Resulting from a cooperative project between three Swiss universities—the School of Architecture, Civil and Environmental Engineering (ENAC) at the École polytechnique fédérale de Lausanne (EPFL), the School of Engineering and Architecture of Fribourg (HEIA-FR) and the University of Fribourg (UNIFR)—the *smart living lab* is a research and development center designed to explore the future of the built environment. Located on the strategic blueFactory site in Fribourg, Switzerland, its innovative embodiment as a built structure aims to serve as an emblem of the translation of academic research and social awareness towards sustainable construction into an actual building.

This book is the first of a series entitled "Towards 2050," which showcases this ambitious undertaking in its various stages. It presents interviews with twelve leading experts from various professional and geographical horizons. Capturing the essence of their prospective visions for sustainable buildings in a 2050 perspective, the book lays out the myriad challenges and opportunities the *smart living lab* project may face, as well as its extraordinary potential to drive change. It can thus serve as a source of inspiration and a tool for producing interdisciplinary knowledge designed to strengthen both research and operational practice relating to sustainability transitions in our built environment.

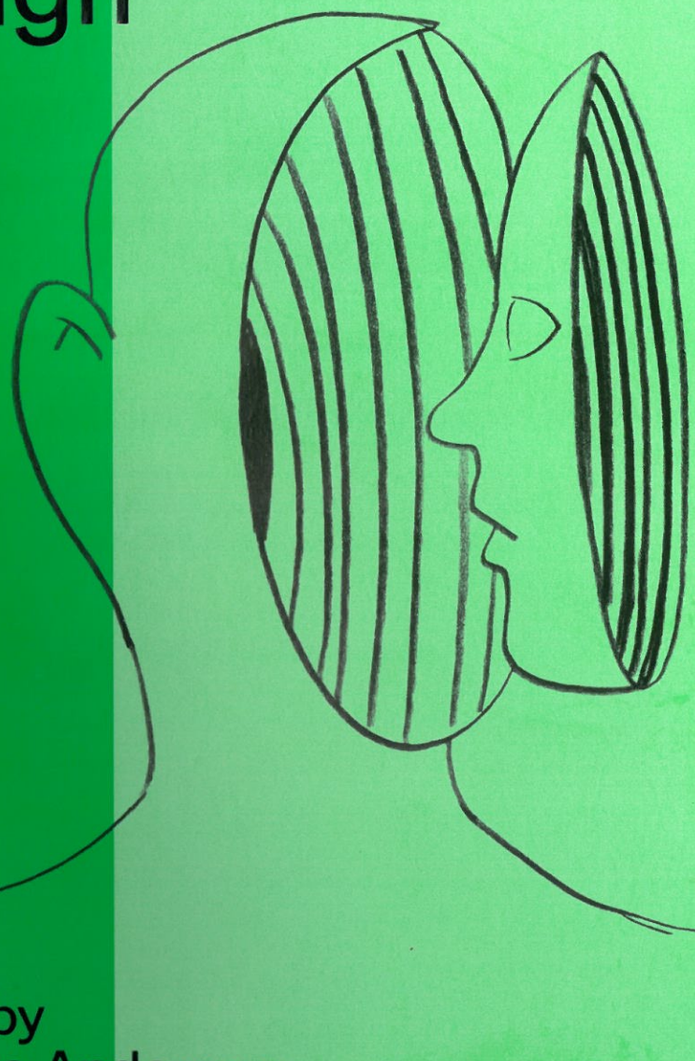
Interviews with Tatiana Bilbao, Paula Cadima, Lionel Devlieger, Herbert Girardet, Alistair Guthrie, Kengo Kuma, Ali Malkawi, Edward Ng, Susan Parnell, Antoine Picon, Carlo Ratti, Koen Steemers.

Contributions by Marilyne Andersen, Sophie Lufkin, Emilie Nault and Emmanuel Rey.

Printed in Germany
ISBN 978-3-03860-131-9

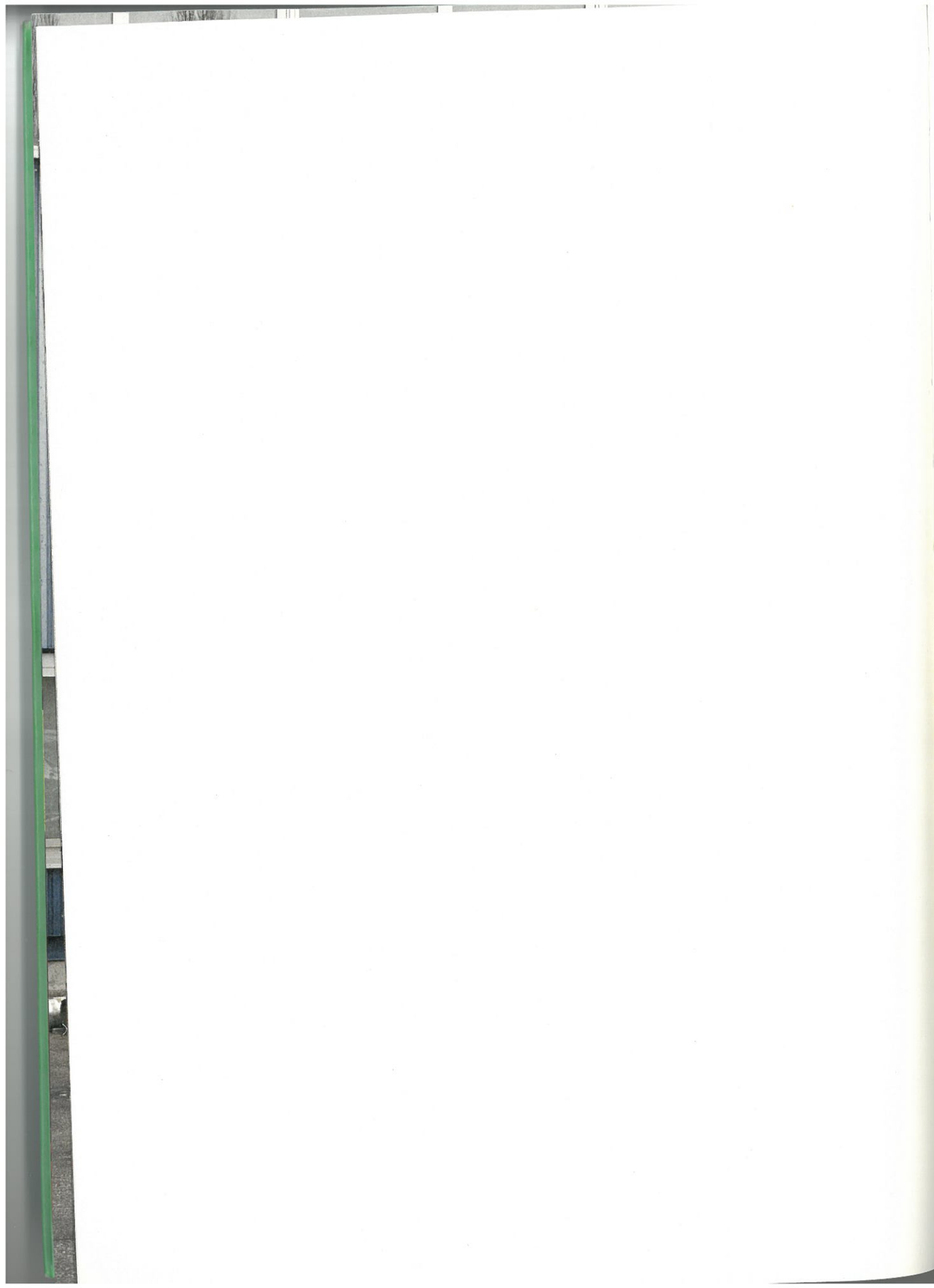
Thinking
Visions for Architectural Design
Marilyne Andersen
Emmanuel Rey

Thinking
Visions for Architectural Design



Edited by
Marilyne Andersen
Emmanuel Rey

PARK BOOKS



15 Foreword
17 Facing design complexity by confronting visions for the future

37 Tatiana Bilbao
51 Paula Cadima
61 Lionel Devlieger
73 Herbert Girardet
83 Alistair Guthrie
97 Kengo Kuma
109 Ali Malkawi
117 Edward Ng
129 Susan Parnell
137 Antoine Picon
147 Carlo Ratti
157 Koen Steemers

169 Three success factors for buildings in 2050
185 Re-thinking sustainability

199 References
203 Illustration credits
204 Authors
205 Stakeholders
208 Acknowledgements & Imprint

"I've always
believed
that a simple
building
is beautiful."

Edward
Ng

Edward Ng is Yao Ling Sun Professor of Architecture at the Chinese University of Hong Kong, where he leads research on topics including solar access and daylighting, urban climatic mapping and climate change. Trained as an architect with a doctoral degree from the University of Cambridge, he conducts humanitarian work with his students while also working as a practicing architect and an environmental consultant to various Asian governmental bodies.

Interview date and location:
4 July 2017, Edinburgh,
Passive Low Energy Architecture Conference

"Everyday we look at how the stock market goes up or down; we never look at how CO_2 goes up or down."

What's your definition of a sustainable built environment in a 2050 perspective?

EN My definition is very similar to everybody's definition: to live within our limits and resources, and not to spend my son's inheritance. Scientifically speaking, we know very clearly what we have. Now, we must find a way to live within that.

What are the main challenges and opportunities with regard to a sustainable built environment?

EN There are many, but one of the biggest challenges, in my view, is that people in general are not aware of the urgency of the problem. We've been living a certain way of life—based mostly on economic development—for the past hundred years. So, our value system is still very much like it was during the industrial age. Everyday we look at how the stock market goes up or down; we never look at how CO_2 goes up or down Figure A.

It's changing the mindset of society that is the major challenge. It is extremely difficult for people to change their mindset. That's why the government doesn't want to change: because people don't want to change, or don't know how to. They're not looking for that.

Some countries have greater awareness of energy and environmental issues, like Germany for instance, or northern European countries like Denmark, Sweden and Norway. In countries like this, where people are very aware and appreciate the urgency of the matter, policies are moving faster. Whereas in some countries like the United States, it's not that they don't know how to change, but rather don't want to Figure B. The value system is such that they want to go on living life as usual. In Asia, it's more problematic because we want to live like Americans, so we're expanding.

What role can buildings play?
Can they educate people?

EN A building can educate people, but people will always backslide. If you design a building and try to educate people about how to change their habits, they'll either complain or cut corners. Relying on buildings alone is not sufficient, as the backslide effect is very common.

I have a good example to illustrate this mechanism. I teach in a five-storey building. I asked the building manager to shut down the lift so that students would have to walk upstairs. Five storeys is nothing! But the students complained they had to walk from the ground floor to the first floor! They didn't want to. They complained so much that the president of the University said that we couldn't stop people from using the lift. The most common answer I got from students is, "I've paid my school fees. That included lifts."

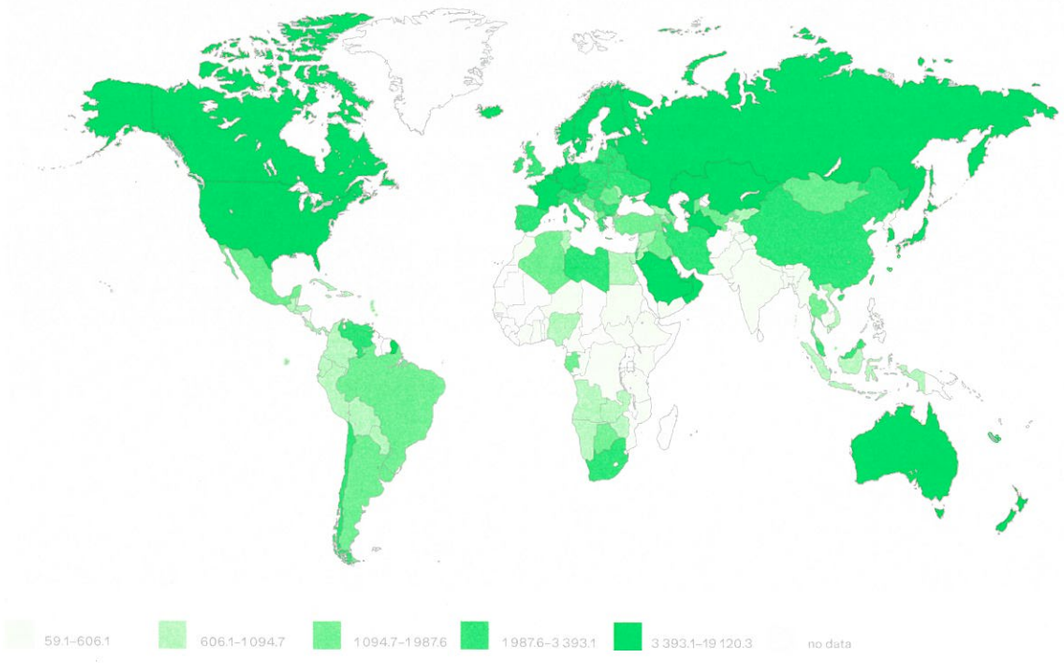
People won't change their habits unless their way of life is jeopardized. Otherwise, it's somebody else's problem. As I said,

A

Dow Jones Industrial Average (Index) vs Atmospheric CO_2 concentrations (ppm), 2016–2017

B

Global energy consumption per capita (kg of oil equivalent per capita), 2010



"The space must be designed such that people will enjoy the walk."

the problem lies in mindsets and lifestyles, not technology. Once you understand that you can easily walk up five storeys instead of taking the lift, then staircases can be better designed. The space must be designed such that people will enjoy the walk. But even if you do that, people will still complain that they don't have a lift, no matter how wonderful the staircase is. They still want the lift because of their lifestyle.

What are the major obstacles to the construction and evolution of buildings?

EN I believe that in terms of construction, design, etc., technology can get it almost right. Regarding management and control systems, however, their responsiveness and user-friendliness still need some fine-tuning. But the building envelope and systems are more or less there.

The difficulties I find and that a lot of research indicates is that, when a system or building is dependent on how people use it, then the two things don't necessarily match up. Therefore, energy wastage is not a by-product of the system itself, but rather of people's improper use of it. My students are perfectly capable of turning on the air conditioning (AC) and opening the windows at the same time because they think they need better "fresh" air. Because the AC provides coolness, they don't mind the hot air coming in from outside. If it gets too hot, they simply turn up the AC because they think having this combination of "fresh" air and AC is best.

So, the obstacle is people's misuse of buildings or lack of understanding of how it works. For example, when you buy a car, you get a manual that tells you which switch does what. If you buy a new computer with a new operating system, you get training. How often do you buy a house and get training on how to live in it? Never. There isn't even a manual that teaches you how to use your building properly. For example, if a building is airtight and people don't realize that, then they can just open a window and all that airtightness is lost. What's the point of designing the best, most efficient, most sophisticated building if people don't know how to use it? People need to learn to use a good building properly. Otherwise, it's easy to turn it into a bad building.

What is technology's role?
Can it be used to make people more aware?

"We have more technology than we need to solve the problem."

EN Technology is there and isn't a problem. In fact, we have more technology than we need to solve the problem. Now, the question is how to solve the problem? Unless, of course, I'm wrong and there's some kind of what we call a "transformational technology" that itself solves the problem. For example, something that generates a lot of energy but no carbon dioxide. Maybe it will happen, who knows, but we shouldn't count on it.

In terms of technology for informing people, most information only reinforces what people already believe. People

select the information they want instead of saying "Oh, I was wrong." This is how we collect and process information. We don't process information to prove ourselves wrong. That's the problem. More information may not be better; it may simply mean people are becoming more stubborn by reinforcing their own ideas. Therefore, you have to have some kind of disruptive education that tells you you're wrong, but we don't like that kind of education. If your mom tells you you're wrong, you won't talk to her for two weeks! It's human nature. We can't fight against human nature.

"My projects are always very low-tech."

How do you deal with all these challenges in your work?

EN The way we do things is by designing simple buildings. We're very down to earth, and my projects are always very low-tech. We understand how people live, how they move in and out of the house, how they spend the day, how they read their newspaper, etc. The first step is understanding people, and then designing spaces using passive means: putting a window in the right place or creating a courtyard with appropriate proportions. We don't use smart systems for most of the work. Instead, we rely on building physics, meaning the building's envelope and geometry. We always observe people and how they behave, and then design something very simple that people can understand. Everyone can understand a window, but not everyone understands all these high-tech gadgets and buttons, which are very difficult to set, especially for older people.

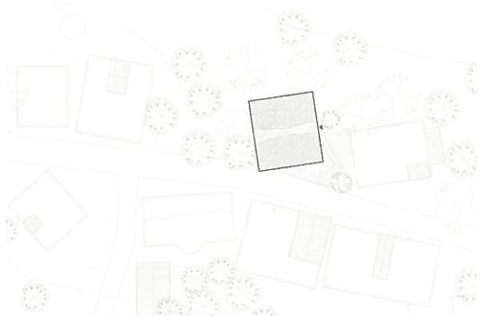
We rely on passive design to solve most of our problems, but that mostly applies to the residential buildings I design, and not office buildings. Personally, I prefer residential buildings because they're closer to people. I feel like I can work better with a closer connection to the occupants.

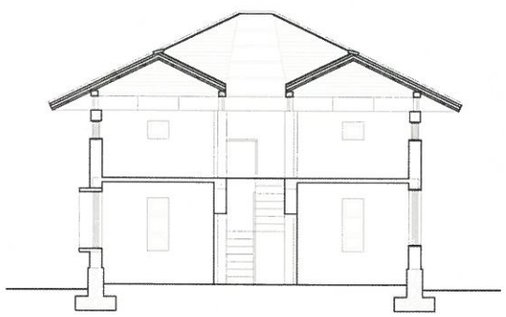
Your anti-seismic house in Guangming seems emblematic of these principles. Can you tell us more about that project?

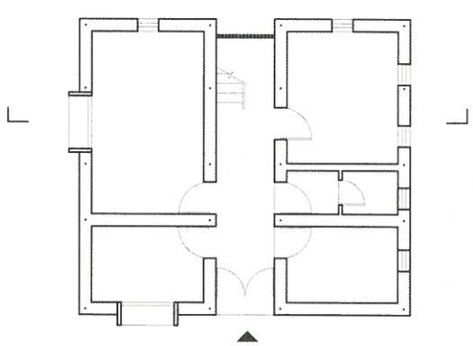
EN Yes, of course! The project Figure C started in 2014 after the devastating earthquake in Ludian County, China. When we ventured into Guangming village, we discovered that most of the rammed-earth houses had been destroyed. In collaboration with members of the local University of Kunming, who helped us connect with both villagers and the local government, we started investigating the shortcomings of these houses that had been destroyed. We also included experts in seismic-resistant design from the University of Cambridge in the team.

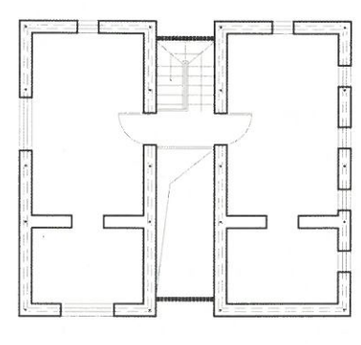
First and foremost, the house design had to be simple because we wanted the villagers to be able to build it themselves. Using our experts' input, we improved the earth mixture that existed onsite by increasing the resistance and workability of the material. Simplicity is also an important parameter for seismic-resistant design: simple geometries are more resistant than

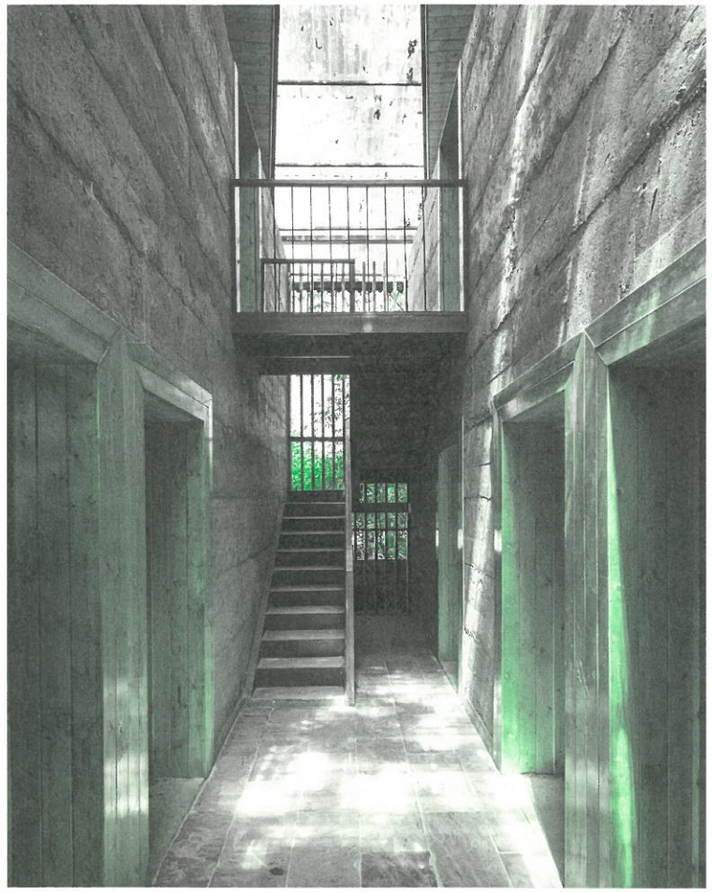
C Post-Earthquake Reconstruction Project in Guangming Village, Zhaotong (China)
The Chinese University of Hong Kong & Kunming University of Science and Technology arch., 2016











complex ones. A square form, for instance, is always stronger. Even if the walls collapse, the pyramid-shaped roof will stay intact, allowing inhabitants to escape from the building uninjured. This is how we started our design—with a square block. Openings also required special attention: every time we create an opening in an earth wall, we weaken it. We had to surround the larger window openings with a concrete frame that would keep the window intact in case the walls started shaking.

But the challenge here wasn't just building a house that's resistant; above all, we wanted to build a house that its inhabitants would enjoy, in this case an elderly couple. We asked them what they needed for their daily lives and then designed the accommodations accordingly. We divided the square form into two blocks separated by an atrium space that is brightly lit by overhead lighting, and cool in summer and warm in winter thanks to the high thermal mass of the earth.

However, the project was more than just a single house; it's a prototype that can allow us to solve many problems in other parts of the world where earthquakes are an issue.

And how do you deal with commercial buildings?

EN For commercial buildings, it's more difficult because the demands are greater and different. A house is for several people, who you can get to know. An office is for everybody, and you don't know everybody. It's more difficult to fine-tune your design for people in an office or school. For those, you may need to design different spaces—some hotter, some cooler—so that people can choose where they want to sit. The downside is that you waste a lot of space. I've done one or two institutional buildings. My approach has always been to create a range of spaces so that the occupants can move around. Instead of trying to create one space that will serve multiple functions, I create different spaces for different purposes. For institutional buildings, because they are so many more people in them and their uses are more unpredictable, the likelihood of using active systems is higher.

Do you use any tools, including digital tools?

EN Yes, we have to use some simulation tools to help visualize performance. However, we know roughly how our designs perform, and are mainly looking for confirmation. We rarely change our designs because they're so simple that it's rare that anything goes wrong. A complicated design can often go wrong. For example, air can go in somewhere that you didn't expect it to. That means it's much more important to make a few iterations to make it right, and that takes time. If you're running out of time and have one month to create a design, and this is a five-month process, then you need to stop somewhere along the way that isn't optimal. Whereas if you design something simple,

you know it works and only need to confirm that. You don't need to change it.

We also use digital tools to do post-occupancy monitoring. This is how we learn from our buildings. Most architects tend to design a building, take a picture and go away. They just don't care! In my office, we put sensors in our buildings and monitor them for at least a year. That way we know what works and what doesn't, and for the next building, we know how to adjust. That's what we do each time.

However, we don't rely purely on technology. We also go back to ask people what's good and what isn't. We learn from the people who use the building. I think this is a very important step for developing sustainable buildings. Feedback, which is neither complicated nor expensive, should be included in the design process. Sometimes the occupants tell you that you made a mistake, which is ok. The sensors are there to confirm our observations. It's rare that we have surprises because our buildings are so simple.

As an architect, consultant and professor,
what do you feel are the main drivers of change?
Where can you have the most influence?

EN In all three. As an architect, as we discussed earlier, you can understand how people live and how to live more sustainably through design.

As a consultant, you help different groups start the process; you teach practitioners the steps to take by pushing ideas that are easy to implement. Once they've started, at least they know what the next step is. For example, sometimes the government doesn't know how to proceed: it starts with the most difficult policy (which nobody follows anyway) and then gets stuck. We help the government draft simple policies so that people know how to begin and move on from there to more difficult policies.

In academia, when you educate, you transfer knowledge to younger generations. Education is the main thing we should get right. Unfortunately it's a long, slow process. By the time we educate, the battle is lost. I have no idea how we can fast-track education. Changing values and mindsets is a long-term process that takes several generations. Sometimes, it takes a disaster to change mindsets quickly, and we don't want a disaster.

What can be done as part of architecture
education?

EN Instead of talking about form, geometry, composition or aesthetics, as most architecture schools do today, we need to come back to the basics. I've always believed that culture, history and theory are built on a foundation of natural laws. Natural laws are those that gave us the laws of physics, the environment and materials. If you understand those, you can see how all culture, history and proportions derive from that basis. For example, in a hot and dry climate, you always build your courtyard with vertical proportions. People now consider that as cultural because in other parts of the world, courtyards are always horizontal. So there are cultural differences, but culture is simply a response to the fundamental laws of how the sun moves. It's as simple as that.

My suggestion to architecture schools is to go back to the laws of nature and rediscover manmade laws based on those fundamentals. Discover how culture responds to the environment, how human lifestyles respond to culture, and how our aesthetic values are based on living and culture, and thus natural laws. Nowadays, many architects talk about aesthetics as though they were abstract. But they've got it backwards! That's how I see architectural education, but I'm quite sure some—or even many—architects wouldn't agree with me.

I've always believed that a simple building is beautiful. I like to call complicated buildings "Mickey Mouse" buildings. It's actually more difficult to make something simple. A building that responds to nature is architecture— and that is truly sustainable! Unfortunately, a lot of people like Mickey Mouse buildings because they're costly, exciting and nice to take pictures in front of, but they don't need to last. So, you can build another one in two years time to replace it. Maybe that's how we treat architecture—as a fashion. It's not about a place to live, it's a fashion statement. In the fashion world, you buy a new dress, take some pictures in it, throw it away and buy a new one. Even if the dress itself is sustainable, the process of renewing fashion isn't. That's my main comment on the architectural profession. Our mindset is not sustainable. I want my building to last 2 000 years, without maintenance. If you want that to happen, you only need a very simple construction detail. If you miss that detail, your building will last three months. Many architects don't pay attention to the small things. They want to design creative forms but don't look at the lines, so their buildings don't last. Their buildings leak, and they think, "Oh, that's normal. All buildings leak." But that's not true. All good residential buildings should not leak.

In this sense, many architects would benefit from rediscovering the benefits of vernacular architecture. However, with the waves of "icon" or "star" architecture, many architects refuse to follow tradition. They think they're creating something new, something unprecedented. The more sophisticated or stranger-looking the building, the more wonderful, interesting and iconic. However, actually building these designs and making them work is very difficult! Even after hiring the best engineers, they sometimes still don't work, so they have to rely on active systems. I think architects forgetting their past is a big problem.