

Eden Project Dundee

– bringing regenerative aspirations to life

How does the adoption of a regenerative design process impact on structural engineering decisions in practice? Helena Russell speaks to the client and designers of the planned Eden Project Dundee to find out.

The revelation that the Eden Project is piloting the use of regenerative design on one of its new outpost projects is unlikely to stop anyone in their tracks. This globally recognised educational charity has long been acknowledged for its sustainability credentials, since the original vision of its founders transformed an abandoned clay quarry in Cornwall into a visitor attraction aimed at bringing humans and nature closer together.

Recent moves to export the Eden Project philosophy and mission to other parts of the UK – and beyond – have provided a live project in Scotland on which the process of regenerative design is being applied and tested right from the start.

The aspiration of this ambitious scheme is to see the 5ha site of the former Dundee Gasworks brought back to life in a graphic demonstration of regeneration – reclaiming contaminated land in the heart of the city and turning it into a place where nature can thrive and communities be built (**Figure 1**).

Project Engagement Manager Caishlan Sweeney is happy to describe Eden Dundee as a demonstration project, and is enthusiastic about how the current scheme, which is just about to take a step up in visibility by entering the planning process, brings a new relevance to the founders' mission.

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‘Twenty-two years ago, the Eden Project was talking about the planetary emergency and sustainability, and the need to see ourselves as part of nature and feel connected to it,’ she explains. ‘But now sustainability means so many different things to people – some use the term to refer to being financially resilient, for others it means going paper-free; some see it as a core value for everything their organisation does. We need to go beyond sustainability and talk about regeneration. Sustainability implies remaining static, whereas we need to be moving forward, regenerating and repairing things, and making those regenerative practices sustainable.’

Expedition Associate Director Eva MacNamara agrees, and explains her understanding of how sustainable design and regenerative design differ. ‘Everyone has accepted the UN’s definition that sustainable development is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. But when you hear that now, it sounds rather selfish; our thinking is that the definition of regenerative development should be “development that meets the needs of the present while *improving* the ability of future generations of all species to meet their own needs *and the needs of others, and allows all to thrive*”.

‘Suddenly, it’s not just the best outcome for my project, it’s how it influences others, how it makes things better and so on, and that’s really motivating. I would say that 90% of the industry is talking about carbon; biodiversity gets a mention sometimes, but there are all these other things – social value, air pollution, populations, health and wellbeing – that are not considered. With that regenerative ethos

you can keep coming back to the wider benefits for society.’

Connections to the past

Dundee is one of a number of sites that Eden Project International has selected to host a ‘New Eden’ – schemes described by mothership Eden Cornwall as ‘our global response to the planetary emergency’ and in locations ranging from Foyle in Northern Ireland to Qingdao in China. Each project is being developed with teams from the different areas, responding to local themes and needs.

Here, the local theme will take inspiration from the Nine Trades of Dundee – originally a union of specialist craftspeople such as shoemakers, weavers, dyers, butchers and so on, but reimagined in a more abstract and inclusive way for the present day. The modern ‘guilds’ are intended to be a conduit through which both visitors and local communities will find a connection to the Eden Project’s resources and partners, and be motivated and inspired to act.

Architect Feilden Clegg Bradley Studios (FCBS) is leading the design of the Eden Dundee site, with structural engineering expertise from Expedition. The choice of site was made public in May 2021 when a memorandum of understanding was signed between Eden and owners National Grid and SGN, kicking off a study to explore the feasibility of converting the site. Since that time, the focus has been not just on developing a masterplan for the site, and exploring options for the main venues, but also on building partnerships for the physical delivery of the scheme, and with communities in the city to build a storytelling and engagement narrative for the project.

FIGURE 1: Eden Dundee aims to reclaim contaminated land near city's docks and create a place where nature can thrive and communities be built



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In March 2022, a funding commitment of £7.6M from partners Dundee City Council, the Northwood Charitable Trust and the University of Dundee was announced to cover the planning and design phases of the project. Eden Dundee is expected to bring 500 000 visitors a year to the region, provide £27M to the regional economy and create 500 jobs. Notwithstanding unforeseen circumstances – Sweeney reels off a list including pandemics, wars, and changes of first ministers and their manifestos – the opening is scheduled for 2026.

The site, which sits just east of the city centre and north of the docks, has been empty for more than a decade. Most of the old infrastructure has long gone, but sufficient traces remain to point to its industrious past, including a 60m diameter gas holder which creates an imposing landmark on the site and could easily accommodate some of the city's better-known buildings. The plan is to morph this steel behemoth into the 'Lush Bunker' – the main visitor venue (Figure 2). At the northern boundary of the site is a brick terrace with openings

through which coal was tipped from rail wagons; another trace of history that will be woven into one of the planned venues. The tall brick walls remaining around the site are reminiscent of the walled gardens of country houses; a ready-made point of reference for Eden Dundee.

Aside from these physical traces, the main legacy of the site is contamination from the former gasworks; this will be remediated by the site owners before handover, but its presence and the restrictions this currently places on access has some implications for venue design.

As Sweeney explains: 'The gas holder is an unknown at the moment – we've been to visit one in Glasgow that's the same type of gas holder, just slightly smaller. Our team went inside and took photos – all things being equal it should be the same as what we are dealing with, but while it remains unknown, it's a challenge. Until you get inside that beastie, I'm not sure you can really account for everything.'

Regenerative aspirations

So, it's fortunate that the regenerative

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design process is being applied to the project; in many ways, the process has the flexibility to accommodate uncertainty in a way that the conventional design process can't match.

But it is no coincidence – MacNamara participated in the first cohort of the Constructivist Regenerative Design Lab in 2022 and had already identified the project as a potential testing ground. The Regenerative Design Lab (<https://constructivist.co.uk/regenerative-design-lab/>) is a six-month accelerator

programme where engineering professionals learn about regenerative design principles and support each other to put them into practice.

‘What we want to show on this project is how, as a structural engineer, you can influence regenerative outcomes that are part of the bigger picture,’ she says. ‘At the Design Lab, we had to pose ourselves a question; mine was how I could use bigger projects to seed smaller projects, and I was thinking about Eden. It was deeply frustrating as I couldn’t talk about it at the time!’ she recalls.

Regenerative design goes to the heart of Eden’s aims and history, agrees Sweeney, explaining that Eden’s mission as a global endeavour is to ‘respect the natural world, protect the wild spaces that need to be left alone to thrive, and to repair damaged spaces that need to be fixed.’

‘Transformation and regeneration are at the core of it, and this site really fits in with that, much more so than the other sites we looked at. We did a lot of research and scored all the options against the same criteria so that we could really be sure that we were saying yes to the right place. The history of this site also lends such a lot to the stories that we can tell, the journey and experience we can take people on across the site. It’s perfect really.’

It also has benefits in terms of the site and the way the team approaches it, she adds. ‘We want to be able to challenge the industry to consider using different materials; but one drawback is that it can make planners nervous.’

FCBS Partner Rachel Sayers points out that the regenerative aspirations of Eden Dundee extend beyond the physical environment, making it a truly holistic endeavour. ‘A key point is that it’s not just about the building fabric, it’s also about social and economic regeneration. Having social regeneration, building communities and Eden’s very specific ambition to give people wisdom around reconnection to the natural world is a huge thing too.’

‘We are looking very closely at what materials we are going to use, both in terms of creating lean buildings, and also taking into account the biodiversity impact of the materials. We need to balance our use of materials as far as we can, reusing as much as possible, and growing as much as possible, while overlaying the biodiversity agenda. Using virgin wood, for example, is not as good as using recycled timber components. It is very much more about trying to tap into available materials, both in the construction industry, and other



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FIGURE 2: Former gas holder will become main visitor venue – the Lush Bunker

industries – wind turbine blades or our disused gas holder, for example.

‘You have to map the materials that you have on the site, close to the site, in the region and so on. We are talking to city planners about how they might share their knowledge of buildings that are planned to be demolished, and that we might approach for materials, so we can help one site avoid waste, and feed materials back to another.’

But to make this feasible, it is crucial to build in flexibility at the very early stages of concept design.

MacNamara explains how this affects the design process: ‘We do need to have details tied down as soon as possible, but because FCBS are really up for doing this as well, for Stage 2 phasing we are giving three different options for what the reclaimed structure might be, whether it’s steel beams, a truss, or reused timber. We are protecting a sufficiently large structural zone so that options can be switched in or out much later without disrupting progress.’

‘We have also pushed really hard, while being mindful of future flexibility, to use smaller spans wherever we can. Longer spans tend to be better for future flexibility, but we can’t guarantee it will need to be reused like that – so smaller spans use less material. It’s been a brilliant process because FCBS are really reciprocal – building in that futureproofing for the circular economy is really important.’

Sayers adds: ‘We are increasingly learning the flexibility that comes from that sort of process, which is a healthy thing. We are quite used to having this agility, as we often work with contractors who might propose an alternative material for reasons of speed, for example, but now there is a bigger calling behind this process. We know that long spans can be very useful when thinking about future flexibility of buildings, but we are finding that a span of about 6m is often what you get when reusing materials – after they have been taken off the building and trimmed down.’

Close scrutiny of all decisions against key principles from the very start of the scoping process is central to regenerative design, says MacNamara, and Eden’s way of working as a client was well-suited to this. ‘What was really interesting was that in the early stages, half of those at design team meetings were from the Eden Project; they were the gardeners, the storytellers and so on, and they spent a long time trying to pinpoint what they wanted to

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say with the project. What an amazing opportunity for a structural engineer! You don't often witness that birth of a project in the same way. We could then say, well, you've got this narrative, and you are talking about the outcomes of the project, but what about the construction process? If we really, collectively believe in a regenerative purpose, this is what it means to us as a design team. We've challenged that over and over again.'

High-level principles

Fundamental to a regenerative design approach from the structural engineering perspective is application of a set of high-level principles across the whole project. These include minimising whole-life carbon, maximising biodiversity and social value, maximising opportunities to support new materials, using

locally sourced materials, and being a regenerative process. Not all of these are directly obvious – e.g. being a regenerative process might include sharing knowledge (including mistakes) with the industry for the greater good, and seeking to establish new methods – e.g. for procuring materials – where necessary. And not all of them are easily done, as MacNamara explains.

'Very few people talk about how you can maximise biodiversity benefits as a structural engineer, do they? Structural engineers have very little impact on the biodiversity gain of a site. However, we specify huge amounts of materials – and while we now know the carbon impact of such materials, we don't really know the biodiversity impact or how that changes depending on which material we specify.

'For example, how does the biodiversity of a monocultural timber

forest compare with a quarry where extraction of materials might be counterbalanced by environmental improvements? We just don't have answers to those kinds of questions,' she admits. Faced with this fundamental knowledge gap, she and colleagues at Expedition successfully applied for an Institution of Civil Engineers research and development grant to compile a framework for measuring the biodiversity impact of different materials.

'As an industry, we focused for a long time on operational carbon, before realising that embodied carbon can be much more significant. In the same way, biodiversity net gain is what we would consider as "operational" biodiversity and the "embodied" biodiversity is what we don't really understand.'

Expedition's spin-off research also neatly demonstrates how regenerative design can have benefits for others,

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FIGURE 3:
Venue will offer
immersive
experience
telling story of
the carboniferous
forest

rather than simply serving the needs of the project itself.

Another of the high-level principles focuses on maximising opportunities and support for future materials, says MacNamara. ‘How do we incubate technologies that could have a big impact on the climate crisis while minimising the risk for projects?’ This might be done by incorporating an innovative material or product in a low-risk environment – e.g. using a carbon-negative concrete to make a kerbstone. If it fails, it won’t have any structural impact, but its long-term behaviour in real-life conditions can be monitored.

Material choice is another focus, with designers encouraged to source the majority of the primary structure locally and regionally, whether that is new or reused materials. ‘We will need to find out if there are any factories in Scotland producing engineered timber,’ says Eva. ‘If not, we should aim to use sawn timber rather than glulam – that kind of issue can have an impact on regeneration of the local economy.’

A living venue

Although venue designs are still in the early stages, the team has agreed on regenerative approaches for each venue, depending on the narrative of that venue and its site context. There will be four main ‘venues’ explains Sayers; three buildings and the site itself as a ‘living’ venue. ‘In a way, the setting of the landscape is “venue zero” – a regenerative landscape that demonstrates principles which are “grown” and incorporates distribution routes for people, services and water,’ she says. It will be immersive, using fast-growing plants to give height and including pavilions which may be living buildings, community builds, or structures demonstrating new materials or technologies.

The ‘Lush Bunker’ occupies the gas holder in the corner of the site and its scale reflects the power and productivity

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FIGURE 4: Site will form ‘living venue’ – regenerative landscape with proposed saddle-shaped roof

of the past site in its industrial heyday. ‘It’s a demonstrative reuse of a former industrial building,’ Sayers explains. The inside is split into two with the story of the carboniferous forest played out in the lower level, and a lush, planted greenhouse demonstrating good design from nature on the top level (Figure 3).

As much steel as possible will be cleaned and retained on the project, but to be truly regenerative, this should be no more than is absolutely necessary, says MacNamara. ‘There’s a lot of steel in it, as it has solid tiers when it is elevated and, in the permanent case, not all the tiers will be required. The conventional approach would just be to deflate it and keep it retracted – we said that we should give the rest back to the industry as we already recycle 100% of what’s available. We should aim to use as little material as possible.’ Roof options are still under discussion and include a saddle-shaped structure – a materially efficient option to provide a clear 60m span (Figure 4).

Pushing back against certain ideas with well-reasoned arguments has been welcomed, she adds. ‘One proposal was for a flat roof, tilting up towards Dundee, and everyone fell in love with it at first,’ she reveals. ‘We are also exploring a more carbon-efficient version of the tilted roof, by adding in additional

support that breaks down the span.

‘As a design team, it’s about brokering a deal at the beginning – making sure your client knows that you will push back and challenge them on everything. They have welcomed that every time, and have also been super clear when it goes too far, or would put the programme at risk.’

Local earth and timber are the proposed materials for the small threshold building on the west of the site, which will welcome visitors as they arrive at Eden Dundee and is modelled on a market building where ideas and objects can be traded and exchanged. ‘Its roof form undulates to accommodate solar gain and reduce noise from the road nearby,’ explains Sayers, ‘and we are currently looking at timber modules that we could use. It’s Passiv design, with low-energy principles, and there’s a solar greenhouse along the southern facade with a flexible market hall space inside offering a range of different ways it can be used by visitors and communities.’

The final venue is intended to be a place where the myths and legends of the past can be reflected on in a cultural context. It will be a wall-derived building, connected to the terrace at the north end of the site, and built in recycled stone, timber or steel.