
CONNECTIONS

The EERI Oral History Series

**Nicholas
F. Forell**

Joseph P. Nicoletti
Interviewer

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Earthquake Engineering Research Institute

Editor: Gail Hynes Shea, Albany, CA

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499 14th Street, Suite 320

Oakland, CA 94612-1934

Tel: (510) 451-0905 Fax: (510) 451-5411

E-Mail: eeri@eeri.org

Web site: <http://www.eeri.org>

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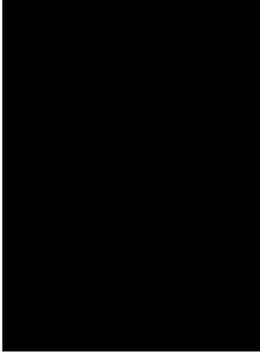
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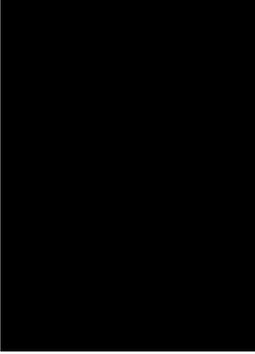
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The EERI Oral History Series

This is the seventh volume in *Connections: The EERI Oral History Series*. The Earthquake Engineering Research Institute (EERI) initiated this series to preserve the recollections of some of those who have pioneered in earthquake engineering and seismic design. The field of earthquake engineering has undergone significant, even revolutionary, changes since individuals first began thinking about how to design structures that would survive earthquakes.

The engineers who led in making these changes and shaped seismic design theory and practice have fascinating stories. *Connections: The EERI Oral History Series* is a vehicle for transmitting their impressions and experiences, their reflections on the events and individuals that influenced their thinking, their ideas and theories, and their recollections of the ways in which they went about solving problems that advanced the practice of earthquake engineering. These reminiscences are themselves a vital contribution to our understanding of the development of seismic design and earthquake hazard reduction. EERI is proud to have part of that story be told in *Connections*.

EERI was established in 1949 as a membership organization to encourage research, investigate the effects of destructive earthquakes and the causes of building failures, and bring research scientists and practicing engineers together to solve challenging engineering problems through exchange of information, research results, and theories. In many ways, the development of seismic design is part of the history of EERI.

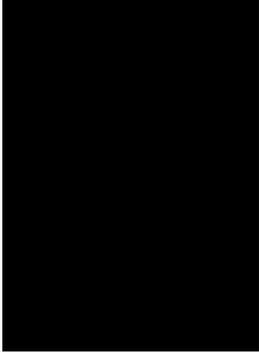
EERI Oral History Series

Henry J. Degenkolb	1994	William W. Moore	1998
John A. Blume	1994	Robert E. Wallace	1999
Michael V. Pagnoff / John E. Rinne	1996	Nicholas F. Forell	2000
George W. Housner	1997		

All interviews have been conducted by Stanley Scott, retired research political scientist, Institute of Governmental Studies, University of California at Berkeley, except for the Nicholas Forell interviews, which were done by Joseph P. Nicoletti. Other interviews completed or nearing completion include:

LeRoy Crandall George A. (Art) Sedgewick Ralph McLean

Work on several other interviews is in progress.



Foreword

I was pleased that Nick Forell wanted me to conduct his oral history interview, but I was reluctant because I thought it would be very difficult for both of us, knowing that Nick had terminal cancer. Nick was very open and up front about his cancer, and we both knew that, for him, time was very limited. Although I had known Nick for more than 20 years and we shared many experiences, our friendship was primarily based on shared professional interests, and I knew little about his family and other interests.

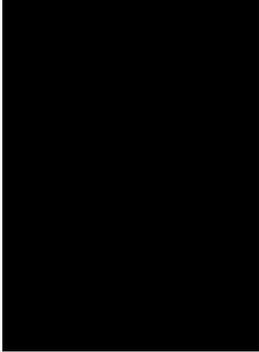
I first got to know Nick Forell shortly after the Oaxaca earthquake of November 1978. John Blume, as president of EERI, appointed Nick, Neville Donovan, and me to conduct a reconnaissance for EERI. I had previously known Nick only as Eric Elsesser's partner (Eric had worked with our firm prior to starting his own). Nick had originally impressed me as being a little stodgy, so I thought our reconnaissance trip was going to be all business. After two weeks of chasing earthquake damage in southern Mexico over rugged mountain roads and in primitive villages, I found that Nick was adventurous, humorous, and a very enjoyable companion. While we were in Oaxaca, Nick contracted a near-fatal hepatitis infection, probably from tainted seafood. Five months later, he was still recovering when the Guerrero earthquake occurred in March 1979. Because of the similarity of damage in the two earthquakes, it was suggested that the same reconnaissance team investigate. I didn't think Nick was well enough to go, but he insisted, and limiting himself to two beers a day, we conducted the reconnaissance.

In 1990, Nick and I co-chaired a peer review panel appointed by Caltrans for the retrofit of the double-deck viaducts in San Francisco that were similar to the Cypress Street structures in Oakland that collapsed in the Loma Prieta earthquake. Nick and I also served on the Caltrans Seismic Advisory Board, which was convened in compliance with Governor Deukmejian's proclamation following the Loma Prieta earthquake.

Our oral history interviews, conducted in the fall of 1997, went much more smoothly than I had anticipated. I think Nick got caught up in past experiences and projects, and it was easy to forget his condition. We finished taping his oral history in four sessions over a period of about three weeks. Nick died February 19, 1998.

Nick's contribution was summed up beautifully by his friend Eph Hirsh at his memorial service, "He truly lived up to the motto of his alma mater, Brown University: to create people of usefulness and reputation."

Joseph P. Nicoletti
URS Greiner
San Francisco, California
November 1999



Personal Introduction

Nick and I began working together in the 1960s. We shared a respect for architecture, a respect for beautiful structures, and most of all, a desire for quality. We pursued our work with the goal of producing buildings and an environment that we could be proud of. After more than 20 years of projects, Nick and I believed we succeeded in that goal.

Nick and I merged our separate practices to form Forell/Elsesser Engineers in 1969. From the beginning, we viewed the firm as special. We went about our work with the goal of providing thoughtful engineering. No matter what the project was, Nick enjoyed the design process. He constantly searched for the right solution and particularly thrived in his collaboration with architects. He urged us all to keep designs simple, to remember basic statics, and to communicate with one another. Nick excelled in facilitating dialogue with clients, architects, and everyone involved in a project.

He was not afraid to state his position and he expected the same from others. While he respected different opinions, sometimes it took awhile for him to appreciate another point of view. He was always a creative partner who urged us to get to the essence of the problem. This combination of creativity and determination allowed Nick to devote himself to engineering for nearly 50 years.

In 1971, Nick and I took an impromptu trip to view the damage caused by the San Fernando earthquake. It was an important inspection—the earthquake bug bit Nick. Though he had looked at some of the problems posed by earthquakes earlier in his career, Nick quickly focused his attention on raising the engineering standards for buildings constructed in earthquake-prone areas.

Nick followed the San Fernando trip with visits to several other earthquake sites, including two EERI-sponsored trips to Mexico in the 1970s and a trip to Algeria in 1980. In addition to the earthquake stories and many photographs, Nick sometimes brought home infections and maladies, but that did not stop him. He was determined to find out about earthquakes. He served EERI and the Applied Technology Council for over a decade. His contributions helped Forell/Elsesser win the Building Industry Conference Board Firm Award in 1993. Four years later, the firm won the Alfred E. Alquist Award for “Longstanding Efforts in

Earthquake Mitigation.” His peers also honored Nick as an “Honorary Member” of the Structural Engineers Association.

Of the many projects that Nick worked on, several stand out. The Santa Cruz Government Center, designed by Forell/Elsesser and built in 1962, was an ahead-of-its-time ductile concrete structure with its expressed concrete vierendeel beams. A couple of years later, Nick participated in the construction of the Lafayette-Orinda Presbyterian Church, which featured monumental soaring timbers and magnificent interior space. The IBM St. Teresa Programming Center, built in 1974, was a sophisticated project that also won several prizes, but perhaps even more impressive was its outstanding seismic performance through three earthquakes. The Life Sciences Building addition at UC-Berkeley featured a unique concrete seismic system and was noteworthy for its direct, simple solution. In 1985, the Keck Telescope at the top of Mauna Kea in Hawaii presented a supreme technical challenge. But for Nick, the challenge he enjoyed most was the strenuous climbing required to reach the 14,000-foot summit to inspect the work.

The San Francisco Museum of Modern Art provided Nick with several challenges and pleasures. It was a unique design and his collaboration with architect Mario Botta was most enjoyable. The fact that the museum itself was a work of art further enhanced his pleasure in the project. He was most proud that his daughter Anne, an architect, could help him on the project by building an accurate study model for the office.

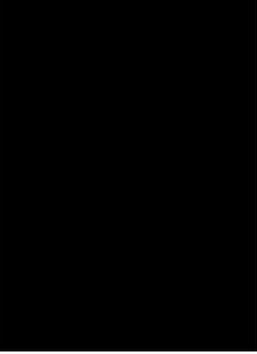
Nick chose to be an engineer, but he could have been an architect or a teacher. Perhaps he was all three. He was a good friend and a good partner. He was thoughtful, urbane, and liberal, and possessed a dry humor. He was committed to doing the right thing, whether it was in engineering, politics, or life. He led a very full life and was a very *uncommon* engineer. He will not be forgotten soon.

Eric Elsesser
Forell/Elsesser Engineers
San Francisco, California
December 1999

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Nicholas F. Forell



The Oral History of Nicholas F. Forell

Family and Background

Nicoletti: Let's start with a brief discussion of your early childhood. Please give us a few words regarding your family and background.

Forell: I was born in 1923 in a small town in Eastern Germany about ten miles from the Polish border. The town was quite old, with about 10,000 people, and it still has the old walls and gates around it. Quite romantic in some ways. I went to elementary school and started high school there. When Hitler came to power, much to my surprise I discovered that there was some Jewish ancestry on my father's side, which made our lives extremely difficult. My father was a pharmacist and did some manufacturing of pharmaceutical products, and, of course, that was not allowed under the new German law. We were forced to sell the family business and my father immigrated to the United States in 1938. I moved to Berlin with my mother, who remained there with me, and I went to high school or "gymnasium" in Berlin. I have one brother who got out early and I did not really see much of him after I was about 14 years old.

Nicoletti: Do you have any fond memories of teachers or role models or mentors in your early childhood?

Forell: Yes, in the early years of education in this little East German town. It was really very interesting because it was part boarding school and part townspeople. It was very classically oriented. I particularly remember a teacher of history and Latin that I was very impressed by, and I think he sowed the seeds of my lifelong interest in history.

The gymnasium in Berlin was a totally different kind of environment. It was a big urban school and I really hated it. I have very few fond memories, but I must admit that the education was very thorough. The only thing that I didn't get much exposure to was English, which later on became a problem. The focus was really on classical languages and French, but not much emphasis was given to English.

Nicoletti: At this point, had you considered engineering as a career?

Forell: No, not at all. As a matter of fact, before all this trouble started in Germany, I wanted to join the Merchant Marines, but my eyesight was poor, and that was out of the question. And, of course, the political situation made it impossible. You see, I was branded as a mixed breed and they had different categories of mixed breed. I was a benign mixed breed, which meant that I was eligible for military service, although not in the role of an officer or high-ranking non-commissioned officer. Anyway, the war broke out in Germany and Europe in 1939. At that time, I was in Berlin and remember vividly the great number of air raids and that I was subjected to spending nights in the basement of the apartment house where we were living. It was really a rather unpleasant situation altogether. I got out with great diffi-

culty. Since I am not Jewish, I did not have the support network of the Jewish communities, which really was very successful in getting a lot of people out of the country. Because of my German citizenship and eligible draft status, I was unable to plan an escape through most countries. I would have been detained, I suppose, as an enemy alien. So the only way that we could get out, my mother and I, was through Russia. We took the Siberia Express all the way across Russia and down to Fusan in Korea, and then to Japan, where we eventually got a ship to the United States.

Nicoletti: When was this?

Forell: This was in the spring of 1941. Interestingly, by the time we arrived in Japan, Germany had invaded Russia, so I was just an inch away from spending my career in the salt mines of Siberia. Fortunately, I got to the United States safely. My father was in New York City, so my mother and I took the Greyhound Bus all the way across the country to Manhattan. We all gathered together as a family, except my brother, who was going to Cornell University at that time.

Nicoletti: At this point Nick, had you finished the gymnasium in Germany? Equivalent to a high school diploma?

Forell: Yes, I had completed the German equivalent of high school. However, when I got to the United States, my father had lost his job and things were extremely tight financially. I went to work doing all sorts of fascinating jobs. I was a lobby boy in a hotel, an elevator operator, and eventually an accounting clerk for the Helena Rubenstein cosmetic firm.

Nicoletti: When did you learn English?

Forell: Well, I knew some English, not a lot, but I really spent my early months in this country going to night school. I studied English, English history, American history and whatever it took to pass the American equivalent examination for high school. In other words, I did get a certificate that my education was equivalent to that of a New York State high school.

Nicoletti: That was at night school?

Forell: Yes, that was at night school.

Nicoletti: Did you enroll in college at this time?

Forell: I went to night school at CCNY briefly and that's quite a frightening experience. That's quite a large place and very competitive. One slip and there were 20 people standing in line to take your position at CCNY. I must say I have a lot of admiration for that school, for what it has done. As I said, the last job I had was as an accounting clerk and I started on this lengthy career at CCNY, which at the best would have taken eight years for a college degree. As you remember, in 1941 the war broke out after Pearl Harbor and I enlisted in the Army in 1942, which was probably the smartest thing that I have ever done.

Military Career

Forell: The Army was, as I said, a beneficial experience for me. After I completed basic training, a number of us were given the option of attending OCS (Officers' Training Corps) or college. The Army, at that time, had specialized training programs in which you would sign up to go to college and then you were obligated to

remain in the Army for a given length of time after completion of the studies. I don't remember exactly how long it was, and since I had no ambitions to be a second lieutenant, the opportunity to get a college education, courtesy of the Army, was irresistible. I was sent to the University of Pittsburgh and the two options offered were the engineering program and the language program. Since I already had two languages, it seemed to make more sense to try to learn something new, so I signed up for the engineering program, which I must say was quite excellent. It was very accelerated, very hard, but I think I learned a lot. The Army specialized training program lasted only a very brief time. It was discontinued and the University of Pittsburgh team was split up. We were sent as replacements for the 95th Infantry Division, Indian Gap, Pennsylvania. I wasn't too wild about that.

Nicoletti: So they terminated the study program that you were in?

Forell: Completely, just like that!

Nicoletti: Up until this point, you had no interest in engineering?

Forell: No, not really. It was a series of circumstances that got me to engineering. I really apologize about that because in a lot of the oral interviews I have read, the great ones in our community apparently wanted to be engineers from the very moment they could crawl out of their mother's womb. This was not the case with me. I really slipped into engineering sort of around the corner. Amusingly enough, after I was finally in college at Brown University after the war, they gave us all a test in order to determine whether we really had the aptitude

in the field we were studying under the GI Bill. Of course, at that time, I had studied engineering for about two years and it wasn't surprising I looked pretty good.

Nicoletti: Tell us a little about your military career in India?

Forell: I got out of the infantry, thank God. They looked for a cadre to start a new battalion and that was the 23rd Signal Heavy Construction Battalion. What a heavy construction battalion really does is install telephone and telegraph lines. That may have given me greater interest or focused me on engineering because it is technically quite complicated and physically demanding. The 23rd Signal Heavy Construction Battalion was sent to Burma and our job was to work on the completion of the telephone and telegraph system between India and China. By that time, the U.S. Army had just succeeded in conquering Myitkyina, which was a great battle.

Under General Stillwell, the war started to swing south toward Mandalay, but we really followed the Burma Road and then the Stillwell Road, as it was called, and then connected to the Burma Road, which went into China. We had to cut our own telephone poles, we trimmed the poles, we muscled them around this very mountainous terrain and dug the holes, set the poles, strung the wire. That was really quite interesting, as a matter of fact, the terrain was so difficult that our equipment was insufficient, so they assigned elephants to us to help us with the logging.

Nicoletti: How long were you there?

Forell: About a year and a half.

Nicoletti: What did you do then?

Forell: Well, the war was pretty well winding up. As a matter of fact, when it was over, I had an accident in which I severely cut my left hand. I was hospitalized for awhile in China and an infection set in. They flew me over the hump to a base hospital in Calcutta, where they then treated me with penicillin. At that time, penicillin was very painful and I was there for quite a while to heal up again. After being discharged out of the hospital, I was sent to New Delhi to the Post Engineers and I enjoyed that very much. New Delhi is a fascinating city and I had whole crew of local craftsmen and technicians working for me. This was with the high rank of sergeant, and it was really a good life.

We got out in a rather complicated way because the Hindu and Moslem difficulties had started and Calcutta was in full riot. We had to be brought to the port of embarkation under heavy guard by the British because our American troops had no weapons left. We got safely on the troop transport and came back home from the war.

Brown University

Forell: OK, now I was back from the war, in the United States and, of course, one of the first things I did was to apply for college. I picked a number of colleges, kind of a strange mix, but the one that I was really most interested in was Brown University in Providence, Rhode Island, which had accepted me.

Nicoletti: What was the reason for choosing Brown?

Forell: Well, I liked the campus, I was familiar with New England and enjoyed living there.

I also was interested in the University of Pennsylvania, but for some reason, Brown made a bigger impression on me. It's a small school, I think the undergraduate enrollment when I went there in the mid-1940s was a little more than 3,000, and it was convenient to Boston and New York. Also, one of the things that impressed me was that they were not too fussy about your past grades, which was important because a lot of my records didn't exist from Germany. I guess the important thing as far as acceptance was concerned, was the lengthy essay that you had to write in which you tried to explain what you wanted from college and why you wanted to attend Brown University. Well, at that time I had decided on engineering and I liked the engineering education that Brown offered.

Nicoletti: Was there a specialty in engineering that you had chosen at this time?

Forell: Yes, I wanted to be a structural engineer. Now the Brown education system was different from most colleges that I know about. The college of engineering was small, the emphasis was on liberal education, and for the first two years it was all general education with really no engineering courses whatsoever. A lot of physics, a lot of chemistry, and in the third year you got into hydraulics, even some sanitary engineering, and I really had the feeling we got an outstanding broad engineering education. The thrust of the college of engineering was very theoretical. Application was not their bag and was not particularly emphasized. Learning to use the AISC manual or the concrete manual was of little interest. I think in retrospect maybe that's a good teaching philosophy, because those documents have changed

so drastically over the years that whatever you learned 40-50 years ago really has nothing much to do with what is going on now.

Nicoletti: Does Brown actually have a specialty, or at that time, did they have a specialty in structural engineering?

Forell: No, not within the civil engineering department. Within my graduating class, the focus on structural engineering was during the senior year and consisted of only ten students. It was marvelous in that the senior year was really a tutorial. In other words, there were few classroom situations, the students met with the professor in his offices, or small conference rooms, and I thought that worked very well. I did get curious at one time about lateral forces design and ultimately asked the question "Professor, what do we do about earthquakes, which I have heard about?" And he said to me, "A building that is well designed and takes wind under consideration really should not deserve any particular attention for earthquakes."

Now, that was the philosophy about earthquake design when I graduated in 1949, which wasn't really surprising, because earthquake engineering wasn't a driving force in engineering practice, as it is now, but was very often an afterthought. As far as analysis was concerned, the emphasis was really on the classic methods of analysis, which is moment distribution, least work, slope deflection, you name it.

First Professional Work

Forell: When I graduated from Brown in 1949, we had sort of a mini-recession in this country, and jobs were very difficult to find. I wanted very much to work in Boston, but

couldn't find a job, so I went to New York, where I also couldn't find a job. I then tried Philadelphia without any luck. Then the opportunity came about to work for the Bureau of Reclamation. Now that was the Bureau of Reclamation in Denver and what attracted me was: one, it was a job; and two, they had a rotation training program for one year. That meant that you worked for four three-month periods for different departments. I worked for three months in the steel design section, three months in concrete, three months in the bridge division—which I really wanted very much to get into and was subsequently terribly disappointed by—and then three months in an analysis section, which really wasn't very interesting either, with a lot of photoelastic studies. Then I was permanently assigned to the Spillway and Outlet Design Section #2.

The spillways and outlet design section was really kind of disappointing. It had its variety, there was a lot of hydraulics involved, quite a bit of civil engineering, and of course, the issues of side channels, spillways, glory holes and all those things, but it really had very little appeal from a long range viewpoint. And then I discovered something that was sort of a crowning blow. There was a group of people in that section who everyday at lunch went outside to have their lunch and play horseshoes. I asked them how long they had been doing this and they told me, "Oh, about 20-25 years." That depressed me. Also, I was put in for a promotion and was told that it couldn't be acted on because the appropriations weren't forthcoming.

So, I took a vacation. I was married at that time to a war widow with three children, so that I was a stepfather of three, and we all went on

vacation to San Francisco. I quickly decided this was the place to be. When I came back to Denver, I got hold of the San Francisco yellow pages and I must have written over 20 job application letters—I got two answers. At one of the companies that replied, it turned out that the principal had died and the firm was closed. The other one was a tentative maybe, so I was disillusioned. Then I got a telegram from the "maybe," which was Sverdrup and Parcel in San Francisco. They offered me a job, so I packed up the family and we came out the Bay Area.

Sverdrup and Parcel was interesting. I mean, at the time, the San Francisco office was a branch office of the St. Louis headquarters, as it still is, but was not as autonomous as it is now. The work that was done there was largely Corps of Engineers work. Power plants were the main emphasis. What I worked on largely was big hydraulic gates. Now these were enormous gates on rollers with enormous pressure on them, depending on how tall the dam was. One project, I think, was the Hungry Horse Dam in Idaho. There were two factors in there that impressed me. One was that when the gate is subjected to full pressure, it bulges and if the rollers are not articulated enough, the edges of the rollers start yielding.

That is the first time that I got to thinking about the performance of steel under yield conditions. It was something that we were never taught in college. Although I must say, one of the strengths at Brown was the emphasis on the strength of material. To them that was the key subject and I think that is correct.

The other thing about hydraulic dams that interested me was that there is very heavy weld-

ing and the pressure is enormous on those things. So they were concerned, I guess from experience, about weld failure—something that we are now always aware of. The way it was solved in those days was that the entire gate was put in the furnace and annealed—structurally. I left Brown in '49, went to the Bureau of Reclamation in late '49, went to Sverdrup and Parcel a year later, and I stayed there only about a year. I wanted to get out of power plant, Corps of Engineers kind of work. One thing that often troubled me was that in those days—at Sverdrup and Parcel—there was no interest on the part of the engineers toward licensing. It wasn't needed and nobody really bothered with it.

Nicoletti: I think that was typical of that time, particularly with regard to public works. People in the Public Works Departments in the city government, state and so forth, were not required to be registered.

Forell: Because it was not private practice.

Nicoletti: Yes, they weren't encouraged to.

Forell: Well, anyway, I wanted to get into something structural like buildings, so I got a job with an engineer that I think very few people remember, a Danish engineer by the name of Kaj Theill. Now Kaj Theill was the antithesis of everything that I had experienced in engineering before. He was truly a private practitioner and things were done according to his way and no deviation permitted. He did all the preliminary design. And in a way, the role of his engineers, of which there were two or three, was really analysis and drafting. I learned a lot and I also learned to become self-reliant.

I have an anecdote from my time in his office that I am fond of telling. When I started working there, I was given a very complicated truss to design and I got stuck. I knocked on the door of his office—he had a glass enclosed office—and he told me to come in. I said “Mr. Thiell,” because you called your boss Mr. in those days, “I have a problem here I can't solve. This truss doesn't work out.” He looked at me coldly and said “Forell, I hired you to do engineering, not for me to teach you engineering. If you can't do the work, you shouldn't be working here.” That really got the adrenaline pumping and I found the answer very quickly. But there's more to it—and that is, I think it is now expected that when most young engineers leave college and start their first job, they will be given a mentor to teach them the practice of engineering.

Thiell was a pretty rough guy, but by being as rough as he was he really encouraged self-reliance and not to ask unnecessary questions. After a year with Kaj Theill, I asked for a raise. He basically discouraged me from even pursuing engineering any further, and said that he was not very happy with me, so I left the organization. Although I don't mean to sound critical of him, he was an old fashioned proprietor of a small engineering firm.

While I was working in these various jobs—Sverdrup and Parcel, Kaj Theill—I took a lot of night courses. As a matter fact, I also took night courses when I was working for the Bureau of Reclamation, and the night courses offered at the University of Colorado were really quite excellent. When I came to the Bay Area, I took extension courses from the University of California in Berkeley. I took a course on lateral force design from Henry Degenkolb

and one on prestressed concrete from T.Y. Lin. The course given by Henry Degenkolb was excellent. This is something that was not taught at Brown and is terribly important. Henry had done this for many, many years and was really very good at it.

After leaving Kaj Theill, I found a job with John Lyon Reid and Partners. John Lyon Reid was an architect specializing in educational facilities, but his firm of about 40-50 people also had its own structural engineering department, which was headed by one of the partners, Dr. Alexander T. Tarics. I was with this firm for about five years and I value my experience there very highly.

Alex Tarics was a very interesting man to work for. He liked to teach. He was a good teacher, and helped people out. He gave you a lot of independence, so that you could do things on your own. It was very good for an engineer to work in that kind of a firm for two reasons: one was the discipline that was put upon you by the State Division of Architecture, Structural Safety, which provided a very, very thorough review of your drawings and really taught you how to chase forces through the structure and analyze and provide answers for every piece of material that went into the building—largely wood frame buildings, although steel frame buildings were not uncommon in elementary schools.

The other benefit of working for a firm like that was the close coordination between the engineer and the architect. We had an opportunity to get involved very early. The fact that the head engineer was a partner gave authority to the engineering department and there was a healthy give and take. Another good aspect about working for an architect/engineering firm

was that you really learned a lot about architecture and I feel very strongly that to be an effective consulting engineer, you should really know a lot about architecture. Ever since those days, I subscribe to every architectural magazine that is worth subscribing to, read them carefully, and I really do understand architectural trends and architectural philosophies.

Nicoletti: Are there any projects that you remember particularly from that time?

Forell: Yes. A project that was noteworthy that I remember well was a series of high schools, steel frame schools—in Hillsborough, Millbrae, Aragon—all for the San Mateo High School District. They were really quite advanced because they took flexibility very much into consideration. Largely they were all steel moment frames.

The final job that I worked on at John Lyon Reid's, and which I really enjoyed very much, was the Greek Orthodox Church in Oakland. It's a big steel dome, about a 123' in diameter, beautifully detailed and designed and quite exciting to work on. That was about the extent of my time with John Reid. As I was about to leave, and let me tell you how that all came about in a minute, the firm was working on the 15-story Health Research Buildings at UC Medical Center, and that was the first time that I had seen computer analysis being used.

There is one thing I remember and will never forget and I have often told that story. Alex Tarics came over, looked over my shoulder and looked at the printout and said "My, my Nick this is very precise. Tell me, is it accurate?" I have never forgotten that comment and I still use it frequently because it is really true. There

is enormous distinction between precision and accuracy and lot of people don't seem to know the difference.

Early Partnerships

Nicoletti: John Lyon Reid has since passed away. Was he still active with the firm when you left?

Forell: Yes. The firm eventually split. It went from John Lyon Reid and Partners to John Lyon Reid. Then it became Reid, Rockwell, Banwell, and Tarics. I had sort of become the chief engineer, which was a great situation. Alex always had his hobbyhorses—jobs that he came up with that he was intensely interested in and he really wasn't interested in all the routine jobs in the offices, so he basically said, "Forell, you take care of that, you get it designed, you get it checked off with the State, and you are doing a great job, and go for it."

So, after I did this for awhile, which was really a marvelous education for me, it was like owning my own office. After five years, I went to Alex and said "You know Alex, we've got to make a decision, at least I do. I would like to be made an associate or start my own practice." Alex smiled at me and stuck his hand and said, "Congratulations on opening your own office."

Alex and I have been good friends ever since. He was a very amusing man to work for. One more thing about Alex: I learned an enormous amount from him and am very appreciative of the opportunity that he gave me.

When I decided to leave John Lyon Reid and Partners, it so happened that one of the architectural partners, William M. Gillis, had decided to leave the firm himself. We got

together and talked about our interests and reached the conclusion that we should start our own firm, which we called Gillis and Forell, Architect and Engineer.

We had really started from scratch and we also made an agreement where we agreed to work for one year without any compensation. In other words, we both had saved up enough money or could find enough money to ride for one year. Now it was just Bill Gillis, a part-time secretary, and myself and even though the firm slowly started to get some work, at the end of the year we decided that we could afford only a \$750 bonus. That was the compensation for the first year of working with Bill.

As time went on, we found business in school work again, and I think this is something that needs to be pointed out, that this was a very, very good field to be knowledgeable about because school construction was one of the biggest activities in the architectural and engineering work at that time which was in, if I remember correctly, was in..., when in the hell was that? 1958 I would say, '58 yes! Now we slowly started to grow, but there was never enough work to really justify another person in engineering, so I basically did all the work by myself with some drafting help from the architectural end.

Looking back on that period, it again was a good learning experience being principal of the firm. I started going to school board meetings, making presentations when I had nothing to do, which unfortunately happened at times. I would write architectural specifications and would actually do some architectural drawings, interior elevations and all that stuff where you don't need to have a great expertise. So this was

a good experience for the reasons that I really got to know more about architecture than I had ever learned from John Lyon Reid's office.

Unfortunately, the firm never got big enough and after almost four years, I decided that this was really not going to be a future for me and that we were not going to grow to the point where there was a whole large engineering department. I don't think that Bill and I had the same kind of goals in mind. So, we decided to split up and establish our own individual practices. I still see Bill Gillis on a regular basis. As a matter of fact, he is one of my oldest friends.

Starts Own Firm

Forell: Now when I decided to go out on my own, again I had an unusual opportunity, and that was that the John Lyon Reid firm—which at that time had become Reid, Rockwell, Banwell, and Tarics—split up. Reid and Tarics went one way and Banwell and Rockwell went another. Rockwell and Banwell then offered me all of their engineering work. That was arranged on a fee basis, which if I remember was 1.5 percent across the board, no matter how small or how large the job.

Nowadays, people would be aghast at the amount of money that the architect was willing to pay to the engineer, but things were different then. As a matter of fact, the Consulting Engineers Association had a fee schedule that recommended a fee of 2 percent for public school work, which I don't think anybody ever got. The 1.5 percent was generous, but we worked for it. My biggest problem, really, was how to keep up with the work—because when they split up, Rockwell and Banwell took with them a fairly large number of jobs and I had to

find myself a staff. This was 1961. I was very, very fortunate in finding the right people to work for me. One of them was Gary Gray, who since then has gotten an architectural license and a practice of his own. Another engineer that may not be known as much nowadays, was Fong Chan, who then became an associate of mine and a part owner of the firm.

The work with Rockwell and Banwell started off with a lot of public school work, but then enlarged into other things. Probably the most important job that I did for Rockwell and Banwell was the Santa Cruz Governmental Center. At that time, it was a large job—a 5-story office building and a 1-story court building. The whole thing was constructed out of precast concrete with the exception of the towers, which were four column structures. There were 36 towers, creating five bays in each direction. The building was totally symmetrical, there were four-column towers that were cast-in-place and from then on everything was precast.

Nicoletti: Was this also done for the 1.5 percent fee?

Forell: Yes sir.

Nicoletti: Very good!

Forell: But, it was a very novel approach. The framing was precast, vierendeel concrete beams. The reason for that was that the architect wanted the right-of-way for all mechanical and electrical, and there were no suspended ceilings anywhere. This was an extremely logical job and like always with Rockwell and Banwell, I was asked what kind of a structural system I wanted to design, so there was input from the very beginning. The job went well and on budget, but unfortunately, it was not

well received by the citizens of Santa Cruz, who felt it was a bit too modern for their taste. This building was built and designed in the early 1960s, and was subjected to the Loma Prieta earthquake with practically no damage at all, even though at that time, ductile concrete design was not yet code-mandatory.

Nicoletti: This very close to the epicenter?

Forell: Oh, right close to the epicenter and I have received quite a few comments on it and basically compliments for the work that we did. We did a lot of the ductile detailing beyond code requirements simply because we felt we should. Aside from doing the work for Rockwell and Banwell, I, of course, tried to diversify the firm and I guess one of the major clients that I picked up was McCue, Boone, and Tomsick, for whom I began to do small jobs. Now the next thing that happened is that Rockwell and Banwell went bankrupt. This was quite a blow to me.

Nicoletti: Because of the fee that they were paying you?

Forell: Well, you couldn't knock the fee. I, at that time, had gotten a divorce and was really left with nothing but my practice. I really needed the income. I was really in big trouble because almost two-thirds of all our work came from Rockwell and Banwell.

I got bailed out in the last minute by Corwin Booth's office. The reason I got that work was because the chief architect for Corwin Booth was an old friend of mine from the Rockwell and Banwell period. No, as a matter of fact, earlier than that, it was the John Lyon Reid period. So again, the point I am trying to make is that you can't have enough friends among the

architects. So make friends with your clients! From Booth, we got two big high schools and about three or four elementary schools. This really tided us over until work started picking up from other clients, such as McCue, Boone, and Tomsick. We did a lot of little stuff for them, but then came our major breakthrough, which was work for IBM.

The first major job we did for McCue, Boone, and Tomsick, or MBT, as they are called now, was the Cottle Road Program Development Center, which was about 620,000 square feet, 4-story, ductile steel frame complex. As always, I worked hard to develop symmetrical buildings with ample seismic separation joints to avoid torsion and stress concentrations.

Nicoletti: You did an IBM project for MBT before you became partners with Elsesser?

Forell: Yes. That building later got hit very hard by the Morgan Hill [1984] earthquake. We had some strong motion recordings and the building experienced acceleration way beyond code requirements, which was not unusual of course, but surprising at the time. After that we got into another IBM project, the Almaden Research Development Center, which was a very, very interesting job. I guess one of the things that saved those buildings from damage was that we spent enormous amounts of missionary work with the architects explaining to them the perils of earthquakes.

This is something I feel very strongly about. That is, it really is the role of the structural engineer to teach the architect subtly, but thoroughly, the problems of structural design in earthquake country. In other words, don't just

do what you are told, argue the point. Have the guts to speak up.

Forell / Elsesser Engineers

Forell: About that time, I got together with Eric Elsesser and we merged the firms in 1963 or 1964. I think it was 1963. Between the two firms we ended up with a staff of around 10 to 12 people. Now the way our partnership was run at the time was that I did my client work and Eric did his client work. So in the early stages we didn't jointly run projects, but the whole idea behind getting together was really strength and numbers. If you are the sole proprietor, you really don't ever get time off. I think we both were naive enough to believe that with two partners it would change, but then, it never does.

Eric and I worked quite well together. We had disagreements, obviously, but they worked themselves out and I think we sort of came up with a rather consistent approach to engineering. We always discussed every job in the office. Eric was interested in base isolation very early, but I was a little reluctant at the time to accept the base isolation for a very interesting reason. I think it was Henry Degenkolb who said to me once, "We know so little about acceleration, why do you want to trade that for displacement, of which we know nothing?" When I explained to Henry that, obviously, we could mathematically arrive at displacement, he looked at me again with a smile—as only Henry could—and said "You know Nick, I have more faith in the almighty than in double integration."

Nicoletti: I think Henry was proved to be right by some of the near-field effects from the Northridge earthquake. The velocity pulse is

something that you can't determine by double integration.

Forell: No, I think you are quite right and so was Henry. And when the first base isolation job appeared, oddly enough, it was one of my accounts and not Eric's, who had worked very hard on this topic. I was really insistent in coming up with a detailing that would permit much larger displacement than indicated by mathematics. I also attempted to come up with a detail that would mobilize Coulomb friction, but the building never got built, so I don't know whether it would have worked or not.

Nicoletti: I know that you and Eric have completed many notable projects, do you want to mention a few?

Forell: Yes, let me try. In the early days, a lot of our work was research facilities. In addition to the Santa Teresa Program Development Center at Cottle Road and the Almaden Research Laboratory, both for IBM, we did a lot of work for IBM on other sites, but those two major projects were extremely successful. Other laboratory projects were Ortho Research Lab for Chevron, the Vision Research facilities for UCSF, the Life Sciences Building addition for UC Berkeley, U.S. West Research Facilities in Boulder, Colorado.

Other projects that were interesting were the Federal Express Headquarters facilities in Memphis. The client at the time was not overly interested in seismic safety, the attitude in Tennessee being what it was. But we succeeded in achieving UBC standard plus by proving that the cost burden was negligible. The Chevron Park Office Complex in San Ramon, California, was a challenge. For one, it was by far the

biggest project for us at this time—1.1 million square feet in ten buildings. Again, most of our effort was directed toward obtaining logical structures with minimal eccentricities and simple structural forms. In the computer center, we used eccentric braced steel frames with backup moment frames.

We started getting into seismic rehab as consultants on the base isolation of the Salt Lake City and County Building and that has, of course, become a more and more important part of our work. As a matter of fact, I would say that probably 50 percent of our work at the time was in seismic rehab. Again, experience helps because you have to know something about mechanical systems, so that you can accommodate and upgrade them in the structure. There is a lot of emphasis on vibration, which has to be addressed, and it helps if you have some experience in that.

Now the major jobs that we have done in recent times are things such as the San Francisco Museum of Modern Art, which I must say, in retrospect, was probably the most fun I have had on any job. It was designed by the Swiss architect, Mario Botta, who spoke not a word of English and came with his translator. Mario was a very charming young architect who knew nothing about current building codes and also nothing about earthquake design. It was really amazing how we worked together and the effort he made to understand the peculiarities of doing a major project here in the Bay Area.

Other jobs that were important were the PG&E Buildings on Market Street in downtown San Francisco. These are two really large buildings and the criteria were very demanding,

in that PG&E wanted postearthquake operational capabilities because this is the central station for controlling all their routing of electrical lines and gas lines. Very tall order, but I think we accomplished what we were trying to do. The biggest difficulty with the project was that this building was considered an historic resource facility and the preservationists got involved. Due to its historic status, we could not destroy or replace the exterior cladding, which is all terra cotta, so we basically peeled back the brick behind the terra cotta, reinforced it with concrete, and then slit the columns so that there would be no restraint from the vertical elements between the top of the mullions, and the bottom of the mullions and that worked out very well during construction.

Other jobs got us into base isolation. We did the redesign of the Salt Lake City and County Building, which was really the first use of base isolation in seismic strengthening. It was the second base isolation job after Taric's Hall of Justice building in southern California. This was followed not too long afterward by the Oakland City Hall. Eric handled these jobs, which were base isolated and unique in that they were fairly tall buildings, generally considered to be problematic—but with base isolation we found a solution to that.

We didn't do only base isolation, we did other major jobs. The Ambulatory Care Medical Complex at the University of California, Los Angeles was in 1993. It was about 700,000 square feet, which also included a 7-story parking garage. I think is probably the first multi-story parking structure in Los Angeles area that was not post-tensioned. It went through the Northridge earthquake very nicely.

Now we've been working on the San Francisco City Hall, and again Eric is the principal on that. What made that job difficult was that we were the prime contract—which is unusual in construction—and basically were responsible for all the other disciplines, including the architecture, which was done by the San Francisco Department of Architecture.

Another project currently under construction is the State Office Building at the Civic Center in San Francisco, which is a 15-story steel frame building using dampers rather than base isolation. The reason for the dampers is that the State wanted to have postearthquake operation capability. This was really our first experience in the use of dampers. The dampers are now installed and the steel frame is complete.

We still do smaller projects in the office. I have an old friend by the name of Chester Bowles, Jr., who still does wood frame schools and we have continued to do his engineering, so we have not forgotten the old ways.

Structural Engineers Association of California

Forell: Now while all this was going on, I started to become involved in the professional organizations and let me just give a quick recitation on the history of that.

My first real involvement with the Structural Engineers Association, which I oddly enough did not join until I got my structural license because I was under the mistaken impression that a license was required, so I didn't really sign up until 1958 when I got my structural ticket. My first involvement with the Structural Engineers Association of California (SEOAC)

was a committee called the Professional Practice Committee. It was sort of that end of the Structural Engineers Association that concerned itself with the practices of structural engineering offices rather than just individual members. About that time, I got tapped to the Seismology Committee [of SEAOC].

I had belonged to the Seismology Committee for some time when I was picked as Vice Chairman. It was really Fritz Matthiesen's doing, getting me appointed. I was somewhat in awe of that assignment because I had never considered myself as an analyst, more as a designer, and was a little concerned that I might not be theoretically qualified, but that didn't turn out to be a problem.

What was interesting was that after having been Chairman of the local Seismology Committee, I then ended up on the state Seismology Committee and I found that fascinating. Here was an opportunity to meet people from other parts of the state and to really observe the difference in philosophy between north and south, which I think was exaggerated. At the time, there was a lot of suspicion between northern and southern California that was unfounded in my opinion. It was back around 1980, that period. I think there was a lot of talk that was really semantics and maybe there was a tendency on the part of the southern engineers to have more reliance on analysis rather than design. I guess they all thought us to be very old fashioned in our ways.

When I was on the state Seismology Committee, I had my first encounter with the Building Seismic Safety Commission and the National Bureau of Standards New Provisions for National Seismic Design Codes. I was on the

Seismology Committee from 1979 until the early 1990s. That was very interesting because it really exposed you to the philosophy of engineers in other parts of the country, and there is really a very distinct difference in the views on risk and seismic safety—which I still think has not been successfully addressed. I mean, what do you really do when you have in one area of the country a probability of a major earthquake every 1000 years and in other parts of the country every 50 years. Obviously, the same approach is not valid for both of them and I think that hasn't really been properly addressed to date. I have always been of the mind, which is the minority opinion, that it would probably be best to have two earthquake codes, one for zones one and two, and one for three and four. I would like to hear your comments on that, Joe.

Nicoletti: The 1997 NEHRP [National Earthquake Hazard Reduction Program] provisions have tried to address that problem. They have used a 2500-year earthquake as a basis of the provisions rather than a 500-year earthquake, and this attempts to pick up some of these earthquakes with a very long recurrence period in the east and central United States. I don't know how successful this is going to be, but this is what they are planning to do in the '97 provisions.

Forell: Yes, and I must say I endorse that approach wholeheartedly. My time on the [SEAOC] Seismology Committee was really filled with suspicions of what NEHRP was going to do and it was very interesting to watch the approach to the whole problem and the sort of slow acceptance that this sort of thing was bound to happen.

During that period, I also served on the Review Committee for the NEHRP provisions, which was still run by the National Bureau of Standards. At that time, I was on the same committee with Henry Degenkolb, which was a lot of fun. I got to know Lee LeMesurier from Boston quite well and have a lot of respect for him. He is a very interesting person, and it was good to get a broader picture of how earthquake engineering was perceived elsewhere than in California.

Having been Chairman of the local Seismology Committee and member of the state Seismology Committee, I sort of was oozed, like it or not, into the Board of Directors for the northern section of the Structural Engineers Association, and I served from 1989 to 1991. I was made President of SEAONC for the year of 1988-89, which was a marvelous opportunity. I really look back on that period with great pride. I think, as a matter of fact, the involvement in committees and professional organizations is terribly important for a number of reasons. I think unless you are on the Seismology Committee you don't think as much about code provisions as you should.

And, it's not only that. It's sort of really getting to know your fellow practitioners, fellow members of the association and I guess gain their respect. I often tell people that if you want to really succeed in this profession, get involved in professional associations. It's terribly important.

Nicoletti: I think the Seismology Committee, for example, is very important for young engineers so that they can understand what is behind the code and what its intent is. I think too many engineers follow the letter of the code without really understanding it.

Forell: That's true and I must say that now, looking back on all this is, I am a little bit perturbed that the codes are becoming more and more prescriptive again. You are quite right in saying most engineers really don't know how those codes were arrived at. I think codes—if you just look at our [SEAOC] Blue Book, or for that matter, the UBC—have just grown in a frightening manner. I must say that I don't really feel that I understand or know enough about the current UBC.

Nicoletti: I don't think anybody does.

Forell: I think there ought to be an effort made to simplify this. It's getting to be too complicated. I remember when I was a young engineer, we used to design a lot of glu-lam arches. I mean this was straightforward. Nowadays, it's a major problem and I don't know whether it has to be.

EERI Earthquake Reconnaissance Teams

Forell: I also got interested in EERI and, thanks to Henry Degenkolb, I was given the opportunity to be on a number of postearthquake reconnaissance teams. One of them was in 1979, the Oaxaca earthquake, when we [Nick and interviewer Joe Nicoletti] went to Mexico, and then a year later we had the Guerrero earthquake and we went down there again in 1980. I was also sent to investigate the El Asnam earthquake in Algeria in 1980, which was a very, very interesting experience. As a matter of fact, it led to a job where I worked with Woodward-Clyde as a consultant on the seismic code in Algeria, basically on practice and construction standards. Then, eventually, we had the famous Loma Pri-

eta earthquake. Before I get on the Loma Prieta earthquake, let me also say something about ATC [Applied Technology Council].

Applied Technology Council

Forell: After I left my role in the state Seismology Committee, I was appointed to the ATC Board of Directors, and I was a Director from 1989 to 1996. I eventually became President, and served as President from 1992-1993.

ATC was very interesting because it was truly an opportunity to direct research in the areas that would be of use to the practicing engineer, and as I have followed it over the past years it is becoming more strongly nationally oriented than California-oriented. It was a good experience and I miss my interaction with the people that I served with on the ATC Board of Directors.

Caltrans Peer Review Committee

Forell: The Loma Prieta earthquake resulted in all sorts of activities and one of them was that you and I [Nick and interviewer Joe Nicoletti] were deeply involved in was the Caltrans Peer Review Committee for the replacement of the damaged San Francisco freeways. This was quite an experience and I felt sort of outnumbered in that the majority of the people that were on the peer review panel were academicians, but luckily there were some practicing structural engineers, such as you and me and Eph Hirsch and Rol Sharpe and a few other ones that sort of kept this thing on a level keel.

It was a very long, drawn out process. Part of the reason was because I was the Chairman and I gave everybody more opportunity to speak his

or her piece than was necessary. But that's the way it was done and it paid off, because part-way through the review, we realized that what was being done had a lot of flaws to it. We sort of brought everything back to point zero and started a more design-oriented process than what we had seen before.

Nicoletti: I think that many of the things that came out of this exercise on the San Francisco freeways have been adopted by Caltrans as part of their criteria for both new and existing bridges.

Forell: That's true. I mean it paid off in the end, but how long did we spend on that?

Nicoletti: Too long!

Forell: Too long is right. But, I mean it was really a situation where people had to speak their mind and learn themselves what was really needed. In other words, they had to find the solution themselves. I don't think you could have thrust it down their throat. So in retrospect, I think it was very useful. This eventually led to my appointment to the Caltrans Seismic Design Advisory Board, which was responsible for giving Caltrans a means by which to review their own processes and procedures and to assist Caltrans in arriving at their goals. I think it has been an extremely useful organization, and of course now their big task is to retrofit the major bridges in the San Francisco Bay Area and southern California.

This group, the Seismic Design Advisory Board was chaired by George Housner, whom I did not really know before. I was immensely impressed by George, who although older than I was, was a lot more with it than I ever hoped to be. It was a joy to get to know him and watch

him operate, which was very quietly, but he always got what he wanted. Unfortunately, he eventually retired from the Board.

Managing the Business of Engineering

Nicoletti: I'd like to hear your thoughts on the philosophy of managing an engineering office.

Forell: Let me try to start it this way. I am very satisfied with the success of Forell/Elsesser. I think it has become one of the premier structural engineering firms in San Francisco, and from my perspective, I have spent a lot of time thinking about how that has happened. Why have we been successful? I think there are a number of reasons. I think that in order to become successful in any endeavor, and here I am quoting the great I.M. Pei, "It takes four things: capability, energy, work, and luck." I think we should not discount luck as a factor in being a success. This really means being at the right place at the right time and the right moment.

One thing I think has made our firm effective is our relationships with our clients and with our employees. I think the relationship with your client is terribly important. I remember back in the '60s when marketing wasn't even heard of. How did we get work? Because we had established a relationship with an architectural firm and really what happened back then was that they would call us and say "We have a new job and we want you to do the engineering." We really didn't go out and solicit, knock on doors, or make cold calls.

All of this has changed, of course, but there is still a large ingredient of having a relationship with your client that is sympathetic, cordial, and involves mutual confidence in each other—I don't think that can be emphasized enough. I talked about what I know about architecture and how I got involved in it, but it's really had a lot to do with the success that I have had during my career. Hard work, capability.

Now capability isn't just really *your* capability, but the expertise of the people that you hire. I think it is very important to screen the people that you want to hire very carefully, and in particular ask them what their aspirations are about their professional career. It's not so much what an employee can do for the firm right now, but where does that employee want to be five years from now, ten years from now? Where does he or she want to be eventually? Usually when you get in conversations like that, rather than going through their curriculum vitae, you get a better picture as to what the person is all about. By the way, as a sideline to that, it's very interesting that very few engineers nowadays aspire to have their own office. Generally, when you interview people now and you ask them, "What is your goal?" They usually respond, "Well, I want to be a principal in a successful engineering firm." Very few people nowadays have the ambition or the guts to start their own practice.

Nicoletti: I know that you talked about the fact that one of the functions of the engineer is to educate the client. I think it's in line with the statement that you need to inform the client on what he should have, as opposed to what he wants.

Forell: Oh, I think that's very true. It's very important to educate the client and you also have to be able to explain what you are trying to accomplish as a structural engineer in terms that the architect and client can understand. We are all guilty nowadays of using buzzwords for our own terminology—speaking about inelastic response spectra—and this doesn't mean a thing to the architect.

Nicoletti: It doesn't mean a thing to a lot of engineers, Nick.

Forell: I am afraid so. I talked about some of the ingredients of success, and another is competence. Well, that is really what we have just been talking about. To get competent people and to let them know that you feel they are competent. As employers, I don't think we do enough patting people on the back. Also, I think you should show genuine personal interest in their lives. This helps make them feel really comfortable working with you and your firm.

The other thing is hard work. Over the years I think the work ethics have changed. We all used to work like fiends really, kind of nuts. I mean, I don't think that my wife even knew that the office wasn't open on Saturdays. I just automatically went to work on Saturdays. Well, that's no longer the way things are done and I think to really be successful, particularly when you get into management, you've got to have what people call "a fire in the belly," to really want to make it go. Sometimes you might have to shortchange your personal life in order to get your professional goals accomplished.

Now luck is another ingredient of success, that's pretty obvious. You have to know to be there at the right spot when the job is there. I

think that in getting work, things have changed tremendously. It used to be really the old boys' network, where you get together with your architect at lunch and, in a way, sort of keep on his good side. That's not the way jobs get done nowadays and, unfortunately, I think that more and more the team is being put together by marketing people in offices. I often worry that they can create a disaster and put together people who really are not compatible, just because it reads well on paper.

Nicoletti: You don't think it's a marriage made in heaven in other words?

Forell: No, I mean it's like some committee trying to design a dog or whatever that story is, it just doesn't always come out that well. Also, I think that now other skills are necessary—such as to make good graphic presentations and the ability to orally present your firm and its qualifications and expertise. Today, it's expected that you will participate in interviews on projects and make a good presentation. The days are gone when the architect, according to his whims or friendships, would select the consultants—those days are over.

When it comes to successful engineering, I think it's terribly important to really get down to the fundamentals. I get worried about the excessive use of computers. I'm not saying that computers are not necessary. I think they are essential. But they also have to be used carefully. The old ways of sitting down with a roll of flimsy paper sketching out structural systems alternatives is still the right way to go. You don't go in there and start off by putting in the coordinates of the building and start running the computer.

Nicoletti: Some of the older engineers I knew would start out with the connections. They would start sketching connections before they even sketched the frame.

Forell: That's very interesting, and I think there is merit to that. Because as Mies Van der Rohe said "God is in the details."

Really what provides earthquake resistance is two things: one is configuration and the other is detailing. I don't think there is enough emphasis given to those two things. Nowadays, there seems to be a whole class or element who believe that engineering equated to analysis is essential. I agree, it's terribly important, but the fundamentals of design are really configuration and detailing. There is no doubt in my mind about it.

Nicoletti: Only design can make a good building.

Forell: That's true.

Nicoletti: Analysis won't make it any better.

Forell: Let me quote Eph Hirsch. In one of his lectures, he said, "You have got to design a building before you can analyze it." Let's not forget that design comes before analysis. The trouble with analysis—which is a good thing—is that it gives us the opportunity to design most anything, including things that are not good engineering. And I think somebody has to be in the office that says "Stop it right here. Let's go back and take a look at this." As I look back on my jobs, what was really important about them was that I always fought tooth and nail for configuration. If necessary, seismic separation joints, to avoid those stress concentra-

tions and problems that you run into if you don't do that.

Today's Engineering Problems

Nicoletti: In addition to overemphasizing, perhaps, the computer, what in your opinion are some of the problems that are facing today's structural engineers?

Forell: One of the biggest problems we face today is the problem that we have found with moment steel frames [after the 1994 Northridge, California, earthquake]. I don't think that problem is solved yet.

When you really think about where it all comes from, I think the problem with moment steel framing is really based on the economics in our society. The production of steel is completely influenced by economics. That's also true about welding procedures. I also think one of the problems is ignorance, and I will include myself on that. When I went to college, I was told loud and clear that weld was as strong as parent material, an assumption that really has turned out to be incorrect. So, solving this issue of weld strength and steel moment connections is one of the major problems we have right now.

I think the other problem we have today is the challenges presented by new trends in architecture. When I think back to the '60s, the dominant influences on architects were people like Mies van der Rohe, and for that matter, the Bauhaus. Structural engineering was pretty easy because architectural form followed function, and basically used the structure as part of the architectural expression. This incorporated structure and architecture. Today, with the expressionist forms of deconstructionism/post-

modernism and the architecture of people like Frank Gehry, it is not so simple.

Nicoletti: Do you think engineers are better understood today by architects than they were say 20 to 30 years ago?

Forell: Yes and no. I would think that in some ways they are better understood, but I think architects maybe have a little bit more exposure to the whole issue of earthquake engineering and what works and what doesn't, which was learned the hard way—by viewing pictures and reading horror stories about what happens after major earthquakes. On the other hand, they are less understood because engineering has become so complex that it isn't even too well understood by engineers.

Nicoletti: That's true.

Forell: I'm going back again to my early days, you know, where you look at the computer printout and like Alex Tarics said, "Well, you know, this is very precise, but is it accurate?" It's very difficult now to debug a job if you just do a conceptual review—which very often has nothing to do with analysis, but with configuration and common sense—or unless you really start off from a parallel run on the whole thing.

Nicoletti: On a slightly different subject, what are your thoughts about this move by [California] State government engineers to retain all of the work in-house?

Forell: Well, that has been a problem in the State of California for a long time, and I really think it's a bad idea. I go back far enough to remember the years when the State of California did all junior colleges and there was a battle

royal at the time between the AIA and the State of California. That particular battle was won by the AIA and now private practitioners design junior colleges. If you look across the country, there are very few states where the government has a monopoly for the design of freeways and bridges, and I think intrinsically that it is not a good idea.

Nicoletti: In some countries, the public works department has been privatized. How do you think that would work in this country? In New Zealand, for example, private firms do all public works projects. There is no public works department in the government any more.

Forell: I wasn't even aware of that and I really don't have a very strong view because I don't really know enough about it, but I do think the idea of design/build may make some sense. In other words, where the team comes up with a proposal for, let's say, a bridge design, and then the selection is made on cost, structural merit. That is the way most work is being done in Germany, I believe, and I think also in Holland. We have had some experience with design/build. The State Office Building at the San Francisco Civic Center was done in a somewhat unusual manner, where there was a partnership formed between the architect, the contractor, and the construction manager and they basically guaranteed the cost of the project and the completion date. And it turned out, in spite of our apprehension, very well.

Nicoletti: Were you part of this partnership?

Forell: No, we were not. We were retained by that partnership as were mechanical, transportation, food consultant, and God knows the hundreds of people nowadays that get involved

in doing a major job. But it turned out that in order to meet the aspirations of the client, the contractor many times was very helpful in preventing things from developing as the job went along because they were too complex or too expensive. So I feel pretty good about it, and I do think that as time goes on, we will find the traditional way of the architect retaining the structural engineer and having complete control over the work will change. In other words, you will find different combinations, working together really becoming the executing element of the development of the design.

Nicoletti: I'm sure that at Forell/Elsesser you have had projects that involved construction management. Has that been helpful in easing this problem that you are talking about between the architect and engineer?

Forell: I am a little bit concerned that it's overblown. I don't think we found it to be very effective. I think it can be helpful, but I would say that our experience has been mixed.

Let me say one more thing about the practice of engineering. I feel very strongly, and I have said this before, that the people in the office are really the biggest resource that you have. I think it's important that you spend enough time mentoring and educating your employees.

Nicoletti: Do you think the universities are doing a good job in preparing the students for employment?

Forell: Yes, I think they are doing a fair job and I think the real problem is that there isn't enough time available. I hate to say this, but I think we are, and I wouldn't be surprised if your firm wasn't also, reluctant to hire people who only have a bachelor's degree. I think we

now feel that the master's degree is mandatory just to give students enough educational experience. What I think is lacking in the education at the university is more time to really focus on, if you wish, the real world.

Berkeley used to have a practice where they would hire outside practicing people to give some courses at the university. I don't think that's much happening anymore. I would like to see just a series of lectures being given for the education of engineers where they are told something about the practice of engineering and construction, experiences that are relevant today.

I have had the opportunity to give some lectures at both Stanford and Berkeley, and I remember particularly a lecture that I gave at Stanford to an engineering class. I explained to them, among other things, how much of the engineering dollar was devoted to what activity and when they found out the small percentage of the total fee available that was allocated for analysis, they were appalled. They really thought analysis was all you did. The large amount of time or money that was spent on things like marketing, administrative things, and construction inspection, they just knew nothing about. I think it's bad to have people come out of the university who do not have any knowledge of the field that they are trying to enter.

Nicoletti: It's also been noted by others that the universities are no longer preparing people to do a design job. For example, the design problems that used to be part of the curriculum at the university are no longer being used. It may be that there is so much new information and, as you mentioned, it requires a master's degree even before someone is ready to

become employed that there just isn't time. Perhaps it's better left to the employer to provide this practical experience.

Forell: Well, I'm very sympathetic with that because, as I told you early in our interviews here, Brown University, of which I am a product, had no interest in application, but was really constructing their curriculum on a theoretical basis. It served me well in the long run.

But I do think that with the investment people put into getting the education that is necessary to be successful, some courses, or just lectures on private practice, would be extremely helpful. I hate to see people go through the whole effort, and figure out two, three years later that well, that's not really what they wanted to do. I have seen that happen, as a matter of fact. I can think of a number of people who all of the sudden started going to night school to get an MBA and then left engineering.

The Influence of Others

Nicoletti: You have mentioned a couple of people that influenced your career in engineering. You have mentioned Henry Degenkolb and you've also mentioned others. Would you talk about some of the people who have influenced you?

Forell: Yes, I would like to. Back to Degenkolb. I got to know Henry quite well. He and I had one thing in common, and that is that we both liked to have a little drink of Sanbucco after technical meetings, and we'd sometimes get to talking about philosophy of engineering. Although I did not always agree with Henry, I think he and I basically had the same feelings about what was needed in structural engineering.

Another person who influenced me quite a bit is Igor Popov. What I really admire about Igor is his total devotion to engineering and the very superior research work that he has done.

Really, when you look back now on all the literature that is published, some of the papers that were introduced by Igor, or with Igor, can be looked upon as high points in the development of analysis in engineering. We have become quite close, and I talk to Igor quite a bit. I really admire what he is trying to do.

I look up to Vit Bertero. I mean, here is a man who is so profoundly involved in engineering that I would call him one of the giants in the field, and he certainly has been recognized as such. I think the only problem with Vitelmo is that he can wear out normal people with the intensity of interest that he has in engineering!

Another person that influenced me, interestingly enough, is Fritz Mathiesen. What happened there is that he is the one who sort of dragged me, kicking and screaming, onto the SEAOC Seismology Committee, and in doing so, I ended up with a profound respect for Mathiesen. I think that his early death was a great loss for the profession. I think he was one of the people who could succeed in putting technical issues in terms that people such as me can understand.

Mike Pregnoff was, of course, fascinating to watch at the Seismology Committee, and I don't think he missed very many meetings. What was likeable about him is that he was so straightforward about everything. He had his opinion and he stated it strongly, frequently, and very convincingly.

Let me see who else I can think of—well, recently with my involvement with Caltrans, I have become extremely impressed by Bruce Bolt and I think again, that he is the kind of person who is way ahead of a lot of people in his field and he has been extremely articulate in making his positions understandable.

That's a very brief summary of people that I can think of right now that I have been influenced by, but I should not only talk about the greats, but also talk about the people less well known.

I think, as I said earlier, Alexander Tarics was quite an influence on me, but that was, of course, during my early stage of development. I shouldn't leave out my partner Eric Elsesser, whom I greatly respect. He is an extremely creative person and works very quickly in thinking things through. He also has been extremely successful in straddling the two major aspects of engineering nowadays: the design of buildings or the conceptual design of buildings, as well as marketing and getting work in, which is very important.

I should also mention some members of the peer review panel for the San Francisco freeways. One person on that committee was a very old and dear friend of mine, Eph Hirsch, whom I respect greatly. He is direct, able to come to the point, and not afraid to speak up. Of course, I should not leave out Joe Nicoletti, who obviously ran things with great finesse.

Nicoletti: Thank you, Nick!

Codes

Nicoletti: The academics seem to be influencing code development. More and more of our codes, I think, are really coming out of the

academic field. Out of research done by universities. Do you think this is a good thing or is it a bad thing?

Forell: I think it's both. The work that's being done is extremely beneficial. That it is appearing in the codes is unfortunate and it's really not because of the desires of the academicians such as Bertero and others, but it's really because the people who write the [SEAOC] Blue Book are the ones who really want it in. I think they are mistaken, in that they are creating more and more complexities in the codes. I wonder really, as I have said before, how many people really understand the provisions that are now slipping into the codes?

I think when you get to be my age, you have a real problem with keeping up with the latest code developments and I think it's almost impossible to run a fairly large office and continue to be really very proficient in the latest analysis processes and computer programs. My position always has been to hire people who are smarter than I am. Because, if they are not, what's the point of hiring them?

In my opinion, what is important, even if you aren't technically as proficient as your employees, is to really look at their work from a very practical point of view to see if it makes sense or not. If you feel that there is something wrong with it, then you really have to sit down and try to get behind the reasoning of the person's solution.

Nicoletti: I think what you are talking about is what Charlie DeMaria used to call the "idiot check."

Forell: I do a lot of that, especially in checking the drawings. It's really the antithesis of the

State Division of Architecture, I mean I don't do a detailed check. I just really look at whether the drawings look reasonably complete, and whether there is anything in the detailing—which is so important—that looks improbable and whether the whole solution is logical and is simple. I think it's so important to make a job simple. You can make more money in the schematics by trying to drive an architect into a logical and reasonable conclusion than you can make on all other phases of the job.

Nicoletti: I think that's true. I think it's also true that engineering disasters result from a mistake by an order of magnitude or by a decimal point, and not by the third significant figure.

Forell: That is correct! That is very correct!

In Conclusion

Nicoletti: Is there anything that you would like to add in conclusion?

Forell: Well, yes. Looking back on my career, I can say that I feel very pleased and I hope that I'll be forgiven for this arrogance, but my alma mater had a motto that said, they wanted "to create people of usefulness and reputation." And I feel I have accomplished that.

Nicoletti: I think you have, Nick. I think you have!

Forell: I also have to thank my family, particularly my wife, Carol, for giving me the opportunity to devote the time that it takes to be successful in engineering. It might be of interest that I have two daughters. My older daughter, Katey, went into business—the stock market—and is very successful. The younger one, Anne, got a master's degree in architecture from Harvard and is working now as an archi-

tect for Skidmore, Owings, and Merrill. I often wonder if I had something to do with that!

Nicoletti: Well, it may be a good thing that you've retired, Nick. You might end up working for her.

Forell: Well, working for my daughter probably would not be the worst thing that could happen to me! I kind of like the sound of Forell & Daughter.

Photographs



Nick at his drafting table at his offices at Gillis and Forell, 1959.



The Santa Cruz Governmental Center was built in 1962. Nick, as Engineer of Record, designed the structural system to use a precast frame of concrete viereendeel beams. The building is supported vertically and laterally by sixteen cast-in-place concrete tower frames, each with four columns. The building performed extremely well in the Loma Prieta (1989) earthquake—it sustained only superficial cracking—especially considering that it was so near the epicenter and was designed in the early 1960s, before most of the modern seismic building code development took place.



The IBM-Santa Teresa Programming Center, just south of San Jose, California, was built in 1974. The building, for which Nick was Engineer of Record, was an array of modular units, and performed very well in the Gilroy (1979), Morgan Hill (1984), and the Loma Prieta (1989) earthquakes. In 1978, the building won the American Institute of Architects National Honor Award for Architectural Excellence, AIA's highest award.



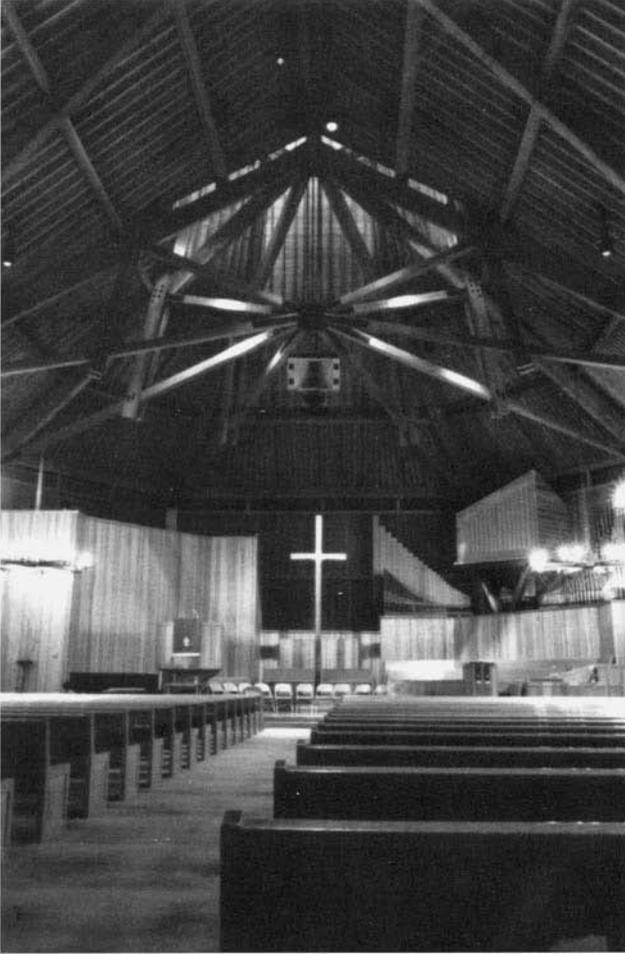
Nick was a member of the EERI reconnaissance team that investigated both the Oaxaca (1978) and Guerrero (1979) earthquakes. Here, he posed next to a reinforced concrete pipe used to repair a damaged aqueduct near Xochimilco after the Guerrero earthquake.



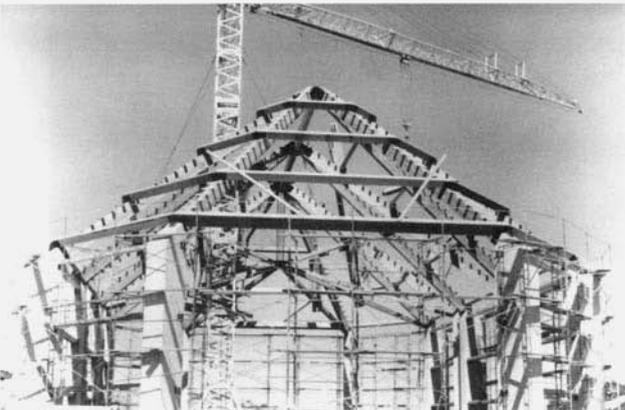
Nick, on the left, Neville Donovan, and Joe Nicoletti during a break from investigating the Oaxaca, Mexico earthquake in 1978.



This addition to the Life Sciences Building on the University of California, Berkeley campus, was built in 1985. It was one of the early applications of coupled shear walls. The floor system is a stiff, but very efficient, waffle slab system designed to minimize vibration-related disturbances to the sensitive laboratory equipment and experiments. In 1987, the building received the American Concrete Institute Award for Excellence in Design and Execution of Concrete Construction, and is also the subject of an EERI publication entitled Design Decisions, Methods, and Procedures—U.C. Berkeley Life Sciences Addition.



The Lafayette-Orinda Presbyterian Church was not the biggest project Nick ever did, but it was one of the jobs of which he was most proud. The cathedral-like structure, with beautiful natural light pouring in from above, has most of its structural system exposed. Nick was proud of creating a skeleton worthy of being viewed and incorporated as architecture.





The Keck telescope, atop Mauna Kea on the Big Island of Hawaii, was the largest in the world at the time it was built in 1984, and was the first to use a coordinated segmental mirror system. Nick Forell was project principal and William Honeck was the project manager and Engineer of Record. Forell/Elsesser engineered the foundation and base ring-shaped walls of the telescope housing, developed the schematic design of the dome housing, and developed a design-build specification for the dome structure, which rotates on a special continuous track atop the ring walls. The lateral design of the Keck housing was governed by wind force considerations, owing to wind speeds well over 100mph. The high, windy peak at an elevation of 13,700 feet is partially covered with snow and ice at all times, and made working conditions extremely difficult. The thin air required the workers, who were used to sea-level elevation, to condition themselves prior to the project.



San Francisco Museum of Modern Art. Nick was Engineer of Record on this landmark undertaking. He strove very hard to create a true collaboration between himself and the architect, Mario Botta, who spoke only Swiss-Italian. This architect-designer synergy helped integrate the many unusual interior spatial configurations with the structural design. The interior structural members of the central turret are exposed, and the interior pedestrian bridge of structural steel beneath it are focal points of the architecture. Nick's daughter, Anne, an architecture student at the time, built a study model for the job.



Nick Forell, left, and Eph Hirsch at the 1994 SEAO convention.



The Forell/Elsesser principals, 1966. Left to right, seated: Mark Jokerst, Simin Naaseh, Nick Forell, and Grace Kang. Standing: Paul Rodler, Elizabeth Halton, Mason Walters, James Guthrie, Eric Elsesser, William Honeck, and David Friedman (now President of Forell/Elsesser). Rodler and Jokerst worked closely with Nick on the SFMOMA design. On the table are models of the Keck Telescope (made by Nick's daughter, Anne) and of SFMOMA.



Nicholas F. Forell, 1996.