Deliverable D5.1

Report on the installation of solutions in the pilot and 3 real demo sites

WP5

Grant Agreement number 723916
Project acronym InnoWEE
Project full title INNOvative pre-fabbricated components including different Waste construction materials reducing building Energy and minimising Environmental impacts
Due date of deliverable 31/03/2019 (M31)
Lead beneficiary R.E.D. S.r.l. - RED
Other authors Giulia Mezzasalma (RED)
Luc Pockelé (RED)
Maria Sachini (AMS)
Anna Casati (MB)
Giovanni Ferrarini (CNR-ITC)
Sergio Tamburini (CNR-ICMATE)
Loredana Fodor (Pietre-Edil)
Leonardo Rossi (Pietre-Edil)
Gianluca Cadelano (CNR-ISAC)
Francesco Cicolin (CNR-ISAC)

Dissemination Level

<table>
<thead>
<tr>
<th>PU</th>
<th>Public</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>Confidential, only for members of the consortium (including the Commission Services)</td>
</tr>
<tr>
<td>CI</td>
<td>Classified, as referred to in Commission Decision 2001/844/EC</td>
</tr>
</tbody>
</table>
Document History

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Authors</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11/03/2019</td>
<td>Giulia Mezzasalma (RED)</td>
<td>Creation of the document</td>
</tr>
<tr>
<td>2</td>
<td>16/08/2019</td>
<td>Giulia Mezzasalma (RED)</td>
<td>Document sent to partner</td>
</tr>
<tr>
<td>3</td>
<td>06/09/2019</td>
<td>Anna Casati (MB)</td>
<td>Document sent to RED</td>
</tr>
<tr>
<td>4</td>
<td>13/09/2019</td>
<td>Loredana Fodor (Pietre-Edil)</td>
<td>Document sent to RED</td>
</tr>
<tr>
<td>5</td>
<td>16/09/2019</td>
<td>Maria Sachini (AMS)</td>
<td>Document sent to RED</td>
</tr>
<tr>
<td>6</td>
<td>24/09/2019</td>
<td>Giulia Mezzasalma (RED)</td>
<td>Draft for reviewers</td>
</tr>
<tr>
<td>7</td>
<td>25/09/2019</td>
<td>Vilma Ducman (ZAG)</td>
<td>Reviewed draft</td>
</tr>
<tr>
<td>8</td>
<td>26/09/2019</td>
<td>Jakub Pluta (IZNAB)</td>
<td>Reviewed draft</td>
</tr>
<tr>
<td>9</td>
<td>29/09/2019</td>
<td>Giulia Mezzasalma (RED)</td>
<td>Final version for Coordinator</td>
</tr>
<tr>
<td>10</td>
<td>30/09/2019</td>
<td>Adriana Bernardi (CNR-ISAC)</td>
<td>Approved and submitted version by the Coordinator</td>
</tr>
</tbody>
</table>

Disclaimer

This document is the property of the InnoWEE Consortium.

This document may not be copied, reproduced, or modified in the whole or in the part for any purpose without written permission from the InnoWEE Coordinator with acceptance of the Project Consortium.

This publication was completed with the support of the European Commission under the Horizon 2020 research and innovation programme. The contents of this publication do not necessarily reflect the Commission's own position. The document reflects only the author’s views and the Community is not liable for any use that may be made of the information contained therein.
# Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contents</td>
<td>2</td>
</tr>
<tr>
<td>Publishable summary</td>
<td>3</td>
</tr>
<tr>
<td>List of Figure</td>
<td>4</td>
</tr>
<tr>
<td>List of Table</td>
<td>7</td>
</tr>
<tr>
<td>Introduction</td>
<td>9</td>
</tr>
<tr>
<td>1 BRIEF DESCRIPTION OF THE SOLUTIONS</td>
<td>10</td>
</tr>
<tr>
<td>1.1 ETICS</td>
<td>10</td>
</tr>
<tr>
<td>1.2 VENTILATED FAÇADE</td>
<td>11</td>
</tr>
<tr>
<td>1.3 RADIANT PANEL</td>
<td>12</td>
</tr>
<tr>
<td>1.4 LIGHTWEIGHT FIRE RESISTANCE WOOD PANELS</td>
<td>13</td>
</tr>
<tr>
<td>2 DESCRIPTION OF DEMO SITES</td>
<td>14</td>
</tr>
<tr>
<td>2.1 PILOT (PADUA)</td>
<td>14</td>
</tr>
<tr>
<td>2.2 OLD CITY HALL OF VOULA MUNICIPAL (ATHENS)</td>
<td>16</td>
</tr>
<tr>
<td>2.3 DON ORIONE RESIDENTIAL CARE CENTER (BUCHAREST)</td>
<td>21</td>
</tr>
<tr>
<td>2.4 RESIDENTIAL ECO-HOUSE (PUTTE)</td>
<td>23</td>
</tr>
<tr>
<td>3 INSTALLATION OF ETICS PANELS</td>
<td>25</td>
</tr>
<tr>
<td>3.1 PILOT (PADUA)</td>
<td>25</td>
</tr>
<tr>
<td>3.2 DON ORIONE RESIDENTIAL CARE CENTER (BUCHAREST)</td>
<td>31</td>
</tr>
<tr>
<td>3.3 OLD CITY HALL OF VOULA MUNICIPAL (ATHENS)</td>
<td>38</td>
</tr>
<tr>
<td>4 INSTALLATION OF VENTILATED FAÇADE</td>
<td>52</td>
</tr>
<tr>
<td>4.1 PILOT (PADUA)</td>
<td>52</td>
</tr>
<tr>
<td>4.2 OLD CITY HALL OF VOULA MUNICIPAL (ATHENS)</td>
<td>57</td>
</tr>
<tr>
<td>5 INSTALLATION OF RADIANT PANEL</td>
<td>68</td>
</tr>
<tr>
<td>5.1 PILOT (PADUA)</td>
<td>68</td>
</tr>
<tr>
<td>5.2 RESIDENTIAL ECO-HOUSE (PUTTE)</td>
<td>71</td>
</tr>
<tr>
<td>6 INSTALLATION OF WOOD PANEL</td>
<td>76</td>
</tr>
<tr>
<td>6.1 OLD CITY HALL OF VOULA MUNICIPAL (ATHENS)</td>
<td>76</td>
</tr>
<tr>
<td>Conclusion</td>
<td>81</td>
</tr>
</tbody>
</table>
The “Report on the installation of solutions in the pilot and 3 real demo sites” is a confidential document delivered in the context of Task 5.1 “Installation of the different solutions in the 4 demo sites”.

This document explains all the phases of the installation of the panels in the 3 demo sites and in the Pilot demo sites.

During InnoWEE project 4 different eco-panels have been developed:

- ETICS (insulated panel)
- Ventilated Façade
- Radiant Panel
- Lightweight Fire Resistance Wood Panel

In this document there is a description of the installation of all these panels in all the Demo and pilot sites. The Demo Sites have been chosen to have different structural/architectural characteristics of the buildings (historical, new and existing). Besides they were chosen also to consider 4 different climate regions.

The Pilot Demo site is located in Padua (Italy). Here 3 different types of panel were installed: ETICS in the north façade, Ventilated Façade in the south’s and Radiant panel in a room inside the building.

The Don Orione Residential Care Center is in Bucharest (Romania) and is an existing building. Here only ETICS panels demo sites were installed in two adjacent façades.

The old city hall of Voula municipality is in Athens (Greece) and is an historical building. Here 3 different types of panels were installed: ETICS and Ventilated façade in the north side of the buildings, the Lightweight Fire Resistance Wood Panel in one of the internal wall of the building.

The Eco-house is a new building in Putte (Belgium). Here Radiant panels were installed in one room of the building. To make a comparison between standard ceiling radiant panel and InnoWEE one’s, UPONOR panel was installed in the room and monitored before the installation of the InnoWEE solutions.
List of Figure

Figure 1: Sketch of ETICS-like panels (a), with an illustrative render (b) ______________ 10
Figure 2: (a) Sketch of the ventilated-façade panel solution with two (b) and four (c) vertical stiffening ribs, prior to the bonding of WGP ______________ 11
Figure 3: Sketch of radiating ceiling panel (a), with a section of the tube embedment (b) and a real-scale prototype front (c) and rear view (d) ______________ 12
Figure 4: Basic commercial false ceiling with omega profiles (a), cold formed hat omega-section (b) ______________ 12
Figure 5: Wood-geopolymer (WGP) ______________ 13
Figure 6: Location of the Pilot House in Padova, Italy (retrieved from Google Maps, goo.gl/k6eVbu). The red arrow indicates the building. ______________ 14
Figure 7: Facade of the building ______________ 15
Figure 8: ETICs, ventilated and ceiling radiant panels position ______________ 15
Figure 9: Location of Old Vouliagmeni Town Hall (retrieved from gis.ktimanet.gr/wms/) ______________ 16
Figure 10: Satellite view of Old Vouliagmeni Town Hall (retrieved from gis.ktimanet.gr/wms/) ______________ 17
Figure 11: Orientated (perspective) view of Old Vouliagmeni Town Hall (retrieved from gis.ktimanet.gr/wms/) ______________ 17
Figure 12: (a) North view, (b) East view, (c) South view, (d) West view ______________ 18
Figure 13: Floor plan of InnoWEE solutions installation ______________ 20
Figure 14: Side view of InnoWEE solutions installation ______________ 20
Figure 15: Visualisation of InnoWEE solutions installation ______________ 20
Figure 16: Location of the Don Orione residential care center in Bucharest, Romania (retrieved from bing.com/maps) ______________ 21
Figure 17: Top view of the Don Orione residential care center, Voluntari, Bucharest, Romania (retrieved from google.com/maps) ______________ 21
Figure 18: Plan of the Don Orione residential care center of Voluntari ______________ 22
Figure 19: Façades of the Don Orione residential care center of Voluntari ______________ 22
Figure 20: Location of the Eco-house of Putte in Belgium ______________ 23
Figure 21: Frontal view of the house ______________ 23
Figure 22: First floor plant of the house. The red circle indicated the room used for InnoWEE project ______________ 24
Figure 23: Ceiling radiant panels position. ______________ 24
Figure 24: Placement of ETICs façade ______________ 25
Figure 25: Measurements ______________ 26
Figure 26: Fixing of the lower guide profile ______________ 26
Figure 27: Fixing of the vertical guide profile ______________ 27
Figure 28: Spread of the adhesive on the wall ______________ 27
Figure 29: Pre-drilling of the panel and the structure ______________ 28
Figure 30: Inserting the silicone into the hole ______________ 28
Figure 31: Fixing of the panel ______________ 28
Figure 32 - Fixing of the other panels ............................................................... 29
Figure 33 - Placing of the paper tape ................................................................ 29
Figure 34 – Filling of the joints with silicone ...................................................... 29
Figure 35 - ETICS façade completed ................................................................ 30
Figure 36: Installation place .............................................................................. 31
Figure 37: ETICS-like panels arrangement on the North-East and North-West façades 31
Figure 38: Rules for moving the panels ............................................................... 33
Figure 39: Cutting instruction ........................................................................... 33
Figure 40: Panels installed at Don Orione demo site ......................................... 35
Figure 41: Working tools .................................................................................. 36
Figure 42: Fixing methods ................................................................................ 36
Figure 43: Trial installation of ETICS panel at AMS’s premises ......................... 39
Figure 44: Thermal performance of ETICS like panels under different emissivity settings 40
Figure 45: Thermal performance of the joints of the ETICS panels under different emissivity settings ................................................................. 40
Figure 46: Site layout and escape routes ............................................................ 42
Figure 47: Storage materials for panel installation ............................................ 42
Figure 48: Storage of panels in Office ............................................................... 42
Figure 49: Wall condition prior ETICS panels installation ................................. 43
Figure 50: Photos indicating uneven wall .......................................................... 43
Figure 51: Preparation of wall for the installation .............................................. 44
Figure 52: First raw panels installation ............................................................. 45
Figure 53: Installation of upper rows of the ETICS panels .............................. 46
Figure 54: ETICS panels detailing ................................................................... 47
Figure 55: Plastering wall edges ...................................................................... 47
Figure 56: Joints sealing .................................................................................... 48
Figure 57: Protection of openings’ edges ............................................................ 48
Figure 58: Visualisation of the installation ........................................................ 49
Figure 59: Place of installation of the ventilated façade ..................................... 52
Figure 60: Executive design of the secondary structure .................................... 53
Figure 61: Fixing of the vertical profiles to the pavement .................................. 53
Figure 62 - Fixing of the vertical profiles to the vertical wall of the existing building 54
Figure 63 - Secondary structure ...................................................................... 54
Figure 64 - Drilling of the panels by hand ......................................................... 54
Figure 65 - Halfen body anchors ..................................................................... 55
Figure 66: Fixing of the ventilated panels .......................................................... 55
Figure 67: Installation of the metal flashing and lateral profiles ....................... 56
Figure 68 - Ventilated façade completed .......................................................... 56
Figure 69: Trial installation of the ventilated façade panels .............................. 57
Figure 70: Wall "buckling" ............................................................................... 59
Figure 71: Inclined part of the wall ................................. 59
Figure 72: EPS wall covering sheets installation ....................... 60
Figure 73: Halfen UMA type anchors .................................. 61
Figure 74: Chemical resin ....................................................... 62
Figure 75: Construction sequence of 1st row panels ...................... 62
Figure 76: Upper rows installation sequence .............................. 63
Figure 77: Edges and windows covering ................................ 64
Figure 78: Detailing (a) Halfen anchor pinned on a panel, (b) gap for air circulation, (c) joints, (d) edge covering.......................... 65
Figure 79: Visualisation of the installation ............................... 65
Figure 80: Damaged panel due to misalignment of the pin ............... 66
Figure 81: Defective anchor .................................................... 67
Figure 82: Floorplan of the demo site of Padova. Radiant panels have been installed in Room C. .................................................. 68
Figure 83: Additional circuit and mixing valve during the installation (highlighted by the red oval). ............................................. 68
Figure 84: Radiant panels during the installation. .......................... 69
Figure 85: Close-up of the hydraulic connection between two adjoining panels. ..... 69
Figure 86: The water supply and return piping are hosted on the sides of the ceiling. ___ 70
Figure 87: Surface area of the flat ceiling .................................. 71
Figure 88: View on collector, dehumidifier and storage tank ............. 72
Figure 89: Water flow meter and temperature wells ........................ 72
Figure 90: Monitoring stand of the comfort .................................. 73
Figure 91: Contact temperature sensors on the ceiling .................... 73
Figure 92: Panels type Teporis from Uponor ................................ 73
Figure 93: Installation of commercial panels .................................. 74
Figure 94: Structure for InnoWEE panels .................................... 74
Figure 95: Installation of InnoWEE panels .................................... 74
Figure 96: Remotely controlled halogen lamps in the guest room .......... 75
Figure 97: Internal wall location & visualisation ............................ 76
Figure 98: PR17 Theoprofil supporting system .............................. 76
Figure 99: 1st row of panel installation (a,b,c) ............................... 77
Figure 100: 1st row of panel installation (d,e,f) ............................ 78
Figure 101: 1st row of panel installation (g,h,i) ............................... 78
Figure 102: Upper row of panel installation (a,b,c) ......................... 78
Figure 103: Upper row of panel installation (d,e,f) ......................... 78
Figure 104: Upper row of panel installation (g,h,i) ......................... 79
Figure 105: Upper row of panel installation (j,k) ............................ 79
Figure 106: Different angle views of the WGP installed wall ................ 80
List of Table

Table 1: Geolocalisation of the Vouliagmeni demosite 16
Table 2: Description of the opaque elements 22
Table 3: Stratigraphy of the external wall 24
Table 4: Technical data of the Keralastic Mapei adhesive 27
Table 5: Installation of Etics 32
Table 6: Bill of Quantities/costs – ETICs-like panels-Don Orione 35
Table 7: Additional instructions to the proposed installation design procedures 39
Table 8 - Technical data of the body anchors 55
**Abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>InnoWEE</td>
<td>INNOvative pre-fabbricated components including different Waste construction materials reducing building Energy and minimising Environmental impacts</td>
</tr>
<tr>
<td>CDW</td>
<td>Construction and Demolition Waste</td>
</tr>
<tr>
<td>EPS</td>
<td>Expanded PolyStyrene</td>
</tr>
<tr>
<td>ETICS</td>
<td>External Thermal Insulation Composite System</td>
</tr>
<tr>
<td>HDG</td>
<td>High Density Geopolymer</td>
</tr>
<tr>
<td>WGP</td>
<td>Wood Geopolymer Panel</td>
</tr>
<tr>
<td>SRM</td>
<td>Secondary Raw Material</td>
</tr>
</tbody>
</table>