FUNDACIÓN EDUARDO TORROJA

ACTAS - PROCEEDINGS

International Conference on Construction Research Eduardo Torroja

Architecture, Engineering and Concrete

AEC

Where do we come from? Where are we going?

21,22,23 November 2018, Madrid

FUNDACIÓN EDUARDO TORROJA
Edición y Diseño / *Editor and Designer*
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FUNDACIÓN EDUARDO TORROJA

Patronato / *Board of Trustees*

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Instituto de Ciencias de la Construcción Eduardo Torroja

Consejo Superior de Investigaciones Científicas (CSIC)

Fundación Banco Caminos

Presentación / *Introduction*

José Antonio Torroja

The Eduardo Torroja Foundation will be organizing an international conference on construction research entitled "**A**rchitecture, **E**ngineering and **C**oncrete / **AEC**", in conjunction with the Eduardo Torroja Institute of Construction Science of the Superior Council of Scientific researches / CSIC, and with the co- sponsors; ACHE, FIB and IASS, and the collaboration of the General Directorate of Architecture of the Spanish Ministry of Development, and the Technical University of Madrid.

The conference is being called to support research – past, present and future- on architecture and engineering built in concrete and concrete as construction material. Following the footsteps of Eduardo Torroja, the conference will be a forum for international reflection and debate. It will revolve around a philosophy and praxis that advocate a view of architecture and engineering as part of the same engine, built in the factory of innovation and serving society by driving progress. The intention is to encourage dialogue among researchers, professionals, builders, ancillary industries and the university, sharing experiences and building relationships among the various actors involved in the development required by a society characterized by relentless change.

Organizers

Management / Organization and Scientific Committee
Pepa Cassinello. *Director Eduardo Torroja Foundation*

Co-Sponsors

Collaborators

Organizing Committee

Chair: Pepa Cassinello, *Eduardo Torroja Foundation*
Eduardo Torroja Institute of Construction Science-CSIC:
Antonio Blázquez, Maribel Sánchez Rojas, Rogelio Sánchez Verdasco
Eduardo Torroja Foundation: David Mencías, Enrique Ramírez

Unidad Asociada RAM "Restauración Arquitectura y Materiales"
Instituto de Ciencias de la Construcción Eduardo Torroja – CSIC
Escuela Técnica Superior de Arquitectura ETSAM-UPM

Scientific Committee

Chair: Pepa Cassinello

The members of the Scientific Committee belong to diferent Institutions, Universities and Countries: *Eduardo Torroja Foundation, Eduardo Torroja Institute of Construction Science, CHEOPU-CEDEX, INTEMAC, fib-International Federation for Structural Concrete, ACHE, IASS, Polytechnic University of Madrid, Polytecnnic University opf Valencia, University of The Andes Bogotá, Universita´ degli estudi di Roma Tor Vergata, Sapienza Universita´Di Roma, Techniches Universität Berlin, Brandenburguische Technische Universität Cottbus, HafenCity Universität Bauingenieurwesen Hamburg, UNAM Universidad Nacional Autónoma de Mexico /* Consuelo Acha, Bill Addis, Josep María Adell, Mar Alonso, Jesús Anaya, Francisco Arqués, Enrique Azpilicueta, César Bedoya, Alejandro Bernabéu, Jorge Bernabéu, Calogero Bellanca, Antonio Blázquez, Annette Bögle, María Victoria Borrachero, Dirk Bühler, Andrés Cánovas, Marta Castellote, Ángel Castillo Talavera, Agostino Catalano, José María de la Puerta, Mercedes Del Río, Cengiz Dicleli, Francisco Domouso, Manuel Fernández Cánovas, David Fernández Ordoñez, Moisés Frías Rojas, Borja Frutos, José Ramón Gámez, Angela García de Paredes, Julián García Muñoz, José Francisco García Sánchez, Alfonso García Santos, Ilaria Giannetti, José María Goicolea, Raúl González Bravo, Enrique González Valle, Ana Mª Guerrero,

Carmen Jordá, Juanjo Jorquera, Jorg Haspel, Francisco Hernández Olivares, Tulia Iori, Ricardo Lampreave, Concha Lapayese, Jorge Ley, Mar Loren, José Antonio Lozano, Fernando Magdalena Layos, Marzia Marandola, Antonio Más Guindal, Roland May, Juan Manuel Medina del Río, David Mencías, Juan Monjo Carrió, José Monzó, Susana Mora, Javier Neila, Manuel Olaya, Juan Gerardo Oliva Salinas, Ignacio Oteiza, Ignacio Paya Zaforteza, Jordi Payá, Alberto Pieltain, Eduardo Prieto, Francisca Puertas, Dolores Pulido, Juan Queipo de Llano, Enrique Ramírez Sánchez, Taba Rasti, David Revuelta, Dolores Romero, Anna Rosellini, David Sanz, Maribel Sánchez Rojas, Massimiliano Savorra, Federico Soriano, Angela Sorlí, Rafael Talero, José Antonio Tenorio, Leonardo Todisco, Patrizia Trovalusci, Sergio Vega.

Lugar de Encuentro / *Venue*

Pepa Cassinello

Director Fundación Eduardo Torroja

Lugar de Encuentro / *Venue*

Pepa Cassinello
Director Fundación Eduardo Torroja

El lugar de encuentro, donde tendrá lugar el Congreso, es un sitio muy especial – el Instituto de Ciencias de la Construcción Eduardo Torroja-, fundado por Eduardo Torroja en 1934.
La dirección es: C/ Serrano Galvache 4, Madrid 28033, España.

The venue is a very special place - Eduardo Torroja Institute for Construction Science - where the Conference will take place. It was founded by Eduardo Torroja in 1934.
The address is: Serrano Galvache Street, nº 4, 28033 Madrid – Spain

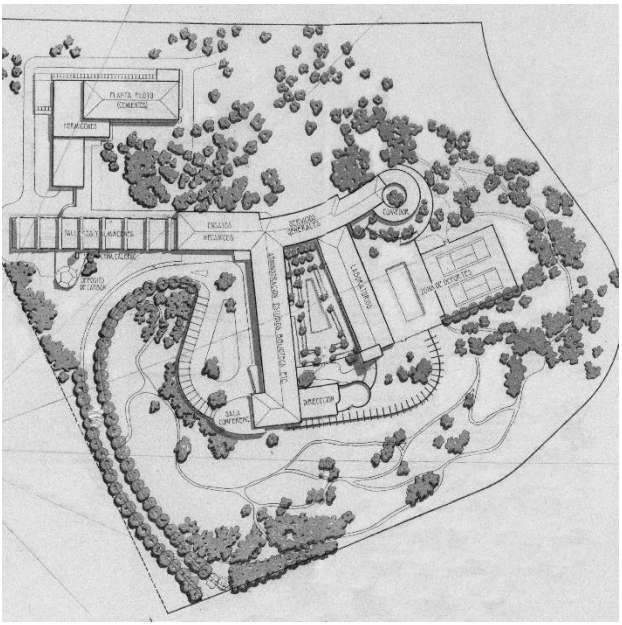


Fig.1 Instituto Eduardo Torroja / *Eduardo Torroja Institute.* 1953

Eduardo Torroja lo proyectó en 1949. Quería construir un innovador edificio para albergar su revolucionaria idea de cómo debía ser el hábitat para la investigación. El conjunto de edificios de la nueva sede del Instituto fue construido en un bosque de pinos. Se levanta sobre una planta que responde a la forma geométrica del número Pi, y los edificios que forman esta macla espacial se insertan en el paisaje como si se tratara de un peine, generando patios abiertos ajardinados. Fue inaugurado en el año 1953. (Fig.1)

Eduardo Torroja designed it in 1949. He wanted to build an innovated building for his revolutionary idea on how it should be a place to research. The set of buildings of the new headquarters was built on a pine forest. Raised on a plant in the form of the number pi, its set is inserted into the landscape as a comb generating open landscaped courtyards. It was inaugurated in 1953. (Fig.1)

Fig.2 Comedor / *Dining room*

Fig.3 Pérgola / *Pergola*

Eduardo Torroja diseñó algunos elementos singulares en este conjunto; el gigantesco Dodecaedro que fue proyectado como silo de carbón, una lámina plegada de hormigón armado que aporta una imagen escultórica y que pronto se convirtió en un icono del IETcc. The Dodecaedro es también la imagen que representa la Fundación Eduardo Torroja. El comedor, un incuestionablemente atractivo

espacio orgánico de piel de vidrio curvada que se introduce en el bosque circundante. Una pieza arquitectónica que atrajo la atención de Frank Lloyd Wright. Su cubierta es como un paraguas, y su estructura está formada por vigas metálicas en voladizo dispuestas de manera radial. La cubierta laminar metálica triangulada de la nave de talleres de ensayos.

Fig. 4 Dodecaedro / Dodecahedron

Some special elements designed by Eduardo Torroja stand out; The giant Dodecahedron which was designed as a coal storage, a folded concrete shell which has a sculptural image, soon became an IETcc icon and the image of the Fundación Eduardo Torroja. The Dining Hall an unquestionably attractive and organic space, with a curved glazed skin that blends into the adjacent garden. This architectural piece attracted the attention of Frank Lloyd Wright. The roof is like a big umbrella, its structure radially arranged cantilevered steel.

The Triangulated steel Shell roof of the workshops. (Fig.5)

La Pérgola situada en el borde del jardín, que está formada por secuencia continua de costillas de hormigón armado cuya forma geométrica responde a la lemniscata de Bernoulli, con curvatura cero en su extremo superior que representa el símbolo matemático de del infinito.

The Pergola located on the west edge of the garden, is formed by a continuous sequence of reinforced concrete ribs forming a lemniscate of Bernoulli. The zero curvature at the end represents the mathematical symbol for infinity.

Un mágico lugar en el que todos los objetos y mobiliario fueron ingeniosamente diseñados. La mesa del hall principal abraza dos sofás que le sirven de patas, otra mesa en la planta superior usa como patas los cables que sujetan el forjado de la planta alta ……

A magical place where all objects and mobility were also ingeniously designed. The table in the main hall embraces two sofas that serve as legs, other table use like legs the cables that hold the upper slab…..

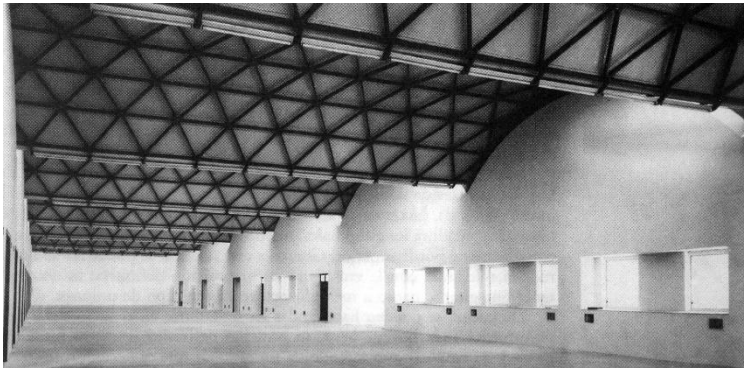


Fig.5 Cubierta laminar metálica Nave de Talleres / *Steel shell roof of the workshops*

Programa ***/ Programme***

Programa */ Programme*

21 Noviembre / *November* 2018

8,30h - 9,30h Entrega de Identificaciones / Registration
9,30h - 10,30h Acto de Apertura del Congreso / Opening Ceremony
Ministerio de Fomento / Javier Martín DG Arquitectura
Francisco Javier Herrero DG Carreteras
Universidad Politécnica de Madrid / Guillermo Cisneros Rector
Presidente Fundación Eduardo Torroja / José Antonio Torroja
Presidente de la fib / Hugo Corres
Director IETcc / Ángel Castillo
Directora Fundación Eduardo Torroja / Conference President
Pepa Cassinello
10,30h - 11,00h Café / Coffee break

11,00h - 12,00h Conferencia plenaria / Keynote lecture: Hugo Corres
Architecture + Engineering, a very powerful collaboration
12,00h - 13,00h Comunicaciones / Technical Sessions
13,00h - 14,30h Comida en el Comedor diseñado por Eduardo Torroja
Lunch at the dining room designed by Eduardo Torroja

14,30h - 16,00h Comunicaciones / Technical Sessions
16,00h - 17,00h Conferencia plenaria / Keynote lecture: Francesco Dal Co
Frank Lloyd Wright
17,00h - 18,00h Conferencia plenaria / Keynote lecture: Javier Manterola
Mi entendimiento de los puentes
18,00h - 18,15h Café / Coffee break

18,15h - 19,30h Coloquio / Colloquium
El Mantenimiento de los puentes en España
Juan Lazcano, President CNC / Coordinator,
Javier Manterola, Jorge Ley (INTEMAC),
Javier León (UPM), Álvaro Navareño (M.Fomento)

22 Noviembre / *November* 2018

8,30h - 9,30h Comunicaciones / *Technical Sessions*
9,30h - 10,30h Conferencia plenaria / *Keynote lecture*
(pendiente confirmación/ *not confirmed yet*)

10,30h - 11,00h Café / *Coffee break*

11,00h - 12,00h Conferencia plenaria / *Keynote lecture*: Tulia Iori
Ricardo Morandi and his bridge in Genova
12,00h - 13,00h Conferencia plenaria / Keynote lecture: Carmen Andrade
Modelos de propagación del deterioro del Hormigón estructural

13,00h - 14,30h Comida en el Comedor diseñado por Eduardo Torroja IETcc
Lunch at the dining room designed by Eduardo Torroja

14,30h - 16,30h Comunicaciones / *Technical Sessions*
16,30h - 17,30h Conferencia plenaria / *Keynote lecture*: Mike Schlaich
Lightweight structures with concrete and other materials

17,30h - 18,00h Café / Coffee Break

18,00h - 19,30h Coloquio / *Colloquium*
"Arquitectura, Ingeniería, Hormigón"
Luís Fernández Galiano / *Coordinator*
Miguel Aguiló, Fernando Menis, Ginés Garrido,
Mike Schlaich.

23 Noviembre / *November* 2018

8,30h - 10,30h Comunicaciones / *Technical Sessions*

10,30h - 11,00h Café / *Coffee break*

11,00h - 11,30h Conferencia plenaria / *Keynote lecture*:
Jerónimo Junquera
Restauración Hipódromo de la Zarzuela
11,30h - 12,00h Conferencia plenaria / *Keynote lecture*: Pepa Cassinello
Museo Eduardo Torroja Museum

12,00h - 13,00h Autobuses desde el IETcc al Hipódromo de la Zarzuela
Conference-Bus from IETcc to Zarzuela Racecourse

13,00h - 14,30h Visita Hipódromo de la Zarzuela y Museo Eduardo Torroja
Zarzuela Racecourse visit and Eduardo Torroja Museum

14,30h - 16,00h Comida en el Hipódromo de la Zarzuela
Lunch at the Zarzuela Racecourse

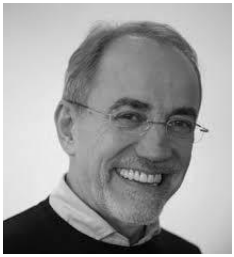
16,00h - 17,00h Autobuses vuelta al IETcc
Conference-Bus Zarzuela Racecourse to IETcc

17,00h - 18,00h Conferencia plenaria de clausura
Eduardo Souto de Moura / *Arquitectura e Engenharia*

18,00h - 19,30h Acto de Entrega de Premios y Clausura
Awards and Closing Ceremony

Conferenciantes / *Speakers*

21 Noviembre / *November* 2018



Hugo Corres Peiret

*Civil Engineer, MSc and PhD from the Technical University of Madrid. Doctor Honoris Causa from the Technical University of Bratislava. Professor of Structural Concrete and Conceptual Design of Structures at the School of Civil Engineering at the Technical University of Madrid. President of **fib** (International Federation of concrete). Former president of ACHE (Structural Concrete Scientific Association of Spain). Member of the Project Team that prepared Eurocode 2 (Structural Concrete). Member of the **fib** Special Activity Group 5 for the preparation of Model Code for Concrete Structures, 2010. Member of **fib** COM10 for the preparation of the new Model Code 2020. Member of different Spanish committees for the development of codes and regulations. Author of several papers and books. Founder and designer of FHECOR Consulting Engineers, www.fecor.es.*

21 Noviembre / *November* 2018

Francesco Dal Co

Francesco Dal Co *is an Italian historian of architecture. He has been director of the Department of History of Architecture since 1994. He has been Professor of History of Architecture at the Yale School of Architecture from 1982 to 1991 and professor of History of Architecture at the Accademia di Architetura of the Università della Svizzera Italiana from 1996 to 2005. From 1988 to 1991 he has been director of the Architectural Secton at the Biennale di Venezia and curator of the architectural secton in 1998. Since 1978 he has been curator of the architectural publicatons for publishing House Electa and since 1996 editor of the architectural magazine Casabella.*

He is the author of many important books on architecture such as; "Modern Architecture" (with M. Tafuri) (1979), Kevin Roche" (1985), Tadao Ando" Complete Works (1995), Centre Pompidou: Renzo Piano, Richard Rogers, and the Making of a Modern Monument (2016), The Guggenheim: Frank Lloyd Wright's Iconoclastc Masterpiece (2017). He is currently Senior Fellow at the Center for Advanced Studies of the National Gallery of Art, scholar at the Gety Center, and Member of the Board of Directors of the Society of Architectural Historians. He is also member of the National Academy of San Luca.

21 Noviembre / *November* 2018

Javier Manterola

Javier Manterola is a Spanish Civil Engineer and professor at Universidad Politécnica de Madrid". Internatonally recognized for his work as a bridges designer such as: Carlos Fernández Casado Bridge (1983), Pepa Bridge (2015), "Consttución de 1812" Bridge over the bay of Cadiz (2017), with a total length of 3 092 metres, it is one of the longest contnuous bridges in Spain and one of the world's largest.

In the performance of his professional actvity, he has been awarded with several prizes, such as: "Convención Europea de Construcciones Metálicas" Prize (1975), Medal of Honor "Asociación española de Hormigón pretensado" (1978), Construmat Prize to the best engineering work (1985), Medal of Honor "Colegio de Ingenieros de Caminos, Canales y Puertos" (1985), "Ildefonso Cerdá" Medal (1995), "Federación Internacional de Pretensado" Medal (1996), National Engineering Prize of the "Ministerio de Fomento" (2001), "Príncipe de Viana de la Cultura" Prize (2005), IABSE Prize (2006). He is member of the "Real Academia de Bellas Artes de San Fernando" since December 2006.

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Tulia Iori

Tullia Iori, civil engineer, is professor of History of Structural Engineering at University of Rome "Tor Vergata", in Italy. She is the coordinator of the 5-years Master degree "Architectural Engineering" and director of the Phd Program "Civil Engineering".
Her research subjects include the history of construction, the history of structural engineering and the conservation of modern architecture. Her Phd book on the history of reinforced concrete in Italy was awarded the Edoardo Benvenuto Prize in 2003.
She designed and headed with Sergio Poretti and, after his death, is now the responsible of the research "SIXXI - XX Century Structural Engineering: the Italian Contribution", funded by an ERC Advanced Grant in 2011. She directs a research group of about ten PHD students and Research Fellows.

She was curator of exhibitions on Pier Luigi Nervi (held in MAXXI Museum in Rome in 2011), on the structures of Sergio Musmeci in Rome (held in MAXXI Museum in Rome in 2014), on the bridges of the Highway of the Sun (held in Bologna in 2014).
She published many books and papers on Pier Luigi Nervi, Riccardo Morandi and on the History of Italian Structural Engineering. She curates the books series "SIXXI - Storia dell'ingegneria strutturale in Italia", which is now at the 4th issues, to tell the stories discovered during the research.

22 Noviembre / *November* 2018

Carmen Andrade

Carmen Andrade is Doctor in Industrial Chemistry. In 1969 stated the work at the Institute of Construction Sciences "Eduardo Torroja"of CSIC-Spain where she became permanent member in 1979, Director during 13 years and was retired in 2017. At present is Visiting Research Prof. at CIMNE: International Center for Numerical Methods in Engineering. Has worked on Concrete Durability and Reinforcement corrosion. Has been President of UEAtc, RILEM, WFTAO y Commitee de Liaison. Has been General Director of Technological Policy of the Ministry of education and Science and Assessor of the Secretary of State of University at the Ministry of Science and Innovation. At present is President of ALCONPAT: Latinoamerican Association of Concrete Rehabilitation.

She has awarded several prices as: Robert L'Hermite Medal-1987, Whitney Award-2013 and ACHE Medal-2017.

22 Noviembre / *November* 2018

Mike Schlaich

Mike Schlaich is Partner and Managing Director of schlaich bergermann partner. He is also Professor at the Technische Universität in Berlin where he is Chair of Conceptual and Structural Design. He is an innovator in engineering education as well as an extraordinary designer of singular buildings, bridges, towers and roofs such as the Wanda Metropolitano stadia roof in Madrid and the Ting Kau Bridge in Hong Kong.

Awards: Deutscher Ingenieurbaupreis 2016, footbridge Rathenow, Germany -Gold Medal by The Instituton of Structural Engineers, London, 2015 -Ingenieurpreis des Deutschen Stahlbaues 2015 for canopy for exit of customer center of Autostadt in Wolfsburg, Germany - Deutscher Brückenbaupreis 2014 for Railway Bridge Gänsebachtal - Deutscher Brückenbaupreis 2010 for footbridge at Sassnitz harbor - Balthasar-Neumann-Preis 2008 for M11 Memorial in Madrid - Ingenieurbau-Preis 1998 for Glacis Bridge Ingolstadt - Schinkelpreis 1992 for footbridge across the river Spree, Berlin

23 Noviembre / *November* 2018

Jerónimo Junquera

Jerónimo Junquera has been developing projects for the last 35 years in diverse fields of architecture and urban design.

Currently has been selected to develop the Almería Port-City Waterfront Development, and the "Fundación Ortega y Gasset" Rehabilitation in Madrid and diverse singular housing projects.

Among his recent works stand out the Malaga Port–City Waterfront Development, and "La Zarzuela" Hippodrome Rehabilitation and Restoration in Madrid.

His work has been published in multiple architecture magazines and exhibited on countless occasions, both at national and international level.

He has received numerous prizes like the 1989, 1997 and 2006 Spanish Architectural National Award, the 1985, 1987, 1993, 1999, 2000, 2001, 2002 and 2006 Madrid City Council "Urban Planning, *Architecture and Public Works" Award and the 1995, 2003 and 2008 COA Madrid Awards and 2013 COA Malaga Award and has been present in almost all the Spanish Biennial of Architecture as well as in other Architecture Exhibitions.*

He has worked as a teacher at ETSAM and as a guest teacher at UIMP, Camuñas Foundation, and CEES. He has been Director of the COAM Architecture Review from 1977-1980.

He is Member of the Board of the "Estudio Foundation"

23 Noviembre / *November* 2018

Pepa Cassinello

Pepa Cassinello is a Madrid-based architect, current Director of the Eduardo Torroja Foundation and Titular Professor at the Department of Construction and Architectural Technologies of the Technical School of Architecture (ETSAM) of the Polytechnic University of Madrid (UPM). In 2011 she founded the Alumni Association (ETSAM-UPM). She is specialist in construction and structural design of both historic and avant-garde buildings. She has been a guest speaker in; RIBA/Royal Institute of British Architects in London, EPFL/ École Polytechnique Féderalé de Lausanne, Sapienza Universitá di Roma, Universitá degli Studi di Roma Tor Vergata, TU Berlin/ Technische Universität Berlin, Deutsche Museum Munich. She has been curator and author-editor of catalogue books; Eduardo Torroja Museum, Eduardo Torroja 1949.Strategy to industrialize Housing in post-World War II, Felix Candela Centenary, Ildefonso Sánchez del Río, Light Structures/sbp, The Spirit of an Idea in Print/ 60 years journal "Informes de la Construcción".

She has been awarded, between others by Madrid City Council, IASS/International Association for Shell and Spatial Structures and XIII BEAU Spanish Biennial of Architecture and Urbanism.

PARTE I / PART I

Premios, Actividades, y Regalos

Awards, Activities, and Gifts

1.Premios / *Awards*

The **3** best papers have been awarded and **6** papers have obtained a mention.

Members of the jury
President: José Antonio Torroja.
Vowells:
Architecture/ Ignacio Oteiza y Juan Monjo.
Engineering/ Enrique González Valle y David Revuelta.
Concrete/ Manuel Fernández Cánovas y Rafael Fernández Sánchez.

Premios / *Awards*

The awarded papers will receive 1000 euros each from **SIKA España**, a certificate from the **Fundación Eduardo Torroja**, and they will be published in one of the journals of the **Eduardo Torroja Institute of Construction Science** - "Informes de la Construcción" or "Materiales de la Construcción" / IETcc-CSIC.

Architecture

Author: Sabine Kuban.
University: Dipl.-Ing. (FH) M.Eng.
BTU Cottbus-Senftenberg.
Title: Building Frames – Aspects of the Development of reinforced Concrete in Berlin.

Engineering

Author: Antonio Burgos Núñez.
University: Ingeniero de Caminos e Historiador.
Universidad de Granada.
Title: J.M. de Zafra y los orígenes de los puentes de vigas trianguladas de hormigón armado.

Concrete

Authors: Luís Saucedo Mora, Stefano Zambonini, David de la Peña, Iván González Ocampos, Carmen Andrade Perdix, Beatrice Belletti, Jesús Rodríguez Santiago, Javier Sánchez Montero.

University/Center or Company: IETcc, University of Parma, Universidad Politécnica de Madrid, CIMNE, University of Parma, Universidad Politécnica de Madrid, IETcc.

Title: Interacción numérico-experimental entre el comportamiento complejo de materiales y modelos a gran escala de elementos de Hormigón Armado.

Menciones / *Mentions*

The mention papers will receive a certificate from the **Fundación Eduardo Torroja**.

Architecture

Author: María Elena Zapatero.

University: Architect MSc. Universidad Politécnica de Madrid.

Title: Underground water supply tanks from the "Canal de Isabel II": Hidden interventions on concealed architectures in Madrid.

Author: Luciano Cardellicchio.

University: Senior Lecturer, Leverhulme Research Fellow.
University of Kent. UK.

Title: Our Future Heritage. Ageing patterns of contemporary concrete: The case study of the jubilee church by Richard Meier in Rome.

Engineering

Author: Juan José Jorquera-Lucerga.
University: Dr. Ing. de Caminos.
Univ. Politécnica de Cartagena (España).
Title: New bridge typologies as a result of classic design strategies.

Authors: Jorge Bernabéu y Alejandro Bernabéu.
University: PhD. Civil Engineer. IDOM.
PhD. Civil Engineer. Bernabeu Ingenieros.
Universidad Politécnica de Madrid.
Title: Composite origin of the first reinforced concrete.

Concrete

Authors: Fernando de Caso, Álvaro Ruiz Emparanza, Miguel Ángel Sanjuán Barbudo, Itziar Adarraga, Antonio Nanni.
University: University of Miami USA, ICEA, University of the Basque Country, University of Miami USA.
Title: Redefining sustainable concrete with fiber reinforced Polymer (FRP) Composite reinforcement.

Authors: Felipe Pich-Aguilera, Oriol París, Teresa Batlle Pages, Zuzana Procházkova.
University: Universidad Internacional de Cataluña.
Title: Climate Concrete-Prefabricated solution for Bioclimatic Façade Design.

2.Visita Guiada / *Guided Visit*

Hipódromo de la Zarzuela / *Zarzuela Racecourse*
Museo Eduardo Torroja *Museum*

The architect Jeronimo Junquera will be the speaker who guided the visit to the Zarzuela Racecourse. He has restored this iconic thin concrete shell structure built by Eduardo Torroja.

The architect Pepa Cassinello will be the speaker who guided the visit to de Eduardo Torroja Museum. She is the director of the Fundación Eduardo Torroja and the curator of the Museum.

Pepa Cassinello

The Eduardo Torroja Museum is located at Madrid's La Zarzuela Racecourse, under the north stands. This building, one of Torroja's most emblematic works, marks an international milestone in the history of Modernist architecture's thin shells. The site is, then, a privileged location, for container and content were authored by one and the same engineer: Eduardo Torroja.

The museum is more than just a vast space for displaying a representative selection of Eduardo Torroja's legacy, however. With a view to maintaining an attractive programme and creating synergies with La Zarzuela Racecourse's many activities, it is also endowed with a hall for temporary showings of present and future Spanish avant-garde architecture and engineering. Yet another is devoted to the history of horse racing at La Zarzuela Racecourse, which this year is celebrating the 75th anniversary of its opening in

1941. Given the diversity of race track audiences, the museum aims to appeal not only to architects, engineers and horse racing experts and fans, but also to their retinue of youths and children. The museum's projection hall will show A/V productions revolving around three subjects: Eduardo Torroja, innovation in the constantly changing architectural and engineering avant-garde, and the world of horse racing. With this inter-related, multi-purpose approach, the aim is to create a museum that actively serves a plural and likewise constantly changing society.

Whilst Eduardo Torroja's extensive and polyhedral legacy is far too vast for the physical space available in the museum, it would hardly be reasonable in any event to display it in its awe-inspiring entirety, for most of the archives (designs, writings, essays...) have been digitized by CEDEX and are available online and at the National Research Council institute that bears the illustrious engineer's name. The museum's 'raison d'être' is to provide a permanent place at which to clearly and concisely describe Torroja's most prominent contributions to progress in construction, architecture and civil engineering, highlighting the reasons for his status as an international and timeless model for professionals and students. The idea is to steer the visitor's gaze to reasons converted into images and scant and concise words. That is the ultimate objective of the museum design. To that end a series of built works, research endeavours and publications have been selected for display, most of which were chosen by Torroja himself for his two most famous books, *Razón y Ser de los tipos estructurales* (1957) and *The Structures of Eduardo Torroja; an Autobiography of an Engineering Accomplishment*, published in English in New York in 1958 and in Spanish in 1999. As the words explaining each image were also taken from texts authored by Torroja, the engineer himself is the visitor's guide.

The works selected are shown in three consecutive halls: S1, S2 and S3. The order of the displays is based essentially on chronology, structure and use, for museum staging sometimes leapfrogs in time and space to highlight certain landmarks, such as La Zarzuela Racecourse, to which more exhibition space is devoted.

Many of my works are not mentioned here, but I feel that the few which are included best exemplify what I was searching for, and what I finally achieved. Eduardo Torroja, 1958

Museum Credits

Curator
Pepa Cassinello
Architect / Managing Director Fundación Eduardo Torroja

Advisers
José Antonio Torroja President, Fundación Eduardo Torroja
Rafael Fernández Sánchez Secretary, Fundación Eduardo Torroja
José Calavera Honorary President, INTEMAC

La Zarzuela Racecourse Restoration and Museum Hall Adaptation
Junquera Arquitectos

PRODUCTION

Fundación Eduardo Torroja

PREMISES

Hipódromo de la Zarzuela S.A

SPONSORSHIPS

Ministry of Public Works

Directorate General of Architecture and CEDEX Fundación

ACS

Ferrovial agroman

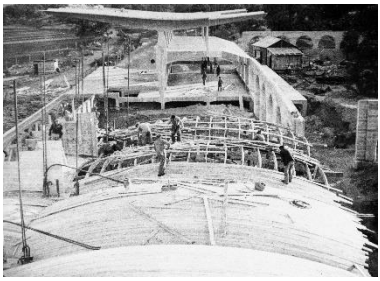
Fundación Banco Caminos

COLLABORATIONS

Universidad Politécnica de Madrid

Fundación Juanelo Turriano

SIKA, España

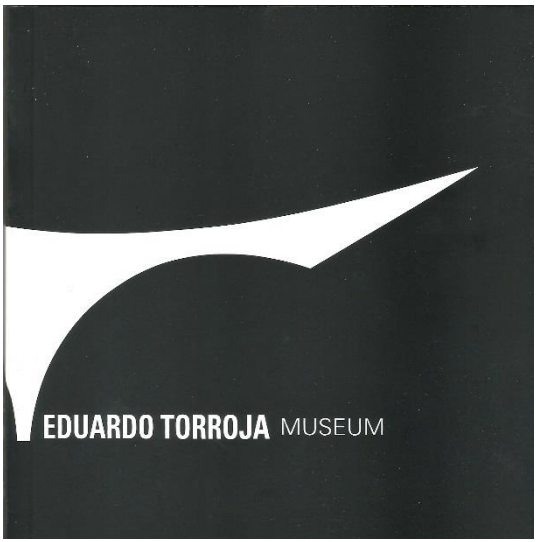


Hipódromo de la Zarzuela / *Zarzuela Racecourse*

3.Regalos / *Gifts*

The Eduardo Torroja Foundation gave a Catalogue Book of the Museum to each participant in the Conference.

The participants could choose the language in which they want the catalogue book: Spanish, English, French, German, Italian, Portuguese.



PARTE II / *PART II*

Autores y Comunicaciones / *Authors and Papers*

INNOVATIVE EVOLUTION OF TRADITIONAL BUILDING TECHNIQUES OF MINOR ARCHITECTURE IN THE EARLY 1900S

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ABSTRACT

The research is part of the field of study relating to the knowledge and recovery of existing buildings in general and in particular in the study of building technologies used in the construction of widespread construction strongly characterized “Lucania” in the early 1900s. The main theme of this research is the development of the technology of reinforced concrete cast in place and subsequently prefabricated, at the turn of the twentieth century, with the first cases of variations made in the construction phase adapting to local construction practices and the new technical standards. We find interesting cases of study in Lucania in the minor widespread architecture such as the rural village "Taccone" of Irsina, as well as water tanks, silos, etc. The research tends to enhance this constructive heritage, analyzing and reinterpreting the used building technologies that, considered innovative for the historical period of reference, today have a value of testimony not to be lost or replaced. For this reason, the research is based on an acquired awareness of the attribution of value for a conservation intervention approach between "tradition-innovation".

Keywords: *knowledge, conservation, recovery, reinforced concrete, building technologies, minor widespread architecture, tradition, innovation.*

1. INTRODUCTION

World War II left the Italian territory in a critical situation. A nation to be rebuilt was divided into increasingly wealthier landowners and increasingly poor laborers. From this need arises the significant testimony of the cultural architectural

heritage of the founding villages. These urban aggregates, created during the '50s in a heterogeneous manner throughout southern Italy, after seventy years still show their compositional language worthy of a strong identity. The Land Reform was able to offer, in addition to a home and a decent work to the common people, a minimum hope, albeit short, of a better life.

The situation unfortunately changed soon. The centers, incomplete and isolated, were forgotten by the institutions and abandoned by the settlers. The main causes of this failure, ignoring the management problems and the delays in the execution of the works, were oversized planning, compared to the actual needs, and the inability to foresee the possible change of the production sectors. Of the original executive projects only 30% of the homes were built.

The current situation is not the best. The villages, populated in the mid-50s, began to be depopulated already in the early '70s. This has weighed heavily on the current situation of constant abandonment of buildings. About two million buildings are part of the abandoned real estate, now a symbol of a worrying situation that necessarily requires a solution.

Urban planning plans and strategies aim to favor the recovery of the structures (more and more common they sell buildings at a ridiculous cost of 1.00 €) and this has led to a significant improvement: the weight of building renovations, in the total turnover of the companies Italian construction sector, has increased from 25% in 2008 to an estimated 40% in 2013.

Unfortunately, these data, although comforting, hide a sad truth that the restructured residences mainly concern the metropolitan cities while the municipalities of the province continue to be abandoned.

1.1. The case study: Borgata Taccone.

Located in Agro di Irsina, province of Matera, the Borgata Taccone was part of the project to build new residential and productive settlements, implemented around the '50s in Basilicata, as in this case, but also in Puglia and Molise. Thanks to the construction of rural villages, the regions of Basilicata, Puglia and Molise made up for the various problems afflicting the south: depopulation due to the crisis conditions that drifted after World War II, high unemployment rate and steady growth, high rate of illiteracy and lack of drinking water out of populated areas. The "Section for land reform in Puglia, Lucania and Basso Molise" stipulated the general criteria, which provided for the general plans of towns and villages to be implemented on the territory. The township Taccone was given particular importance and urgency.

The village is located about 14 km North-East from the Municipality of Irsina, about 15 km South-West from the City of Genzano di Lucania and about 15 km East from the border between Puglia and Basilicata.

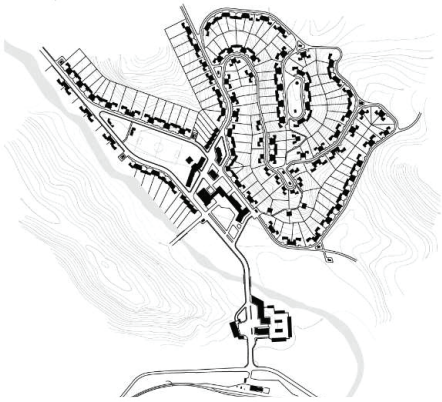

Figure 1 Plan of first project of the Arch. Plinio Marconi

Inside the village mainly families of service workers and artisan families had to reside,

while the remaining families, around, would have remained scattered inside the farms. The project of the township Taccone was entrusted to the architect Plinio Marconi. He has planned the division of the village into three main areas: the area in which the "dwelling houses" are inserted (as defined by the designer), organized in a system of subdivision with an adjoining farm; the social area, designed to accommodate both the planned users of the village and the units from the rest of the territory; the administrative core where to settle the colonization center. The public area, which includes the church, the shop, the cinema, the post office and the building of the municipal delegation, is designed in such a way as to respect the prospective hierarchies of the countryside, the station and the access road. Open space is conceived as absolute, in which boundaries are defined by the masses of buildings and by the landscape in the background. The garage, the clinic and the school are located in a unique perspective that closes the public nucleus of the village. The homes, those built, are located around these public areas: designed of four types, Marconi for the houses chooses a terraced distribution dictated mostly by the morphology of the territory. The houses are all one floor, with pitched roofs, designed with attached barn for animals. The functional nucleus is located halfway between the station and the village.
Divided from the access road to the village, it includes the building of the administrative offices and the staff quarters, the set of warehouses for the workshops, the carpentry, fuel depots, seeds and the granary.

1.2. Current situation.

About 65 years after the design and construction of Borgo Taccone it is possible to immediately notice the situation of high degradation in which it pours. It is immediately deducible that of the ninety-five residential properties provided for in the original project, only fifteen were built. Of the five building types studied previously, the semi-detached villas with a central plan, only two were built: the "B" typology and the "C" typology. All the other design options, including the two types of terraced houses, were set aside to be built later, if there had been an excessive population growth requiring expansion of the center. The project of the church, before being approved by the Ente Riforma, was immediately the subject of confrontation between the client and the designer. In fact, the presence of three project proposals for the sacred building and the rectory testifies to what happened. Even today the sanitary building presents a different project, despite the almost similar form to that presented in 1951. In fact, the Committee that had commissioned the project, previously communicating to the architect Marconi the different objectives, the number of dwellings and even commercial activities, had reserved the possibility of revising it and, if necessary, reworked before its realization. However, this downsizing of the village has evidently weighed heavily on the development of the village. Around 1955, when actually the village could be considered completed, all the lodgings were immediately assigned, and the population reached a peak of about 1000 inhabitants, counting also all the farmhouses scattered in the countryside. The end of the 60s marked the passing, in financial terms, of the secondary and tertiary sectors, relegating the primary sector to the last position. So, in all likelihood there were many different reasons, as reported, the reasons that led to the abandonment of the cause of rural

villages. In fact, currently Taccone, like other villages that have not been able to suddenly change its economic destination, pours into a state of advanced degradation and advanced abandonment.

2. METHODOLOGICAL APPROACH

The hamlet Taccone, as already established earlier, pours into a situation of complete abandonment. Its progressive depopulation, over the years, has led to a total lack of maintenance. The currently situation is that now exist twenty-four buildings, most of them are units in a state of collapse, in state of advanced degradation; the few inhabited buildings are easily recognizable; many others are used as warehouses for agricultural implements. The recovery project aims to recover all the buildings, present in the urban area, without exception, so as to keep the collective imagination intact, now fundamental in the memory of the place. The recovery and conservation of the building heritage are not reserved exclusively for buildings with significant historical importance, but also for buildings with a shorter history, which for various reasons have exhausted their initial function. Obviously, the redevelopment is a complex process dictated by a study that aims to avoid that the mistakes made in the past are repeated. In order for the recovery project to be functional, it is necessary that the approach is interdisciplinary and that all the steps are respected, from the investigation to the research, without leaving anything to chance.
The methodological approach must be such that it can provide for every need, based on an in-depth knowledge phase. The recovery and redevelopment of an urban conglomeration with such historical memory must take place through a sensitive multidisciplinary approach, with the aim of recovering to safeguard the historical heritage and redevelop it so that it can be used again.
The recovery project needs to work on several scales, from the territorial to the detailed scale, even simultaneously. The intervention methodologies are subdivided into three phases:

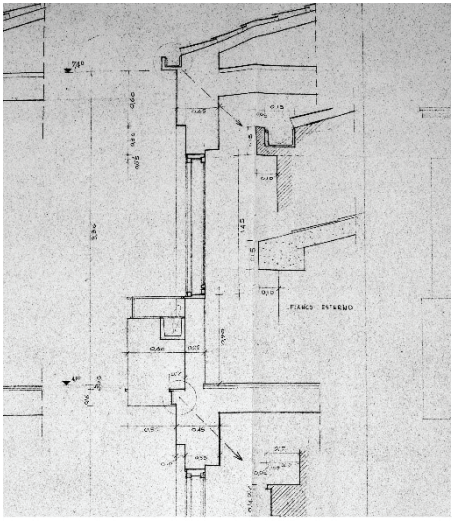

Figure 2 Technological detail made by the Arch. Plinio Marconi. Scale 1:20

- Preliminary knowledge phase.
This phase consists in the in-depth study of all the historical documentation, the original projects, the projects actually realized, the subsequent modifications and the state of affairs, in order to better compose the cognitive framework in motion to operate with the minimum risk in all tranquility. At this stage it is necessary to start the evaluation process of the properties present, understand the current needs of the village, evaluate the use destinations that you have and need, proceed with the planning of

which buildings must be recovered and which no.

- Geometric and material relief phase

the geometric and material relief of the artefact. It consists of a preliminary step through which one becomes aware of the dimensions of the structure and of what it actually consists of. Thanks to the practical application of the rules of descriptive geometry it is essential to create very accurate preliminary surveys so that the project is not flat-rate. It is necessary to consider that everything that is represented is not simply a graphic design but each line corresponds to a physical element that depends on the choices of the designer. Entering more specifically the survey consists of two different moments: the campaign phase and the return phase. The campaign phase takes place only on site and constitutes the set of photographic research, realization of sketches, creation of preliminary surveys, taking measurements, identifying materials. The representation phase, happens in a different time, not on the site, and takes care of drawing all the data collected in the previous phase, with the use of tools and software, thanks to which will be processed graphics and multimedia of the technical drawing. In the specific case of the village, in addition to the traditional materials, innovative construction technologies were detected, for the 1950s as: "Torino TL" concrete slabs; prefabricated concrete eaves channels with aluminum core; prefabricated concrete lintels; cruciform pillars tapered inside the ecclesiastical building.

- Diagnostic phase

All the constructive elements, listed above, present themselves today very differently from the time of their installation. The weather, neglect, and acts of vandalism have led, nowadays, to a critical situation. To fully understand the current situation of deterioration, for the purpose of an efficient building restoration, material-pathological investigations were carried out on all materials and surfaces of the buildings of the Borgata Taccone. The analyzes, purely visual, were carried out according to the indications of the old Stone Materials Regulations called NorMaL (Recommendations NorMaL 1/88) and according to the current UNI 11182: 2006 regulation. These regulations deal with the classification of the degradations affecting natural stone materials, such as stones and rocks used in architecture, and artificial stone materials, such as bricks, mortars, stuccos, plasters, conglomerates and ceramic products. The most used materials, subject to pathologies, are the plasters based on hydrated lime, the calcarenite blocks (stone material composed of calcium carbonate CaCO3) used for vertical closures, reinforced concrete (composed of Portland 500 cement) for structural parts. Following the acquisition of all the basic notions of the project, following the realization of all the drawings, we proceed

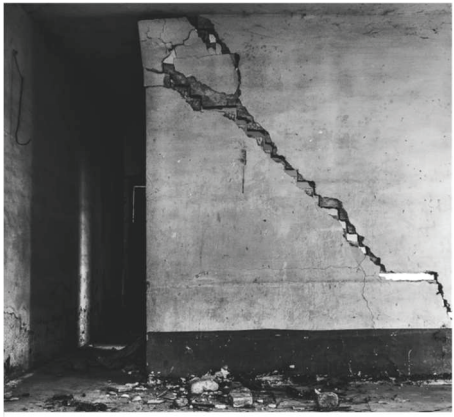

Figure 3 Cracking of partition walls

with the recovery and restoration phase. In this step we try to understand the main causes of obsolescence of materials, and if the degradation is chemical, physical or biological. The most dangerous chemical reactions to the manufactured articles can be: the attack of calcium carbonate by acid precipitations, containing carbon dioxide and phosphorus anhydride, on all materials characterized by a high content of calcium carbonate (CaCO3) as limestone , cement, dolomites, mortars and plasters; the carbonation of concrete consists in the main cause of the deterioration of Portland cement, both reinforced and not, and involves the reduction of the porosity of the conglomerate, the increase of the mechanical properties of the material, favors the priming of the corrosion of the iron rods of the reinforcement . As far as the physical alteration of the materials is concerned, it occurs differently at different observation scales: macroscopic ones that observe phenomena, visible to the naked eye, of structural and nonstructural instabilities; microscopic i.e. the set of phenomena, visible observations with precision instruments carried out in the laboratory, which generate mechanical alterations from the inside such as the gelidity or crystallization of the salts. The alteration of the materials can be of biological type: caused by bacteria such as thiobacillus, present in meteoric waters or condensate or capillary rising, capable of generating sulfuric acid (H2SO4) from the transformation of hydrogen sulfide, present in the air, with the sulphides present in the soil; caused by moss and lichens generated by the porosity of the material and by the presence of moisture in the material itself. Of all the buildings present in the village, the most degraded situations were examined, in such a way as to obtain, as a result, the complete pathological picture. Among the most significant pathologies, which best represent today's situation, we find: chromatic alteration, material casting, biological colonization, crust, anthropic decay, detachment, efflorescence, cracking, vandal graffiti, stain, presence of vegetation.

3. INTERVENTION TECHNIQUES

The strategies for the recovery and redevelopment of buildings have set the goal, as already said in the past, to make a new environment usable and functional. The innumerable techniques of all kinds can be grouped into two macro areas:

-Architectural recovery

Architectural recovery consists in recovering entirely a building that does not perform the function for which it was designed. In this specific case the recovery strategies are to recreate the static equilibrium of units in a state of collapse buildings, restore all obsolete materials, modernize the plant in line with

Figure 3 Degraded facade

regulations, redistribute the interior in accordance with the current minimum planning standards, making reclamation operation for the changing object environments intended for use; replacement of obsolete construction technologies with innovative solutions.

-Restoration

Architectural restoration is the discipline that aims to preserve and safeguard the aesthetics and functioning of a historical or political heritage. Operations can be more or less invasive but all necessary for storage. In the specific case of Borgo Taccone, restoration interventions are intended only for buildings with greater importance such as the Church and the Municipal Building because it is the hub of the service center and iconic images of the village itself. The main phases of the conservative intervention are three: cleaning, all the foreign substances, harmful for the preservation or for the aesthetics and the legibility, present on the surface of the manufactured article are removed; consolidation, improvement of the cohesion between components of the same material or between materials of different origins; protection, treatment of materials and surfaces, with chemical or non-chemical agents, aimed at removing, over time, the occurrence of degradation phenomena that had already appeared in the past.

4. CONCLUSIONS

The process of redevelopment of the Italian architectural heritage, in this specific case of the Borgata Taccone, and its conservation presuppose the transmission of a substantial cultural heritage to future generations, with a very important economic value. The project of recovery, following an in-depth historical and social analysis, recognizes its critical points and its weaknesses, and tries to resolve them so as to be able, without any arrogance, to cancel the causes that have led to today's failure. The main objective is to restore an identity to the place without obscuring the architectural language from which it is constituted. The research aims to lay the foundations for a multidisciplinary and meticulous recovery system, and at the same time generic, in such a way as to create a real tool to be applied in other situations similar to the case study.In the specific case of the township Taccone, a multidisciplinary recovery project was conceived. From a cultural point of view, it was preferred to preserve, as much as possible, the building heritage in such a way as to preserve its identity. From a functional point of view, we tried to rethink the village with current needs so as not to risk making the same mistakes of the past. In addition to the restoration of the green areas and roads, the entrance squares, the project dealt with the recovery and

Figure 5 Rendering of the new project of intended use

refunctionalization of all existing buildings and, in some cases, of the change of intended use. In order for the project to be complete, it was decided to include new elements within the village that would complement and enrich the urban aggregate. The new buildings are mainly of three types: public, public-private and private. The public consists in the realization of an eco-sustainable market, at km 0, in such a way as to offer a place to sell everything that is produced in the surrounding areas. The public-private sector provides for the inclusion of a building on a balcony where the houses are spread out, able to offer residences and work areas for craftsmanship. Finally, the private area characterized by the inclusion of different residences on the patio. The whole work was, moreover, an opportunity to measure oneself with those responsibilities and social aspects of great relevance, such as the theme of immigration. Throughout Europe, with particular attention to southern Italy, the phenomenon of migrants is the subject of heated debates and diatribes. In recent years, the reception of foreign ethnic groups has become too important a problem that architecture can try to solve. Issues such as public architecture and residential architecture often take the form of delicate historical contexts as elements to overcome the problem of hospitality and living in harmony. The village as an object of "aggregation" is a social opportunity that the dispersion denies and perhaps this is the principle that most clearly expresses the renewed connection between home and city. Finally, the intent of the design phase does not only concern the reorganization of existing spaces and the insertion of new ones, but consists in a reconnection of the entire urban fabric capable of generating between the future and the present inhabitants.

REFERENCES

[1] Le Corbusier, *Verso un'architettura.* casa editrice Longanesi, 2003

[2] B. Zevi, *Storia dell'Architettura,* Moderna casa editrice Einaudi, 1950

[3] G. Caniggia, G.L. Maffei, *Composizione architettonica e tipologia edilizia,* Marsilio Editori, 1984

[4] *G. Samonà, La casa popolare degli anni 30, Marsilio Editori, 1972*

[5] *A. Guida, I. Mecca, Forme|norme e tecniche dell'edilizia del novecento in Basilicata, EditricErmes, 2012*