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ModCell is a novel and innovative building system utilising prefabricated panels. The panels are suitable for a wide range of low and medium rise wall and cladding applications. This new solution replaces non-renewable insulation products, such as rigid polyurethane and mineral fibre materials, with straw bales or lime-hemp composites in designed and engineered panels suited for modern methods of construction. ModCell delivers resource efficient and renewable insulation components capable of sequestering and storing significant quantities of atmospheric carbon dioxide.

Construction using indigenous crops utilises low cost, locally grown and renewable materials that offer exceptional levels of thermal insulation. Though still primarily restricted to the self-build fringes of the construction sector, there has been growing interest in the use of straw bale construction in recent years. Building in straw is clearly not a new innovation, but ModCell is very innovative in an important number of aspects. Firstly it brings the benefits of straw bale construction into the mainstream of the construction industry for the wider benefit of society. This can only be achieved through the development and manufacture of a high quality robustly engineered and architecturally detailed product: 'ModCell'. It is not simply tinkering with an existing process, but undertakes fundamental development of straw bale technology. No equivalent product is currently available anywhere in the world. Straw bales are presently produced as an agricultural by-product in modular sizes for the convenience of farming. However, as straw bale building market develops in the future straw bales and other crops will be packaged directly to suit the requirements of 'Modcell', and other construction industry applications, as the market grows and new baling machines are developed to meet this need. This opportunity opens new and innovative markets for the agriculture and agricultural plant industries. ModCell uses innovative manufacturing practices, using farm based temporary 'flying factories' located close to the building site, as required, and producing 'Modcell' panels, using locally sourced materials. De-centralisation of production and offering new non-food markets for the farming industry to exploit is indeed innovative.

The 'Modcell' building system uses timber framed panels in-filled with straw bales or lime hemp blends. The straw bales are compressed vertically to improve their structural robustness and dimensionally regularity in preparation has been achieved using external threaded steel bars to pull down the top timber beam, though in development alternative systems, such as meshes, plastic strapping and fibre reinforced renders are being investigated. On completion of compaction, the timber frame is fixed together in preparation for plastering. In the 'wet' method the internal and external faces of the panels are covered in 30mm of lime based renders applied directly onto the surface of the straw bales. In an alternative 'dry' method the panels are covered in timber based fascias. It is important that the bales remain throughout their life at a moisture content below which biological decay will occur, typically around 20%. The facings must therefore protect the bales from direct weathering but also allow water vapour to escape as part of a breathing wall system.

A simple solid panel wet method prototype of the system has been developed and demonstrated to work well in a number recent projects. At present these solid panels measure 3 metres high by 3 metres wide, though a range of modular sizes, including window and door openings, are envisaged in the final system. Panels are secured directly to the primary structural frame of the building using steel ties and fixings, removing the need for secondary members such as purlins and side rails.

A DTI funded project is under way in conjunction with Bath University with the following primary objectives: develop a thorough understanding of the construction, structural and environmental performance to provide robust design guidance and data; complete design studies to explore optimum panel details, materials, finishes, fixings, and building applications; complete system life-cycle assessment; review and monitor previous projects; and, complete marketing study and assess paths for commercialisation.

Although the potential for 'Modcell' has been established in early prototype applications, there is still significant uncertainty involved in launching a straw bale building system onto the mainstream market. Establishing the durability, robustness and environmental performance of the system is critical to its future success. Though the prototype panels have proven commercially viable, the finished costs of the cladding system also need and can be reduced through refinement in design and manufacture to be truly competitive. Deliverables from this project include: high quality scientific and technical data on

the performance together with a thorough understanding of the design potential of 'Modcell' panels, providing a sound basis for expansion and future innovation; improved understanding of materials supply chain; manufacturing models for 'Modcell', including decentralised 'micro-production'; comparative life-cycle assessment data for product promotion; a plan for commercial exploitation and marketing.

Therefore, in line with consortium member needs, successful completion will establish a robust modular straw bale building system ready for full certification, commercial production and exploitation in less than 5 years of completion.

Nationally the market in building cladding systems, including SIPS, masonry and other systems, can be estimated at between £3-4 Billion pounds per annum [Monthly Statistics of Building Materials and Components, 334, HMSO, 2003]. It is very difficult to predict future market size of such a novel and innovative product as 'Modcell'. However, within the initial five year period of project completion the number of new projects using Modcell panels is expected to grow by at least 500%-to-1000% from the current 2-3 new schemes per annum. Though the main constituent material for the cladding is very inexpensive, the cost of prototype panels has proven higher than many competing systems; typically around £200-250 per sq. m. Client choice to use straw bale has therefore typically been motivated by other considerations, such as environmental impact and performance. Value engineering of the design and construction of 'Modcell' through this project will aim to reduce finished cost of production by 50-70%, establishing a much improved commercially competitive basis. The UK agricultural industry will directly benefit from a significant value added non-food application of straw bales. As cereals are grown widely across the UK, local supplies of good quality straw should always be close the building site. This could see development of localised flying factories, using mobile plant, processing straw and manufacturing panels close as possible to site, significantly reducing the impact of transportation. As Modcell and other competing prefabricated straw bale panel systems grow balers will develop in size to produce material specific for the construction industry rather than the convenience of agricultural storage and handling. The general public and UK plc will benefit from more energy efficient low carbon buildings, reducing energy bills significantly and helping to tackle the problem of climate change.

