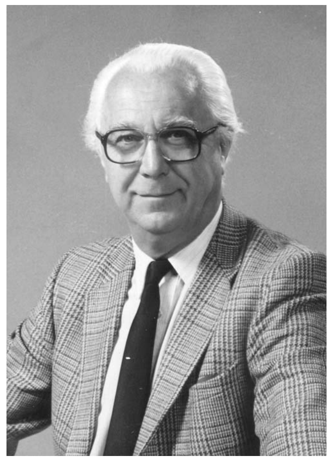
IN MEMORIAM

Thomas Paulay
1923-2009



The life of Thomas Paulay—a life that left a strong imprint on the many people who knew him personally and that affected many more around the world through his accomplishments in earthquake engineering—ended 28 June 2009 in Christchurch, New Zealand, where he had lived and spent many years on the faculty of the University of Canterbury. Over the previous year, his health had declined from cancer, but he had remained active in the earthquake engineering field, and in his correspondence with friends and colleagues, well into his eighties.

Paulay was born in Sopron, Hungary, 26 May 1923. Like his father, he became an officer in the cavalry of the Hungarian army. He graduated from the Royal Hungarian Military Academy in 1943, having just turned 20, and a year later, was the second in command of a cavalry unit. When his superior officer was killed, the young Paulay found himself in charge of 283 men and 308 horses. He was critically wounded three times, returning to duty each time. After the war, he struggled to complete an engineering degree at the Technical University of Budapest under difficult conditions. He later recalled how snow fell through a hole in the bombed-out roof of the lecture hall where he sat for mathematics lectures. Having been an officer in the Hungarian army, which fought against the Soviet Union in the war, and because he was living in Catholic student housing and had a well-to-do family background, he was marked for arrest as the communists took over the political and academic institutions of Hungary. After several dangerous adventures, he made his escape to Austria and then to West Germany.

Paulay and his wife Herta met at the very end of World War II as he led a group of Hungarian hospital evacuees into Austria. After Paulay escaped communist Hungary in 1948 as the Iron Curtain was being constructed, they were reunited and married in 1949 and then enjoyed 58 years of marriage before Herta passed away in 2007. Paulay is survived by his two daughters, Dorothy and Esther, his son Gregory, and six grandchildren.

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Once he immigrated with his family to New Zealand in 1951, his new life began. After practicing structural engineering, he began his 28-year career at the University of Canterbury in Christchurch, helping it to become a world-renowned center for earthquake engineering. He obtained his Ph.D. at the late age of 46, a fact one would not assume on the basis of his extensive research output and the number of undergraduate and graduate students he taught.

His Ph.D. in experimental and analytical research resulted in the seismic design innovation of X-oriented reinforcing in the beams that couple structural walls that resist lateral loads (Paulay 1969). With others in New Zealand, he was also one of the key developers of capacity design, whereby the structural engineer "tells the structure what to do," as he put it. By design, some portions of the structure are forced to yield before others, and those yielding regions are designed by the engineer to have the necessary ductility. When applied to frames, capacity design is sometimes called the "strong column-weak beam" approach. In his later research on the need for displacement-based rather than force-based seismic design, Paulay continued to stay at the leading edge of the field (Paulay 2003).

While most books published in the past few decades in the rapidly developing field of seismic engineering have not been able to avoid obsolescence, two by Professor Paulay have become classics. Both had co-authors who were prominent in the field and were also longtime friends. With Bob Park, he wrote *Reinforced Concrete Structures* (Park and Paulay 1975) and with Nigel Priestley, *Seismic Design of Reinforced Concrete and Masonry Buildings* (Paulay and Priestley 1992). Details on his life and career are provided in his EERI Oral History (Park and Paulay 2006) and are posted at his university department's website (University of Canterbury 2009) and in Table 1.

Tom Paulay was not only one of the most important figures in the history of earthquake engineering; he was also a person who had a very strong and very positive effect on the people who knew him. Below are reflections on his life, from individuals who were both his colleagues and friends.

REFLECTIONS BY ATHOL CARR

In 1961, Thomas Paulay was invited by Harry Hopkins, head of the Department of Civil Engineering at the University of Canterbury, to apply for a faculty position to teach structural design. Tom began his classes by telling his students that the course would be taught in Hungarian but with a very strong New Zealand accent. His afternoon three-hour design classes started with a lecture ranging from an hour to an hour-and-a-half. The lectures were intense; four large sheets of finely written notes could be taken during that time. The lecture was followed by time in the drawing office. The afternoons were usually an hour to an hour-and-a-half longer than scheduled and sometimes rolled over to Saturdays as well. Tom is remembered for his enthusiasm and practical knowledge of structural design, his interest in his students' welfare, and how he injected recent research findings and ideas into his classes. This helped build up an interest in seismic engineering in New Zealand and had a major influence on design practice there. Even 20 years after he retired, some of the final-year design afternoons are still referred to as "the Tom Paulay afternoons."

Table 1. Brief chronology of the life and career of Thomas Paulay

1923	Born in Sopron, Hungary
1943	Entered the Hungarian Army in the Second World War
1948	Escaped from Hungary
1949	Married Herta Grossalber
1951	Immigrated to New Zealand
1954	Completed undergraduate engineering degree at the University of Canterbury
1961	Began teaching structural design at the University of Canterbury
1969	Ph.D., University of Canterbury; thesis topic: The Coupling of Shear Walls
1975	*Reinforced Concrete Structures*, co-authored with Robert Park
1979-1981	President, New Zealand National Society for Earthquake Engineering
1986	Order of the British Empire
1989	Retired from the University of Canterbury as Emeritus Professor, continuing to advise graduate students and conduct research
1992	*Seismic Design of Reinforced Concrete and Masonry Buildings*, co-authored with Nigel Priestley
1992-1996	President, International Association of Earthquake Engineering
1993	Mallet-Milne Lecture: "Simplicity and Confidence in Seismic Design"
1997	EERI Distinguished Lecture, "Professional Commitments to Earthquake Engineering"
2001	Outstanding Paper Award, International Association for Bridge and Structural Engineering
2009	Died in Christchurch, New Zealand

Tom supervised and cosupervised 16 Ph.D. students and 26 master of engineering students. In 1969, under the supervision of Harry Hopkins, Tom completed his own Ph.D. on the coupling of lateral-force-resisting structural walls. He also became interested in the concepts of capacity design, and he often used the analogy of a chain, whereby the designer chooses the weak link and makes that link, which was often the beams in multistory frames, very ductile. The designer made the inelastic behavior take place there in a major earthquake, while all other links—the columns, joints, and foundations—would be sufficiently strong so that only the weak-link members would yield. Tom also recognized the power of modern computer analysis to extend the work in the laboratory, and many masters students over the next few years carried out a large amount of research to determine the overstrength factors required to prevent undesirable soft-story failures. Tom was promoted with a Personal Chair in Civil Engineering in 1975 as recognition of his contributions.

Tom retired from the Department of Civil Engineering in January of 1989 and became an Emeritus Professor. He continued his research interests and helped supervise postgraduate students, still present in the department for most afternoons until about 2006, when Herta's declining health meant that he spent more time at home. While Herta's death in 2007 hit Tom very hard, he still kept in touch with his former colleagues in the department and always had that cheerful outlook that was so much a part of Tom.

REFLECTIONS BY NIGEL PRIESTLEY

Tom Paulay was one of the greats of earthquake engineering—one of a handful of people around the world who shaped the art and science of seismic design into the form it has now. In my opinion, of these few greats, he had the most important influence on earthquake engineering, and with his death, an era in New Zealand earthquake engineering has come to an end. Like all true greats, he possessed the gifts of innovation and intuition, which enabled him to develop completely new concepts, rather than the incremental changes and improvements made by lesser mortals. He continued to write elegant and insightful research papers in this and allied areas into his late seventies and early eighties.

Tom was primarily a teacher, researcher, and designer, and he had no great love for administration, which he felt got in the way of his research. In fact, he avoided university administrative duties whenever possible. Nevertheless, he was pressed into a few important positions—first as President of the New Zealand National Society for Earthquake Engineering (as it was then named) and later as President of the International Association of Earthquake Engineering.

Tom was a brilliant and charismatic teacher, as attested by all of his "victims," as he called those students fortunate enough to attend his design classes. He worked them shamelessly, expecting them to spend at least twice or three times as much time on his course as on any other course, but the students loved it. His clear insight into structural performance and his emphasis of the different roles of analysis and design enlightened his students. The outcome of this is a generation of New Zealand design engineers who understand structures at a level that is envied in other countries. Like all brilliant teachers, he had a natural sense of the theatrical. No dry mumbling into the blackboard for Tom. His lectures were full of action.

Tom was a gregarious man; he loved life, loved company, and loved humor, which tended to permeate all his social interactions. He loved good food and wine and was at his sparkling best in company with a glass of good wine in one hand and a good joke in the other. His store of jokes, some of which were as risqué as they were rollicking, was endless.

It is my good fortune to have known Tom for 47 years, first as one of his "victims" in 1962, then, after a ten-year hiatus, as a colleague at the University of Canterbury, assisting him in the design classes and in collaborative research, and subsequently as a co-author of one of his books. The experience of writing a book with Tom was one of the formative highlights of my professional career and one that bonded us closely. The process was very interactive, full of intense discussions, disagreements, and resolutions. Tom's intellectual rigor, which brooked none of my natural laziness, has had a lasting influence on me. It has been an enormous pleasure and privilege to have had Tom as a mentor and close friend, and I will miss him sorely.

REFLECTIONS BY GREGORY PAULAY

My earliest memories of my father and family life in the Paulay household are centered on the dining table, especially at the evening meal. It was as much about the wonderful food my mother prepared as it was about the almost ritualistic importance placed on this opportunity to share ourselves as a family group. It was a table around which anything could be—and was—discussed. Fierce debate was celebrated, and we as children, and later as young adults, were encouraged to explore our interpretation of the world around us. At the head of the table, my father would fully and enthusiastically engage us, yet always hold the veto of moderator when things got out of hand. One of Dad's most wonderful gifts was his ability to view the world with the same equanimity and total fairness he displayed at the dinner table. Despite his experiences through the horrors and injustices of the second World War, his faith in the inherent goodness of people remained undiminished. Of all the memories I have of my father, the most enduring will be his optimistic outlook on life and his wonderful sense of humor. He loved nothing better than a good joke. The ones he loved the best were not always the best in taste, but their humor would leave him doubled over in spasms, tears streaming down his cheeks. His legacy of laughter and joy will live on in our hearts for the rest of our lives.

REFLECTIONS BY SHUNSUKE OTANI

Tom Paulay had a strong effect on seismic design in advanced, as well as developing, countries. Of Tom's most important contributions to seismic design—capacity design, beam-column connections, flexural wall design, and diagonal reinforcement for shear-governed members—the first two had an especially strong influence on Japanese earthquake engineering.

The capacity design method was introduced to the international community at the 1977 workshop on "Earthquake-Resistant Reinforced Concrete Building Construction" at the University of California, Berkeley. The workshop, organized by Professor V. V. Bertero, attracted the world's top researchers in that field, and Tom's paper, entitled "Capacity Design of Reinforced Concrete Ductile Frames" (Paulay 1977), was one of the most influential papers. Professor H. Aoyama of the University of Tokyo studied the capacity-design method in detail during his stay at the University of Canterbury in 1980-1981 and subsequently introduced it to the Japanese engineering community. An Architectural Institute of Japan design guideline was published in 1988 based on the capacity-design concept, which became the state-of-the-art in the design of ductile reinforced concrete structures.

With regard to the design of beam-column connections, a significant difference was noted in the 1980s regarding the required amount of lateral reinforcement in New Zealand and U.S. codes. The New Zealand concrete design code required the design engineer to develop fully conceived resisting mechanisms, while the U.S. ACI code was based on empirical evidence. In Japan, the seismic design of beam-column joints was not important for a long time because of large beam and column sizes that resulted from the use of the allowable stress design procedure and large seismic design forces. The adoption of the ultimate strength design procedure, however, made joint reinforcement more critical. A trilateral research program on the design of reinforced concrete beam-column joints was launched, with Paulay and Bob Park the leaders from New Zealand, Jim Jirsa from the United States, and Hiro Aoyama from Japan. After heated discussions and experimental demonstrations from 1984 to 1989, one result was that Tom and Bob agreed that the New Zealand requirement was too strict, and they modified the interpretation of their resisting mechanisms. Another effect was that the New Zealand approach, which insisted on the use of a rational mechanical model, impressed many young Japanese researchers who had been accustomed to the empirical approach.

One brief example illustrates the flow of information from Japan to New Zealand via Professor Paulay. As early as 1933, Professor Kiyoshi Muto of the University of Tokyo developed a simple but accurate procedure for routine structural analysis of a moment-resisting frame under lateral loading (the "D Method"). Long before digital computers were available, Muto's method replaced tedious, time-consuming calculations with numerical tables. Tom Paulay was fond of this simple structural analysis procedure that efficiently served the design process, and he taught it in his structural design classes until his retirement from the University of Canterbury.

REFLECTIONS BY DAVID HOPKINS

Tom Paulay's passion for life and for structural engineering affected all who knew him. He had unparalleled insights into structural behavior and had an incredible ability to communicate these insights to others, through colored chalk on the blackboard, books and papers with simple but effective diagrams, enthusiastic presentations, English tinged with Hungarian, and through his humor. His skills imparted knowledge to us while the overall impact of his passion was subliminal but strong. Deep down, he conveyed to us that structural engineering was a special art and a worthy professional calling. We were privileged to have such an inspirational teacher and mentor.

More than three decades of students at Canterbury, as well as many others in earthquake-prone countries, have benefited from his teaching, wisdom, and inspiration. Many communities in New Zealand and beyond have benefited either from his personal involvement or from the efforts of his former students as they have applied what he taught them. More broadly, his work has shaped the way earthquake engineering design is done throughout the world.

How do those who knew him personally recall his character? Warm always, especially on greeting. Witty, able to see the light side of many situations, often at his own expense. Energetic and enthusiastic. A restless, penetrating intelligence. Exemplary integrity and respect for others. Polite, refined, thoughtful, gentlemanly. Selfless and modest in his approach, yet charmingly forceful and persuasive in getting his views across and accepted. Generous in sharing his insights and knowledge. A stunning, stimulating zest for life and all its human interactions, professional and personal.

REFLECTIONS BY HUGO BACHMANN

In the life of a person, especially one so well known as Thomas Paulay, there are both outward and inner qualities. The outward qualities are visible. Everyone can see the person's achievements, even from a distance. The inner qualities are important human characteristics like one's attitude toward others, the desire to do good, personal ethics, and belief or unbelief in the transcendental. Those who knew Tom personally could see those inner values, and we could see how important they were to his outward career.

One of Tom's chief inner values that gave him a good foundation was his deep European roots. He greatly valued good and stable relationships between different peoples and communities, and his possession of the necessary language skills and cultural interests needed for this were always among his great assets. For example, his marriage to Herta involved a lifelong commitment between two people with different languages and cultures, Hungarian and Austrian. He spoke German as fluently as his native Hungarian. Tom always also followed with keen interest the current political, cultural, and scientific events in Europe, and in his creative work, he always took into account European engineering developments. In his stays in Zurich at ETH, the Swiss Federal Institute of Technology, where Tom and I shared so many wonderful times, he had the opportunity to strongly affect European design practice and research.

In Tom's life, the presence of God—in other words his relationship to the Creator—formed the basis of his faith, his trust, and positive attitude. It was also the source of many fruitful and interesting discussions between him and many of his friends. He firmly believed that a rewarding and fulfilled life is enhanced by a consciousness of the presence of God, and without that strong personal belief, Tom Paulay would not have been the man that he was.

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