UTILISING LIFE CYCLE COSTING AND LIFE CYCLE ASSESSMENT FOR AN INFORMED DECISION

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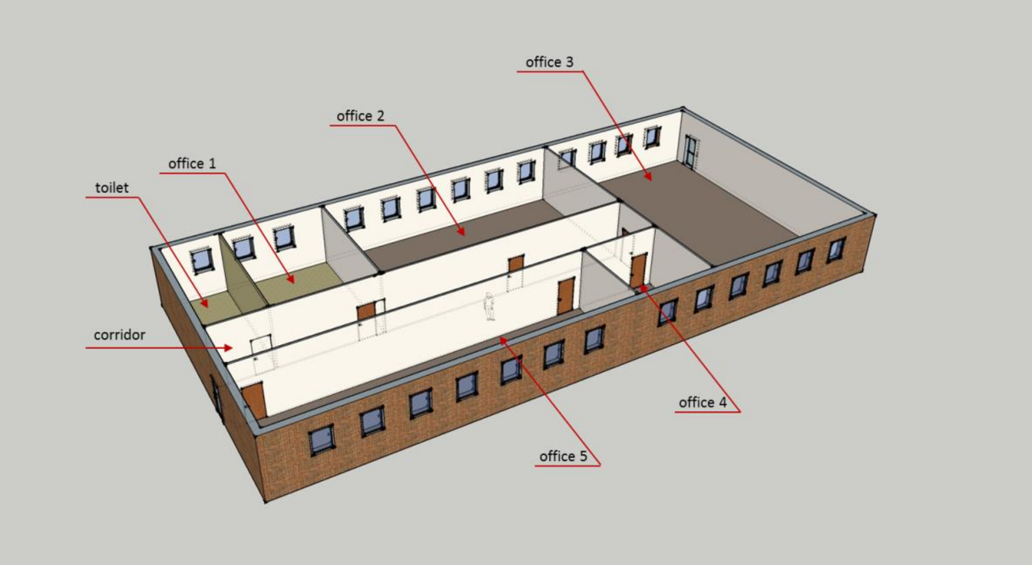
In the backdrop of more austere times and a strengthening green agenda in the construction industry, clients are requesting more economic and environmental information to base their business decisions. This includes a fundamental shift towards long term thinking, capturing through life cost and impacts of a product, a system or entire building.

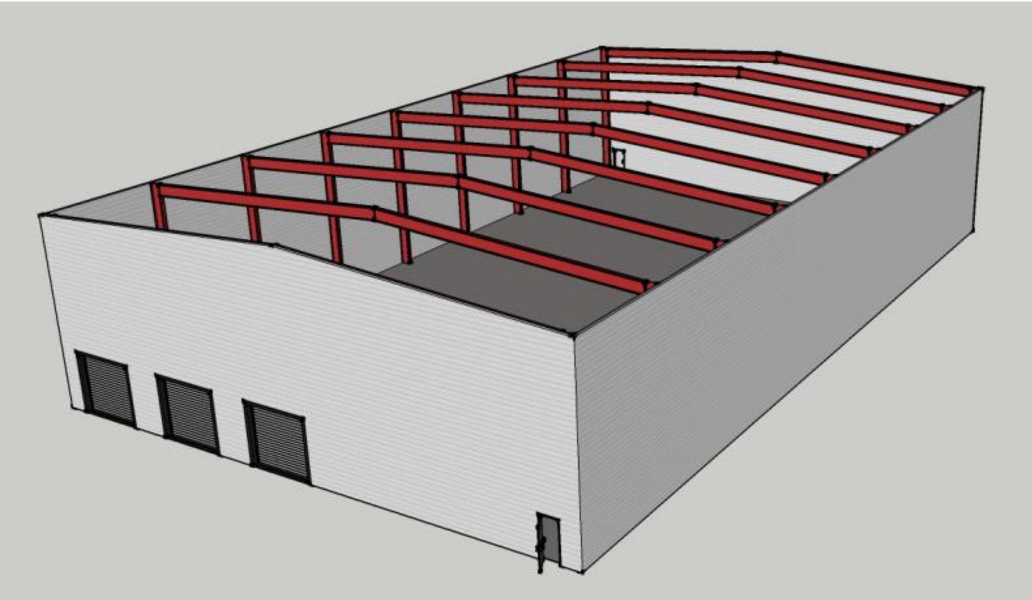
Life cycle costing (LCC) in accordance to BS ISO 15686 provides a methodology for the systematic economic evaluation of combined capital, operating and end-of-life costs of construction project alternatives, to ensure long-term value for project funds. Assessments involve identifying activities during the life cycle, when the activity occurs and associated cost or benefit information for the activity. Taking an air handling unit as an example, activities are broadly split between one-off activities such as installation costs of the air handling unit at the beginning of the study period and recurring costs such as annual maintenance and electricity to run the unit. Alternative solutions for assessments have to provide the same functionality; in regards to the air handling unit example an alternative solution would have to provide the same amount of space cooling as the AHU. For comparison of alternatives, costs are commonly expressed as net present values. This entails translating future costs and benefits to equivalent value today with application of a discount factor, and adding present costs and benefits to provide a net present value.

Life cycle assessment (LCA) in accordance to ISO 14040 defines a methodology for compiling and evaluating environmental impacts of a product system throughout its life cycle. The standard is not specific to the construction industry, but the principals can be applied for products, building systems and complete buildings, capturing environmental impacts associated with manufacturing, use and disposal. Similar to life cycle costing, the assessment can be used as a comparative tool indicating relative environmental impacts of alternatives with a common function. In life cycle assessment the common function is referred to as the functional unit; which typically includes some form of performance specification and a time element, such as a cooling system that delivers 200,000kWh of cooling annually to an office with a 25kW peak load. Once the functional unit is defined, accumulation of environmental impacts is required for the inputs, output and emissions associated with the product system assessed with actual quantities to provide the functional unit.

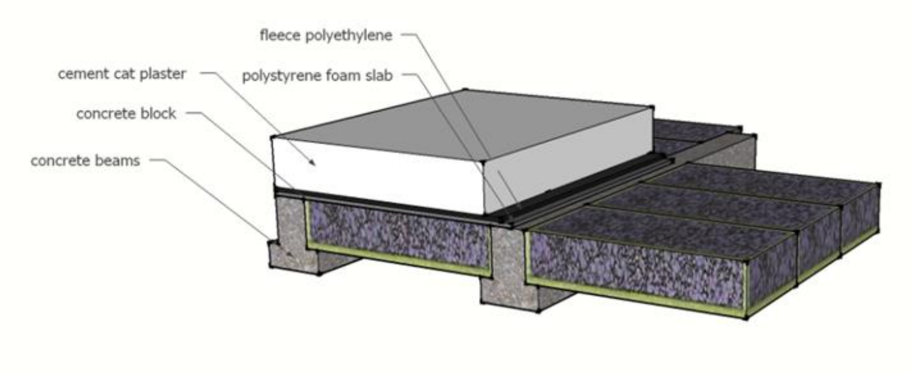
It is clear these two complementary assessment methodologies run in parallel provides a solid foundation for any client to make a business decision. These assessment methodologies are to be utilised as part of EC-funded NANOPIGMY project to produce cost-efficient multi-functional ceramic pigments with additional functionalities beyond colour for the materials of plastic, paint and concrete. The goal is to evaluate economic and environmental impacts with using the innovative pigments in comparison with conventional alternatives. The additional functionality of the pigments to be studied provides thermal storage, self-cleaning, self-healing and antibacterial capabilities.

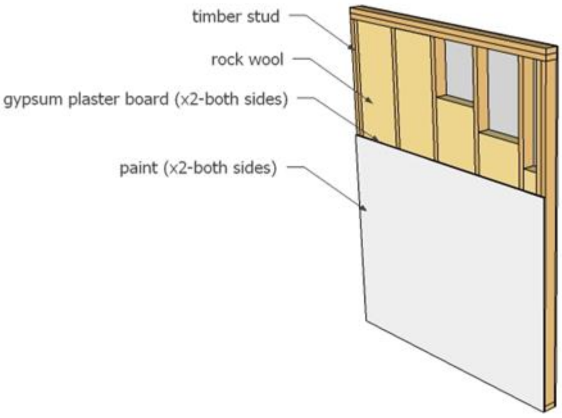
To allow assessment of the additional functionality of the pigments compared against conventional means, and satisfy the common functionality of alternatives for both assessment methodologies; two notional base case buildings were created for the project. The building types are a conventional office building and warehouse, which the innovative pigments can be applied for internal paints, external paints, external render and polymer boards.





For the life cycle analysis, these buildings were used to define the functional unit; a building (office or warehouse) including the production, use and disposal of its element over 100 year period. 100 year time period is commonly used for environmental studies, and is mirrored as a study period for the life cycle costing assessment. For a comprehensive assessment it is critical to define all the elements and quantities that constitute the building. In the case of the office building, this included external wall, internal wall ground floor, roof, windows, external doors, internal doors, windows and cooling and heating services. Details of the office floor and internal wall can be seen below.





To accommodate the assessment of the addition function of thermal storage, heating and cooling systems were added to the buildings for analysis, with a potential to reduce mechanical equipment capacities with the application of the thermal storage pigment. Both buildings were modelled in Integrated Environmental Solutions (IES) software to define heating and cooling requirements, to size equipment.

Whilst the life cycle assessment focus is on environmental impact of production, use and disposal of the buildings, the life cycle costing assessment centres around cost for construction, operation and maintenance over the study period. A category of cost that is not included in the life cycle costing assessment is end of life costs, as cost associated with disposal and demolition between the alternatives would be similar, thus be a common element in the assessment which can be omitted for purposes of the study.

There are a few key points that worth noting with just the creation of these two base models for conducting these assessments. Although economic and environmental assessments can be core elements to a project appraisal, social-economic aspects should also be considered including relevant occupational health, ethical and regulatory issues. For different clients, each of these appraisal element will also carry greater weight in a decision making process. The key decision maker is unlikely to review all the information and assumptions within each assessment, but usually query certain outputs. Thus is it vital for persons conducting the assessments that all information and assumptions used is well documented. These assessments take a considerable amount of time and effort to conduct, thus it is critical the value of the decision being made warrants the resource to conduct the assessments to provide an informed decision.

Now the base models for the office and warehouse are complete, we can now move forward and quantify the environmental and economic impacts of the innovative pigments, with outcomes to be published in future articles.

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