

Infrastructure for a better future

Very simple and very beautiful

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Please note: the transcript has been edited to make reading as easy as possible.

Introduction: Welcome to 'Infrastructure for a better future', a series where we have honest conversations about the infrastructure challenges we are facing and how we can build a better Aotearoa New Zealand. In each episode we'll talk to experts from here and overseas about what works, what we can learn from, and where we're going.

Peter Nunns: Michel Virlogeux is one of the world's most respected bridge designers and structural engineers whose career has helped to shape some of the most notable bridges of the modern era. He's perhaps best known for his central role as the designer of the Normandy Bridge and the Millau Viaduct; projects celebrated not only for the scale and technical achievements, but for their elegance in response to place. Over a career spanning more than five decades, Michel has brought together engineering, architecture, constructability and economy to rethink what bridges can be. Michel is down in New Zealand today as a keynote speaker at the Bridge and Geotechnical Association Conference in Auckland. I'm

privileged to be able to speak to him today about his work and his advice to engineers about how to deliver better value enduring for generations. Michel, thank you so much for joining us.

Michel Virlogeux: Thank you very much, and I'm very happy to be in New Zealand for the third time, because I've been to Auckland in 1996, 2009, and today. It's a great pleasure.

Peter Nunns: While you've visited New Zealand, you've never designed a bridge here, unfortunately. So, for a local audience, it might be quite useful to have a bit of a run-through of some of the work that you have done internationally and in France.

Michel Virlogeux: No, I've never designed a bridge in New Zealand, nor in Australia either. So, I graduated at the École Polytechnique first and École Nationale des Ponts et Chaussées later. My first professional activity was in Tunisia, because my father was professor of geography and I was really interested to work in developing countries. I very much liked working there. I kept good friends in Tunisia. But I was more working

on roads at that time. I came back to France in the beginning of 1974.

Then I worked in the French administration, in the technical service of the highway administration for a bit more than 20 years. I started as an engineer. Progressively, I started with some small bridges because you never start with big ones – it's not very wise to start with big ones. And after 1980 I became head of the concrete bridge division and in 1987 of big bridges, concrete and steel. I had the opportunity to take part in many bridges: arch bridges, bridges built with a cantilever method and so on. But the big affair for me was the Pont de Normandie (Normandy Bridge).

One thing I must say is that big projects are always controversial and take much time. So, the time between my first participation in the Normandy Bridge project and the opening was 19 years. I started, not designing the whole bridge, but only working on the approach viaduct and on the towers, because there was already a chief engineer. But for financial reasons, due to the oil crisis in 1978, the project was abandoned. The project came back in 1986 and then I became the designer. I was rather young – I was 40. I took the risk to say that we must design a bridge spanning the total width of the river Seine. It held the world record at the time for have the longest cable-stayed span.

It has created some controversies, a German professor wrote directly to the President of the French Republic saying that it was shocking that such a big project was given to a young engineer. My administration thought that I was strong enough to develop this project. They let me go to international conferences in many countries, and I saw many constructions and met great engineers. When looking at the cable-stayed bridges which were already built, especially the German ones, I was convinced that there was no reason to limit the span of cable stayed bridges at 400 or 500 metres. If you look at the big German bridges in Düsseldorf, they have a span of 350, but with one tower.

This is simple: when you look at these bridges and if you make a symmetry, the span is 700 metres. I was convinced that it would work for the span of the Normandy Bridge at 856 Metres long. At the same time, if you want to have a safe main span, you must have rather rigid side spans. It's

why when I was free to design the bridge, I made side spans with short spans and then a big main span, so that the stay cables anchored in the side spans maintain the tower. The deflection of the main span is then limited and the bridge is very stable. I was convinced of that. There have been controversies, some pretended that the bridge would collapse during its erection. We also have some corrosion problems at the anchorages of the stay cables, but the bridge behaves perfectly.

Peter Nunns: This touches on something from your talk this morning about the role of the designer, the engineer, in the job being about balancing forces throughout the structure. So, could you talk a little bit about what you have seen there, in terms of the approach the engineering profession has taken over time, the changes from when you were a young man through to today?

Michel Virlogeux: Many things have changed with time. Of course, I'm obliged to evoke the development of computations and of structural analyses. When I started working, we had very, very limited computer systems and computer software. But today we are very rich. But this richness must not prevent us to organise the design. We must feel how forces work in a bridge and we must design the bridge in such a way that these forces work as we like it. It must be a choice from the designer. This is why, as I just said, I designed rigid side spans on the Normandy Bridge, which stabilise the system. I also decided to make a rigid connection between the deck and the tower for the same reason. Because I was convinced that the large value of the displacements under the wind or traffic loads would frighten people.

Peter Nunns: It had to look and feel solid, so people felt safe with it.

Michel Virlogeux: Absolutely.

Peter Nunns: That brings on to the question of design and design for the site, which has been a feature in your work. How have you approached this throughout your career?

Michel Virlogeux: This is a very good question. Another very good question. Well, when I was at the École Polytechnique, we had lessons of architecture. It was done by an engineer who had been at the polytechnics like myself. I listened to his lessons. He was not giving big

theoretical lessons. He was just showing slides and saying, “Look at that. At the same time, it’s very simple and very beautiful.” You see? Simple and beautiful. That’s very important. I was really impressed by what he was saying and showing.

Later, when I was at the École Nationale des Ponts et Chaussées I had a professor teaching bridges, he was not a bridge designer himself, but he knew very well the history of bridges. With these two people had a big influence. The moral is that I felt that my role was not to make detailed calculations, but to understand the forces, to evaluate the forces and to consider the bridge in its site and for its elegance. At this moment, I really completely changed and considered that the elegance, the position of the site, were key factors. Of course, the bridge must be stable, must be maintainable, but it must be elegant.

Peter Nunns: Have clients always appreciated that approach? And have you seen a change in how clients approach this sort of thing in your career?

Michel Virlogeux: There were two parts in my career. The first one when I was in the French administration. Not in the last years, but during 15 years approximately, I had two successive highway directors. Not immediately, because when I was very young in the beginning that wasn’t the case – but I received from them the mission to design beautiful bridges and to promote innovation. I was really pushed because they believed in my capacity. Of course, I couldn’t do anything I wanted to because I had to propose a design, to discuss it and to show that it works – there was a system of approval. But I was free to propose and that was very, very important.

When I left the French administration in 1995, it changed everything because I was no more supported by the weight of the French administration and of two very good highway directors. Then at this moment, I could work either by entering design competitions. When I started to work in 1995 and until now, I work alone. But of course, you don’t make a project alone. So, each time I try to enter a team, preferably a team of friends, because it’s difficult to work with a person with whom you do not have good relations with. I must also say that I have been sometimes called by owners. This was the case for the Vasco da Gama Bridge. In this case, the Portuguese administration called me because they had seen the Normandy Bridge and they said, “Michel, could you come and help us?”, as an independent checker.

Peter Nunns: This was on the extension of the bridge, the new deck they were constructing or the original?

Michel Virlogeux: No, this is a new bridge, the Vasco de Gama Bridge. I did not design this bridge. I gave some important advice but I was not the designer, and I was not officially the independent checker, I was the advisor to the Portuguese administration.

Peter Nunns: What do you see is critical there in terms of what engineering capability, planning capability you need in government?

Michel Virlogeux: I think that first, it must be somebody who has some real authority. I always say that to make a good bridge, we need a good owner, a good designer and a good contractor. So, that’s clear. Because if you are not a good owner, it becomes difficult. The owner is not necessarily someone with a large technical experience. But I think that in administration you must have some engineers who have an experience of projects and construction, who have been on construction sites, in order to be able to evaluate designs and decisions.

I must say something: in each bridge or case I’m working on, I discover things I didn’t know. Nobody knows everything. For an example, I’m now trying to understand more closely how some type of boring machines work, because there is a controversy and it’s very difficult to know who is right and who is wrong. You have to enter details, and you must remain open to new questions. You must still remain considering that you must have to listen to people. I can give you an example with a discussion with an architect.

We were designing a bridge on the River Vienne at Limoges. It was a design competition. We were on site where there was an architect with whom I have worked many, many times, Charles Lavigne, a colleague of a design office, and myself. Perhaps a fourth one, I don’t remember. And we were on site looking at what could we do? I made very simple sketches, and suddenly the architect said, “You have not correctly read the programme. In the programme, the city of Limoges wants to reappropriate the riverbanks. Your bridge doesn’t answer this question.” I said, “Okay, you’re right.” We changed completely and we built the programme from that. We wanted to make an arch bridge because in this city, there were two bridges of the Middle Age, with arches. So, it had to be an arch, due to history. We go back to what I said – to history. We organised a system where people on the bank could climb on the arch, pass through the deck, so that they

can go from any place to any place. It works wonderfully.

Peter Nunns: So, for that, the history and the context, and the climate need.

Michel Virlogeux: Absolutely.

Peter Nunns: As a final question, on your third visit to New Zealand, although it's brief, you must have built up some observations about what you're seeing here, the challenges that you hear from people. Do you have any advice for us in terms of what we could do next?

Michel Virlogeux: Well, first, you have very specific problems: earthquakes that you are perfectly able to manage. As I said you have a school of Paulay, Park and Priestley [seismic engineers] who really developed theories which are introduced in the codes, but I prefer the theory more than the codes.

What I noted is that, in my opinion and I'm being very frank here is, as in the United States of America, too much concern about the cost. Of course, I understand from what was said this morning, that there is a problem of finances everywhere. You have a very beautiful country. You must make an effort for the architecture of your bridges, for the integration of their site. I've seen the little pedestrian bridge which had been presented. This is well done. That one is very beautiful. I've seen others which are not so beautiful. So, I recommend to do what was

ordered by my first two highway directors: try to promote a beautiful bridge architecture adapted to each. It's not so much more expensive.

Peter Nunns: So, thinking carefully about it can lead to solutions that are beautiful and fit for purpose.

Michel Virlogeux: Yes.

Peter Nunns: Michel Virlogeux, thank you very much for your time.

Michel Virlogeux: Thank you very much. It has been a pleasure.

Narrator: Thanks for listening to this episode of 'Infrastructure for a better future'. Find out more about the work of the New Zealand Infrastructure Commission and what we're doing to transform Aotearoa at www.strategy.tewaihang.govt.nz.