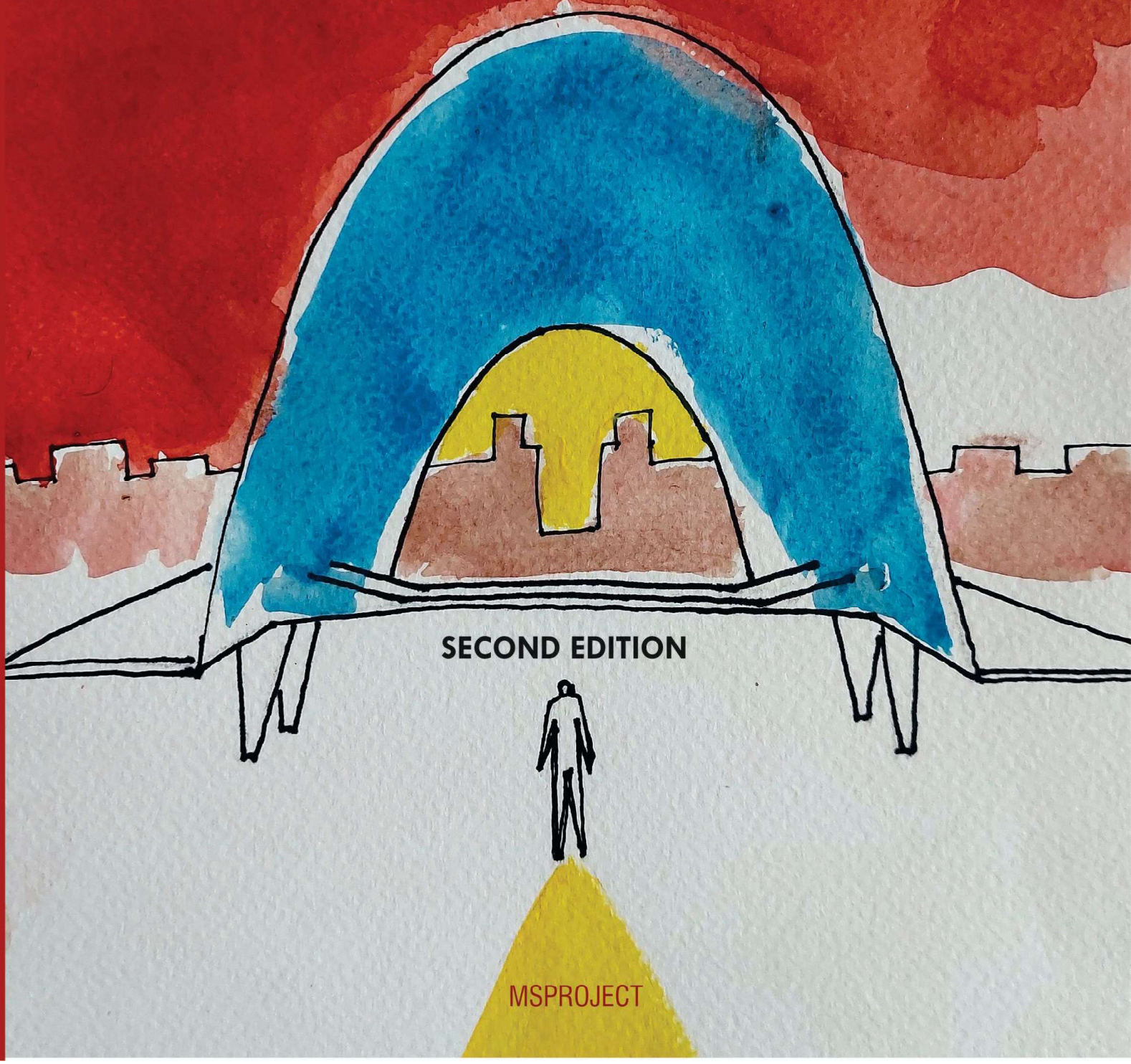
MENTOR LLUNJI

TOWARDS A NEW ENGINEERING

REFLECTIONS OF A PRACTITIONER



SECOND EDITION

MSPROJECT

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Second edition

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The future of structural engineering is about unlearning the technology. It is about returning to the fundamentals.

Mentor Llunji

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PREFACE TO THE SECOND EDITION

"Towards a New Engineering" is not about the new technologies and digital tools as the title might hint. It's actually about a bigger picture and returning to the fundamentals. Strange as it may sound, the future of engineering is about unlearning the technology and introducing some humaneness into our profession.

This is a very personal book. A collection of intimate reflections on structural engineering, its present and future. A testimony on many issues that 'bothered' me during my years of designing structures. A critique and praise of built structures, structural design strategies, codes, educational system, digital tools and much more. It's dedicated to the unsung heroes of structural engineering. Not the unknown ones, but the unrecognized ones. It's an album of their thoughts and designs.

My reflections on profession, published in the first edition, resonated with many colleagues around the world. I knew that I had done the right thing when I received a two-sentence letter from Leslie Robertson, the engineering legend, stating that he read this "thoughtful book within two days". At that moment I felt that my "mission" was complete, considering that I had said it all. But I didn't.

I haven't said enough about engineering practice and how it functions in the real world of design. I should have said more about engineers' relation to creation, architecture and archi-

tects. To deconstruct the myth about their collaborations and tensions, something I know very well, as a result of my nearly 20 years of engineering practice. Something that might serve practitioners.

I have added three new chapters, expanded and reduced others to make the text and message more direct and clear. This edition is more graphically oriented to guide readers smoothly throughout the text. The drawing of freehand sketches and figures, was for me the most enjoyable part.

I consider this book as a modest contribution to developing a much needed philosophical thinking on structures, on the engineer's place in society, relation to art, architecture, the future and the design process in general.

The book is intentionally filled with references to famous engineers of the past and present, their thoughts and distinguished projects. All this, to draw attention to the lack of knowledge on famous structures and engineering personalities, especially among fellow engineers of today. You'll not find a violin player who is not acquainted with Paganini, but you'll find that the majority of engineers have never heard about Riccardo Morandi or Eduardo Torroja. This is something unparalleled in any profession. Very few engineers are interested in the history of their own field, thus the work of leading structural designers remains unexplored.

Engineers in contrast to architects, are accustomed to reading only "design of structures" type literature, concerned with techniques, steps of analysis to follow or learning a new computational tool, which undoubtedly, in the long run, will narrow their thinking and creativity. There are no critical texts on engineering projects, methods, techniques or approaches. We may find, here and there, some notes from Nervi or Torroja, a few memoirs or some quotes from Candela or Maillart. Engineers rarely write about their own kind, and our history is

written mainly by architects. However, as long as these types of books are being published, there is always a hope that in the future we may see positive changes in this direction.

My ultimate goal was to offer a sincere and personal look at structural engineering, without coloring my thoughts with mainstream attitudes, not dazzled by technology achievements, and thus trying to see beyond everyday trends and hype.

I hope these frank thoughts will inspire engineering professionals in their personal quest for the new and optimistic vision that is so much needed for the future of structural engineering.

In Dulcigno, May, 2022 **Mentor Llunji**

PREFACE TO THE FIRST EDITION

Reading Eduardo Torroja's book "Philosophy of Structures" reminded me of why I wanted to be a structural engineer. It was a childhood dream of mine to design beautiful buildings and leave behind structural works that would be remembered. As usually happens, reality proves us wrong and the dream and idea of being a master builder has been traded in for the real world of formulas, equations and computer modeling. Today, apart from a few exceptions, the master builder is an extinct species. Instead, we have technicians, analysts and software operators. For me personally, engineering was a synonym for creation, just as it was architecture. The distinction between those two has always been blurred. I identified engineering with da Vinci, Brunelleschi, Sinan, Eiffel, Shukhov, Nervi and Calatrava. Alas, our educational system from the first day tries to convince us of the 'unnatural' symbioses between architecture and engineering, sterilizing and framing creativity with codes and regulations.

We are persistently trained to believe that the idea of the architect-engineer has been lost. This short book presents a collection of long essays containing the author's thoughts about the structural engineering profession – its present, its future and its relation to architecture and aesthetics. A future which is already here and which warns us about drastic changes to come in terms of thought, education, interconnection with architecture and the overall work of today's engineers, as well as those in the next 10 or 20 years. It is an homage to talented and creative engineers of the past and present, and a

notice and admonition to those who are to come in the future. It is a collection of meditating thoughts about structure, architecture and design in general, accumulated throughout the last decade and written between May and September 2017.

This book is not a philosophical treatise or a 'Le Corbusier-type manifesto', nor does it intend to discover the prospects of the future of this creative, inventive and at times routine profession. Instead, it seeks to open the door to its future, a door being kept closed by the professional community itself, embedded in the old schemes and with an attitude of disinterest toward the coming change. Unlike architects, who regularly contribute to the architectural literature, structural engineers have always behaved very dully in regard to their profession. Besides "scientific" papers and dealing with, as Felix Candela once remarked, "discovering little bending moments unfairly hidden in unsuspected places of the shell", engineers have never bothered to look at the bigger picture of our profession. Instead, they have isolated themselves between the imaginary walls of calculations and spreadsheets. The title is a tribute to the Le Corbusier book "Toward an Architecture" in which he explored the need for a new (modern) architecture.

This book (with no ambition for comparison) maintains the similar purpose of exploring the need for a new engineering, an engineering which delves more into art and architecture, an engineering which is more inclusive, which sets its sights higher and broader. It is a quest for engineers' new identity. It is time to reinvent ourselves. Engineering is not just engineering; it is art, architecture and a philosophy all its own. An engineer should be more than just an engineer and a structure is more than just a support. It is about a concept that is actually very old and expresses the need to seek a lost creativity in the profession, to return it to the artistic place it deserves.

Today, engineering is still seen as only a technical, analytical or calculating effort which has nothing to do with invention

or creativity. Engineers have lost the glamour of the past – and this statement can be heard by engineers all over the world. They are willingly (or not) accepting the role of technical support to the architect, becoming its technical servant. The creative-inventive nature of their work, which has been an initial impulse for choosing this profession, is fading. It is a challenging time for structural engineering. This book is a rare possibility for structural engineers to consider the meaning of their profession, to meditate about it and its relation to, or distinction from, the practice of architecture.

Working as a practicing structural engineer, designing all types of structures, communicating with a large number of architects and having published several books - all this, gives the author an ability to more closely "read" the trends and concerns of the profession. Including its good and bad aspects – to demystify it and offer some ideas for rediscovering it.

This is a collection of thoughts but not conclusions and theories. These are simply the reflections of a practitioner. The book is recommended for all structural and architectural engineers, as well as for students of engineering and architecture, especially those who have chosen structural engineering as their lifelong profession. It is an eye-opening book that will provide a clearer, more realistic perspective while also offering an idea of where engineers will be in the future and how they should adapt to the time that comes.

In Dulcigno, September, 2017 **Mentor Llunji**

INTRODUCTION

There are more engineers in the world than architects. More than five million. However, today, in structural engineering there are perhaps only 10 true designers – no more than that. All others are technicians and supporters of architectural ideas; fulfillers of the architect's wishes, usually servants, very rarely partners and never leaders. It sounds harsh, but it is true.

In our present post-industrial digital world, civil engineering no longer finds itself in the avant-garde of social development. [1]

Engineers, in their quest for the automatization of structural analysis and design, are becoming dull, losing their sophistication and some of their creativity, and transforming themselves into purely technical support for architects, with limited creative input into the final design. Somewhere along the way structural engineers became "subjects" of technology rather than being at the forefront of technological innovations. According to recent reports[2], there is a consensus that "automation is diminishing prestige and authority of the engineering community, and digital coordination is changing the way the industry operates". Most of us working in the structural engineering industry are aware that our branch has been hit by a major earthquake of changes, which might make the role of engineers irrelevant and which is a major concern among

[1] S.Devoldere, I.Strauven S.Adriaenssens, Shaping forces-Laurent Ney, A+ Editions / Bozarbooks , 2010, p.37

[2]Vision for the Future of Structural Engineering and Structural Engineers: A case for change -The Structural Engineering Institute(SEI) of the American Society of Civil Engineers (ASCE) , October 16, 2013

practicing structural engineers throughout the world. Christian Menn, the most famous Swiss bridge designer, provides an interesting observation in the same spirit: "Today, like two hundred years ago, we are in the midst of an economic revolution that is accompanied by great political changes. This time the economic revolution has been triggered by information technology and globalization, and in this process the scientific aspects of our profession [are] producing dubious results. The following trends have become particularly noticeable in structural engineering: the overrating of analysis and underrating of creative work[3]. Once considered a savior from the dullest part of structural engineering activity (i.e., calculation), advances in computer modeling are leading to more complex design, which advances architectural-structural perversity and which will, of course, call for even more complex tools. It's a kind of "self-fulfilling prophecy", a paradox in which developments in digital technology that enable engineers to be more capable and talented are also making them less necessary and more irrelevant. We are willingly (as there is no other way) delegating our 'engineering skills and powers' to computers, surrendering in this way our role, importance and place in the design team. This is not an anachronous call against computers, but rather a call for adapting to new circumstances. The current triviality of once-traditional laborious and time-consuming engineering tasks undoubtedly translates to the commoditization of the structural engineering profession. For example, calculating a simply supported truss beam is a task that once required a day or two. Now it can be executed on an Android app within seconds, with the highest accuracy (and better optimization). Frankly, a 10-year-old could do it.

For almost a century we were trained to calculate; we were good at numbers, and numbers actually differentiated us from architects. For over a century we traded creativity and inven-

[3]Guy Nordenson, Terence Riley, Seven structural engineers, The Museum of Modern Art, New York, 2008, p.124

tion for formulas and numbers. Today, numbers and formulas have been taken away from us (fortunately) and we are left with "nothing"...no creativity and no numbers. It is not an apocalyptic prediction which is seeing engineers going the way of the dinosaurs. It is a reality we should adapt to, whether we like it or not. Simply put, in these new circumstances, the profession must change. The question is: Are engineers ready to embrace changes in their industry and what long- or short-term effects will these changes have on the structural engineering profession? This will likely require a drastic shift in their mind-set, adapting to or evolving into something else, perhaps to structural analysts, structural consultants, structural architects, or, as Werner Sobek coined it, archi-neers!

Lots of voices in the building industry minimize the role of an engineer. Now that almost every phase of structural design is automated, some think that structural design might not need to be done by structural engineers at all. If a computer (program) can do it, the operator could be a technician with elemental knowledge of structures. However, this expansion of digital engineering can be "a double-edged sword" because the unskillful use of computer tools can result in building failures for which engineers will be blamed. It is important to underline the notion that the software itself is not faulty; instead, the main problem relates to how and by whom these tools are used. New tools require new ways of working, which in turn require new methods of quality assurance. Regardless of the availability of user-friendly structural analysis software, we are seeing cases in which a building hasn't performed as intended due to faulty structural concepts and a lack of understanding of the software's limitations. Envisioning the future of the structural engineering profession is not an easy task considering the swiftly moving developments in technology. As mentioned above, some see the future of structural engineering in full automation of the design process and in this view, structural engineers will need to be very technically able –

much more than is common today. Perhaps 95 percent of the projects we have done up to this point, will be the work of technicians or automation, leaving the truly unusual structural engineering tasks, the remaining 5 percent, as the definition of structural engineering.[4] Others, to whom this author belongs, see the future through the lens of "structural architect", with the structural engineer of the future being more architecturally equipped and the architect of the future being more structurally inclined. Whatever the future brings, there is general agreement that the future will require change. If we accept that our profession is in crisis, and if we want to make it attractive again, we should introduce drastic changes to the education of engineering students, which currently leaves much to be desired. Younger generations would rather choose architecture over engineering because they no longer identify civil engineering practice with creativity and innovation. We must emphasize and promote the creative side of our profession, in this way reinventing a recognizable image and opening the closed doors of engineering protagonism.

[4]Vision for the Future of Structural Engineering and Structural Engineers: A case for change -The Structural Engineering Institute(SEI) of the American Society of Civil Engineers (ASCE) , October 16, 2013