envelope, natural indoor ventilation, indirect heat gain, etc. The latter reside in the geographical, climatic, physical, natural characteristics of the context.
SMART CASE research has highlighted the implementation of calibrated solutions in relation to the following requirements: space and temporal flexibility for each type of functional destination (residential, schools, etc.) in order to change the conformation of both interior spaces and envelope; reduction of energy consumption for indoor livability and greenhouse gas emissions; compatibility with seismic and energy efficiency regulations, in order to ensure maximum safety, energy saving and efficiency; compatibility with the climatic context; containment of construction and management costs.
The objectives have been translated into a system of parameters that guide the most appropriate architectural concept to the specific context in which they will operate, searching for the best achievable value in new construction projects, in relation to social, cultural, environmental and economic contextual data, between employed resources and energy and environmental performance, as the holistic result of the architecture-technology-environment system.

The main output of the research, beyond the methodological and skills-integration aspects that have characterized the whole process, is related to the experimental verification and dissemination of the results of the entire study, providing for the application of innovative methodologies for the integrated design of NZEB applied to a demonstrator building.
Aspects related to the building orientation and shape, envelope insulation, solutions for solar irradiation and its thermal load mitigation, use of high performance materials, integration of RES, have been the key elements to maximize the overall performance of the residential unit that will be built in Benevento by 2017 (fig. 3/4).

Fig. 3/4. The demonstrator project of SMART CASE research - residential unit for students in Benevento. Southwest and west render views..

The importance of the demonstrator is also to launch a dissemination and exploitation phase of the achieved results, in order to activate the technology and knowledge transfer process towards the whole construction sector. The need to develop case studies starts also from the consideration that European regulations on sustainable and energy-efficient design, implemented at national level, are scarcely supported by the current design practice.
Further research developments on the subject may relate to any action targeting the transition from the Nearly zero energy to the Net zero energy up to the energy Plus model in architecture, while preserving and enhancing the architectural and environmental quality instances of the inhabiting culture as a purpose for architectural technology.
Moreover, in terms of potential applications for the Italian context, the development of strategic operational guidelines and integrated projects targeting at technological innovation, based on the improvement of structural adequacy, thermo-hygrometric wellbeing, energy savings, allow to activate the necessary synergies to meet the different measures envisaged by the energy roadmap, which foreshadow future developments towards 2050, and the need to design and build resilient buildings and cities.

Notes

1. 2014/2015 – Convention between the City of Casalnuovo and the Department of Urban Planning and design at the University of Naples Federico II: "Riqualificazione degli edifici scolastici comunali in relazione alla eco-sostenibilità e alla sicurezza degli interventi" scientific director S. Russo Ermolli; 2014 – Convention between the City of Lacco Ameno e the Department of Architecture at the University of Naples Federico II "Ricerca applicata sugli aspetti tecnologici e ambientali per gli interventi di riqualificazione sostenibile del Palazzo Comunale di Lacco Ameno" within POI Energie Rinnovabili e Risparmio Energetico 2007-2013, scientific director V. D'Ambrosio; 2012/2014 – Scientific collaboration agreement between the City of Naples, the City's Planning Department and the Department for Schools and Education, and the Department of Urban Planning and design at the University of Naples Federico II: "Attività di studio ricerca e sperimentazione per la riduzione degli impatti ambientali relativi ad un campione di edifici scolastici e agli spazi aperti", scientific director V. D'Ambrosio; 2010/2012 – Research funded by the Science and Technology Hub of the University of Naples Federico II, FARO Programme, Startup Funds for Original Researches: "Innovazione e sostenibilità negli interventi di riqualificazione edilizia. Best practice per il retrofit e la manutenzione", scientific director R. Landolfo.

2. 2016 – Convention for applied research between the Department of Architecture and the City of Aquilonia AV: "Studio specialistico di supporto alla redazione del Piano energetico comunale per il rendimento energetico negli edifici e l'integrazione dei sistemi per la produzione di energia da fonti rinnovabili nel comune di Aquilonia" scientific director M. Bellomo; 2015 – Framework agreement for scientific collaboration between the University of Naples Federico II and the City of Casal di Principe: "Studi e ricerche di fattibilità strategica, operativa e funzionale finalizzate alla valorizzazione alla riqualificazione dell'area del Comune di Casal di Principe", scientific director M. Losasso, F.D. Moccia; 2014 – Scientific advice between the Department of Architecture and the City of Pisticci (MT): "Strategie di rete per il governo del territorio comunale di Pisticci (MT)", scientific director A. Falotico; 2013-2014 – Convention among Regionale Department for Cultural Heritage and Landscape of the Molise Region, Università degli Studi Suor Orsola Benincasa in Naples, Department of Architecture at the University of Naples Federico II, Istitute for Technologies applied to cultural Heritage at CNR for "Attività di studio, rilievo, indagini conoscitive, definizione del progetto di gestione del sito, progettazione delle coperture e delle strutture di accoglienza, dei supporti alla visita e didattici dell'area archeologica di S. Vincenzo al Volturno", scientific director for DiARC S. Pone; 2010 - Programme for "Valorizzazione mediante attività di animazione dei parchi esistenti; indagini rilevamenti e catalogazione delle aree naturali destinate a parco", funded by the Ministry for the Environment and the Protection of the Territory, implementation body City of Naples, general operational coordination ANEA, general coordinator M. Macaluso, scientific director of "Progettazione e gestione dei parchi urbani" A. Claudi de Saint Mihiel; 2010 – Research agreement among the City of Naples, the City Department for the Environment, the Parks Office and the Department of Urban Planning

and design at the University of Naples Federico II: “Programma integrato di solarizzazione e di riqualificazione sostenibile dei parchi urbani cittadini”, scientific director M. Losasso; 2009 – Convention between the City of Meta (NA) and the Department of Urban Planning and design at the University of Naples Federico II: “Studio specialistico per la valorizzazione e la riqualificazione innovativa e sostenibile del litorale di Meta”, scientific director S. Russo Ermolli; 2008 - Convention between the City of Naples Department for the Environment, the Department for the Environment and the Department of Urban Planning and design at the University of Naples Federico II: “Assistenza e supporto scientifico per l’elaborazione di soluzioni esecutive sostenibili per la qualità degli interventi di riqualificazione e manutenzione di parchi e giardini della città di Napoli”, scientific director M. Losasso; 2007 – Convention between the City of Naples Department for the Environment, the Department for the Environment and the Department of Urban Planning and design at the University of Naples Federico II: “Consulenza specialistica per l’elaborazione di linee guida e strumenti di supporto decisionale per gli interventi sui parchi urbani” scientific director M. Losasso; 2007 – Convention between the City of Battipaglia and the Department of Urban Planning at the University of Naples Federico II: “Studi preliminari e linee d’indirizzo per gli interventi di riqualificazione dell’area demaniale e fascia costiera di Battipaglia - Elaborazione di linee guida e strumenti di supporto decisionale all’attività dello Staff Operativo di progettazione del PUAD del Comune di Battipaglia”, scientific director M. Losasso.

3. 2014-2016 Convention between the Department of Architecture at the University of Naples Federico II and the City of Naples: “Riqualificazione sostenibile degli spazi pubblici nell’ambito del Grande Progetto del Centro Storico di Napoli sito UNESCO”, scientific director M. Losasso; 2014 – Scientific collaboration agreement among the City of Naples, the Department of Structures for Engineering and Architecture (DIST), the Department of Civil, Building and Environmental Engineering (DICEA), the Department of Architecture (DiARC) at the University of Naples Federico II, “Studi e ricerche di fattibilità strategica, operativa e funzionale finalizzate alla valorizzazione e alla riqualificazione dell’area delle Vele di Scampia”, coordinator M. Losasso.

4. 2015-2017 – PRIN (Research Projects of Relevant National Interest), Ministry for Education, University and Research, “Adaptive design e innovazioni tecnologiche per la rigenerazione resiliente dei distretti urbani in regime di cambiamento climatico”, national scientific director M. Losasso; 2013-2016 National Operational Programme for Research and Competitiveness 2007-2013 – Ministry for Economic Development, Ministry for University and Research in EU, implementation body STRESS S.c.a.r.l., District for High Technology for Sustainable Building in Campania Region, “Project 4: METROPOLIS - Metodologie e Tecnologie integrate e sostenibili per l’adattamento e la sicurezza dei sistemi urbani” scientific director G. Verderame, coordinator for STRESS V. James; project director for the Research Group at DiARC V. D’Ambrosio; 2010/2012 – Research funded by the Polo delle Scienze e delle Tecnologie, the University of Naples Federico II, FARO Programme, Finanziamento per l’Avvio di Ricerche Originali: “Spazi aperti urbani resilienti alle acque meteoriche in regime di cambiamenti climatici”, scientific director F. Palestino.

5. 2016 International research agreement between University of Naples Federico II and ENSA Paris-Belleville on product innovation and advanced design with UHPFRC high performance fiber reinforced concretes, scientific director M. Losasso; 2005-2007 - PRIN (Research Projects of Relevant National Interest), Ministry for Education, University and Research, “Procedure e strumenti per la diffusione e il controllo dell’innovazione tecnica con materiali compositi fibrorinforzati nel recupero degli edifici in cemento armato. Progettare con l’informazione”, national scientific coordinator A. Nesi, director of U.R. in Naples M. Losasso.

6. 2013-2016 Programma Operativo Nazionale Ricerca e Competitività 2007-2013 - Ministry for Economic Development, Ministry for Education University and Research in EU, implementation body STRESS S.c.a.r.l., High Technology District for Sustainable Building in Campania Region, “Project 1: SMART CASE – “Soluzioni innovative MultifunzionAli peR l’otTimizzazione dei Consumi di energiA primaria della vivibilità indoor nel Sistema Edilizio” Project scientific director G. P. Vanoli, coordinator for STRESS F. De Falco; project director of the Research Group at DiARC A. Claudi de Saint Mihiel.

7. 2016 – Research funded by Ateneo di Napoli Federico II, “Tecnologie e strumenti per la *digital fabrication*”, scientific director S. Pone.

8. The METROPOLIS Project, in the four-year period 2013-2016, is a cooperation of the University of Naples Federico II and the University of Sannio with Research centres and industrial partners C, with the collaboration of Local and Institutional Bodies that have provided an important support to the research activities (City of Naples and Campania 2 Basin Authorities, Civil Protection and The Campania Region). The general scientific coordination is in the hands of G. Verderame, DIST – Department of Structural Engineering for Engineering

and Architecture, the coordination for the implementation body STRESS Scarl is in the hands of V. James. The scientific and industrial partners are AMRA Scarl Analysis and Monitoring of environmental risk, D'Appolonia s.p.a., ETT s.p.a., Geoslab s.r.l., ICIE Istituto Cooperativo per l'InnovazionE, Tecno in s.p.a., Tecnosistem s.p.a.

9. The SMART CASE Project, in the four-year period 2013-2016, has benefited from the contribution of the Departments of Architecture (DiARC), Industrial Engineering (DII) and Structures for Engineering and Architecture (DIST) of the University of Naples Federico II and the Department of Engineering (DING) of the University of Sannio, Research centres and industrial partners as well as the collaboration of Local Bodies and Institutions. The general scientific coordination is in the hands of G.P. Vanoli, DING – Department of Engineering at Unisannio, the coordination for the implementation body STRESS Scarl is in the hands of F. De Falco.

10. MATTM – Ministry of the Environment, Land and Sea (2014), *Rapporto sullo stato delle conoscenze scientifiche su impatti, vulnerabilità ed adattamento ai cambiamenti climatici in Italia,* available at: http://www.minambiente.it/sites/default/files/archivio/allegati/clima/snacc_2014_rapporto_stato_conoscenze.pdf

11. The Research group of the METROPOLIS project within the Department of Architecture at the University of Naples Federico II consists of the following member: V. D'Ambrosio (coordinator and scientific director), M. Cerreta, R. A. Genovese, M. Losasso, A. Maglio. F. D. Moccia, F. Palestino, M. Rigillo, S. Sessa, A. Sgobbo, F. Visconti; L. Boccia, F. Di Martino, C. Filagrossi, M. F. Leone, C. Apreda, A. Arena, A. Capolupo, E. Bassolino, B. Cardone, R. Mele, G. Poli, C. Sansò, C. Visconti; with the contribution of F. Abbamonte, C. Carifi, L. Conte, A. De Chiara, L. Lenoci, E. Mastroianni, M. Santaniello.

12. Cfr. *Costruire città resilienti. Linee guida per l'adattamento al cambiamento climatico*, *ACT* project's report – *Adapting to Climate changein Time***,** funded by the European Commission in the programme LIFE Environmental Policy and Governance, 2013.

13. The research has studied the urban system by means of different disciplinary approaches that have considered the typo-morphological, functional-spatial, environmental, technological, historical and conservation-related, perceptual, urban and evaluation-related aspects.

14. These aspects will be the subject of the research project named "SIMMCITIES_NA - Scenario Impact Modelling Methodology for a Climate change-Induced hazards Tool for Integrated End-users Strategic planning and design – NAPOLI" funded by Federico II University (scientific directors M.F. Leone, M. Losasso, S. Russo Ermolli).

15. The PRIN research – Research projects of relevant national interest 2015 entitled "Adaptive design e innovazioni tecnologiche per la rigenerazione resiliente dei distretti urbani in regime di cambiamento climatico" consists of the following Operational Units: University of Naples Federico II (scientific coordinator M. Losasso), the University "Mediterranea" of Reggio Calabria (director M.T. Lucarelli), University of Rome "La Sapienza" (director F. Tucci), Second University of Naples (director R. Valente), University of Florence (director R. Bologna), Politecnico of Milan (director E. Mussinelli).

16. These issues were addressed at the Conference: "The Technological Districts for innovation in the construction sector: research, transfer, experimentation" held in Naples - Palazzo Gravina in June 2014.

17. The Research Group of the Department of Architecture of University of Naples Federico II involved in SMART CASE research project is composed by: A. Claudi de Saint Mihiel (coordinator and scientific director), M. Bellomo, U. Caturano, A. D 'Agostino, P. De Toro, D. Francese, M. Losasso, A. Piemontese; with the contribution of E. Buiano, E.A. De Nicola, C. Filagrossi, C. Girardi, E. Porcaro, C. Tomeo, T. Venditto.

18. The research activities are framed in the "Nearly Zero Energy Building" cluster as a research network of the Italian Society of Architectural Technology – SITdA, officially presented at Made Expo in Milan in March 2015, that includes the participation of 18 Italian research branches, coordinated by F. Tucci and A. Claudi de Saint Mihiel respectively at national and local (Naples - Federico II) level.

The authors

Valeria D'Ambrosio, Associate Professor of Architectural Technology at the Department of Architecture, University of Naples Federico II, her research interest is in the area of technological retrofit and environmental design of urban buildings and open spaces. The main implementation scope refers to rehabilitation processes of the historic centres and social housing districts. Environmental strategies and design solutions for adaptation and mitigation of climate change related hazards are particularly investigated following the adaptive design approach.

Alessandro Claudi de Saint Mihiel, Professor of Architectural Technology at the Department of Architecture of the University Federico II of Naples, carries out research activities on technological innovation and sustainability of building construction and environmental transformation. The main application fields concern the effects that experimentation and technological development have both on the design and implementation processes and on the evolution of architectural styles through the study of design strategies for the reduction of energy requirements for buildings.

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