

## Table of contents

|                                                                                                                                                                                                |      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| Preface                                                                                                                                                                                        | xi   |
| Organization and committees                                                                                                                                                                    | xiii |
| Conference sponsors                                                                                                                                                                            | xv   |
| <i>Plenary lectures</i>                                                                                                                                                                        |      |
| “Pisé”: Evolution, innovations, resistances and future directions<br><i>H. Guillaud</i>                                                                                                        | 3    |
| Which course of action for earthen architectural heritage preservation?<br><i>M. Correia</i>                                                                                                   | 9    |
| Earthen architecture: Clay feet or a feat of clay<br><i>F.G. Matero</i>                                                                                                                        | 17   |
| Restoration of rammed earth structures<br><i>F.J. López Martínez</i>                                                                                                                           | 21   |
| The Nasrid ramparts of the Albaicín (Granada, Spain):<br>An analysis of materials and building techniques<br><i>J.M. López Osorio</i>                                                          | 27   |
| Tórres Bermejás: Conserving the past<br><i>J. Gallego Roca</i>                                                                                                                                 | 33   |
| <i>Rammed earth architecture and construction</i>                                                                                                                                              |      |
| Methodological proposal for rammed-earth wall characterization:<br>Understanding of material in preliminary studies<br><i>F.J. Alejandre, J.J. Martín-del-Río, F.J. Blasco &amp; V. Flores</i> | 41   |
| The formalization as an identification process of a constructive way:<br>The rammed earth of Cherrchell (Algeria)<br><i>S. Alliche &amp; Y. Chennaoui</i>                                      | 47   |
| Traditional braces for rammed earth walls constructions in La Manchuela albaceteña,<br>Castilla-La Mancha, Spain<br><i>Q. Angulo, A. Mas &amp; J.L. Santolaria</i>                             | 53   |
| Godelleta's watchtower (Valencia, Spain)<br><i>S. Baños, A.C. Barbosa, B. Herrero, I. Jordán, I. Ontiveros &amp; S.S. Sánchez</i>                                                              | 59   |
| Earthen architectural heritage in the South Piedmont area (Italy):<br>Strategies for its re-evaluation and for local territorial sustainable development<br><i>G. Bollini &amp; I. Parodi</i>  | 65   |
| The rammed earth walls in the watchtowers of the order of Santiago in Albacete province (Spain)<br><i>F.J. Castilla, J.L. Serrano &amp; D. Sanz</i>                                            | 71   |
| Montroy Islamic Tower (Valencia, Spain)<br><i>P. de Mazarredo, A. Garre, V. Lassala, R. Martínez García de la Cuadra &amp; E. Méndez</i>                                                       | 77   |

|                                                                                                                                                           |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Sustainability lessons from the past: Rammed earth architecture in Vojvodina, Serbia<br><i>Z. Djordjevic</i>                                              | 83  |
| The monitoring of rammed earth experimental walls and characterization of rammed earth samples<br><i>P. Faria, V. Silva, C. Pereira &amp; M. Rocha</i>    | 91  |
| Earthen architecture in Galicia (Spain): Rammed earth in Terra de Lemos<br><i>A. Fernández Palicio</i>                                                    | 99  |
| Rammed earth walls in Serón de Nágima castle (Soria, Spain): Constructive lecture<br><i>I.J. Gil</i>                                                      | 107 |
| Rammed earth—its use in new building and training as a building-school<br><i>A. González &amp; G. Mingolla</i>                                            | 113 |
| Patrimonial rammed earth structures at the Sierra Nevada, Mexico<br><i>L.F. Guerrero</i>                                                                  | 117 |
| Characterization of compressed earth blocks built with natural low-cost energy stabilizers<br><i>C. Guerrieri</i>                                         | 125 |
| Rammed earth architecture in the middle course of the river Júcar, Spain<br><i>J. Hidalgo &amp; I. Matoses</i>                                            | 131 |
| About the rediscovery of the <i>tapia valenciana</i><br><i>F. Iborra</i>                                                                                  | 139 |
| Clay in architecture: Slovenia and beyond<br><i>B. Juvanec</i>                                                                                            | 145 |
| From the ground up: Building the Dirt Works Studio<br><i>C. Kraus</i>                                                                                     | 151 |
| On perceptions of rammed earth<br><i>C. Kraus</i>                                                                                                         | 157 |
| The construction of the Valencian rammed earth walls in the Corpus Christi College-Seminary in Valencia (Spain)<br><i>C. Lerma, Á. Mas &amp; E. Gil</i>   | 163 |
| Rammed-earth construction in Southern Morocco: A reappraisal of the technology<br><i>J.M. López Osorio, A. Montiel &amp; U. Martín</i>                    | 169 |
| Analysis parameters for systematization of rammed earth walls in Granada and Almería (Andalucía, Spain)<br><i>J.M<sup>a</sup>. Martín &amp; M. Martín</i> | 175 |
| Rammed earth construction in El Rincón de Ademuz (Spain)<br><i>C. Mileto, F. Vegas, L. García Soriano &amp; M. Mestre</i>                                 | 181 |
| Building rammed earth walls in the municipal swimming pool in Toro (Zamora, Spain)<br><i>A. Raya, C. Crespo, S. Sánchez &amp; E. Antelo</i>               | 187 |
| Introduction to traditional rammed-earth building in the Aragonian valley of Jiloca (Spain)<br><i>F.A. Rivas</i>                                          | 193 |
| The citadel of Reina (Badajoz, Spain)—10 years of interventions on its walls<br><i>M. Rocha</i>                                                           | 199 |
| Rammed earth architecture in La Hacienda de Santa Teresa Ixtafiyuca, Mexico<br><i>M. Rodríguez Licea &amp; L.F. Guerrero</i>                              | 205 |
| Restoration of the gypsum wall built with formwork in the tower of the castle of Villed (Teruel, Spain)<br><i>J.M. Sanz</i>                               | 211 |
| Rammed earth floors in historic orangeries and greenhouses—Belvedere castle in Weimar, Germany<br><i>H. Schroeder, D. Ahrendt &amp; C. Hille</i>          | 217 |

|                                                                                                                                                                                                                  |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Optimal rammed earth wall thickness for a single-family house in Serbia<br><i>S. Stevanović</i>                                                                                                                  | 223 |
| Rammed earth in Moravia (Czech Republic) in the context of neighboring lands<br><i>Z. Syrová &amp; J. Syrový</i>                                                                                                 | 229 |
| Valencian <i>tapia</i> in the walled city of Mascarell (Castellón, Spain)<br><i>F. Taberner</i>                                                                                                                  | 237 |
| Experience of rammed earth construction—rural and urban India<br><i>C. Vishwanath &amp; S. Nayak</i>                                                                                                             | 243 |
| <i>Conservation of rammed earth</i>                                                                                                                                                                              |     |
| The restoration of <i>tapia</i> structures in the Cuarto Real de Santo Domingo (Granada, Spain)<br><i>A. Almagro &amp; A. Orihuela</i>                                                                           | 251 |
| The Moroccan Drâa Valley earthen architecture: Pathology and intervention criteria<br><i>E. Baglioni, L. Rovero &amp; U. Toniatti</i>                                                                            | 257 |
| Characterization of the rammed-earth structure of the Moon Castle<br>in Mairena del Alcor (Seville, Spain)<br><i>A. Barrios, A. Graciani &amp; L. Núñez</i>                                                      | 263 |
| Structural criteria for the restoration of rammed earth buildings in Barcelona province (Spain)<br><i>S. Bestraten &amp; E. Hormias</i>                                                                          | 269 |
| Restoration of the rammed earth walls of the Generalife, (Granada, Spain)<br><i>I. Bestué &amp; F.J. López Martínez</i>                                                                                          | 277 |
| Characterization methodology to efficiently manage the conservation<br>of historical rammed-earth buildings<br><i>J. Canivell</i>                                                                                | 283 |
| Critical analysis of interventions in historical rammed-earth walls—military<br>buildings in the ancient Kingdom of Seville<br><i>J. Canivell &amp; A. Graciani</i>                                              | 289 |
| Core, connectors and crust: Methodological restoration options for reinforced rammed<br>earth wall with bricks<br><i>V. Cristini &amp; J.R. Ruiz Checa</i>                                                       | 297 |
| Preliminary study to the restoration of the Tower Keep in Jérica (Castellón, Spain)<br><i>J. de Neuí, A. Lamas, J.V. Mañes, P. Moreno, G. Ramo, A. Rico &amp; F. Rubio</i>                                       | 303 |
| Interventions in Portuguese rammed earth architecture—from ignorance to good practices<br><i>M. Fernandes</i>                                                                                                    | 309 |
| Intervention in a rammed earth tower at the castle of Oropesa del Mar (Castellón, Spain)<br><i>F. Font</i>                                                                                                       | 315 |
| Restoration of Llotja del Cànem (Castellón, Spain) walls—"Witnesses of History"<br><i>J.I. Fuster, A. Gallud &amp; M. del Rey</i>                                                                                | 321 |
| Restoration criteria of the Valencian rammed earth walls<br><i>M. Galarza</i>                                                                                                                                    | 327 |
| Consolidation and restoration of the Castle of Biar, Spain<br><i>A. Gallud, M. del Rey &amp; J.I. Fuster</i>                                                                                                     | 333 |
| Restoration of monumental rammed earth buildings in Spain between 1980 and 2011<br>according to the Archives of the IPCE<br><i>L. García Soriano, C. Mileto, F. Vegas &amp; S. García Saez</i>                   | 339 |
| Preliminary studies for intervention, interpretation and value enhancement<br>of Tower of Don Fadrique (Albaida, Seville, Spain)<br><i>A. Graciani, J.J. Martín, G.M. Mora, F.J. Alejandro &amp; J. Canivell</i> | 345 |

|                                                                                                                                                                                         |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Restoration of the rammed earth walls of the Poniente Tower and the Alafia wall in the fortified complex of Xivert (Castellón, Spain)<br><i>V. Hofbauerová</i>                          | 351 |
| Conservation of rammed earth works in the Islamic fortified complex of Calatayud (Spain)<br><i>P. Iglesias, B. Rodríguez Nuere, M.D. González Casado &amp; E. Bailliet</i>              | 357 |
| Rammed earth wall restoration method using the earth reintegration technique by ramming<br><i>F. Jové, F. Díaz-Pinés, J.L. Sáinz Guerra &amp; P. Olmos</i>                              | 363 |
| Restoration of rammed earth architecture: The projects funded by the Diputación Provincial de Valencia (Spain)<br><i>V. La Spina, F. Martella, C. Mileto &amp; F. Vegas</i>             | 369 |
| Restoration of the Castle of Sot de Chera's Tower (Valencia, Spain)<br><i>V. López Mateu, S. Tormo &amp; T.M. Pellicer</i>                                                              | 375 |
| Restoration of rammed earth architecture in the Iberian Peninsula: Ongoing research<br><i>C. Mileto, F. Vegas, V. Cristini &amp; L. García Soriano</i>                                  | 381 |
| Reflections about the restoration of a rammed earth Islamic tower<br><i>C. Mileto &amp; F. Vegas</i>                                                                                    | 387 |
| Restoration of two rammed earth walls at Sagunto's castle (Valencia, Spain)<br><i>M.E. Moliner, L.M. Almena, C. Camps &amp; S. Tormo</i>                                                | 393 |
| Restoration of the Andalusí wall of the Alcazaba Antigua (Ancient Citadel) of Granada (Spain)<br><i>A. Orihuela &amp; J.M. Castillo-Martínez</i>                                        | 401 |
| Historical rammed-earth structures in Eastern Andalusia: (Spain)<br>The restoration philosophy of the architect Prieto-Moreno<br><i>A. Romero &amp; J.M. López Osorio</i>               | 407 |
| Restoration of the stone <i>tapia</i> of <i>hsin al-Qala</i> (Castell d'Alcalà de Gallinera), Alicante, Spain<br><i>A. Soler, R. Soler &amp; J.R. Ortega</i>                            | 413 |
| The valencian rammed-earth wall ("tapia valenciana") in the restoration of Alaquàs Castle (Valencia, Spain)<br><i>S. Tormo, V. García Martínez, L. Cortés &amp; L. Palaia</i>           | 419 |
| Xàtiva's Castle (Spain)—constructive analysis of rammed-earth walls and its interventions<br><i>V. Torregrosa, S. Tormo &amp; M. Torregrosa</i>                                         | 425 |
| <i>Earthen architecture and construction</i>                                                                                                                                            |     |
| Ksar of Timinoun—a Saharan traditional earthen architecture heritage<br><i>N.A. Mahindad</i>                                                                                            | 433 |
| Cob, a handy technique for a new self-builder<br><i>M. Alcindor &amp; O. Roselló</i>                                                                                                    | 439 |
| Analysis and characterization of earthen architecture as a structural material:<br>The corbelled course domes in Syria<br><i>A. Alonso, A. Martínez Boquera &amp; V. Llopis</i>         | 445 |
| Municipal School in Santa Eulalia de Ronçana, Barcelona, Spain<br><i>G. Barbata, P. Palau &amp; E. Navarrete</i>                                                                        | 451 |
| Earthen and water architecture: University workshop in Ksar of Tamnougalt, Drâa valley (Morocco)<br><i>F.J. Bautista, M. Sevilla, F. García Carrillo, M.G. Aguilar &amp; A. Torices</i> | 457 |
| Infomes de la Construcció, N° 523 Monograph <i>Earth as building material</i> , a contemporary approach<br><i>S. Bestraten &amp; E. Hormias</i>                                         | 463 |

|                                                                                                                                                                                              |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| The first Italian experience of industrialized earthen products for the building trade<br><i>G. Bollini</i>                                                                                  | 469 |
| Earthen building: A comparative analysis of three texts<br><i>C.A. Cacciavillani</i>                                                                                                         | 475 |
| Embodied energy assessment of rammed earth construction in Pozuelo de Alarcón (Madrid, Spain)<br><i>F.J. Castilla &amp; A. Baño</i>                                                          | 481 |
| Earthen architecture in Southern Morocco<br><i>F. Cherradi</i>                                                                                                                               | 487 |
| Cataloging and typological study of Mgoun Valley's traditional fortified architecture, Morocco<br><i>G. Cimadomo, J.A. Simón &amp; A. Vacas</i>                                              | 493 |
| Contemporary earth houses and evolution models in the Mgoun Valley, Morocco<br><i>L. Díaz del Pino, M.A. García Alcántara &amp; D. Natoli</i>                                                | 499 |
| Lunch in the domes of Tierra de Campos (Palencia, Spain)<br><i>P. Díez Rodríguez</i>                                                                                                         | 505 |
| Constructive systems in the Spanish North-western area<br><i>J. Font</i>                                                                                                                     | 511 |
| Earth's role on Moroccan High Atlas villages' urban evolution<br><i>A. García Ramos, B. Marín, M.M. Carrión, J.M. Mateos &amp; P. García Sáez</i>                                            | 517 |
| Learning approach from the invariants of earthen construction in Andalusia, Spain<br><i>A.M. González Serrano, R. Rodríguez García, A. Romero, J. Canivell &amp; M. Ponce</i>                | 523 |
| Earthen architecture in Guatemala<br><i>G.P. Gordon</i>                                                                                                                                      | 529 |
| Earth and gunpowder: The earth in the modern fortresses<br><i>G. Guimarães, J.F. Noguera &amp; V. Navalón</i>                                                                                | 533 |
| Mixed building techniques in Abruzzi (Italy): Cob, adobe, stone and brick<br><i>C. Mazzanti</i>                                                                                              | 539 |
| Earthen architecture landscapes as identity items in southern Morocco—Studies in Mgoun Valley, High Atlas<br><i>B. Nogueira, J. Asencio, T. García Ruiz de Mier &amp; I. Álvarez-Ossorio</i> | 545 |
| The barraca of the Valencian agriculture field: A construction built with earthen techniques<br><i>R. Pastor, V. Blanca &amp; J.M. Ozores</i>                                                | 551 |
| Excavated housing in Crevillente (Spain): Constructive and typological study<br><i>B. Piedecausa</i>                                                                                         | 557 |
| Peruvian earthen architecture: Reflections on traditional constructive techniques<br><i>J.R. Ruiz Checa &amp; V. Cristini</i>                                                                | 563 |
| Earth construction techniques in the Northern High Atlas, Morocco<br><i>P. Rodríguez-Navarro, F. Juan Vidal, T. Gil &amp; F. Fantini</i>                                                     | 569 |
| Earth constructive systems in northeastern Segovian domestic architecture<br><i>A. Romero &amp; A. Vela</i>                                                                                  | 575 |
| Earthen structures in the missions of Baja California (Mexico)<br><i>M.Á. Sorroche</i>                                                                                                       | 581 |
| The architecture of earth in the northwest of Argentina: Tradition and modernity<br><i>M.E. Sosa</i>                                                                                         | 587 |
| Earth architecture and construction in the colonial archaeological site of Piura la Vieja, La Matanza (Piura, Peru)<br><i>F. Vela, L.F. Abril &amp; A. García Hermida</i>                    | 593 |

|                                                                                                                                                                            |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Earthen architecture, an evergreen type of building method<br><i>D. Zupančič</i>                                                                                           | 599 |
| <i>Conservation of earthen architecture</i>                                                                                                                                |     |
| Elements for the definition of good practices for the conservation and the restoration of the historical urban fabric of a Moroccan pre-Saharan oasis<br><i>M. Achenza</i> | 607 |
| Cave-Houses in Valtierra, Navarra, Spain<br><i>C. Ardanaz</i>                                                                                                              | 613 |
| Cobquecura, a southern earthen Chilean town: Intervention criteria for the reconstruction after Chilean 2010 earthquake<br><i>E. Baglioni &amp; N. Jorquera</i>            | 619 |
| Preventive maintenance of an Himalayan earthen temple and studies on its reduced scale model<br><i>M. Bertagnin &amp; D. De Antoni</i>                                     | 625 |
| Cooperation projects for the preservation of earth architecture in Chiquitos, Bolivia<br><i>S. Bestraten &amp; E. Hormías</i>                                              | 631 |
| Vernacular adobe architecture in Texas: Conservative issues<br><i>A. Bianco</i>                                                                                            | 637 |
| Test and device to evaluate the capillary absorption in soil specimens of adobe and rammed earth<br><i>S.A. Cirvini &amp; J.A. Gómez Voltan</i>                            | 643 |
| Earthen domes in Northern Syria: Problems and criteria for the conservation<br><i>L. Dipasquale &amp; S. Mecca</i>                                                         | 649 |
| Defense tower turned into an artist bottega<br><i>P. Diez Rodríguez</i>                                                                                                    | 655 |
| Earth-based repair mortars: Experimental analysis with different binders and natural fibers<br><i>M.I. Gomes, T. Diaz Gonçalves &amp; P. Faria</i>                         | 661 |
| Buddhist clay sculptures in Central Asia: Conservation and restoration problems<br><i>M. López Prat</i>                                                                    | 669 |
| Energy rehabilitation of buildings of earthen construction<br><i>A. Lozano, J.M. Lozano &amp; A. Ruiz Taroncher</i>                                                        | 675 |
| Aït Ben Haddou—Fortified City, Ouarzazate, Morocco<br><i>P. Martínez Barranco</i>                                                                                          | 681 |
| Conservation of earthen constructions: Earth-gypsum plasters<br><i>M. Mattone &amp; E. Bignamini</i>                                                                       | 687 |
| The ksour of the Saharan Atlas of Algeria: Reflection on conservation issues<br><i>A. Mebarki</i>                                                                          | 693 |
| Earth and bricks architecture: For a conservation of stratigraphical traces<br><i>D. Pittaluga</i>                                                                         | 699 |
| Repair of rammed earth walls in the walled enclosure of Daroca (Zaragoza, Spain)<br><i>J.M. Sanz</i>                                                                       | 705 |
| Linhas de Torres historic route rescuing and enhancing earthworks<br><i>A.C. Sousa &amp; J.S. Gomes</i>                                                                    | 711 |
| Author index                                                                                                                                                               | 717 |