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## Investigating the Benefits of Swiss Lightweight Organic Meadow Roofs in the Green Retrofit Construction Sector.

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### Premise: Are Swiss lightweight meadow roofs ready for the UK retrofit market?

Basel City Council and others in Switzerland some years ago made it compulsory for all new buildings, and temporary buildings with an 18-month or longer lifetime, to include organic green roofs. The primary drivers were to reduce the impact of seasonal storms: green roofs are able to provide excellent water attenuation, and to promote biodiversity (urban areas are heavily developed in Switzerland because the mountainous terrain outside cities prevents sprawl).

ZHAW (Zurich School of Applied Science) green roof research department has been given input into the design of green roofs even on commercial projects as stakeholders in the planning and Building Control process, and this has enabled them to undertake multiple experiments on public and commercial buildings into the viability of different lightweight build-ups, primarily in respect of the impact on vegetation. One in particular, which utilises locally available agricultural waste (china reed) to replace much of the heavy growing medium, has proven particularly successful. This approach currently has been replicated on many roofs including Basel central tram depot over the ensuing fifteen years.

The University of Brighton's Knowledge Transfer Partnership (KTP) programme supported an emerging company 'Organic Roofs Ltd' to undertake research that built upon ZHAW plant monitoring, looking further into the potential benefits of these lightweight meadow green roof systems to be used on existing buildings: to satisfy the requirements of designers, contractors and occupants requiring a climate resilient refurbished building stock.

The KTP team, including Baker-Brown and Evans, considered how the Swiss-inspired 'haybase' roofs compared with other and popular systems currently available in the UK (mainly Sedum roofs). They considered:

- Water attenuation ability
- The weight of roof systems when saturated
- Levels of biodiversity & plant succession
- The Longevity of vegetation
- Evaluation of how the performance of roof systems varies over time, and its characteristics when stable
- Levels of Carbon sequestration (from the straw itself and the atmosphere)
- Material provenance and sustainable supply chain
- Requirements for maintenance

### Research Approach

The KTP team were assemble for a year with the objective of testing the 'haybase' lightweight meadow roof system as a viable commercial option to popular green roof systems. It comprised Evans who is an expert green roof contractor, Knights a full-time research fellow, plus Baker-Brown an architect and academic, and finally Dr. Anja Rott an academic botanist (both employed by the University of Brighton).

The following research methods were employed:

- The KTP team have been in regular communication with the research team at ZHAW whose research was focused on issues of the biodiversity of meadow roofs in urban environments
- The KTP team met with ZHAW research team in Switzerland and visited numerous new and established green roof sites including the famous 'chicken shed meadow roof'.
- The research fellow and Evans constructed nine purpose-built 'test rigs' comparing nine different green roof systems i.e. substrate/ no substrate, drainage/ no drainage, pre-grown planting/ seeded etc. including an empty flat roof control rig. An additional rig was set up to enable visual monitoring of the process of organic material breakdown.
- The test rigs were monitored for cumulative rainfall over the duration of the KTP.
- A further dynamic loading test saw the development of new saturation methodology which provided real-time evaluation of loadings of HayBase and alternative build-ups during 6 hour 1/100 year rainfall event. The novel contribution is itself the subject of a paper by Evans, Knights and a member of the Institute of Materials, Mr C Fentiman.
- At the start and completion of the year-long research project key stakeholders and professionals were contacted and asked to take part in an on-line survey considering the benefits and challenges associated with green roofs.
- Samples of substrate were sent to a Newcastle University research team working on 'carbon capture gardens' to test permanent carbonation by the ingredients of the commercial substrate of the CO<sub>2</sub> in the straw and hay.
- Samples of 'haybase' roofs at ages 0, 1, 1.5 and 3 years were dried and incinerated under lab conditions to test organic content (which relates to existing UK ordinances regarding fire safety of green roofing materials).

### **Research Outputs**

The research has produced data from the two online surveys as well as findings from monitoring the nine test rigs and four commercial green roof installations that were between twelve months and four years established. This will be presented within our paper.