The Building Sustainably Podcast

Episode 3: How Green Concrete is reducing carbon footprints in construction with Conall Boland

Host: James Bowman, Director, RPS

Guest: Conall Boland, Senior Consultant – Sustainability, RPS

Intro - 00:00:05:

Welcome to The Building Sustainably Podcast by RPS. Sustainable, resilient development demands a new approach to how we plan, design, and build. We invite you to join us as we explore real-life case studies and offer practical guidance. Here's your host, James Bowman.

James - 00:00:26:

Conall, thanks for joining us today. It's great to have you with us and what we're about to learn from your expertise. But can you start us off by giving us a bit of your background, how you've come to be involved with green concrete?

Conall - 00:00:39:

Yes, so I'm Conall Boland and I'm from County Mayo in Ireland. So I studied civil engineering at Trinity College, Dublin. Just 30 years ago this year, I graduated from there. And I suppose my career has taken me into just a little bit of construction and then quite a lot of environmental aspects of engineering. And right now I'm a senior consultant in sustainability with RPS. So I focus mainly on where the built environment meets sustainability. So decarbonisation, biodiversity, circular economy, they're the three big themes that we're grappling with at the moment.

James - 00:01:11:

Yeah, and makes you a very suitable guest for this podcast and this series. So thank you. Thinking back, you said you've been in the game for about 30 years. Is there something that strikes you as really changing over that time or maybe more recently?

Conall - 00:01:25:

When I came through undergraduate education, sustainability wasn't a buzzword. We did talk about environmental protection and there was awareness about things like pollution and water resources, but not so much focus on carbon or... Embodied carbon or energy management. So right now, all the engineers in the world who have qualified in the last 20, 30 years have to retrain and upskill in that. The new graduates coming out will be much better prepared, but that's the focus. So instead of just having buildings stay up or having buildings last a long time, we now have to make sure that buildings have as low a carbon footprint as possible. And that's because cement and concrete are key ingredients in most structures around the world. That's where the focus is at the moment, reducing embodied carbon in design.

James - 00:02:08:

Building on that point you've just made, have you got some stats in mind in terms of how big a challenge are we tackling when it comes to concrete in construction?

Conall - 00:02:17:

Yeah, so one of the statistics that stood with me was something we learned in our very first year in engineering, was that for every person in the world, it was one meter cubed of concrete poured every year. So one meter cubed of concrete, that's more than two tons in weight. And it's a really striking statistic. So I looked that up recently to see where we got on that trajectory. And right now it's something like 1.75 cubic meters per person per annum around the globe. We're pouring more for the 8 billion people in the world. It's

something like 14 billion cubic meters of concrete. So after water, it's the most used construction material globally. It's something you can almost picture just how big is a cubic meter, one meter by one meter filled with concrete. You almost double that. Every one of us is responsible for that. And I think it's down to urbanisation, more and more people moving into cities, buildings getting taller and more and more infrastructure. And then I guess maybe a developing world catching up in terms of things like sanitation, and water and energy systems. But it is a kind of a frightening consumption of resources when you think about it.

James - 00:03:20:

Absolutely. And then when you tack on the carbon impact to that, not just the raw materials that go into it, but the carbon impact. Yeah, you can start to understand the scale of the challenge. That's why we're having a conversation today. So going back to the bare bones, why is concrete so popular? Why is it so ubiquitous with construction?

Conall - 00:03:37:

I think there's a number of reasons. It's a very flexible material. You can form it into whatever shape you want. It's a relatively simple process to mix and pour and create new material, new structures from concrete. So it's just as simple to do in India as it is in Newcastle or in Brisbane or wherever you are in the world. So it's transferred quite quickly around the world. And the fundamental ingredient in cement being Portland, being limestone is very readily available all around the world as well. So. Those kind of factors have contributed to it becoming like the go-to construction material for civil engineering. You know, everything from tunnels, wastewater collection pipes, building structures, dams, coastal protection. I think for a lot of engineers, when you think I need a new structure, I need a solution. The default thinking is to go to concrete as your first resource.

James - 00:04:26:

Okay. And so potentially we'll come to that. Potentially there's a solution down the track for that very response. And I guess not forgetting that concrete in various forms has probably been used. And it's been around for thousands of years. So it's probably no surprise that it's fairly commonplace today.

Conall - 00:04:43:

If people have visited Rome, I think it's at the Pantheon. It's one of the oldest buildings there. And that's one of the early concrete structures.

James - 00:04:51:

Yeah. I think the roof there is quite unique in terms of both being concrete, but being a dome and otherwise unsupported**.**

Conall - 00:04:58:

Apparently, if you take a sample to that concrete and do the analysis that's been done, it's still gaining strength. So it continues to gain strength. Year on year. So that's one of his key, you know, saturability and reliability is another key aspect.

James - 00:05:11:

Like I said, there's no surprise that it seems to be everywhere. But that does bring us to the key topic of today's discussion, and that is, what about the carbon impact? And how do we address that, given that it is ubiquitous? That stands to reason that if we can solve embodied carbon in concrete, we can solve quite a bit of the embodied carbon challenge for construction generally. So can you take us through what it is in carbon that contributes to its embodied carbon? And then we'll delve into some of the solutions or innovations of how we address that.

Conall - 00:05:43:

If you take a section of concrete that, by weight, the main ingredients are aggregate and sand and water, but the material that binds it all together and makes it hard is called cement. And it's the cement that's responsible for probably 80 to 90% of the embodied carbon footprint in a section of concrete. And the reason

why cement has such a high footprint is because it's very energy intensive. So to make cement in this part of the world, you take limestone, you heat it to 1400 degrees centigrade, and that takes a lot of energy. So it's very energy intensive. So you can think of the emissions from traditionally, that's been fossil fuel-based energy. Plus, when the limestone breaks down, there's what they call process emissions. So that's actually release of carbon dioxide from the chemical process itself.

James - 00:06:29:

Because this limestone is a calcium carbonate?

Conall - 00:06:31:

This is it. So you've got a lot of CO2 coming out the stack, coming out the endpoint of the cement kilns. So that's where the pain is felt in terms of carbon footprint. And that's really the big challenge. So the cement companies themselves, they've switched to alternative fuels. They've used a lot of energy efficiency. They're beginning to use renewable energy where they can. But there's still the process emissions, which is about two-thirds of the carbon emissions from cement production. That's the big challenge for that sector. So that's the origin of the big footprint of concrete in the cement.

James - 00:07:04:

Yeah, that's an interesting clarification, I think, for many. The layman may not appreciate that concrete and cement are two different things. Concrete is the finished product. Cement being, as you say, the binder that holds it all together. But the two are not interchangeable in the sense of what they actually are. So that brings us to, we've got to solve the cement challenge in concrete. And is there, I'm just trying to think here, are there, where are the innovations coming from? What are we seeing? Is there anything clever that's going to save the day? Or is it down to a reduction in just general application?

Conall - 00:07:41:

I suppose the tried and trusted way to reduce carbon and concrete up to now, and it's been for several decades, it's gone back probably over the last century has been to replace some of the cement, some of the high energy material with other products. And the two main ones that have been used, they're byproducts of iron ore smelting. So you have something called blast furnace slag, which is a byproduct from iron ore smelting, and that can be ground down. So it's called GGBS, Ground Granulated Blast-furnace Slag, which has very good cementitious qualities. So at the moment, across the UK and Ireland, if you ask for low carbon concrete, you'll get a combination. Portland cement, traditional cement, and GGBS. That's one of the go-to products at the moment. The other go-to product for low carbon concrete is what they call PFA, so Pulverised Fly Ash. And that is a residue from coal, fire, energy production, so coal fire power plants. So it's readily available. It's like a circular economy solution. And that also, you can mix some of that in with your concrete and reduce the amount of cement used. So those techniques are tried and trusted. They result in very durable concrete products. The difficulty with those techniques and those solutions is they rely on maybe unsustainable industries themselves.

James - 00:08:58:

I was about to say, so yeah, the iron ore industry coming from Australia, I'm fairly familiar with it, at least as it's a big contributor to the economy over there. And I have a background in mining, so I have been on smelter floors and seen the smelting. So I appreciate that slag is, it's more of a, like you said, it's a byproduct, and it's more of a problem for smelters, is that they basically just have to dispose of. But in economies where, yes, we're trying to reduce our reliance on those things and the energy intensity of those industries themselves. Similarly, a coal-fired power station is no pun intended, but going away the dinosaur. Then where will something else come from? If we're going to see the availability of those products diminish, is one question. I guess the other question there is in a geography like the United Kingdom, that to my knowledge doesn't have very many coal-fired, if any, power stations, or iron ore smelters. What's the actual carbon footprint of trying to get those products into the country? That's probably maybe a question for extra credit, so to speak.

Conall - 00:09:59:

Yeah, I'd start with the transport question, because when you measure the emissions related to international shipping, they tend to be relatively low. So whether your blast furnace slag is coming from, you know, Germany or Japan or Belgium, if it's coming by ship. It tends to be a relatively small percentage of your overall footprint. And it still is a reduction compared to all the really intensive energy in a traditional cement kiln. So I guess based in Ireland where we haven't had a steel furnace for about 20 or 30 years, and we have only very limited coal-fired power plants, we're thinking more in a globalised supply chain. So, we know that whatever we use is probably going to be imported at the moment. I know in the UK there has been more of a sentiment to be more self-sufficient, to reduce travel distances, which is the most sustainable, and create circular economy loops within the country. But I don't think transportation need necessarily be an obstacle to, you know, achieving sustainable low carbon concrete outcomes. One of the, you know, medium to long-term replacements for those products we talked about could be something like calcined clays. So they're naturally occurring clay materials that have pozzolanic properties. So they can be combined with Portland cement and maybe GGBS to create a ternary blend, what they call, so the three different cementitious materials. So that's one of the areas of research at the moment, where can we find suitable clays and whether they're available in Great Britain and Ireland, or whether they have to be imported further, and then testing them to make sure that they're going to give a long, a good long-term durable concrete.

James - 00:11:33:

The other question we talked about there was just the sustainability of, can we continue to rely on glass furnace slag and ash from coal-fired power stations in the long term? Or will those sources eventually disappear?

Conall - 00:11:46:

I think we're all hoping that, that the world will turn us back on coal-fired power plants, and that pulverised fly ash will be a very limited material in the decades ahead. But I suppose there are geopolitical dimensions to that, what will happen in China and India and places where there still is a lot of reliance on coal. And then in the deal production, there's a switch towards electric arc furnace production methods, and they're much less polluting and they create less residues. So again, we're hopeful that over the coming decades, we'll phase out the supply of PFA, I think our efforts need to be on finding replacements and being innovative, and working hard on a technical front to make sure that we have net-zero solutions for the cement sector.

James - 00:12:28:

That's just focusing on a concrete solution. We did touch on earlier, I think we'll come to later, how else we might solve the problem, rather than just making concrete better and concrete cleaner. There's potentially other ways to square that circle. Touching on the concrete and cements contribution to global emissions, have you got some figures in mind? In terms of just how big this contribution to global emissions is.

Conall - 00:12:52:

Yeah, I don't have that at the tip of my tongue.

James - 00:12:55:

That's all right. I have some in front of me that come from 2020, so they're probably out of date now. But you mentioned earlier there's 14 billion cubic meters of concrete poured or estimated to be poured annually. Percent of concrete poured appears to come from production for the residential market. I think that's acutely relevant here in the UK with the discussion of the housing crisis and the need to build more houses urgently. This all comes from the Global Cement and Concrete Association, just for reference and acknowledgement. There's $440 billion, I assume that's US dollars, spent in global cement and concrete products in the market in 2020. So that's no doubt gone up quite a bit since 2020. It's not a small problem, right? It's not a small quantity. And there is big money in this as well, as far as whether it's governments, whether it's developers, private companies, investing and spending on concrete. So arguably there is money here to, or there is a reason, I should say, to solve the problem and hopefully reduce, both reduce cost, but reduce environmental impact. As far as your role, you contributed to a report to government, I believe, and that has gone on to now become quite an important piece of Ireland's approach from a government level. Can you tell us a little bit

about that? And take us through what that report was, what it involved and how it's evolved into the way Ireland is taking forward infrastructure.

Conall - 00:14:24:

Yeah, first of all, the background. So our National Climate Action Plan in 2023, it identified the need to address construction emissions and to decarbonize the sector. And it also said, look, the public sector needs to lead by example, and we need to set the tone for building with low carbon materials. So there was a cement and concrete decarbonisation working group, established. And we want to tender along with EY and an architectural firm, Arcadia to research this and develop a green procurement blueprint for the public sector. So that was really interesting project, you know, involved international research and stakeholder consultation with the supply chain here in Ireland. And I suppose we found that amongst the public sector, there wasn't a consistent approach. So some agencies were really progressive, really ambitious, had been designing out embodied carbon and using low carbon materials for decades and others were really just coming to the table. So an interesting challenge on what we developed was, I suppose, a high level strategy to enable a consistent approach so that all local authorities, public agencies, government departments, they would all ask for the same low carbon results and low carbon concrete. And that would send a very strong message then to the concrete sector and cement sector that the government is going to lead on this transition. So that report was completed earlier this year and subsequently the Ministry for Enterprise, Trade and Employment has issued a set of guidelines just focusing on the short term, what can be done. And there's a lot of more work in the medium and long term, but we're really pleased that from September this year, there's a new six-point plan for low carbon concrete procurement across Ireland.

James - 00:16:02:

And where does that put Ireland? Maybe just your personal view, but globally is Ireland then at the forefront of this sort of thinking or is it catching up? Where does it sit?

Conall - 00:16:12:

Yeah, I think we're knocking on the door for Champions League football, but we're not there yet. So like a lot of things, the Nordics seem to be the lead societies or lead countries in terms of addressing embodied carbon, creating standards, creating regulations and publishing data. And I think the UK is there thereabouts as well with some very good policies, some good tool and a lot of good research. Even if maybe the performance isn't consistent and there's still some high carbon cements and concrete's being used in the UK, but I think the framework is really strong in the UK and we drew a lot on the Institution of Civil Engineers, the ICE. Low-carbon concrete route map in our research. I think countries like Netherlands and France appear to be doing well. So Northern Europe in generally is responding. I think we're probably ahead of maybe the States when you look, we look to the States and we looked Australia, but we didn't really find any, anything very rigorous or structured just yet.

James - 00:17:02:

Probably interesting. We could probably do a whole podcast on how the politics of those two countries has some benefits, but being state-based makes it very hard to get a national aligned approach on things. And it really requires strong leadership from that federal level, but we digress. So. Can you take us through, you said there was a roadmap and a few points in a plan, how they will be rolled out or how they will manifest in reducing carbon?

Conall - 00:17:25:

We developed just a simple kind of four, four tier structure or four themes. The first one is it's very simple use less cement and concrete. And the other ones, number two is that the government would procure low carbon concrete. And we we've said what that means that they'd use lower carbon cement. And finally, we've recommended a carbon management approach projects and managing the entire carbon of public projects, you know, infrastructures and buildings. So I can take you through what's in those four elements in a little bit more detail, if you like.

James - 00:17:56:

Yeah, sure. Please happy to expand on that.

Conall - 00:17:58:

When we talk about using less cement and concrete, there's kind of two sides for that coin. One is switching away from concrete, maybe towards timber-based materials, bio-based materials. And you know, you, you mentioned the residential sector. So, one of the things that's happening is a move towards timber frame construction, factory fabrication, modern methods of construction. And a lot of that is actually it's based around timber and lower carbon materials. So that's one of the solutions. On the other hand, there are lots and lots of projects, you know, everything from motorway bridges to rail tunnels to, you know, new port infrastructure that is going to be concrete based for the foreseeable future. Yeah. So, what we're saying there is, okay, the kind of three stages to reducing the carbon footprint there. One is better design. So, designing out concrete as much as possible and using it as efficiently as possible. There's a specification step, which is where you focus really on precisely what concrete makes you want and precisely how much carbon you want in it. And then thirdly, there's the site management and construction management, how much you deliver to site, how much is wasted, how much you've got to dig up and repour. And that just purely construction stage management, that's important. So, the research internationally suggests that maybe 15, 20% reduction in carbon and construction can be achieved just at the design stage. That's really promising. It doesn't necessarily cost you any more money and maybe possibly can reduce your capital costs if you get some of those design decisions right.

James - 00:19:22:

And interesting, you touched on at the construction stage, how much is delivered, how much is wasted. And you also mentioned modern methods of construction. So is there a solution here where we use more precast or modular componentry? So to speak of concrete components?

Conall - 00:19:37:

Yeah, definitely. On paper, if you're manufacturing in a factory environment, you're manufacturing offsite, you have just better technical controls. In theory, less waste, or if you have waste, you can recycle it back into the production process. So it's more material efficient. And then the other saving really, when you get to construction site, typically you'll have fewer temporary work, you might have a shorter construction program, you're lifting components into play, as opposed to have to build shuttering. And poor concrete and take down shuttering. So, there's a cumulative benefit there. Not always easy to see the statistics to back that up. So, I think we do need to prove that, but in theory, that the direction of travel of construction should be a lower carbon, we should get lower carbon outcomes.

James - 00:20:21:

Yeah, excellent. Okay. That sounds quite promising. And have you seen or do you have examples on hand of having personally delivered or been associated with the work that has yielded those benefits across those four steps?

Conall - 00:20:34:

Yeah, so we did a project in Glasgow for Renfrewshire Council. It was called the Glasgow Airport Investment Area, which has a nice acronym called GAIA. So we were, RPS were the design element of a design-build partnership with Wills Brothers Construction. And that was a project where the council, the client, put an emphasis on carbon from day one. They required the use of a carbon management standard, which meant there were target setting and measurement of all elements of construction from start to finish. So we engaged in this. And one of the interesting parts of that project, we had to build a bridge structure to cross over some buried electrical cables. So you had some quite old high voltage power cables. These are oil-filled cables that have a little bit of heat dissipation through them. Very old. And they were maybe just in an area with poor ground conditions and quite sensitive to disruption. So, the conservative approach from the client designer had been to build a concrete bridge across them. And we had to carry a new road, a new infrastructure, across these cables. So when we sat down at construction stage to look at how we were going to build this bridge crossing, our geotechnical team and the construction team said, hang on, maybe there's an easier way or a better way or maybe a cheaper way. And they suggested, let's do this using a

Styrofoam block. So, Wills Brothers had lots of experience building wind farms, where sometimes you float the road across the bog with a lightweight embankment. So, you have your Styrofoam block, you have your gravel, your geotextiles, and you have a serviceable road on top. And we put that to the client and to, to Scottish Power Electricity Networks. And they said, we like the idea, but we're concerned that the Styrofoam blocks will just, they'll retain too much heat and the cables will overheat. So, they couldn't sanction it. So that was a pity, but we weren't deterred, went back to the drawing board. And again, our Geotech team and the Wills engineers worked together and they said, hang on, why don't we use stormwater crates? So, these are plastic crates, they're made out of recycled plastic. They're assembled by hand, very like your old crates that you would have had your beer bottles or your milk bottles. In the old days. And they're used to store water underground as water attenuation. And maybe you can put car parks or roads on top of these in construction. So, we adapted those to carry the motorway embankment across the cables. We put the design to the client and to SPEN and they said, yeah, we're happy with this. So we went, the project was complete on that basis. So, carbon saving there by avoiding the new concrete pile foundation and concrete beams. It was something like 1600 tons of carbon, 1,600 tons. And it was a reduction of 87%. And the carbon footprint of the project. And it was very well documented. And plus, it was a kind of a safer and neater construction site. So really delighted with that. So that project went on to win some awards, including the ICE carbon champions award. So, we're delighted with that. So, I suppose that's an example of just maybe spending a little bit more time with design to try and design things out. And that's a win for the client.

James - 00:23:22:

You touched on probably a couple of things to focus on there. One, I'm gathering from the timelines you've laid out here, the client had this view and they said that earlier that you said was, was to be carbon conscious from the outset. So, no doubt that that set the project on a path. But they did that. Am I right in saying they did that at a time that predated? The roadmaps and the work you did for government more recently.

Conall - 00:23:44:

Yeah, so we would probably started that project maybe four or five years ago. So yeah, absolutely. That was a client with a bit of foresight and putting carbon as one of their number one priorities. And we had to report to them, quantify it. And what's happening now in big construction projects, you're getting a carbon budget based on an initial design, but you're being challenged. You'll be challenged to say, can you beat that carbon budget? Can you reduce your carbon footprint by 20%, 30%? And we're beginning to see in some contracts now that you're beginning to receive a financial benefit or bonus payment. If you can reduce carbon beyond the targets that's been set.

James - 00:24:17:

So like a pain gain sharing model?

Conall - 00:24:19:

Yeah. So that's really interesting. And I think that's going to stimulate a lot of innovation, particularly at that construction stage and dealing with contractors. Because if there's a bonus there, they'll redouble efforts to find the good solutions.

James - 00:24:31:

And yeah, we all know that a financial incentive is probably one of the strongest ways to motivate people. Just going back, I would never have thought if you'd said you need to put a concrete bridge in. My first instinct would not be to think. Let's use styrofoam instead. That says a lot about innovation, I guess. And then second to that, my next solution would not be let's use milk crates. And I know they're not milk crates, but analogous enough to. So, I guess that's exciting given that occurred a few years ago now. Is there, are there other products that you're seeing come out in the market with more technology? There anything else that is substituting for concrete now?

Conall - 00:25:06:

There's research happening in what they call alkali activated cement materials. So that would be, you know, some people. Up to now, the approach for low carbon concrete has been to keep a certain amount of the traditional ordinary Portland cement and to combine it with other materials that we discussed like GGBS or PFA and limestone dust. But some of the researchers say, look, we can skip all that. We can go to these new materials. They're alkali activated binders and they don't require the ordinary Portland cement. They rely on other minerals and other chemical processes. So that's potentially a way to leapfrog the older technologies and get to net zero using a new range of materials. Alternatively, we can go more traditional route and sort of use the existing materials and kind of bit by bit, try and reduce the carbon in those materials. So I think there's an interesting, maybe a little bit of competition beginning to happen there. These new novel materials have a long way to catch up, but if they can achieve the performance, I think the industry will, will pivot over reasonably quickly. So that's interesting times for the cement sector, I think.

James - 00:26:04:

Yeah. And this is all emerging as we speak. Fascinating. Let's move. We talked about Ireland government's climate action plan. And you started talking about projects having a carbon budget. Is that coming out of the recent introduction of PAS 2080? Or is it just from natural evolution in industry?

Conall - 00:26:26:

Yeah, I think it's a combination. So at government level, so for public project governance and for public money to be spent on a big infrastructure project, there's increasing focus on what's the carbon footprint of the project. And it will become more and more decision point on whether to approve something for funding or not. How carbon efficient is it? What's its impact on our overall national budget? So each country will ultimately have a budget, carbon budget for transport, carbon budget for energy sector. And so there's going to be a lot more transparency and a lot more focus on what the carbon impact of any particular project is. So I think building up a good, clear evidence base that you have minimised carbon as much as possible, that's going to be increasingly important. So, there's a new carbon management standard called PAS 2080. It's on its second iteration now. The 2023 is the second iteration. It was developed by a consortium of sort of public and private bodies in the UK. And the first iteration was 2016. So, what it does is it creates a management system framework for understanding carbon in a project, reporting on it. And it also promotes innovation and collaboration in trying to reduce carbon in all projects. So, it's quite a powerful tool. And we think now in the next five, 10 years, pretty much all projects will end up following a carbon management approach. So probably the UK is first out of the blocks in this area, but I think it's going to be very popular internationally.

James - 00:27:45:

Am I right to say it was developed in the UK?

Conall - 00:27:48:

Yeah, so it was really just the whole combination of academia, industry, from the bigger construction companies and some of the bigger consultants across the UK. And if you look at the project like HS2, people will be familiar with the High-Speed Rail project. That was one of the first big projects that decided to implement PAS 2080 across all elements. And there's so many big elements of work in that. So that was a good example of a big organisation deciding, we're not just going to talk about carbon, we're actually going to do something about it. Yeah, and it's been a good success story.

James - 00:28:19:

And a bit of self-promotion for RPS Ireland here. I'm right to say that RPS Ireland are verified. One of the first to be verified is PAS 2080 designers.

Conall - 00:28:29:

That's right, yes. So we achieved verified status independently audited by the British Standards Institute last November. So, they came in and they looked at our systems here in the consultancy team. How have we got the tools to examine carbon? Do we understand it? Do we know how to identify hotspots? Do we know how to workshop and find design solutions that can reduce carbon? And it's not just concrete, so it's all materials from asphalt, steel, geotechnical work. So yeah, I'm very proud of that. I think we're the first consultancy in

Ireland to achieve that independently verified status. And yeah, I think we're trying to upskill and train right throughout the organisation so that it permeates every project as much as possible.

James - 00:29:08:

Can you take me through a, you said it's not just concrete, but an approach, let's say, for an infrastructure-focused type project? What would be the key stages? And what would be unique in terms of adhering to PAS 2080 and focusing on embodied carbon?

Conall - 00:29:24:

Yeah, maybe the best way to explain is to take a project we're working at the moment. So there's a new bridge in Sligo, which is a big town or a small city in the northwest of Ireland. So there's a really attractive new bridge being designed across the Garavogue River and the client is Sligo County Council. And we had a sustainability workshop on the project. And emerging from that was, you know, an agreement with the client that we needed to really focus on carbon the bridge, because their main stakeholders, the general public and the general public is now really asking for this. So they commissioned us now to do a full baseline whereby we'll take all the designs. We look at all the quantities, all the materials, all the travel distances. And we're going to do a full inventory of the embodied carbon in the whole project, you know, from earthworks, foundations, new materials, the bridge itself. So we're going to complete that footprint. And then we're going to sit down and go through with the client and identify part of the top five or top 10 contributors to the carbon in the project. And then we go back to the design team and see how do we engineer those out or how can we reduce those. And we're thinking not just short term. We're not going to change something if it's going to mean, let's say we'd have to replace the fencing after 10 years. It's a lower carbon, but we're not going to necessarily just default to short term solutions. So you have to look across what they call the project lifecycle and make solutions that are going to deliver results over a 120 year period. Because that's the design life of one of these bridges. So that's the kind of lifecycle assessment stage. And the design team then is challenged to find solutions and reduce carbon and then it gets transferred. You go to construction stage; you're going to give all that data and information over to the contractor and we're going to set targets in the construction contract for them to adhere to and surpass if they can. And I think one of the key things on this is promoting innovation. So, you say to them, here's our best shot at it. If you want to come back and change something here, it gives a good carbon result. We'll be open to that. And we'll be, you know, we'll help you get that solution through if it makes sense. So A kind of change of mindset in terms of leaving those doors open for contractor innovation as well.

James - 00:31:21:

Yeah, okay. That's a great segue to one of my questions for today. And that is, how much success are you seeing in the translation from the desktop part of a project where the concept is born and the design is expanded upon? And then it goes across the table to someone who actually has to build the scene. And it's great that we've got aspirations in that desktop portion. Can they be realised and translated? And as you said, there's details in there around what the contract requires and how a contractor is held accountable for that, but also incentivised. So what are you seeing?

Conall - 00:31:53:

Yeah, I think we're in a transition phase. And at the moment, there's a tension between everyone's bottom line requirement to reduce cost and then our newer aspiration to reduce carbon. And sometimes they go hand in hand, like in the Glasgow example. But sometimes you'll have a value engineering stage and a contractor will say, look, if we change X, Y, and Z, we can come back. We can get that quicker or maybe a bit less expensive. But sometimes they'll have simplified the concrete order so that they're just one type of concrete instead of the three very carefully selected types of concrete that you might like. So you could call it a shortcut or you could call it being pragmatic at construction stage. And with some contractors, they're very aware of the carbon implications and they're upfront on it. And with others, they haven't really embraced that yet and they just want to get it built as quickly and easily as possible. So, there is a tension still. And I guess it's about holding firm. In terms of the contract specifications, you said, and making carbon reduction non-negotiable as much as possible and trying to stick with the intentions and make sure it's recorded and as transparent at the end of the job so that the client can see what the outcomes were as well.

James - 00:32:57:

Yeah, and I'm sure taking us back to some previous points we've discussed already, having a national level policy as well as a standard or a framework that you will work within and will become more and more mainstream and enforced potentially. Hopefully, start to give you the skeleton to then flesh out. So you'd like to think, I'm sure in your time you've seen some evolution and we're just, we're at a point on that curve somewhere that it'll be improving.

Conall - 00:33:25:

We all have a lot to learn still in this area. One of the things we want to happen in Ireland is that the consistency from one procurement body to another. And if we can achieve that, then we'll get everyone moving at the same pace and we'll collect a lot more information. We'll understand how much concrete we're buying, how much carbon is in it. And we can use that knowledge then to set more sophisticated targets and reach for further levels of ambition and realize that the public sector has massive purchasing power, particularly when it comes to construction materials. So if they use that power correctly, it can be a really important force for change. Whereas at the moment with agencies and departments doing some slightly different things, it's not coherent signals for the suppliers and they're happy enough with business as usual unless they get a really strong signal.

James - 00:34:09:

Have you got some stats on just how big a role? I guess in the Irish context, have a procurement place?

Conall - 00:34:14:

It was difficult for us to find out exactly how many cubic meters or tons of concrete are bought every year in the public sector. The overall capital expenditure across the public sector is in the region. It's more than 10 billion euro annually.

James - 00:34:28:

That's just Ireland, right?

Conall - 00:34:29:

That's just Ireland. It's just the Republic of Ireland. And it's hard to say. Some of the capital investment is in things like new trains, new rolling stock.

James - 00:34:37:

Sure. So it's spread around.

Conall - 00:34:38:

Spread around. But a lot of it is in bricks and mortar. So there is a housing crisis. There's a lot of emphasis on new housing development, but there's also a catch up in terms of infrastructure here. So a lot of that 10 billion is in traditional construction materials.

James - 00:34:52:

And then therefore in concrete. It starts to make a lot of sense when you spell it out like that, that we need a cohesive approach. Obviously Ireland's got a view in terms of how they accelerate it. Sounds like the UK's done some work towards it as well. Standardising at government level gives us one approach that then cascades to industry. And through industry. So turning to the future and how we think green concrete and green procurement might evolve. Can you talk me through procurement guidelines and is there a vision for that to evolve beyond where it sits today?

Conall - 00:35:26:

Yeah. So the short term requirements from the Irish government are very specific and relatively simplistic targets. So we're saying things like you must request an EPD, an Environmental Product Declaration. We're saying you need to move away from SEM1 cement, which is the highest carbon cement. And we're also saying you need 30% linker replacement. So that's reducing the traditional cement content by at least 30%.

And that's giving flexibility to concrete suppliers as to what replacement materials they use. They're short-term measures and they're achievable under the current concrete standards that are in operation. But I think in the medium to long term, we need to get more sophisticated. We need to start specifying. We want maybe an A rated concrete or a B rated concrete. Or maybe we say all concrete of a certain strength has to have no more than a certain number of kilograms of carbon per meter cubed. So that we get more intelligent and more prescriptive. So, in the same way, if you buy a fridge or electrical appliance, you've got an A, B, C, D rating. And it's very easy for anyone in a procurement team to say, yeah, we're going with B rating or we're going with A rating. At the moment in the UK, the curves and the data intelligence in the market is being used to develop those curves. So there's a kind of an embryonic Rating system available. What we found in Ireland is we just didn't have the data. We didn't understand enough about the current baseline situation. But with a bit more research and a bit more technical analysis, we can start moving to a more sophisticated purchasing requirement. So if you think of that, if you're in Dublin City Council and you could make a plan in 2025, we'll want no more than 300 kilograms of CO2 per meter cubed concrete. But we're going to reduce that by 2030 to 250. And by 2050, we want no more than 50 kilograms of CO2 per meter cubed. So, if we get more intelligent, we can become more, I think, more progressive in what we ask of the market. And that's good for the market as well. Yeah. And they can see we need to invest so many millions because we have to meet the increased standards that are going to apply in the future.

James - 00:37:30:

And so coming back to some of those technical aspects you mentioned, to use a couple of terms, they used SEM1. Can you expand on SEM, what SEM and SEM1 is and what are the other types of concrete?

Conall - 00:37:41:

So I suppose. I suppose the traditional, the main product that comes out of a cement kiln is called clinker. And that's ground down into a fine powder and mixed with a couple of other small components. Traditionally, that would have been almost 100% clinker, maybe 95 to 100% clinker. And that type of cement is currently, it meets a certain norm, a certain international norm in terms of content and performance. And that's called SEM1. But over the years, the cement industry has evolved to have a lot, a big wide range of different cement. And they've been given these international norms called SEM. So SEM2 has lower carbon because it has some limestone powder, limestone dust and other components. So maybe I think it's around 87% clinker and then replaced with other. And then as you go down to SEM3, SEM4, SEM5, there are different formulations and they're quite regulated and they achieve different levels of performance. So, it's like the shopping list. You can go for a more sophisticated lower carbon. You can go for a kind of bog standard, higher carbon version. And that's all governed at international level by quite rigorous technical standards**.**

James - 00:38:49:

And there's a carbon cost attached to both, pretty much all of those as well, established?

Conall - 00:38:54:

Exactly.

James - 00:38:54:

Yeah, okay. So that gives, as you say, the shopping list of where investment is required. I guess if we turn around, where is the innovation and the research required to find the solutions, new materials, as it may be, so that we have lower carbon concrete?

Conall - 00:39:10

So if you're in the cement industry today, you've probably replaced your fossil fuels with maybe waste-derived fuels, refuse-derived fuels, or some other lower carbon approach to heating to reach your 400 degrees centigrade. You're also probably working on energy efficiency in the machinery in the plant and the mechanical electrical plant. You're probably also bringing renewable energy into the plant to try and reduce your electricity use and the carbon and electricity. So you're doing all that, but the big challenge for the cement sector is to introduce carbon capsules. So remember, we talked about the emissions, the process emissions from a cement kiln, capturing two-thirds of the carbon emissions and capturing that. So if the

cement sector is to achieve a net zero status, they recognize themselves internationally, all cement plants will have to have carbon capture. So it's a big challenge, big investment, big technical challenge. It's only happening at a handful of plants in the world at the moment, but it needs to become prevalent across the world. So it's a big investment. And then you have challenges of managing that captured carbon. Do you store it? Do you transform it into something else? And that's another whole big challenge that, you know, it's not just for the cement sector, it's also for some of the traditional energy sectors. So that's, you know, that's where you're at if you're in a research team in a cement company now. You have short-term, medium-term measures looking at efficiency, but then you're also beginning to look at what are we going to do on carbon capture and utilisation and storage.

James - 00:40:32:

There's plenty of opportunity out there for bright people to find the solution. I'm thinking just for yourself, pick a number. 10 years, 15 years into the future, where do you think, and probably the Irish context is the easiest here, where do you think the industry will be in somewhere around that 10, 15 years from a concrete point of view?

Conall - 00:40:51:

Yeah, we're already beginning to introduce an alternative material so that there is growth in timber, structural timber construction and switching to alternative materials. And there's also a move towards off-site construction and modern methods. So I think that trajectory will continue. And for projects where we use concrete, I think... We will understand an awful lot better what we're doing. We will be much more frugal with the concrete and much more aware that every single meter cubed has a big footprint. So I think we'll be maybe, will we be two-thirds, maybe 50% of the footprint we have today? I'd like to think we could reduce it by that much in a 15-year period. So, I think we just have to be kind of mean with concrete, be stingy and treat it as a really precious resource and, you know, waste as little as possible as well.

James - 00:41:38:

And do you see the... Like the action plans, the standards evolving into like a regulation, a legislation or more likely just a norm across all of industry?

Conall - 00:41:49:

Yeah. Already at European level, there's a requirement in the energy performance buildings directive that there has to be an upfront transparent statement of not just operational energy, which is already there, but also embodied carbon in all building. And I think the next natural step for that will be setting limits on that. So not just a report, but then I would expect in the next 10 years there'll be a limit and that limit will progressively become lower. So, and that those kinds of directives then are underpinned by national legislation. So, one of the parallels sometimes we draw is between safety and carbon. So, we have a very regulated approach to safety. It's an all of project, all designers, all constructors. It's number one item on all project management meetings. And we've managed to make construction a lot safer. Still progress to be made, but we'll, if we follow the same approach in carbon, we'll achieve that sort of same all of project outcome. And we probably will need more legislation just to underpin that. So probably in the long term, this will become more systematic. And probably underpinned by regulation.

James - 00:42:50:

That makes a lot of sense. Just something I picked up here we haven't gone over was your Saggart reservoir project. Do you want to run us through the Saggart reservoir project and what that was, how it relates to green concrete and what was achieved?

Conall - 00:43:03:

Yeah. So Saggart reservoir is another nice example. It's recently completed. So Saggart is just a suburb of Dublin and the southern suburbs. And there's a strategic water drinking water reservoir that was just completed. So, our client here was Irish water, is called Uisce Éireann. And we were the client's representative. So quite a lot of carbon reduction was achieved. And our contractor here was Coffey Construction. And, you know, we worked closely with them. They brought forward a lot of innovation at the

design stage as well. But just to give you an example of what kind of reductions were achieved through a design change in the foundation underneath the reservoir, there was a saving of 9,600 cubic meters of concrete. So that's about 15,000 tons of carbon reduction, you know, which is really big. The second way to reduce carbon in the project then was, okay, we're still using concrete. It's an essential material. But we introduced clinker replacement through using GGBS and different proportions and different parts of the pores and different parts of the site, depending on the purpose of the concrete. But the overall saving, given the scale, you can think of how big a drinking water reservoir is. It's got a concrete lid on it. So we saved 26,000 tons of carbon in that part of the project. So overall savings there are 40,000 tons. So it's really satisfying from a, A technical point of view. So if you think of an individual, your footprint, my footprint in the course of a year is probably 10 to 15 tons, depending on how many flights you take and how good you are individually. So over your lifetime, you know, you're going to maybe get into the thousands, maybe a thousand. But in one project to achieve a 40,000 ton saving is really special. So that's just, you know, using just a bit of ambition there on the carbon reduction that was achieved. So I think there's much more ground we can make on that.

James - 00:44:44:

Yeah. It's hugely exciting, I think, as far as the future of construction generally. And specifically concrete. On that point, we might wrap it there. So thank you for your time. It's been really great speaking with you and look forward to hearing more about the success that RPS in Ireland are delivering for clients.

Conall - 00:45:01:

Thanks very much, James**.**

Outro - 00:45:07:

The Building Sustainably Podcast is brought to you by RPS. To find out more about RPS and how we can help you deliver future-ready development, visit rpsgroup.com and then search for The Building Sustainably Podcast in Apple Podcasts, Spotify, and wherever else you get your podcasts. Make sure to click subscribe so you don't miss any future episodes. On behalf of the team here at RPS, thanks for listening.

Disclaimer: This podcast transcript has been automatically generated using AI technology. While efforts have been made to ensure accuracy, the transcript may contain errors or omissions. For the most reliable information, we recommend referring to the original audio recording. Please contact us directly if you have any concerns or questions regarding the content."