Regional Oral History Office
The Bancroft Library

University of California
Berkeley, California

CHARLES SEIM

The Bay Bridge Oral History Project

Interviews conducted by
Sam Redman
in 2012

This series of interviews was funded through a contract with the
Oakland Museum of California, the California Department of Transportation,
the California Transportation Commission, and the Bay Area Toll Authority

Since 1954 the Regional Oral History Office has been interviewing leading participants in or well-placed witnesses to major events in the development of Northern California, the West, and the nation. Oral History is a method of collecting historical information through tape-recorded interviews between a narrator with firsthand knowledge of historically significant events and a well-informed interviewer, with the goal of preserving substantive additions to the historical record. The tape recording is transcribed, lightly edited for continuity and clarity, and reviewed by the interviewee. The corrected manuscript is bound with photographs and illustrative materials and placed in The Bancroft Library at the University of California, Berkeley, and in other research collections for scholarly use. Because it is primary material, oral history is not intended to present the final, verified, or complete narrative of events. It is a spoken account, offered by the interviewee in response to questioning, and as such it is reflective, partisan, deeply involved, and irreplaceable.

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The Bridges and the San Francisco Bay Oral History Project: Series History

The Regional Oral History Office (ROHO) of The Bancroft Library at the University of California, Berkeley, launched a new oral history series on the history of the San Francisco-Oakland Bay Bridge in May 2012. At that time, ROHO entered into an agreement with the Oakland Museum of California (OMCA) to conduct approximately 15 oral histories, totaling about 30 hours of interviews, on the history of the Bay Bridge, the San Francisco Bay, and bridges in the surrounding region.

This project was a collaboration between ROHO, OMCA, the California Department of Transportation (Caltrans), the Bay Area Toll Authority (BATA), and the Metropolitan Transportation Commission (MTC). This project was designed to fulfill the historical mitigation requirements associated with the dismantling of the eastern span of the San Francisco-Oakland Bay Bridge. The series coincided with, and contributed to, the research phase and design phase of an exhibit at OMCA on the social and environmental history of the San Francisco Bay.

This project provides a new set of resources widely accessible to students, scholars, and the public interested in the San Francisco Bay. Interviews focused on the men and women who spent a good portion of their careers working on the bridge, whether as painters or engineers, toll-takers or architects, labor or management. Beyond the human dimension of the bridges, these structures also connect geographic spaces, providing conceptual linkages between cultures, environments, and political discourses. This oral history project, then, explored the role of the iconic bridges in shaping the identity of the region, as well as their place in architectural, environmental, labor, and political history. This project enhances the historical understanding of the San Francisco Bay and the natural and built environment that helps define the region.

The Bay Bridge Oral History Project launched with an investigation of the history of the bay and the architectural, social, and political history of the bridges that span the waters of the region. Planning meetings attended by representatives of ROHO, OMCA, Caltrans, BATA, and MTC began in mid-2011. In these meetings, representatives of the various groups discussed the topics that should be covered in the interviews as well as the kind of people who should be interviewed. Although there were no known individuals who worked on the construction of the Bay Bridge (1934-36) still living, a foremost goal of the project was document the construction of the bridge and its early years, especially before the bridge was altered in 1959 with the removal of rail tracks on the lower deck. Beyond that initial goal, interviews were sought with individuals who would be able to share unique experiences related to the bridges from a variety of personal and professional vantage points: from laborers involved in maintenance of the bridge through bridge engineers who worked on the design on the new eastern span. The primary focus of this project was to dig deeper into the complex history of the San Francisco-Oakland Bay Bridge and its changing relationship to human communities and the environment.

The project interview staff at ROHO consisted of Sam Redman, PhD, and Martin Meeker, PhD. The project interviewers were assisted by David Dunham, technical specialist, and Julie Allen, editor.

Interview #1 September 4, 2012
Begin Audio File 1 seim_charles_01_09-04-12_stereo.mp3

01-00:00:07
Redman: All right, my name is Sam Redman, and today is September 4, 2012. I am in El Cerrito, California with Chuck Seim. This is our first tape together today, and our first session. Chuck, to begin, very simply, would you mind stating and spelling your full name for me?

01-00:00:25
Seim: Well, I go by the formal name of Charles, and the last name is pronounced "Seim." It's simply S-E-I-M. Rhymes with time.

01-00:00:36
Redman: But you prefer Chuck, is that correct?

01-00:00:38
Seim: My first name, I prefer Chuck, but the last name has "E" before "I," which is pronounced "I," and it's amazing that 50 percent of the people call me "Seem." And when they do that on the telephone, I say, "Well, he's not here."

01-00:00:57
Redman: So you can tell pretty quickly who knows you and who doesn't, I guess.

01-00:01:01
Seim: Yes. You'll have to speak a little bit more defensive. I didn't hear—

01-00:01:05
Redman: That's fine, [I'll speak up]. Let's start with, can you tell me your date of birth?

01-00:01:09
Seim: Yes, I was born on May 23, 1925, in Los Angeles. But it was not the Los Angeles that's there today.

01-00:01:23
Redman: Can you tell me a little bit about who your parents were?

01-00:01:27
Seim: They were uneducated laboring people. They graduated from the sixth grade and went to work. My father was a laborer all his life. My mother worked in a candy shop until she got married. Then she was then a housewife and mother.

01-00:01:51
Redman: You must have come of age as a young boy during some pretty trying economic times.

01-00:01:58
Seim: Very much so. My father would scrounge boxes of tin cans and toys that were put out on the curb to be picked up to take to a dump. If he'd find a toy, he would pick it up, hammer it out, and paint it, and that was my one and only Christmas present. He worked hard around the neighborhood. He got me

going about eight or nine years old to help him, [things] like, mixing cement to repair concrete, or repairing a fence. So he was a neighborhood handyman. That kind of passed on to me, because everything you see here in this room, I did that.

01-00:02:54
Redman: So you learned pretty early on how to work with your hands.

01-00:02:57
Seim: Yes. When I grew up as a teenager, we didn't have TV, of course. I built model airplanes. I got an erector set for a Christmas present. My father actually bought it. I would build—excuse the expression—bridges. Well, any kind of structure I could put together.

01-00:03:23
Redman: So let's talk about, growing up in that time, what early school must have been like for you. Tell me a little bit about what you recall about elementary school, perhaps.

01-00:03:38
Seim: That's easy to remember, because we lived on the west side of Main Street, in what is now called South Central. On the east side was all Hispanic. This was lower, laboring-class neighborhood. I had shoes to wear all year long, but the Hispanic boys went barefooted year-round. In those days, Los Angles got pretty cold in the wintertime. That really bothered me, that these people were so poor. Their girls wore shoes. My first girlfriend was Hispanic and lived on the other side of Main Street.

01-00:04:30
Redman: It sounds like the neighborhood you would have grown up in would have been very diverse in terms of the background of the other young children that you might have been going to school with.

01-00:04:41
Seim: Yes. There was a structural engineer living on our block. My father used to say he could multiply numbers in his head. I thought that was so wonderful. He was such a nice guy to me as a kid. That always impressed me. That structural engineering ought to be a lot of fun. Well, none of my family had ever gone to school.

01-00:05:20
Redman: Talk about your parents, their relationship with your schooling. Did they encourage you to go on to school? You had mentioned that your father had pointed out another structural engineer. I wonder if he encouraged learning in other sorts of ways or pushed you in that regard.

01-00:05:40
Seim: That was maybe my strength and my weakness. My father was killed two months before my fourteenth birthday. So I went to work at sixteen to support my mother. She got very little pay for his death. It was an industrial accident.

So he was not alive to guide me or even pay for me. I wasn't in the Army during the war, but I worked for the Army as a truck mechanic, and I was able to support her and myself. At the age of about twenty-one, I said, I've been working with these people, and I know a lot more about trucks than they do, and I haven't been working very long. Maybe I ought to go to school. The closest school at the time was USC. I went down in the fall because I heard that they were starting school, and I found a line of people. I got in the line. I got up to the table and I said, "I want to go to college." I gave my name and they looked for my transcript. "Where are your high school transcripts?" I said, "What's that?" They gave me the best advice I ever got in my life, to go back to my high school and ask for a counselor. Well, I was working. But a counselor came at night to talk to me, and he advised me to go to a junior college and make up all my high school deficiencies. Because during the war, I worked. I got a high school diploma, but it wasn't because I was doing high school work. I was working for the Army.

01-00:07:52
Redman: What sort of work did you find during the war?

01-00:07:55
Seim: I was a truck mechanic, repairing Army vehicles.

01-00:08:06
Redman: Your father sounds like he taught you a lot in terms of actual constructing and building and maintenance of structures and things like that, but I wonder if he maybe didn't have the training to, say, read an architectural plan or rendering. Did you start to acquire a little bit of that during that work experience with the Army during World War Two?

01-00:08:31
Seim: No. There was not much you could do during the war, anyway. No. I read manuals on automobile repair.

01-00:08:42
Redman: I see.

01-00:08:44
Seim: And so that was the beginning of my study. I could retain that. I was eighteen or nineteen. They put me in the premiere spot in the repair shop. I was the tune-up man. Now, all these other guys would crawl under the truck, take off the wheels, [or] change a transmission. But you could actually wear a suit and tie to tune-up a car. There was about four or five of us all lining up with cars, trucks, and I was assigned to that at a very early age. Of course, all the older mechanics were wondering about that – a high school boy doing their work!

01-00:09:43
Redman: You'd shown some aptitude for the job? I wonder how that came about that you got—

01-00:09:51
Seim: That's precisely what drove me to go to school. These guys had been working their whole career. They were forty-five, fifty-year-olds, and they really didn't understand how the mechanism they were working on worked. They could only know how you take off these screws and pull this out and put that in.

01-00:10:16
Redman: I see. That's very interesting. Let's talk about, then, after the war, did you get benefits from the GI Bill?

01-00:10:24
Seim: No, no, because I was not in the Army; I was working for the Army.

01-00:10:29
Redman: You were a civilian working for the Army. I see. So, then, after the war ends, you decide to enroll in, first, junior college, to make up those high school credits, but then eventually you enroll in a university program.

01-00:10:47
Seim: Well, yes, but when I was going to junior high, I only went in the morning. Because in the afternoon, I had a job. It was a great job. Before I worked for the Army at the age of sixteen to maybe eighteen, something like that, I worked in a woodworking shop with a German craftsman. He taught me how to set up machines and build things out of wood. Fact is, we [even] built airplane parts out of wood. Then I went and worked for the Army. After I started to go to school, the new owner of the woodshop had heard about me and asked me to come and work for him, doing what I was doing before, setting up the machines and so forth. In the afternoon, I would drive my little Model A and work in the afternoon. So I worked my way through school. It took me six years. But I took my junior year at UCLA and my senior year at Berkeley.

01-00:12:15
Redman: Okay, so you transferred up to Berkeley. By your junior and senior year, between that time at UCLA and Berkeley, you'd chosen a major.

01-00:12:30
Seim: At UCLA, it was just starting its engineering program. Dean L.M.K. Boelter came down from Berkeley to start the engineering school. The purpose there was what we call general engineering. So I took courses in thermodynamics and electricity and mechanical, as well as civil. I always wanted to do something in the civil area. Build things to benefit people. That's strange, isn't it, that I would have that inclination, but everybody has inclinations that make them go through school. I said, "I want to be a practical civil engineer." So I transferred, in my senior year, to Berkeley.

01-00:13:32
Redman: Do you recall what year that was?

01-00:13:34
Seim: Yes, it was 1951.

01-00:13:36
Redman: Can you tell me about what it was like, what the experience was like, and what your impressions were of the engineering department at Berkeley in 1951 when you arrived?

01-00:13:52
Seim: The only word I can think of, it was *marvelous*. I knew all the professors, and they knew me. And they lived in this neighborhood where I am now living. There were at least six or eight professors here in this neighborhood.

01-00:14:13
Redman: In El Cerrito?

01-00:14:14
Seim: When I bought this property.

01-00:14:16
Redman: That's amazing.

01-00:14:19
Seim: Fact is, Professor Scordalis lived a block this way, and Professor T.Y. Lin lived a block that way.

01-00:14:29
Redman: I understand that his house is somewhat unique in its engineering. T.Y. Lin, of course, becomes very well-known for expanding—I understand he doesn't exactly invent prestressed concrete, but he greatly expands the practical use of what prestressed concrete is able to accomplish. I guess his house was the first built out of prestressed concrete, is that correct?

01-00:15:02
Seim: Yes. You've done your homework. I'm surprised that you know that. But I'm glad you do—

01-00:15:09
Redman: Can you tell me a little bit more about T.Y. Lin?

01-00:15:12
Seim: I worked with him, elbow-to-elbow, from 1980 to 1992.

01-00:15:18
Redman: Take me back. We'll get into that. That's an important story. Take me back to, in 1951, is that when you first met T.Y. Lin, among the other engineering professors at Berkeley at that time?

01-00:15:32
Seim: Yes. I'll have to start by saying, I was always interested in writing technical articles. Not technical from, say, a Ph.D. standpoint, but from a layperson

standpoint. Can I write in such a way that they can understand what's going on, and why does a bridge work and so forth? When I was at UCLA, I wrote an article for what was called the *Cal Engineer* magazine at that time, which was published on the Berkeley campus, but it was distributed to UCLA. There were two of us doing that at UCLA. When I moved to Berkeley, I continued on, but I actually worked with the staff of students, putting out an edition every month, that was sold for twenty-five cents by women who were also part of the staff.

The editor said, "We should have an article on prestressed concrete." He said, "Why don't you see what you can do?" Well, I had had T.Y. Lin as my professor for reinforced concrete, and he had one lecture on prestressed concrete at that time. I asked him, and he invited me to his office, and he spent a whole hour with me. I tell you, if you ask me what was the best hour I ever lived in my life, I'd have to say—because I was overwhelmed that this very—I found out later how brilliant he really is—professor would spend an hour with little old me as a son of a laboring father and so on. I had never had anybody do anything like that for me. So that's number one to explain my affection, whatever you want to call it, for T.Y. Lin. I wrote an article that I hope will be published in November, because in November it will be his centennial. The title of my article is "The Legacy of T.Y. Lin."

01-00:18:30
Redman: Can you tell me a little bit about, during that hour—we can talk a little bit about the details of what you guys talked about in technical side, but can you tell me, just first, a little bit about what his personality was like? As an undergraduate student, you would have been surprised that here this brilliant professor was spending so much time explaining these things to you. Can you describe his personality for me a little?

01-00:18:57
Seim: He was very, very active. He had tremendous energy. He was five six, five eight. Very small man. He said when he went back to China after he got his masters degree at Berkeley in 1933 they called him "Little Lin." But he had this tremendous energy. He was constantly moving. He wouldn't sit still. He was constantly moving. When we were in his office, he would be grabbing pieces of paper and scribbling. He didn't stand still at all. But he was giving me pictures and diagrams and explaining to me by drawing and making calculations. He did calculations in his head. It was a very dynamic meeting. Just fantastic. When I walked out of there, I had so much information that my article ran for three or four pages. Usually they were only two pages for an article. Ran three or four pages. I had pictures that we put in. I still have it. I still have that magazine.

01-00:20:24
Redman: It's fascinating, because this is also happening at an interesting time in U.S. history in terms of infrastructure in the United States. It's right before the

launching of the massive infrastructure project of the interstate highway system.

01-00:20:46
Seim: Oh, absolutely.

01-00:20:49
Redman: I wonder if maybe you could tell me a little bit more about the mood in the engineering department as it related to infrastructure. It seems like in that postwar moment, there would have been a lot of optimism about, potentially, opportunities for the expansion of public works projects that hadn't been possible since the New Deal because of the war.

01-00:21:17
Seim: Before we touch that, we're still talking about T.Y. Lin.

01-00:21:20
Redman: Sure.

01-00:21:25
Seim: He and his wife were great ballroom dancers, and they built a thirty-foot by forty-foot prestressed concrete ballroom floor in their house. It's only two blocks up from here. The unique feature is that that was the first house, and maybe the last house, to feature a prestressed concrete floor.

01-00:21:55
Redman: I see.

01-00:21:57
Seim: If you look at the house, you can see the edge of the concrete floor, and you can see the prestressed tendons. The prestressed concrete has steel strands embedded in the concrete. You can see the dots, the end of those strands. You can see it on his house today.

01-00:22:15
Redman: It's probably the sturdiest dance floor in California, I would imagine.

01-00:22:20
Seim: Yes. They would practice dancing all the time. He's invited me to his house several times. Every time I go in, I look around and take a look at that prestressed concrete floor. So that answers your question.

01-00:22:41
Redman: Thank you.

01-00:22:42
Seim: The reason that house is notable is because of that thirty-foot by forty-foot dance floor made out of prestressed concrete. T.Y. gave me all the information I needed to write an article on prestressed concrete for the *Cal Engineer*. But at the same time, in 1951, the infrastructure, as your question states, began to expand. We needed it. During the Depression, there wasn't

any money to build infrastructure. That sounds familiar today, doesn't it? During the war, there was no steel available to do that, to build infrastructure, so we were way behind. But fortunately, because of the GI Bill of Rights, many of the returning soldiers studied engineering. Fact is, I was advised not to go into engineering in 1946, because there were so many people studying it that when I graduated, there wouldn't be any jobs. Well, I thought, all right, I'm not after money. I just want a job that I can do things on. I ought to be able to find a job somewhere. So I persevered, and I graduated. Took me six years. But lo and behold, nobody else was going into engineering, so when I graduated, there was a dearth of engineers. So you have to be careful what you tell students. Now we have the need for infrastructure and not a lot of engineers graduating to do it. It was a very unusual part of—to get started in doing that.

01-00:24:51
Redman: Now, you start as a junior engineer with the state of California, Division of Bay Toll Crossings. Is that correct?

01-00:25:00
Seim: It was actually called Division of San Francisco Bay Toll Crossings.

01-00:25:05
Redman: What does one do as a junior engineer starting out in the mid-1950s?

01-00:25:13
Seim: At that time, we were building the Richmond-San Rafael Bridge.

01-00:25:19
Redman: The Richmond-San Rafael Bridge, it opens in 1956. It's two cantilever spans, making room for two major shipping channels. It's among the largest bridges in the world when it's completed, I understand. It's among my favorite bridges to drive over in the United States, just because of the gorgeous vistas. But I wonder if maybe you could tell me a little bit more about the engineering side of it.

01-00:25:42
Seim: Well, first, let's put the bridge in context. It's not the longest span in the world. Nowhere near. At the time it was built, it was the longest bridge in the world. See, there's a distinction. It was the longest bridge over the San Francisco Bay Bridge by several hundred feet. It's not a spectacular dimension, but it was true. It took a while to get a bridge longer than the Richmond-San Rafael. Now, the twin spans, they were spanned by what we call a steel cantilever span. But the interesting thing is that these shipping channels were not parallel to one another. They angled. Everybody working on that bridge—I think it's safe to say all the higher-echelon engineers—were the same engineers that worked on the San Francisco Bay Bridge. I had a chance to work with engineers who actually worked on the San Francisco Bay Bridge, and I used to read about that when I was a kid. I thought it was the most marvelous thing in the world.

01-00:27:19
Redman: Let's step back, because I want to connect that experience right there. First, tell me a little bit more about, as a child, what you knew of the San Francisco-Oakland Bay Bridge. I suspect the Golden Gate Bridge, it's hard to—

01-00:27:39
Seim: Both of them.

01-00:27:39
Redman: Right. It's hard to parse those apart. They go up simultaneously. They're celebrated with a fair.

01-00:27:46
Seim: I was fortunate that we did get newspapers and we got some magazines. I guess I was fortunate there were articles in both of those about the Bay Bridge, and I just devoured those. First thing I'd do, I'd look for them. I would read about this and I'd say, my, that must be the most interesting job in the world. You see, that's that exposure, maybe once a month—if I was lucky, I'd be able to read whatever it is—but that exposure, plus the structural engineer down the street. So I decided I want to go to school. I knew I wanted to be an engineer.

01-00:28:40
Redman: So it's safe to say that the Bay Bridge and the Golden Gate Bridge, the time when that goes up, that makes a big impact on you as a child. That makes a mark on what you were interested in, who you would eventually become.

01-00:28:56
Seim: Oh, I think it's safe to say it's the most important impact in my entire life. When I decided I wanted to go to college, nobody in our family had ever gone to college. Of course, my widowed mother constantly told me, "Go to work and support me." That's her words. She didn't want me to go to school. I had to defy my mother to do that.

01-00:29:32
Redman: That must have been a hard decision to make as a young man.

01-00:29:33
Seim: Oh my god, it's the hardest thing I ever did. But it was even worse than that. When I decided to take my senior year at Berkeley, that meant I had to move out of the house and come up. It really shakes me today to even think about it. And how I did that. I just can't imagine doing that, but I did. I knew I had to do that to advance myself, because I didn't want to live like my father, who was always straining for money. He was uneducated. He couldn't get a job. He could only do what his hands and back could do. It killed him at the age of forty-two, doing the job that he was doing. Of course, in those days, safety was always second place. We need to talk about that when we talk about building bridges. Safety on the San Francisco-Oakland Bay Bridge and safety on the Golden Gate, because that's, to me, like night and day between the two bridges. But that's later on.

01-00:31:13
Redman: Let me ask about those engineers that you met on the Richmond-San Rafael Bridge, in particular, those who had experience on the San Francisco-Oakland Bay Bridge. What sort of lessons were they—I suspect especially there must have been lessons from the cantilever eastern span of the Bay Bridge that may have transferred over, in some respect, to building similar spans further up the bay. I wonder; what sort of impression did those men leave on you and what sorts of things were they telling you about that experience that they had had a couple decades earlier?

01-00:31:59
Seim: I never thought about it until this moment, but they were my mentors. First of all, they were bright. Second, they were hardworking. And third, they were very good engineers. You put those three together, that's why they worked on the San Francisco-Oakland Bay Bridge. Because if you didn't have those attributes, you wouldn't be working on those structures. They came to the Richmond-San Rafael with that drive of their own, plus the experience they learned on the San Francisco-Oakland Bay Bridge. They applied that to the Richmond-San Rafael. However, there was a problem there in that, in the 1930s and in the early 1950s, steel bridges were pretty well standardized. You had eyebars and members that formed together to form triangles. A truss is nothing but triangles put together, but a triangle is the greatest, most sturdy structure. If you put it into a rectangle, it distorts. There's nothing magic about a triangle. It's the most rigid structure. Of course, if you have any sides less than that, it's not an enclosed figure. That's all we had. We had trusses, and we had members that made up those tresses. We had eyebars, which are just bars with expanded ends, with holes in it that looked like eyes. We had rivets. We had gusset plates. What we'd do, we'd just put these together to get the span that you want. If you want a longer span, then you go deeper. That's all we had. It wasn't until T.Y. Lin, on a Fulbright scholarship, went to Brussels, in a top prestressed concrete laboratory in Europe, and spent his sabbatical—he started in 1946, so 1954—and came back and wrote his famous book. Now we have a new material that we can use and develop and expand. Then, of course, a little bit later, from Europe, they developed—I'm going to use the technical term, but I have to use it to try to answer your question. What they call orthotropic steel decks, where you take plates and put them together in a certain way that become very economical. Fact is, I'm working on orthotropic steel decks for the last fifteen years.

01-00:35:29
Redman: To this day, they're still—

01-00:35:31
Seim: An orthotropic deck is on the new San Francisco-Oakland Bay Bridge. Then, a little bit later, later in the 1950s, they began connecting cables from a tower to these decks, and they called it a cable-stayed bridge, which is another type of bridge that didn't exist prior to that. Then, on the concrete side, instead of bringing up a girder that spans from pier to pier, they started with a pier and

they built cantilevers by putting extensions on each side so it comes like that. Then over here at the next pier, you do that, then you connect the two together.

01-00:36:18
Redman: So that aspect of building the cantilever was only possible with the prestressed concrete?

01-00:36:23
Seim: That's only possible with prestressed. It's called segmental concrete construction. That came in in the early sixties and so forth. So now we have new types of structure coming into our repertoire of bridges. I was going to say we don't have any new types since then, but we have some, but they are not for long spans. They're called stressed steel bridges. Stressed ribbon, actually. Stressed ribbon bridges. But they're minor. There haven't been many built that way. That came in, and as part answer to your question of what did we have in the way of advancing our infrastructure, particularly in the bridge part of it.

01-00:37:20
Redman: But it sounds like these—it doesn't replace the experience of these engineers and what they're able to pass on with some of these older methods. To me, it comes off as sound, well-thought-out, well-practiced engineering methods, and that these new methods are coming in to complement existing methods, but that it was advantageous for you to learn the old ways of building as well as incorporating these new ways. Is that an accurate characterization?

01-00:38:02
Seim: Yes. Well, yes. It's like writing articles. If you want to write, you have to write. If you want to build bridges, then you have to work with people who have built bridges. But the point here is that there was no real advancement in our technology between the construction of the—I'll go back to the Dumbarton Bridge, which is the first crossing of San Francisco Bay in 1927, or the Carquinez Strait Bridge, 1927. Both bridges were open the same year. Truss bridges. Triangles. Eyebars. The same thing. So that had been perpetuated up to 1936 and '37. Well, of course, the Golden Gate Bridge is a suspension span. We'll have to talk about that later, but the Golden Gate Bridge, of course, set the longest span in the world. Then when the Richmond-San Rafael Bridge was built, starting in 1954—it was actually '53, I think it was, '53 to '56—the same applications. After that, then we'll get into the San Mateo-Hayward Bridge. That's welded steel girders and orthotropic deck.

01-00:39:40
Redman: I see.

01-00:39:41
Seim: That's where they're transition. That was 1967. We started that about 1964. So 1964, from 1956, we got this welded steel girders and orthotropic deck that I had mentioned before, and we used it on that bridge.

01-00:40:04
Redman: I would love if you would talk as much as you'd like on this topic: the reconstruction of the San Francisco Bay Bridge and the reconversion of the decks between about 1957 and 1963. The removal of the rail, the key system rail, from the lower deck, and other changes to both decks. I am reading this as resulting in a brand-new traffic pattern and numerous changes in the stress and load and design considerations of both decks. Would you explain what your involvement on that project was? I understand it's a massive conversion that takes place over several years.

01-00:40:47
Seim: You've summarized it very well. After we finished the Richmond-San Rafael, I was asked to go into, at that time, the Berkeley office of the San Francisco Bay Crossings. The story is that one of the engineers Norman G. Raab who worked on the San Francisco-Oakland Bay Bridge didn't want to stay in—he had to go back to Sacramento after the Bay Bridge was completed in 1939. He came out of Sacramento to work on the Bay Bridge in 1933. One day, January 1, 1948, they established the Division of San Francisco Bay Toll Crossings. He came down to work on a parallel bridge to the Bay Bridge.

01-00:41:51
Redman: Now, this was an imagined span that was proposed, but was never built, in the 1950s. I know a little bit more about it, but that's about it. Was it, by any chance, a cable-stayed bridge that they had proposed? Tell me more about that.

01-00:42:09
Seim: No, it was just a parallel. That's all it was, is just a parallel copy of the 1936 bridge. Of course, it was defeated, primarily, in the press. *San Francisco Chronicle*. It's too bad it wasn't built, because we could use it today.

01-00:42:30
Redman: I have characterized the engineers who first imagined the Bay Bridge as being tremendous engineers, but poor estimators of traffic protections. But how could they have known that the age of the automobile was only going to expand exponentially in the postwar era? The mood about that must have been a bit conflicted amongst the engineers who saw the need for it, but then saw it get killed in the press.

01-00:43:04
Seim: I have to correct you here on this. Bridge engineers don't estimate traffic. We estimate gravity, and wind, and current. They have to know what that is. We're completely dependent upon another portion of civil engineering, called traffic engineering. However, in defense of the traffic engineer, they usually are right, but there's not enough money to build a structure that they say is needed. That's been totally held, absolutely true, all the way through recent history of bridge building.

01-00:43:48
Redman: Do you have to—of course work within the budget that you're given, but you're maybe, then, more inclined, in order to do that, to aim for the lower end of their traffic projections, since it simply might not be possible to accommodate all of the traffic that the traffic engineers are projecting?

01-00:44:07
Seim: But that leads in to what happened to bring in the conversion of the bridge from the original to what we see there today. This one engineer, who I'd mentioned [Norman C. Raab], had came back from San Francisco to—well, at that time, yes, their office was in San Francisco. When the parallel bridge was defeated, he stayed over with, I think, about five people, and they moved the office to Berkeley, where he lived. Then the next step was that they stopped the rail traffic on the Bay Bridge in 1957. There was not enough ridership to pay for it, so they just stopped running trains over the Bay Bridge. The parallel bridge has been defeated. Now we have a quarter of the deck unused. He came up with this idea of converting the Bay Bridge from six lanes, three in each direction on the top deck, three lanes of trucks on the bottom deck—only two lanes were used in each direction, and the center was used for passing—and take off the rails, and deck it over with concrete, and open that up to five lanes going into Oakland, leaving San Francisco, and converting the upper deck from the six lanes to five lanes, leading into San Francisco. He wrote the report, he estimated the cost figures, and it was accepted by the then Department of Public Works. So we got the job to start. It happened that we started in 1958. I had transferred from the Richmond-San Rafael to the Berkeley office, 1956. I was working, but we had run out of work. So I stayed over to work on that conversion. That's how it started. It was the vision of one person. The interesting thing is that, in 1957, when they stopped the trains on the bridge, the Bridge Department in Sacramento, which was principally highway bridges, was asked if it's possible to convert. They wrote the report that it's impossible to do that. On the strength of this one person [Norman C. Raab], the conversion started.

01-00:47:37
Redman: What was the tipping point there, that they said that—wouldn't work? Do you recall what maybe the major concern was for this process? Or even if you recall what your major considerations or concerns were in this conversion process. Did you fear that any aspect of this may or may not work, or were you pretty confident in the plan?

01-00:48:02
Seim: Oh, I was going to quit, because I didn't believe it. I didn't think it could be done. I thought that the traffic projections in the report was false. I came home and told my wife, "I just can't go on with it. This is the most ridiculous thing." But anyway, I started working on it, and I was working with some other young engineers. The guy that wrote the report, the older engineer, was upstairs in his office, and he didn't talk to anybody. By golly, we started getting some ideas, and we say, hey, wait a minute, on this stretch, if we did

this, we could strengthen it. A problem was very simple the solution was difficult. We had to strengthen the upper deck to carry trucks, because it was only designed to carry automobiles. The upper deck was three lanes of automobiles into San Francisco and three lanes to Oakland, and there was always a head-on collision, at least once a year, if not more often. Just like there used to be on the Golden Gate Bridge. It wasn't designed. But we started figuring out how to strengthen it, and this is why the report in Sacramento said it's not possible, it's not feasible. They don't say possible; they say it's not *feasible*. It's not engineeringly feasible. We started doing the impossible. It's like anything else. If you start studying things, and you really work hard, and you have some pretty talented people, you can do things. The example I can think of right offhand is development of the atomic bomb during the war. That was impossible when they started. If you work hard, apply engineering principles, you can do almost anything that falls within engineering principles. You can't fall out of that. Unlike politicians, you cannot reverse or eliminate gravity. We started working on this bridge conversion, and I said, wow, wait a minute we can do this. In 1963—that's five years later—I was still there. But now we have a problem. There's six lanes on the upper deck. In an ordinary roadway, a lane stripe is painted on. If you want to make five lanes out of six, you just sandblast off the stripe and paint other stripes. But for some reason, when they built the upper deck, they took little four-inch tiles, ceramic tiles, and they embedded them in the concrete.

01-00:51:30
Redman: So they wanted to make permanent lane markers—

01-00:51:32
Seim: Oh, yes. That's exactly right. They built this bridge forever. I was assigned a task to eliminate those tiles. Ooh. You can take a chisel and you can pound on it, and you can pull the tile out. You can take the next one and pull it out. There's thousands, ten thousand—I don't know. I don't know how many. That would take you forever. But now you've got a hole in the concrete deck. So how are you going to fill that? Well, we can mix up some mortar and fill the hole, but drives would still see a line of patches that could confuse drivers. I suddenly thought—oh, we can cover them over. That's what we did. We covered them over with a very tough—it's a combination of asphalt and epoxies thin surfacing. Epoxies are very strong adhesives. Shell Oil Company had developed this here in Emeryville, in their laboratory, which closed up about that time. We covered the whole deck, and then we painted the signs. I was so proud of that. They did the work at night. No, no, I'm sorry. They did it during the day. I went out and I talked to one of the engineers that I knew that was watching, trying to make sure it's done according to specs. He says to me, "Hey, Chuck, how are you going to get rid of that stuff when it wears out?" I said, "Frank, by the time that wears out, you and I will be retired." Well, guess who got the job of removing that? In 1969, the boss calls me up and tells me and says, "Go out and find why that material is causing sliding traffic." It was actually causing hydroplaning, too, but they didn't know what

it was in those days, but it was hydroplaning. So I went out and I tested it. All the skid resistance that we built into it had worn away, and so they asked me to find a replacement. But first, we had to tear off that stuff. The irony of that really impressed me as something, because I thought it was so clever to cover it up with just something thin. Then I said, "It will never wear out," and then five years later, I had the task of finding out why it was failing and to find a substitute.

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02-00:00:08
Redman: All right. My name is Sam Redman, and today is Tuesday, September 4. This is my second tape today with Chuck Seim. When we left off, we were talking about the reconversion of the San Francisco-Oakland Bay Bridge and what that entailed. I wanted to ask a question we sort of alluded at a little bit, about the mood at what is now Caltrans. The idea of taking the trains off the bridge and making it to auto, all time. You had mentioned that ridership on the Key System train had declined to the point that it was no longer feasible [to maintain]. What was the mood in the public? Did Caltrans have a sense that the public wanted the bridge to go all automobile?

02-00:01:06
Seim: I don't know, because I wasn't working with them at that time. All I know is that they did write a report that said it was impossible to convert the upper deck to carry trucks, and the lower deck—well, essentially what we did. That's all I know. Although it is clear that people like to drive their cars and do not like to take public transportation.

02-00:01:25
Redman: That's fine. It was a few years later that you had arrived.

02-00:01:29
Seim: But it's not important to the point that we did what we did. Because that's it. We know that we could do it, and we did it. Well, we didn't know we could do it when we started, but we finally found a way. But there were some things that might be of interest in terms of the technology. I talked about prestressed concrete and T.Y. Lin. Part of our strengthening of the upper deck involved pre-stressing steel. It's the same mechanism that you used to pre-stress concrete. You can apply the same to the steel. There were bridge deck members—there quite a number of them along the length of the bridge. They're called floor beams, but it doesn't make any difference what their name is. They're a transverse steel member that holds up the deck. We found that by putting a steel plate on the bottom and pulling it, which is called pre-stressing, to a high strength, and then we lock it off. Here's a beam. Now, if I put a steel plate on the bottom and pull it and lock it off, the beam moves up. It reverses the stress of gravity pulling it down. So you counteract gravity.

Now, when you have an automobile cross, it goes down, and the automobile is off, it comes back up. Everything is elastic. It moves. You can't see it, but it moves. Now, a truck goes across, it goes way down and comes back up. But you can't do that, because it exceeds the limit of the steel. So you have to strengthen the steel so it holds the truck up. The mechanism to do that was the stressed steel. That took a lot of thinking and playing around and calculating and laying out to come up with that concept. That's what the people who wrote the report in Sacramento didn't have time to do. They weren't asked to design it; they were asked if it was feasible. Well, it wasn't feasible. But if you apply this pre-stressing, then it becomes feasible.

02-00:04:02
Redman: So a decade earlier, the conversion of the Bay Bridge would not have been possible as we see it today.

02-00:04:13
Seim: I don't think pre-stressing steel—well, I'm not aware of it ever being used before. Let's put it that way. It may have been.

02-00:04:24
Redman: It would have been a major innovation, then, to see it actually implemented. That must have been a pretty exciting project, then.

02-00:04:35
Seim: It's so unknown. Nobody knows about it. Even when you drive over it, I can look up there, but I'm driving, I can see the thing. I can see it there. But to tell you how it works and how we did it, that takes you another hour. We had to develop a pre-stressing gadget to be able to pull that steel plate. We pulled it about five-eighths of an inch, as I recall. Then we have to bolt it off. One of the events after the war that we didn't talk about when we were talking about that—I need to talk about that—is, they call them, high-strength bolts. All the structures that we have talked about now—the Dumbarton, the Carquinez, the Bay Bridge, the Richmond-San Rafael—used rivets. There was an old standby. But we don't use rivets today. We use high-strength bolts. Now, the high-strength bolt was developed sometime during the war, principally, I think, to use on war machines, or maybe even bridges built and so forth. It doesn't work like an ordinary bolt. They distinguish it by calling it a high-strength bolt. The easiest way to describe it is, if you have a bolt and you tighten it, it tightens the two plates together. But if you want to really design something to take truck weights and so forth, you put in a high-strength bolt, and you stress it very high so that the plates are compressed under the pressure of the tension in the bolt. When it's compressed like that, it doesn't slip. And it doesn't loosen. You don't have to use a lock washer. It's an improvement on bolts and improvement on rivets. Rivets started in the 1800s, when they started building bridges, and then I guess they used bolts here and there, but the bolts were so weak that they didn't use them extensively.

02-00:07:09
Redman: Now, the San Francisco-Oakland Bay Bridge must have, originally, in 1936, when it opened, it must have had a million rivets in it. The process of converting those rivets into these new, high-strength bolts must have been a massive project in and of itself.

02-00:07:31
Seim: Well, yes. When we join all these members together, if the members are not strong enough, you just knock out a rivet, and then you put a high-strength bolt in. You knock out a rivet and you put in a high-strength bolt. One by one, you can replace it, and you do not lose any forces that are in that particular joint, just by doing that. Some of the retrofitting that we did in ’58 to ’63 was to replace rivets with high-strength bolts.

02-00:08:08
Redman: Tell me a little bit more about that group of junior engineers that you had working on the Bay Bridge. Would you guys work collaboratively, and how many of them were there at that time?

02-00:08:22
Seim: We were split up into groups, small groups. Five or six. Eight. Each was assigned a certain task. One group was the one that developed the pre-stressing on that. The other group developed a method of putting in transfers, beams, between the beams that were there originally. So you take the span and you cut it in half. If you cut the span in half, it will take—and you can put trucks on it. Maybe six or eight of these groups. We had about forty, maybe fifty engineers and drafts people.

02-00:09:32
Redman: Did you come to a deeper understanding or appreciation or a different sort of feeling about the work that the original designers and engineers had done on the bridge? I know you, when working on the Richmond-San Rafael Bridge, had an opportunity to meet and work with some of them in person. I wonder if, then, returning to the Bay Bridge and working on that project gave you a different perspective.

02-00:09:59
Seim: Oh, it was a marvelous bridge to work on. It was just beauty. Just pure artistic—not in the beautiful artistic sense, but in the way they put everything together. How they solved all their problems. It was just marvelous. Now, to give you an example that you can see today—and it’s kind of controversial, but it illustrates it—on the western span, they used the suspension span. We can get into why they did that. On the eastern span—well, I’ll go back. On the western span, we had suspension spans, long spans, huge foundations, because rock was 200 feet down. On the east bay span, rock is 600 feet, and you can’t build on the rock. So we had to support it on mud, and to do that, you had to have shorter spans. What Purcell—we haven’t mentioned him, Charles Purcell, who was the leader and was given credit for a lot of what was done—

he led the team that designed the original San Francisco Bay Bridge, and he did a marvelous job.

On the east bay span, now we have mudflats. As we get to the island, the rock does come up to form the island. There was a proposed navigation span right next to the island on the east side. So we had to have a long span. Well, the long span was what we call a cantilever today. It was a 1,500 feet span. That had to be high to get over the navigation. A beautiful solution. Then, of course, connected to the island with shorter truss spans, with the rail and trucks on the bottom and cars on top. That swung westerly into the tunnel. Then, as they got nearer to shore easterly and the bridge dropped down in elevation, they didn't need long spans, so they shortened it. They went with 505-foot-span trusses. You drive through them, and the span, the steel, is up above your head. They call it a through truss. Then as spans got shorter, farther towards the shore, we dropped down to shorter spans. Two hundred and eighty-nine feet, I think it is. These were deck spans. Double-deck. They had a lower deck and an upper deck, but they didn't have any steel over above, so they called those deck spans, beyond the longer span, through spans. Then when spans got even shorter, they stopped using trusses and went to what they call girder spans. As it goes down to join the shore, you went into—right on the shore. Turn it around. As you look at the span and you start up, it's short span, girder spans, gets higher. We go into deck spans. It's getting higher. Now we go through into truss. Then we head to cantilever. Boom. Then it goes back down. To me, that's the most beautiful solution that any engineer could come up with. My wife says it's the ugliest bridge in the world.

02-00:14:19
Redman: When you see the Bay Bridge, you see—a layperson may see one bridge, but are you inclined to see five bridges?

02-00:14:29
Seim: Yes, I see five on the eastern span and there's seven bridges on Golden Gate, but everybody sees just one. That doesn't make any difference. If you look at a bridge and you say, "That's a beautiful bridge," it doesn't make any difference. What's important is it's serving society and people can admire it. Now, for me, as an engineer, when I look at a bridge, I look at how it conducts forces down to the ground. That's the first thing I look—oh, wow, that's a beautiful bridge, too. Yes, but it's got a logical stress flow.

02-00:15:11
Redman: Let me take a similar sort of question, but in a different direction. As a bridge engineer, when you look at the bay, what is it that you see?

02-00:15:23
Seim: When I look at?

02-00:15:24
Redman: When you look at the *bay*, the actual water and the actual thing that you're trying to cross, what is it that you see when you look at the bay? I wonder if maybe you could consider that based on what the San Francisco Bay looked like in the 1950s versus what it's like today.

02-00:15:47
Seim: I'm not sure I understand the question. I think I'm like a diver. I don't look down. I just dive, because I know that I can do enough flips and go in. If I see a structure that needs to be crossed—oh, okay. I don't look at the water. I look at what's under the water, in the soil. Maybe that's what—

02-00:16:19
Redman: That's good. That's interesting. One of the differences, in terms of the challenge that the Bay Bridge presents, is that it's very deep on the western span to get to the bedrock. It's impossibly deep on the eastern span, so you have to build into these mudflats while still providing a solid foundation for the structure. It seems to me that you're wrestling a little bit with the bay, and that there's that unpredictable nature of mudflats versus the bedrock, which seems to be a challenge. But I don't know if there are any other thoughts that you might have to add on the bay. We'll get back to—

02-00:17:05
Seim: I think my description of the eastern bay span, going from slowly building and getting higher and longer span, to me, that's the beauty of bridge engineering. People look at it and they say, "Well, it's ugly." Well, okay. In 1930s, they did the possible. Today, we're replacing that structure, and it's not the same structure at all. It's a different kind of structure. It uses the precast, prestressed, segmental structures that I mentioned earlier, and it has an orthotropic steel deck, which I mentioned earlier. Those things have [changed]. Now we have a different set of structure, and I think it's also improved the appearance.

02-00:18:13
Redman: Let's see. I'd like to ask, before we move on to other bridge structures in your career—and we can certainly return to the Bay Bridge. It's the central thing I'd like to talk about. Is there anything else that, before we get on to your work on the new replacement crossing for the San Mateo-Hayward Bridge, which I understand is more like 1967—first, can I ask, were there any other things that you'd like to add based on that experience of working on the Bay Bridge during that time of the conversion and some of the legacy of what that conversion meant?

02-00:19:05
Seim: The engineer that I mentioned [Norman C. Raab], that had written the report in 1957 that says it's feasible to convert the Bay Bridge, when he finished that work, he continued on to the San Mateo-Hayward Bridge. He called himself Projects Engineer. "Projects" with an "S." He finished one project, the Richmond-San Rafael, and he went to another one, Oakland Bay Bridge

conversion. Now he's going to his third project, which is the southern bridge that connects the cities of San Mateo and Hayward. He proposed a truss bridge. Of course, everybody criticized the truss bridge on the Richmond-San Rafael, that Raab designed and they said, "We don't want an ugly truss here."

02-00:19:57
Redman: Did they criticize the truss for the aesthetics of it?

02-00:20:00
Seim: Yes. Well, if you had to award the ugliest bridge in the world, I think the Richmond-San Rafael would certainly be in the running. If not the first one, then top three. It is an ugly bridge. But that's a story that maybe we shouldn't get into. It was driven by economics, and it was driven by the obstinance of this one engineer that I referred to. He wouldn't change. He then proposed a truss for the Hayward area, and everybody said, "No, we don't want that. It's an ugly bridge." He said, "Well, it's the most economical." The *Chronicle* came out with several articles written by I might as well say [the name] Allan Temko, because you'll maybe encounter his writings in your research. He could write like Herb Caen. I wish that I could write half as well as he could. But what he wrote was—I'm not quite sure, but he criticized the truss bridge, and he did it in issue after issue in the *Chronicle*. They finally, at the state level, the Toll Bridge Authority said, "We'll build a steel girder bridge with an orthotropic deck."

02-00:21:44
Redman: Did the success of the Golden Gate Bridge as an aesthetic icon, as a beautiful structure, did that influence how the general public—or what they expected out of what bridges could and should look like? Maybe unrealistically so?

02-00:22:05
Seim: Oh, yes, absolutely. Because during the Depression—well, up until the Depression—bridges were built economically. They always—the lowest cost. During the Depression, it was even intensified, that you don't put any more money into a bridge than is absolutely necessarily. For instance, you only provide a deck to carry the traffic. You don't spend extra money to provide a shoulder if somebody has to stop on the bridge. He has to stop and traffic has to go around him. It's too expensive to provide what they call a breakdown shoulder and so on. This engineer that I referred to was totally driven by cost and excluded aesthetics. Now, we have the Golden Gate Bridge. If you go through and study that, if we get into that, all the money was put in the main span for aesthetics. The approaches were just trusses, very cheap—and I don't mean that in the unusual form. Lower-cost, I guess, is a better way—just lower-cost and ugly [in appearance]. People look at the main span, because that's the dominant span. That's the one you look at. But if you, as an engineer, you look down and look at these approaches—and I had to do that, because I worked on the Golden Gate Bridge—it's pretty bad. So Joseph Strauss, the designer, saved all the money on the approaches and put it in the main span, which is the correct engineering decision. But Strauss, did that,

Strauss is ridiculed, and rightly so, for some of his earlier proposals. When it comes to the Richmond-San Rafael designed by Norman C. Raab, first of all, it zigzags because of the two alignments of the navigation channels. It goes up, and then it sags down, and then it goes up. The cardinal rule of aesthetics in a bridge is it has to soar. You can't sag it in the middle. The other is it connects from here to there as a straight line or as a curve line. You don't make an "S" out of it. Those violate both of those very strong principles. This engineer [Raab] was soundly criticized for creating this ugly bridge. Of course, his defense was, "I saved a million dollars by putting the sag in it." Which is probably true.

We can see the effort spent on aesthetics the Golden Gate Bridge. There were three architects on the San Francisco-Oakland Bay Bridge. The suspension span—I have a little problem with the aesthetics, but I think most people think the Bay Bridge a nice-looking bridge. But everybody agrees that the Richmond Bridge is ugly. Now we pulled all that to the Hayward Bridge. Yes, let's build a nicer-looking bridge. Well, it would cost more money to do that. Raab was removed. He retired. They brought in a new engineer, who was absolutely the reverse type of engineer. We built the longest girder span in the United States at the time 750 feet, and it still is today.

02-00:26:33
Redman: Oh, is that right? Oh, that's interesting.

02-00:26:34
Seim: Yes.

02-00:26:37
Redman: There were lessons, it seems like here, which are being learned about not only the engineering aspect of this work, but also the political aspect of this work. That there's not only a general public, there's a government bureaucracy that's involved with this, and that there's also a media that writes about—sometimes, from a not very well-informed perspective—about what they approve of or don't approve of that these engineers are doing. It seems like these are kind of eye-opening experiences, potentially, for a young bridge engineer who's learning about how things actually work in the real world of construction. Can you talk a little bit about some of those impressions or things you may have been learning in that stage?

02-00:27:31
Seim: They don't teach that in school. It's funny. I've been, actually, doing research with the university in Berkeley. I know most of the professors there. Some of them have retired. So I always kid them, "Hey, you never taught me that when I was going to school here." My joke is that it took me a long time to learn that my salary was paid, for all the work I've done, by a politician voting yes someplace. We bridge engineers are controlled politically. Maybe that's as it should be. It's like the military. We don't want the military to direct themselves; we want the civilians to direct the military. Maybe we want the

civilians to direct bridge engineers to eliminate the ugliness of the Richmond Bridge. But that's what happened on the Hayward Bridge. It was spearheaded by Allan Temko writing very critical articles, and they were so well-written. That eventually made its way to Sacramento, and the Toll Bridge Authority caved in, as it were—no, I shouldn't say that. The Toll Bridge Authority voted that we would spend extra money to build a girder span. But the same thing happened on the parallel structure to the Bay Bridge. When they tried to put a parallel, the *Chronicle* fought it, saying that they would be dumping a lot of traffic into San Francisco. The irony of it is that all that traffic is now using the Bay Bridge and is being dumped into San Francisco, without the benefit of a parallel span. Part of that increase in traffic was due to the conversion of the bridge. Put it another way, maybe we really have to question when the media attacks. They're saying something; we've got to listen and look at it and evaluate it and so forth. If it has merit, fine, we use it. If not, then they can just continue articles. But anyway, what did happen was, for whatever reason, the *Chronicle* and Allan Temko was able to get the girder bridge that we see today, and that's a beautiful bridge. Incidentally, they said that we had to employ an architect to help us on that. So the Toll Bridge Authority hired Steve Allen as the architect.

02-00:31:12
Redman: Let's talk just briefly about that. I look at some of the touches that are in particular on the suspension span of both the Golden Gate Bridge and the San Francisco Bay Bridge, the suspension spans, and as an untrained observer, I'm inclined to see some art deco touches. The exposed steel. Unlike the Brooklyn Bridge, it's not covered in brick. There are some design elements, those towers, that make it feel a little bit more like an art deco structure. Is that the sort of thing that an architect would want to add into these types of structures later on in the process, that they would encourage engineers to add those types of touches? Can you explain that just a little to me?

02-00:32:08
Seim: That's a difficult question to answer, because it involves a type of, I'll call, person that the architect is. On the Golden Gate Bridge, the architect was Irving F. Morrow, who, at that time, was a house designer, and never had designed anything large like a Golden Gate Bridge. Now, before him was, I've forgotten his name. He was a New York architect. Strauss asked him to design the towers of the Golden Gate Bridge. He's from New York, so guess what he had? Gothic arches. He had a gothic arch over the roadway, and at the top he had another gothic arch. What do you expect? He's a New York architect. So that particular architect leaned towards the Brooklyn Bridge and its gothic architecture as his example. His tower for the Golden Gate Bridge was an ugly design. I threatened to write a paper on it. It was not a very good design. However, it did have the tapered towers that we see today. They start off at the base with something like fifty-five cells, and you get at the top, twenty-four cells. As it goes higher, it gets thinner. Morrow used that principle to do what he did. I did write a paper on that. I measured the spaces

between the struts and the thicknesses of the struts. What Morrow did is he took the stair-step of the tower itself, the two legs, and that goes from wider at the bottom to thinner at the top. The first strut is thick, the strut above that is a little bit thinner, and then the strut above that is thinner yet. The space between the struts get smaller and all the way up. The spaces between the struts get narrower and the depth of the strut gets a little bit thinner as we go up. That gives the beauty of the bridge. That's the contribution of the architect. If he didn't do anything else on the bridge, he was well-paid. A lot of people don't know that. I wrote a paper on that. The architects also did the same thing on the Bay Bridge. The same thing. The lower crosses brace are so deep. The next cross is shallower. The next cross, above shallower than that. The thickness of the members at the lower strut are thicker than at the top strut. As you go up, they thin the cross bracing, and that's what gives the bridge its beauty.

02-00:35:27
Redman: Following your experience on the San Mateo-Hayward Bridge, I understand you go down to San Diego and work on the San Diego-Coronado Bay Bridge, which is a bridge that has prestressed elements, concrete steel girder bridge. That would have been somewhat similar to your most recent experience at the San Mateo Bridge. Can you talk about that, the San Diego experience?

02-00:35:55
Seim: The architect Steve Allen that we used on Hayward Bridge to do the girder span would carry the experience over. We used him to work with us on the San Diego bridge. They also got a local architect in San Diego, so they had two. I remember the predominant view of the towers—well, the towers are always the problem of any bridge, any long-span bridge. I worked with this architect on the Hayward bridge. It went really well. We just integrated back and forth, back and forth, and we'd come up with something. We did the same thing on the San Diego bridge. He did take the mission arch theme, which is a Roman arch, actually. They call it a mission arch in California, as it should be, because they're Roman. But there's nothing magic about it. When you build something out of brick, like adobe brick, and you want to put an opening in, you almost have to make it into a Roman arch, because it's self-stressing. It holds itself up. He took that as a theme, and that was the theme that was used for the towers, which are reinforced concrete. Then we started off on the San Diego bridge with prestressed concrete, which now is 1967 to '69. It was opened in '69. Now we used modern prestressed concrete for the approach spans. Then when we got to longer spans, we went to steel. But this time, we didn't use trusses. We used girders. We didn't use double-deck. We used a single deck. Put traffic side by side, so that they have nothing to obstruct their views from the bridge. When you drive over the bridge, you can see all over. Then another fortunate thing happened. Instead of making the bridge straight, which is the normal way to do it, we couldn't, because the Navy had something to do there to keep us from going straight. So we curved it. Now, as a person drives over the bridge, they climb up and they see ahead and they see

the structure curving, and they see this ribbon of concrete in either direction. Then they see the mission towers, and it's a beautiful bridge.

02-00:38:51
Redman: It really is a gorgeous structure to drive over. Now that you're explaining it, I'm thinking of all of the differences between that and the Richmond-San Rafael Bridge. It's quite remarkable to think about. You mentioned something that was interesting that I'd like to give you a chance to speak to. That's the Navy's consideration in the San Diego example, in terms of where the bridge would land, but I understand that the War Department has always played a major role in terms of bridge-building and what would be considered acceptable and what would be considered problematic, because of shipping lanes and other sorts of considerations. Can you just give me a word on how bridge engineers think about those types of considerations with the war department and the U.S. Navy?

02-00:39:41
Seim: Yes. I got involved in that very heavily, because we were proposing a crossing of a shipping lane that also employed Navy ships. The Navy ships would pass under the bridge for their anchorages. Of course, they were afraid that the bridge would be blown up and close the ability for the Navy ships to pass—and they also were concerned about the height. That they couldn't get battleships to pass under. What we did is we raised the height of the bridge much higher than we would normally do for ordinary shipping so they could get battleships or whatever they wanted to pass under. I don't know if they could [even] get a battleship in San Diego Bay. But anyway, we raised it up high enough, so they didn't object to that.

But they were still afraid the bridge would fall down, it would be blown up. I don't know how that was resolved, because that was outside of my hands. I just raised the thing up. But they voted to go ahead with it. They gave us the permit to go ahead with it, doing that. That was six or eight months of trying to juggle to get that thing passed through.

02-00:41:17
Redman: So there would be some communication going back and forth with the needs and requirements of what they wanted and what you were maybe able to do?

02-00:41:28
Seim: Very formal letters back and forth. And some meetings also.

02-00:41:30
Redman: Okay, okay. Let's return to the Bay Area, if we may. Let me ask you about the Dumbarton Crossing at the southern end of the San Francisco Bay. I understand you worked on the Dumbarton Bridge replacement between 1972 and 1975. Can you tell me about that experience?

02-00:41:49
Seim: The Dumbarton?

02-00:41:50
Redman: Mm-hmm.

02-00:41:51
Seim: That was my last bridge in California on which I worked and now shorten to be called Division of Bay Toll Crossings. They dropped San Francisco out of the title. We started on that as a replacement needed, because it had a lift span. The lift spans use steel cables to lift it, of course. There was a lot of wear and tear on cables, and so those cables had to be replaced from time to time. It's always a maintenance problem. But traffic was increased, too, because it was twenty-one feet between curbs. It's pretty hard to get two twelve-foot lane on that. So here's a typical example of a structure becoming obsolete because of traffic. It was still structurally okay, because you could change the cables if you had to. As a matter of fact, occasionally a truck would run into a truss member, because it was so narrow. I think we replaced two truss members on it. We could do that. If they knocked out a truss member, we could change it. It was structurally sound, but expensive to maintain, but it was horribly narrow, and actually did cause wide trucks to damage the structure. Occasionally, there would be a head-on collision. It really needed to be replaced. That was the emphasis for replacing it. Again, we had the same architect with us as on the Hayward and San Diego Bridges, Steve Allen. Now we had to go through an organization set up in San Francisco called *Save the Bay*. Thank the lord that that was pushed through. It was pushed through by three ladies, one of which was the wife of the chancellor at Berkeley. Because they were filling the bay like mad, there was no control over the appearances of and need for infrastructure around the bay, and nobody paid any attention to seismic design problems. They set up this organization with top people. A lot of the professors from university, engineering professors, sat on it. I had to go there and make the presentation to get our approval for building the replacement for the Dumbarton Bridge. That has changed everything with this peer review board. Everything else I had worked on, [previously I'd] just do it. Put it in the plans without peer review. Contractor would then build it.

I remember I appeared there six or eight times. One of those appearances, the head guy came up and greeted me, as he always did. He says, "Well, we're always glad to see you, because every time you come, we learn something." I thought, my god, here they have these top professors. But of course, I was using professors for consultants to me for the seismic retrofitting. Professor Frank Baron. Fantastic guy. He did some seismic analysis that had never been done before. He had developed these seismic analysis programs. He came up with movements, because that's where everything failed. The thing would slip off the seats and fall down. He gave us these values, and it was a marvelous piece of information. Then I had a few others professors. Professor Harry Seed. His son is now at the university. It was Harry Seed. I think the son is Ray Seed. Very prominent in soils. So we used him, and so on. But I did all that in order to get this group—*Save the Bay*—to approve what we were doing there at Dumbarton.

02-00:47:06
Redman: I want to ask just two more questions on this tape. It seems like you've just got so much knowledge of bridges and bridge engineering that we might have to do a follow-up visit. Let's jump ahead in time to two or three final questions. First, can I ask where you were on October 17, 1989, at 5:04 p.m., at the time of the Loma Prieta earthquake, and what did you think when you saw the news reports of what had happened?

02-00:47:39
Seim: I'm laughing because I was in Los Angeles, inspecting a garage for seismic retrofitting there. Two of us down there. We had just gotten back to our motel room. I was doing something, nothing. I heard these heavy footsteps—boom, boom, boom—running down the balcony, and a pounding on the door. Wow, what's that? I opened it. It was my partner. He said, "The Bay Bridge collapsed!" I said, "That's impossible." Because I had worked on the bridge. I had been its maintenance engineer. I knew it so thoroughly, like the back of my hand. He said, "No, turn on the TV!" So I did. I went over and turned on the TV, and I saw the failure. It was the last place in the whole length of the bridge that I would have guessed would have failed, because it was a cross-braced bridge tower, and that bridge tower was designed back in the thirties to take all the longitudinal wind forces—well, they had a seismic force, too—from all directions, so it was really sturdy. The brace tower that I saw on TV was still intact; all later we found out that forty bolts sheared—what we call sheared—and allowed a piece that was supporting the tower, supporting the truss—moved. In the act of moving, it pulled what we call stringers, longitudinal structures, off its seats, and it went down. Those forty bolts didn't do what they were supposed to do. If all had been high-strength bolts, it would not have happened.

02-00:49:52
Redman: This is my final question for this afternoon. When you look at the rising new eastern span as it is today, next to the old eastern span of the Bay Bridge, what does that make you think?

02-00:50:08
Seim: Comparing the old with the new. There's no comparison. One of the things that I learned is that, in engineering, we have changes constantly coming in. For instance, I talked about high-strength bolts. We've had tremendous improvement in welding. When we can weld a bridge, you don't have to use rivets or high-strength bolts. These changes come in, and we can go from steel to concrete. We can now build concrete bridges as long as steel bridges used to be. Change is inevitable. It looks better. It's going to last longer. It's well-designed. So welcome in the new era.

02-00:51:04
Redman: Is there anything else that you'd like to add, based on our conversations that we've had today so far about these experiences? It seems like you've had a really exciting career, and talking about these early years in your career, you

had so many wonderful opportunities and really fascinating people to learn from.

02-00:51:24
Seim: I don't know whether it's appropriate to end it this way, but let me tell you that Professor T.Y. Lin asked me to come to work for him in 1980.

02-00:51:37
Redman: That seems to change your life pretty radically.

02-00:51:39
Seim: Now I've expanded my work from California, with just roughly five or six bridges, to the entire United States and South America and Asia. So I've been doing the same thing that I did in California over a larger and larger area. I can repeat many examples I've given on a lot of other bridges, too. But let's stay with the Bay Bridge, because that's your focus. There's just one other item I want to mention, if I still have a few minutes. That is the tunnel. The tunnel was the toughest one to convert to truck traffic. The reason for it is we had to lower the upper deck to get trucks to pass through the tunnel, because the trucks would hit the arch of the tunnel. That was a tremendous struggle, and it was one of the last things that was done. It was done not by my crew, but another crew. I worked on the viaduct next to the tunnel, but this crew did. They finally came up with—I think it was the twenty-first version to reach what was actually done. We actually lowered the tunnel height about two feet, so that trucks can pass—there's restrictions in the outer two lanes, external lanes. But we were able to get most of the trucks though. In the act of lowering that, we had to do it a little at a time, and we had to use a detour to do it. But instead of detouring around the island, we did a vertical detour. We built a ramp to go over the work and come down. I don't know if you're aware of that. It's called a hump.

02-00:53:45
Redman: Here's the thing that blows my mind, is that I understand that, through none of this conversion was traffic stopped, or was the bridge totally shut down. You detoured over the—

02-00:53:58
Seim: Over the construction. If you have not heard about it—

02-00:54:02
Redman: I had not heard about that. That's really amazing.

02-00:54:04
Seim: It was so terrible.

02-00:54:05
Redman: Thank you.

02-00:54:07
Seim: The contractor was behind schedule and he needed additional time. So he scheduled to move this hump, which would take maybe six or eight hours closure. He did it on Friday night before the big game between Cal and Stanford. Now here's all these happy people driving over the Bay Bridge, leaving at their usual time, and then they see this red barrier. It was painted red lead, and blocking their way. What's going on? It goes up and it goes down. Well, you have to slow down. There's a sign, "Fifteen miles an hour." Can you imagine the shock of the people using it, for god's sake? And they were all late to the game. Of course, the chief engineer, the guy that wrote the report that I referred to Norman C. Raab, that got the conversion, left town, because he knew his phone would be ringing off. But he would not give the contractor an extra week. Giving the contractor time is the same as giving him money. Now, that shows you how important money was to this guy, and the fact that he had no respect for the traveling public. The rest is history.

02-00:55:58
Redman: Wow. Amazing story.

02-00:55:59
Seim: The hump was there for two years.

02-00:56:01
Redman: Amazing.

02-00:56:02
Seim: Oh, it was.

02-00:56:04
Redman: Well, with that, I'd like to say thank you so much for sitting down today. I really appreciate it. Thank you.

02-00:56:10
Seim: You're too young, but I would have thought that—I guess the hump is gone now. [Nobody thinks about it anymore.] It was terrible.

Interview #2 December 5, 2012
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03-00:00:04
Redman: Today is December 5, 2012, and I'm pleased to be back in El Cerrito with Chuck Seim, who sat down for an earlier interview session on the subject of his engineering career as it related, in particular, to the Bay Bridge. Today, I'd like to expand on that interview by talking more about the history of bridge engineering in the Bay Area and then beyond, especially as it relates to the life and career of Chuck Seim. But today, I'd like to actually begin our session not by talking about bridges, but by talking about the San Francisco Bay. This thing that we talk so much about that needed to be spanned, that needed to be crossed. In thinking about the San Francisco Bay as a challenge for bridge engineers, a body of water that needs to be spanned, I wonder if you could lay out for me, what are the most basic challenges that an engineer thinks about before proposing a bridge and when thinking about a bridge? Are the challenges of the San Francisco Bay unique in many respects to that body of water, or are there things that are there that are similarities between other bridge spans?

03-00:01:14
Seim: There are probably similarities, but there is something unique about the Bay Bridge, and the bay itself, and the bridges [in this area]. I'd like to go into that, because it demonstrates the short snapshot of the history of bridges over about seventy years. Most people are not aware of that, and most bridge engineers are not aware of it. But to start with, first there was the bay. The first thing they did after discovering gold is to start filling it. They were filling it and filling it until Save the Bay, three wonderful women, stopped it. That's a story in itself. But right now, since about 1970, you can't fill until you get a permit, and you have to have a very, very good reason for it. So here's the bay, and the first thing they did with it was fill it, but they didn't fill it all the way across. They still relied on boats and ferries. Then, in 1927, they built the Dumbarton Bridge. Actually, it started in 1926, when they built the original Antioch Bridge. We call it the Antioch Bridge today. That was built as a precursor for the construction of the 1927 Carquinez Strait Bridge. The two went together. They got a permit and had to build both the Carqunez and the Antioch bridges. Then, in 1926, the Dumbarton came in. Nineteen twenty-seven, both the Carquinez and the original San Mateo-Hayward Bridge, was built. There was intense activity right before the big Depression. These were all built with the technology of their time, because that's all we can use for bridges. Then the next one after that was the San Francisco-Oakland Bay Bridge in 1936, then Golden Gate Bridge, 1937. Those two were built in parallel, as you know, and those stories are wonderful to read and see the films that have been made on them. They both used the same technology. Then there's always the question of which one is the, quote, "greatest" bridge? I'm asked that all the time.

03-00:03:58
Redman: Is that right?

03-00:04:23
Seim: Yes. I work on both of them. I have worked on both of them. So when I'm asked that question, well, I'm working on the Golden Gate Bridge, so that's the greatest. But five years later, I'm working on the San Francisco Bay Bridge; that's the best one. That's a toss-up. It's whatever you as an observer of the bridge thinks—because after the bridge engineers go away, and the politicians open it up by cutting the ribbon—never the engineer.

03-00:04:33
Redman: Never the engineer opening it up.

03-00:04:35
Seim: Then what remains is for the public to use it and to view it. The reason I went into bridge engineering is I wanted to build things for the traveling public. I think most engineers basically want to do that. They want to serve society. What's left is what you view. That's either good or bad. Now we move forward. In 1956, the Richmond-San Rafael Bridge was opened. An interesting thing about that is that most of the senior engineers that worked on the Bay Bridge stayed over in San Francisco and worked on the Richmond-San Rafael Bridge, because they both used the same technology, with some minor variations. Then, after 1967, we went back and replaced the San Mateo-Hayward Bridge with the bridge that's there now. A long-span steel bridge. Set a record. Orthotropic deck. All those fancy things. Then, for me, I went down to San Diego and did the San Diego-Coronado Bay Bridge, which had the same technology as the San Mateo Bridge. The 1960s technology. The next step was to parallel the Carquinez Bridge, [the] 1927 [span], in 1958.

03-00:06:26
Redman: So that existing span had to be replaced by the 1950s?

03-00:06:29
Seim: No, it was a parallel bridge to the original 1927 span. They turned one that was carrying traffic in both directions to one direction. The old '27 carried it south, and the new '58 carried it north. The '58 is about thirty or forty years difference there, and it has a completely new technology that has come in through the war. The war developed a lot of things, like welding of steel, things like that. So now we have a contrast between those two periods.

03-00:07:00
Redman: Actually, the '27 span and the 1958 span, that's a really intense time of American bridge-building, as we've talked about. Not only with the Bay Bridge and the Golden Gate Bridge as being a very dramatic example of that, but I imagine, like you said, a lot was learned in terms of bridge engineering between the 1920s and 1950s that are basically represented in those two structures.

03-00:07:28
Seim: The important thing that happened was, in 1956, President Eisenhower signed the interstate highway bill. Now, Eisenhower was in Germany, of course, during the war, and he saw the advantages of the autobahn. You get on it and you can go forever until you get off. You don't have to stop for stoplights. That's what their interstate was doing. He saw it as a defense measure more than what it really is now, a transportation corridors for everybody. But that started it, 1956. That started the whole looming expansion of our highways, and highways need bridges. About the same time, 1956, Professor T.Y. Lin published his book on prestressed concrete, and so prestressed concrete bridges started growing. The advantage of concrete is that all you have to do is dig up some aggregate and mix some cement, and put in a high-strength cable, which then became available after the war. You pull the steel cables, put the concrete under compression. It's cheap. It's very cheap compared to cutting up steel and put one piece on the other and welding it, and making it bigger and bigger. It gets so heavy you have to have a crane to lift it up. So prestressed concrete came in on highway bridges. To go back to Carquinez, in 1958, of course it carries interstate eighty. It was a manifestation of the interstate bridge act. Then, just concentrating on that, in 2003, they opened up the third Carquinez crossing, a suspension bridge A little bit later, they made another crossing down at the Benicia-Martinez. I left that out. There's too many bridges. The original Martinez-Benicia Bridge was built in 1958—no, no, 1962. Nineteen sixty-one or nineteen sixty-two. That was after the 1958 Carquinez.

03-00:10:05
Redman: First of all, that was a really great summary of these different spans. What about the geology that you're working against, in some sense, in the Bay Area? Obviously, gravity is the same force everywhere, but the geology that you're working with in terms of where the most stable parts of the, I suppose, anchorage systems that you would have to build before spanning. What does the San Francisco Bay mean for an engineer that's taking on that type of a project? Does it really depend radically on the placement of the bridge maybe a few miles away? The Carquinez Bridge being a few miles away from, say, the Bay Bridge. Does that make a radical difference in terms of the job of an engineer?

03-00:10:57
Seim: That brings up another interesting parallel, because a professor by the name of [Karl von] Terzaghi developed what we call soil mechanics in the early fifties, and other professors started building on what he established. We now have a whole profession called soil engineers, soil mechanics, that deal with what you don't see when you look at a bridge. That came into development in parallel. If it wasn't for that, I don't think we could have built any of the bridges that I just mentioned, because the original Antioch and the original Dumbarton and the original San Mateo, all they did is they take a concrete pile—and not prestressed, but just concrete with reinforcing—and they turn it up and they drive it in the ground. When it gets real firm, then they build short

spans on top of it. Now, all the bridges I've talked about as either replacements or built in the thirties were what we call long-span bridges. Long-span bridges are heavier, and they have to be supported by foundations that are larger and deeper and can support that weight. All of this kind of came together.

03-00:12:26
Redman: It sounds like it was more guesswork in the 1930s than by the 1950s, where there's some science, some soil science, being applied and some geology being applied to these questions of where the most stable place is. Does that have an impact now, when you're looking back on these older spans and sort of re-checking their work, in terms of what might be done to retrofit and improve some of these structures in the fifties and sixties and onward?

03-00:12:57
Seim: I can answer that question by calling out two examples. One is the original San Francisco-Oakland Bay Bridge. The head guy was a guy by the name of Purcell. He worked with—I'll call him a soil mechanic engineer, soil engineer, by the name of—Moran. Purcell, being a structural engineer, and Moran being a foundation engineer—that's a better term for him—got together in a hotel room, because Moran's office was in New York, and they came up with this gadget that was used and allowed the San Francisco Bay Bridge to be built. Now, along with that, Purcell located the bridge on the top of a rock outcropping. On either side—

03-00:14:06
Redman: On the eastern span or western? On either side, okay.

03-00:14:09
Seim: Either north or south of where it is, the rock falls off. There just happened to be a ridge of rock, except that it was 200 feet below sea level. It's 100 foot of water and 100 foot down to rock. That's 200 feet. That's a twenty-story building. Nothing had been done at that point to get that deep a foundation. The whole thing that made the San Francisco-Bay Bridge feasible was what they came up with through an idea in that hotel room. Of course, it's been used ever since for deep foundations. It's a caisson that has cylinders that are filled with compressed air. They put a temporary dome on top of open shafts. They literally float that on compressed air as it sinks down through the water. Of course, they're building it with concrete at the top. So they pour some and it sinks a little bit. They pour some more and it sinks a little bit. They control all that by this compressed air. It's really floating. They have it guided with cables and stuff. Then when it hits the ground, the bottom of the bay, which is mud and soil, then they bring in these excavating gadgets that brings out the dirt. They dig out the dirt and they keep sinking, and it goes down another 100 feet, 200 feet down. Two hundred and ten feet was the deepest one out there. That's what it's founded on. To me, that's a remarkable story, particularly with two people in a hotel room. That's not often known.

Now turning ahead to 2003. I had mentioned that the third Carquinez crossing was open. It's a suspension bridge. The 1927 [bridge] was riveted steel with eyebars. It's important to call attention to the eyebars, because they're special members within the truss configuration that failed. Actually, there was a failure on the Bay Bridge last year, 2011, where the eyebar cracked. [That received a lot of] attention in the press. Anyway, rivets and eyebars, '27, and then a truss bridge next to it in 1958. Welded. All welded members, bolted together with high-strength bolts. Now the third one is even a longer span, and it's a suspension bridge. It's a steel girder, welded steel girder, with an orthotropic deck, which is a fancy name to mean—

03-00:17:23
Redman: New.

03-00:17:24
Seim: Yes. The deck is about five-eights inch thick, and then they put some learning surface on top of that for traffic to drive on. All that was developed after the war. Now we have these three bridges. I didn't work on maintaining the last one. I worked on the other two. I did most of my work on the 1927 span, because it needed a lot of attention because of corrosion and so forth, and many eyebars, several corroded. So we see that in sequence. Now, the point here is that the southern foundation for the suspension bridge was located in a terrible spot. The original Carquinez was built in the best spot as far as the soil was concerned, and the 1958 span went to the east, and now this new one went to the west, and the foundations are awful. But we're now in the early 2000s, and the advancement of soil mechanics, with computerated design and all that stuff—so engineers said, "We can do that." And they did. They built a strong foundation.

03-00:18:42
Redman: So this is part of the 2003 construction of the western span?

03-00:18:44
Seim: Yes. Well, it's a brand-new bridge. We have progressed from where we had to pick the locations of foundations in order to build a bridge, but in the act of doing that, we still advanced the art of foundation—not particularly soil mechanics, because it doesn't take much soil mechanics to put something on rock—to a point where they had no rock—it was way down deep—and they were able to support it with—well, they were just great, big piles. They call them caissons. They're about eight or ten feet in diameter. They drive them down, [then] pour concrete in it. To answer your question, today, if you talk to a soil engineer—"We can put it anyplace you want." That's not quite true, but it's pretty close to true.

03-00:19:46
Redman: And very different, certainly, from the 1920s and thirties. Very advanced.

03-00:19:50
Seim: Yes. But that brings up the point that all the foundations on all these bridges are unique to the geology of where they're located.

03-00:20:00
Redman: That's great. You just did a tremendous job summarizing all of that, and I so appreciate it. You tied in the Interstate Highway Act very nicely, and I want to ask about the 1950s. In terms of your education, first at UCLA, then at Berkeley, but then also in your earliest days with the San Francisco Bay Toll Crossings, were your efforts geared towards automobile traffic? [Automobile numbers continues to outpace the growth of] public transit, and just continues to grow and grow in the 1950s and sixties. I wonder to what extent the conversations among the people who were maintaining and designing automobiles were thinking about what we now consider the Age of the Automobile, in terms of the 1950s and sixties.

03-00:21:08
Seim: That's an interesting question that I've only recently thought about. Because, hey, my first car was a Model A Ford. You get tied to your own car. That's a psychological story all on its own. When we looked at the Golden Gate Bridge, the engineers analyzed—maybe I shouldn't say analyzed, they thought about putting—I'll call it mass transportation—they didn't call it in those days—some form [of transit] other than a car on the bridge. They abandoned the idea. The bridge design took from 1930 to 1933, when they started construction. So you have to go back to that interval of three years. There really wasn't any transportation other than automobiles. There were trains and there were streetcars, and not much else. They could put a streetcar on the bridge, but how do you get the streetcar up 220 feet from San Francisco on a terrible steep grade? Then on the Marin side, what do you do to get the streetcar down to sea level? You have nothing but rolling hills. So how do you get the streetcar down? The highway that they built wanders through the hills, and it's on quite a pronounced grade.

03-00:22:52
Redman: It sounds that it was considered both untenable, engineering-wise, to include a mass transit system of some sort, maybe similar in some ways to the Key System on the Bay Bridge, but that was a conversation that, as far as you're aware, took place between 1930 and 1933. But once the design was locked in, the Golden Gate was going to be all automobile. Similarly, it seems like many of the remainder of the bridges from '33 on were going to be automobile-focused.

03-00:23:27
Seim: Yes, that was the focus, but I gave you an engineering reason why you cannot put—could not at that time put mass transit on the Golden Gate Bridge. But if we turn the clock ahead to 1989, our firm -T.Y. Lin [International] was assigned the task of analyzing the Golden Gate Bridge to carry rapid transit and I was the project manager. We studied five different transportation

systems including BART. We found that the cables were capable of carrying that load, and we could make room on the lower deck to install it. We issued a report on it, and it says it's feasible. But how do you get from San Francisco up to the Golden Gate Bridge, and how do you get down on the Marin side? The approaches would be—had no idea—four or five times the cost of putting it on the Golden. The idea was never implemented after that study, because for the Golden Gate Bridge, it's feasible, but the approaches to it are what we call, in engineering, not feasible.

03-00:24:53
Redman: I wonder if you could talk a bit about someone you mentioned. Do you have anything else to add about Professor Scordelis at Berkeley, and who he was and what his influence was in the department? It was a name that you had mentioned as one of the engineering professors. I also want to ask about Dean Belter.

03-00:25:13
Seim: I'm sorry, what about him?

03-00:25:17
Redman: I wonder if you could add a little bit more. You had mentioned him as being a figure. Last time we spoke, we talked mostly about T.Y. Lin as an engineering professor in the department. I wonder if maybe there were other engineers and faculty in the engineering department that were particularly important or had a big influence on the story as it comes about, in addition to T.Y. Lin.

03-00:25:45
Seim: Yes. I think I can comment on that. But one of the things that we left dangling is that the San Francisco-Oakland Bay Bridge was built with a transit system on it, and it didn't last. It had to be taken off and the deck closed. The original Carquinez, 1927, had provisions for a streetcar—we call it light rail—down the center. It was never installed. To answer your question, on other bridges, yes, it was considered, and in fact there was facilities put on the Carquinez to allow that, and it was actually put on the Bay Bridge. Then, on the east spans that we're replacing now, the whole structure is designed for a BART system. It costs millions and millions of dollars to add that facility. Now you get in a BART car and you go up, and then all of a sudden you hit Yerba Buena Island.

03-00:27:04
Redman: And then what?

03-00:27:07
Seim: We'll drill a tunnel for the original bridge. Now we go over to the island. Now we've got the suspension span. Where are you going to put BART on there? It's not feasible, but the people who are advocating mass transit was able to get the politicians to vote BART in, and we designed it as engineers. But I don't think it will ever be installed there, because you can't beat an independent, like a BART tube. A tube under the bay. To bring closure to

your question is that, yes, you can put mass transit on bridges. That has been thought about, has been installed, or facilities do that, but it can't beat an independent rapid transit. You get on it and you go all the way, and you don't have to worry about taking away spots from highway traffic and so forth like that. To go back to your question on—

03-00:28:10
Redman: The faculty.

03-00:28:11
Seim: Yes. I would think that, from my prejudiced viewpoint, the fifties were the golden age of engineering professors at Berkeley. There was one that kind of came together, Bruce Jamieson, who taught bridge structure. He was actually a practicing engineer. He designed several of the crossings from Alameda to Oakland. One of the things about Jamieson was, when T.Y. Lin came to Berkeley in 1932, '33, Jamieson was his mentor. Then when T.Y. wrote his famous letter to come back for years of teaching, Jamieson was the one that picked up and said, "Let's get him back here." I had him later, in 1951, as the instructor in bridges, and he was a wonderful instructor. Very, very practical. Then there's Scordelis, who came in about 1949, '50, something like that. He was so student-organized, student-focused, he became the American Society of Civil Engineer's student representative. That's when I first joined what we call ASCE now. I remember working with him. Just a wonderful professor. He was like T.Y. He was student-oriented and just a wonderful person to work with as a student. I can't really understand it, but it's an emotional moment. I never had anything when I was a kid. My father was killed in an industrial accident when I was almost fourteen. I had no male people to associate with. No mentors. Nobody did anything for me. I was taught that if I had to do something, I had to do it myself. I still do. That's why I built this house. Then all of a sudden, I get into this university, Berkeley, and here are all these professors, very brilliant guys doing all kinds of research and stuff, and they're paying attention to me. That's an emotional thing that really impressed me. I remember, I timidly went into T.Y. Lin's office. I was writing a paper on prestressed concrete. It was going to be published in the *Cal Engineer*, which was a student engineering society's publication on the campus that came out every month. Twenty-five cents. He spent a whole hour with me. I talked about that in our last interview. Then there was another one that was really impressive, was a Professor Baron, who I worked with later on the Dumbarton Bridge. Oh, there's so many of them that would pay attention to students and help them.

03-00:32:16
Redman: Do you know how so many of them ended up living here in El Cerrito?

03-00:32:21
Seim: I'm sorry?

03-00:32:22
Redman: Do you know how so many of the faculty ended up living here in this neighborhood in El Cerrito?

03-00:32:29
Seim: Both Scordelis and T.Y. [Lin]. Baron was also a block away. Professor Perts lived down in Kensington. There was Cluff two blocks away. There were probably half a dozen. These professors were maybe only four or five years older than I was, because I went to school late. I was twenty-six years old when I graduated. These guys were maybe not even thirty, so we're kind of all the same age, and we all bought houses up in this area. It was kind of a coincidence. I used to kid them. I'd say, "You know where the Carquinez fault is?" "Yeah, yeah." "The word is it runs right by my house." "Oh. Well, why did you buy a house up there?" They'd kid me back by saying, "We want to see the activity when an earthquake comes." But actually, across the street, there was a Professor Gwynn, who was a chemist in the department of chemistry, and the Calaveras runs right through his driveway. It's up there. I can look at it. It's about 200 feet from this house. I didn't know that when I bought it.

03-00:34:04
Redman: I want to return to the subject of T.Y. Lin. In particular, I'd like to ask you about your time working with him between 1980 and 1992, in particular. We'll get started with that. I'd like to understand a little bit better about why his ideas became so influential, but I'd also like to understand a little bit more about this organization that he starts, and what is some of the background of T.Y. Lin International. How does that get going, and then how do you get brought into the fold in 1980? Was there a conversation, a big consideration? Can you tell me about that transition?

03-00:34:47
Seim: We have to go back to, say, 1951, when he had taught one hour on prestressed concrete, and then he became interested in it. He got a Fulbright scholarship in 1954, and he studied in Belgium, at Professor Magnel's Laboratory. He actually did testing of prestressed concrete beams. He was on sabbatical, incidentally, because he started back in 1946. That doesn't add up to seven years, does it? But no matter. He was on sabbatical, and he had this Fulbright scholarship, and he actually wrote most of his book in that interval of one year. Then it was finally published in 1956. That begins the start of T.Y. Now, the interesting point here is that I had read about prestressed concrete before his book came out. The book was that thick [indicating about 2" thick]. It said if you have this condition, this condition, or this condition, then you use this equation. And if you have this other condition, this condition, or that, then you use this other equation.

03-00:36:13
Redman: So it was very specific.

03-00:36:13
Seim: So the whole book, the whole thing was a series of equations relating to a specific loading condition. That's why [it was so thick]. T.Y.'s book is about like that [indicating about 1" thick]. He came up with this—we'll call it an internal couple. It doesn't make any difference what it is called. By varying the height of the internal couple inside this beam, you're able to develop your own equation and solve what you need in that beam for that loading condition. You were able to do it with a slide rule, for gosh sakes. That shows you the contrast between a very bright professor applying what he was taught to apply. T.Y. was a very, very brilliant professor who had this inspiration—I don't know where it came from—and came up with something simple. One occasion, we were talking about how he developed this stuff, and he said, "Chuck, there's an old Chinese saying." He said it in Chinese. He says, "It means, deep in, shallow out." What this means is you thoroughly study a subject, and then when you talk about it or teach it or write about it, you write it so that someone can understand it, because you're so familiar with it. Now if we take this point of prestressed concrete, in order to design it before his book came out, you'd get this great, big, thick book and you'd thumb through it, and you'd find something that's close to your condition and write down the equation, and you solve it. But T.Y., in his brilliance, says, no. There's this internal couple, and this changes as your loading changes. If you know what you've got down here, you can calculate what's here because you can get it spiraled down. In other words, I'm telling a very technical situation, trying to simplify it, but it's very difficult. But suffice to say, it's very simple. It was shallow out. That popularized the whole thing.

One day, I was talking to T.Y. We always had conversations. I said, "T.Y., how did you come up with that internal couple?" He said, "I was in Magnel's laboratory. I was testing a beam, and I had a variable load going on it." He said, "I had a little wheel. I could turn it or increase the load and decrease the load." He said, "I looked at the beam and I saw it in there." He saw something that you and I could not see. He saw how that internal couple was moving in and out. It was an intrinsic part of a prestressed concrete beam. He didn't invent it. He didn't make it. It was there; he discovered it. He had the brilliance and intelligence to look at that and discover it, and then take that idea and put it on a piece of paper and write about it so other engineers can do it too. It was a masterful stroke of something that was very complicated, simplified to something very simple. It's just an amazing translation—I can't get over it every time I think about it.

03-00:40:22
Redman: One of the things I want to ask, actually, is next about [different] generations of engineers. This is something that you got at a little bit with the Bay Bridge engineers, learning some lessons. I wonder if maybe we could think about infrastructure projects as geared around sort of these New Deal-era infrastructure projects. Obviously the Bay Bridge starts before the New Deal. It's one of these big Public Works projects initiated under Hoover. We can

think of a lot of engineering projects as taking place during the New Deal in the 1930s, but then in the 1950s, we've talked about the Eisenhower expansion of infrastructure. I'm also thinking about the GI Bill and how many students must have gone to college after World War Two on the GI Bill. In particular, how many engineers, young engineers, there must have been coming home from World War Two and getting their career started. Was there a distinct generational feel along those lines between the engineers, or was that something that is maybe only clear in retrospect, that there's an era of New Deal engineering, and that maybe there's a post-World War Two era of engineering?

03-00:41:39

Seim: I think that, first of all, when you look at the professions, like the doctor I had yesterday, or an engineer, you're in that profession because there's something in your brain that makes you an engineer, or makes you a doctor. You, Sam, have a Ph.D. Something made you do that. We're kind of creatures of what we're born with. If we're very, very lucky, we find a profession that matches what we've been born with. I've been fortunate. I could never be a doctor. I could never be a lawyer or a preacher. I could only be an engineer; because that's the way my brain is wired. You have to have that to start with. Then, of course, you have to have the availability, accessibility, the need. Need is a better word. When we expanded the highway system in the fifties, there was the need. But right after the war, we needed houses and buildings and that kind of activity, so that's where it was specializing. In the thirties, of course, the need was to employ people. To think the two bridges here, Golden Gate and the San Francisco-Oakland [Bay Bridge], were built when the need was to employ people. If it hadn't been that need, there would not be enough money available to build the bridges. The need was there, of course, for them. All these things are semi-political. You have to tie politics in too.

03-00:43:47

Redman: The last point that I want to clarify in that is, were the engineers—certainly they're influenced by the political landscape in that if there's infrastructure investment, they have a job. But would you say they were influenced by the mood of a particular era? Was the mood of the Public Works projects in the 1930s—I know this is before your time, but I wonder if that created a different sort of bridge engineer than the 1950s era of the Eisenhower expansion. Or when you were working with what must have seemed like old-timers for the first time on the Dumbarton Bridge, did they seem like they had a similar sort of engineering brain? Were the similarities greater there, or were there some generational differences that were maybe influenced by the politics?

03-00:44:44

Seim: It was profit. It wasn't political. It was just plain profit. The original Dumbarton, the Carquinez, and the Antioch, and the San Mateo-Hayward bridges were built by private companies, and their motivation was to charge tolls and put the money in their pocket. They were built cheap. They just found an engineer that would work for them. There was no high-minded thinking about that. Pure profit.

03-00:45:26

Redman: I want to jump now to the state of California Public Works, and maybe we can talk about how the spirit of what civil engineers are doing might be a different beast, or is a different beast, than those trying to make a profit off of bridge tolls. You joined the state of California Public Works Department as a junior bridge engineer in 1954. What were the major responsibilities of a junior bridge engineer in 1954?

03-00:45:57

Seim: We were at the bottom of the food chain. You were assigned whatever the boss wanted you to do. You're limited to what you can do, because you haven't had the experience. You've had the training, but not the experience. When I was hired, I started on the construction of the Richmond-San Rafael, as I wanted to work on a bridge. I really wanted to work on a bridge and see it grow up, and they put me on a survey crew. What a thumb down that was. However, it did allow me probably more freedom to see the construction than if I were assigned to the construction crew, because if you're a construction engineer, junior engineer, they put you on a tugboat and they take you out to a pier that's being built, and you sit there all day watching somebody build this thing, and you don't know what's going on somewhere else. But if you're a surveyor, you have to move all the way over to make measurements all over the bridge. I traveled all over the Bay in a tug, watching all this stuff going on. We'd go there and make a measurement or whatever it was they were doing, and then go someplace else. It happened to be a fortuitous assignment, even though I thought, no! And it has a challenge to do, too.

03-00:47:37

Redman: You got exposure to the different parts of the bridge, or bridges around the area, that are being surveyed, from the sounds of it. What about the senior bridge engineers? Can you talk a little bit about, then, what their responsibilities might include in the 1950s? We'll move it forward, but what were your bosses like in those days?

03-00:48:06

Seim: There were a series of contracts to build a bridge. Each contract had to have what we call a resident engineer. He's in residence on that particular work. He was responsible for inspecting and making changes and paying the contractor and all these things from, I'll call it, the administrative point of view, and also going out and inspecting and making sure everything follows specification and so forth. Then at the end, they write a little report, a final report. These were experienced engineers. Some of them had actually worked on the Bay Bridge originally. They had all the responsibility. They sat mostly in the office, but they would be called out occasionally when something was wrong or something needed to be cleared up. They had junior engineers and associate engineers that would be dispersed every day to particular spots that happened to be being built at that time.

03-00:49:25
Redman: Can you talk for a moment about the size and makeup of those field crews that are inspecting bridges?

03-00:49:32
Seim: The size?

03-00:49:33
Redman: Yeah, how many people would be in a crew?

03-00:49:38
Seim: Of course it depends on what you're inspecting, but usually if you have a pier that you're working on, you probably have one person at each pier. I can't think you would have more than one. If we go into the superstructure, the superstructure would be built in pieces, and you might have two or three on one end of the bridge that's being built and the same at the other end. But, it would be small groups. One to three at most.

03-00:50:21
Redman: Not large. One of the things that came up in our interview was that the safety approaches on the original construction of the Bay Bridge and the Golden Gate Bridge were like night and day. They were very different. I wonder if you could elaborate on that issue, comparing the two bridges specifically, because I know they're managed by entirely different entities. But from there, I'd like you to elaborate a bit on bridge safety, if you would, and maybe how those two bridges might compare to the rest of the state of California, and then bridge safety internationally from what you've seen. Do those bridges create a model for other similar bridges being constructed around the world, and in what ways do you think they try to improve upon, say, the safety considerations?

03-00:51:07
Seim: I think one is a nice model, and the other one is a model of not how to do safety. Night and day is a good way to explain it. I don't know why that is. Let's go with the Golden Gate Bridge, because that's a model bridge. Strauss has been written about [quite a bit]. He's not the best, nicest guy in the world. Very difficult to work with. [But] he valued the life of the workmen. He established a value in that, because he paid extra money for safety. That guy was tightfisted in terms of money, because he put out, "I'm going to build this bridge for twenty-five million dollars," and he did. But he had to watch everything that was being expanded. He paid for putting a net under the superstructure, and it saved nineteen people, nineteen people joined the *Halfway-to-Hell Club*—[laughter]

03-00:52:20
Redman: [The Halfway-to-Hell] Club. Right, okay.

03-00:52:22
Seim: One of them that fell in the net, an ironworker, they named the Carquinez Strait Bridge after him [Alfred Zampa Memorial Bridge]. That suspension bridge is named after that ironworker. It's the first bridge that's not named after a politician, but actually an ironworker, for God's sake. [Strauss] valued this and he insisted on hard hats. He insisted on lanyards always being tied off. And it paid off, up until 1937. There was only one death, and that death was accidental. There was an ironworker on the deck, and the cable was pulling something, and the cable broke. It was under tension and it just came back and snapped his head off, or I don't know what killed him, but it was a very unusual accident.

03-00:53:19
Redman: I've read that the estimates on these major Public Works projects in the 1930s, that you basically assume that for every million dollars you were putting into a Public Works project, you would have [approximately] one death. Near the end of this twenty-five million dollar project, to have your first death—and then I believe there were a few more fatalities towards the end of construction—but it came in well under the estimates, you might say.

03-00:53:46
Seim: The real tragedy was Strauss lost ten men on this net in one day in 1937. There's a picture of it happening. They built what they call a traveler—travels on wheels running on a rail—underneath the deck. [Phone rings – brief interruption]

03-00:54:36
Redman: Safety considerations. Go on.

03-00:54:43
Seim: They had this rule of thumb, one million dollars, but that's just something to call attention to safety. But if you have somebody that really cares about it like Strauss and strings this net that I was talking about—and then they built this traveler, and unfortunately it was supported by a steel casting. Now, in those days, steel castings weren't very reliable, and it was casted with a bunch of holes so they could bolt it together. They had ten men on it. Or was it eleven? Eleven. They started to roll this traveler out to strip out the plywood material that was used to cast the concrete deck. They just got started, and one of those castings failed. Of course, there were only four castings holding up the traveler. The other three failed, and the whole traveler came down. On the way down, these ten workmen were clinging to the net, and the net was hanging down. You could see them up there like fly specks. Then they went all the way down to the water. One guy grabbed steel as it started to fall, and he saved himself. So they got ten all at once, but you can't blame that on Strauss, because it was a failure of this casting. Of course, there was a big investigation of why it failed. On the Bay Bridge, there were no safety cautions—I've talked to guys that worked on it.

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04-00:00:09
Redman: Today is December 5, 2012. My name is Sam Redman, and I'm back with Chuck Seim. This is our second tape together today. Before we move on, I'd like to continue on about Bay Bridge safety considerations. We talked about the Golden Gate Bridge and some of the successes in terms of safety implementations. I want to ask about the Bay Bridge. One of the things that I'd be curious to get your opinion on is, to what extent do you think that the numbers that were reported in the fatalities of Bay Bridge work crews—are those accurate? What's your personal opinion on that? Do you think that those numbers are a little low? Are they accurately represented? What were the major safety questions in regards to the Bay Bridge?

04-00:00:58
Seim: I know what they were. There were twenty-four killed up to the opening in 1936, and there were twenty-nine total when they opened it up for the rail transit we talked about in 1939. So there was twenty-nine total. I know that because my father was killed in an industrial accident when I was a kid, so I'm very aware of safety in terms of workmen and so forth. When I go to China, my heart just goes out to those laborers—the safety practices in China, just terrible. Let's go back to Bay Bridge. Purcell did not have the consideration that Strauss had for the safety of life. He just let everything go. If you can do it, do it. I talked to my best guy that told me, was a guy by the name of Art Elliott, who was the chief bridge engineer in Sacramento for Caltrans for twenty years during the 1950s and 1960s. Just a remarkable, very bright, articulate, friendly guy. He started on the Bay Bridge as a junior engineer, and his first job was tender for the diver Bill Reed, who would go down 200 feet at the bottom of these caisson that I talked about earlier as it was being sunk to make sure it was sealed before placing concrete—

04-00:02:42
Redman: Who was famous for his ability to dive so deep without getting what's commonly called the bends [decompression sickness], I understand. He was compensated quite well for that.

04-00:02:52
Seim: Well, no, but Art Elliott told me he's also famous for hitting the bars at night.

04-00:02:57
Redman: Is that right?

04-00:02:58
Seim: Yeah, he burned the candle at both ends. He didn't live very long.

04-00:03:02
Redman: That's very interesting.

04-00:03:03
Seim: Yes. Anyway, Art followed up after that, and followed out the whole construction. We used to talk about that. American Bridge built the suspension span, and they required their people to wear a leather safety hat. If you look at pictures, you will see people with leather safety hats and bare-headed people or felt hats, because there was no safety enforcement. Strauss insisted that they have a safety hat. Then when you get up into the superstructure, pieces of steel have to be hung and put into places, and then people have to get there. Strauss would put up a line, and you put your lanyard on it. If you slip off, your lanyard would hold you. They didn't have that on the Bay Bridge. That was not a requirement. Art tells me the story that he was working on a spot someplace up in the superstructure. They blew the whistle to quit, so all the ironworkers folded up their work. Of course, the engineers that were doing the inspection followed the ironworkers. He was walking along the steel, and he said there was about a ten-foot gap, and someone put a two-by-six or a two-by-ten [board of wood] down. So now you're going from a steel member about that wide [indicating with hands about 2 feet] to a wooden member like that [indicating with hands about 10 inches]. He looked at the plank and he said, "I couldn't stop. I had to go, because if I didn't, if I halted a little bit or didn't go, the ironworkers would never let me back up again." There was this macho-ism. You know what I mean. If you showed any kind of fright, boy, they'll drum you off the bridge right then and there—

04-00:05:09
Redman: Wow.

04-00:05:10
Seim: He had to walk across that thing. Every time I think about that, with my loss of balance—I've walked on steel, but it was always broad or I had my lanyard on. I've never walked across a ten-inch plank without a safety hand cable—

04-00:05:28
Redman: No, sir. No thank you.

04-00:05:31
Seim: That's the kind of things that happened there. As a result, by 1936, when they opened the bridge, twenty-four people were lost. Then they continued on with the rails. They didn't finish that until 1939, and five more were killed. When you look at that, that's pretty bad.

04-00:05:55
Redman: It's a big difference. You explained in your first interview that you began first working at the Berkeley office of the SF Bridge Toll Authority. I just want to ask, was there a San Francisco office, how big were the offices, and what were the distinctions between being on the Berkeley side or—is it true that at one time, that there is a San Francisco office of the Toll Authority? But you had mentioned being at the Berkeley office. I wonder if you could explain a little of how that worked.

04-00:06:28

Seim: When I first started work on the Richmond-San Rafael, I worked out of a field office, a temporary field office. Then when that was completed, I moved into the Berkeley office. But to go back, the Division of San Francisco Bay Toll Crossings, when it was created in 1948—I think it was January 1 when they started, designing a parallel crossing to the Bay Bridge—they were headquartered in San Francisco. That project didn't go through. We talked a little bit about that last time. Then there were five people left, and the head guy, Norman C. Raab, that I mentioned was the designer of the Richmond-San Rafael Bridge, moved his office to Berkeley, because he lived in Berkeley. So at least five people continued—

04-00:07:28

Redman: Oh, that's really—okay. So it's just because he lived in Berkeley?

04-00:07:33

Seim: I think it was 1951 or '52. He then wrote a report in 1953 to have a bridge cross between Richmond and San Rafael, and that report was approved and the money was appropriated, and they sold bonds and so forth. That was designed in the Berkeley office. They just expanded it. They completed that particular construction. Of course, that bridge I was finished in 1956, and they brought in to the Berkeley office and they assigned me to what was then called the Southern Crossing, midway between San Mateo and the Bay Bridge. I worked on that for a year or two until that project went down. But in the meantime, Norman C. Raab wrote another report in 1957 on converting the San Francisco-Oakland Bay Bridge from its original construction of only automobiles on the top deck. Three lanes into San Francisco and three lanes east. These were only eleven-foot-wide lanes. That report was accepted, and it was built. We got the money, and it was actually designed and built. At that time, then, he moved the offices back to San Francisco. That's how I wound up in the Berkeley office. I was only there for about two years.

04-00:09:16

Redman: I see, okay. When you're working on the reconstruction of the Bay Bridge that we talked about last time, between '58 and about '63, that's mainly out of the San Francisco office?

04-00:09:28

Seim: Yes.

04-00:09:29

Redman: I wonder if we could jump ahead and if you could talk a little bit about your role in the investigation of the concrete deck on the Golden Gate Bridge in 1977. What was the story of that investigation and what was the outcome?

04-00:09:46

Seim: That was a wonderful event for me. First of all, I have to tell you about what happened to me. We finished the Dumbarton and all that, and so I didn't really have a job. I'd finished all the bridges I worked on. They changed the name from Public Works to Caltrans, and so they appointed me as the maintenance engineer of all the bridges in 1975, all nine bridges, of state-owned toll bridges. That was a wonderful start. I had an office at the toll plaza at the San Francisco-Oakland Bay Bridge. I'd sit in my office. It was a wonderful job. My God, I got to go and work on all these structures. Phone rang, and it was my ex-boss that I worked for when I was working on the southern crossing. He said that he just got a call from the Golden Gate Bridge District, which was a completely separated political entity, and they have a report that says that their concrete deck is fatiguing out and it has to be replaced. In order to do that, you have to build a lower deck, put the traffic on it, take off the concrete deck, and then recast it. They wanted to get a second opinion. Oh, wow, that's right down my ally.

04-00:11:38
Redman: Now, at this time, Golden Gate might have been on your bucket list, because you had worked on all the other bridges, but up until this time—

04-00:11:47
Seim: Not on the Golden Gate.

04-00:11:49
Redman: So this was a really exciting opportunity.

04-00:11:50
Seim: I get to walk on the Golden Gate Bridge! We called up and we said, "We're going to come over and we're going to do the inspection of the bridge deck." They were very cooperative. I remember—I'll always remember—they drove us out in these little scooters on the sidewalk on the west side, and we got to what they call a traveler. It was a vertical structure that moved along on rails on the outside so they could paint and have access for inspection. We had to get down on that traveler to inspect the underside of the deck. Then they had another traveler under the deck pulled up next to the side traveler that you could walk out on, and then the whole under side of the deck was available.

04-00:12:38
Redman: Wow. Can you see down below to the [water]—

04-00:12:41
Seim: Yes. To get to the side traveler, you have to climb over the rail. Ah, that was wonderful. I put my leg over the rail and got down on the top cord. Ah! I'm on the cord. Just wonderful! Then you crawl down a ladder, and then you cross over the lower cord, and you're on this big platform, and we get to inspect the deck. That was a wonderful day. But anyway, we did all kinds of testing. We inspected. We made corrosion inspection on the upper deck. Had to close the lane to do that. I finally wrote a report. It wasn't fatiguing out; it was corroding out. The first report was written by a consultant in New York City, and they wrote it to get more work, because if your top deck is fatiguing out, well, we'll have to replace that. To replace it, we've got to put the lower deck on, and then take the top deck off, and then put it back on. Well, now

you’ve got two decks in each direction. No, it wasn’t fatiguing out, because I put strain gauges on the rebars in the top deck. I had full access to the Caltrans lab. When you’re assigned something like that, if you want it, you can get it right then and there. I had these technicians come down and expose the reinforcing bars, put strain gauges on it, and drive trucks back and forth and commuter buses to see what the stress was. It wasn’t fatiguing. It wasn’t even near fatiguing. But when we made our corrosion tests, we found the reinforcing bars were corroding. They only had ten years of life, or fifteen years of life left. Anyway, I wrote the report. In the report, we put in a method of replacing the concrete deck without building a lower deck. We’d take off a piece of concrete deck and put back a steel piece of orthotropic deck. I keep using that fancy word. We could do it piecemeal at night. We put that in the report, and some of the guys up in Sacramento developed a little scheme to do that.

04-00:15:39
Redman: So the advantage of the new deck is that it can be installed in a piecemeal fashion, meaning that you don’t have to shut down the bridge. It’s also a lighter and a more durable deck. So those three factors. Were there additional factors? I assume that’s enough to call for that new deck.

04-00:16:05
Seim: Yes. That’s the main advantages. It’s been used on bridges in New York. It’s a technology that we kind of invented at the time that it is needed. By golly, we did it on the Golden Gate Bridge.

04-00:16:26
Redman: We’ve talked about T.Y. Lin, the faculty member. Now let’s talk about T.Y. Lin as the founder of T.Y. Lin International and as your boss. I’d like to know more about T.Y. Lin International as a firm, and how that actually worked on a day-to-day basis. To get our conversation going, I discovered on your resume a really fascinating bridge that I understand never comes to fruition, the Ruck-a-Chucky Bridge over the north fork of the American River in Auburn, California, that is an absolutely wild design. I want to know more about it.

04-00:17:09
Seim: You picked a good one. Let’s just start there, and then maybe we can close in on other things. To start with, T.Y. founded his firm in 1954, right after he got back from Belgium, and he called it T.Y. Lin and Associates. All they did was they pioneered the early prestressed concrete construction in California. Then he moved that office to San Francisco about 1970, and then he branched out and started to do work around the country, the U.S. He also had a Spanish-speaking person that would go to South America once a year and he’d bring back some projects. So he was growing in San Francisco. When I came to work for him, I was employee number forty, so he had grown quite a bit from about four of five in Los Angeles—actually, Van Nuys—to forty. He was getting jobs, but the way I made the connection here is that I was a member of

the American Society of Civil Engineers we talked about, and I got on committees, on bridge committees. T.Y. was also on some of these committees, so we would come together at a committee meeting, and that's where we first met after I graduated. He had a pretty good memory. He remembered me from—

04-00:18:59
Redman: Student days.

04-00:18:59
Seim: —my Berkeley days. Then one day when I was at my toll plaza office, the phone rang. It was T.Y., and he said, "I've got this question." He didn't say, "How are you doing?" "T.Y." "Yeah?" "I've got this question." [laughter] Wonderful person to work for. I just answered it off the top of my head, and then he called me a month later. He would then call me occasionally and ask me these questions, and I was able to answer them right on the phone. That's what they call experience. He wasn't looking for something like that. He was looking for something like that. Something not precise, but close enough. Order of magnitude. Twenty or thirty or even fifty percent was enough to get him to go ahead and take that information and refine it. That was one of the advantages of T.Y. He would work with just general approximations. He would make approximations. It's a wonderful way to work. Today, engineers are trained to go on a computer, and you print out to the fourth or fifth decimal point. They want more precision.

04-00:20:35
Redman: Which is good ultimately, but in terms of—

04-00:20:37
Seim: Oh, yes, right. When T.Y. would do approximate calculations, he would always assign an engineer to put it through the computer to verify it. There are very famous engineer that says that a computer just tells us something we already know, and that's a wonderful way to say it. You've got to have some kind of thought about where this is going to be, and then you can analyze it in a computer, and if it verifies it, that's what it's all about.

04-00:21:16
Redman: But having the computer invent a structure is a mistake, from the sounds of it. You don't want the computer to originate it. The engineers have to sort of own the concept intellectually before having the computer merely confirm their suspicions.

04-00:21:37
Seim: Some of the younger engineers—and I don't mean to be critical of them, but that's the way they were trained. They don't understand that. They've been trained to get precision. They can only work with precision.

04-00:21:52
Redman: Now tell me about the Ruck-a-Chucky Bridge if you would.

04-00:21:55
Seim: Well, that's it. TY got the job. I was on a competing team.

04-00:22:02
Redman: Oh, really?

04-00:22:03
Seim: Yes. What they did in those days, you'd put in a proposal. You'd get a group of people together and you'd write up all the "world's greatest bridge engineers" you have on your team. We'd submitted it. I was on a competing team. Just went after as a traditional cable-stayed or a truss bridge. Nothing exciting. And T.Y. got the job. But then they knew about me, and they also had a professor of engineering at Brigham Young University who worked with T.Y. and had also worked with me on these committees, so the three of us got together. I was still with Caltrans, so I did all of this at night or by phone. Anyway, T.Y's idea was to throw away the towers that would be built to hold a cable-stayed. You have a vertical towers, and then you've got straight radiating cables from that tower. Not curved cables.

04-00:23:18
Redman: So get rid of those.

04-00:23:20
Seim: If the cables are curved, it's a suspension bridge, but if the cables are straight—

04-00:23:24
Redman: Then it's cable-stayed.

04-00:23:25
Seim: Cable-stayed.

04-00:23:26
Redman: I learned something today. Okay, go ahead.

04-00:23:29
Seim: Okay. TY throws those towers away, and he anchors the cables into the canyon walls. It's simple. That's so simple. That's the shallow out, but the deep in was that he had to come up with that. Then, he eliminated tunnels at each end of the bridge, he curved the roadway. He had both the curved roadway and these cables anchoring it into the canyon walls. It was a simple solution to a very difficult problem. It's usually the other way around. That just shows you his way of thinking. That's how I got connected with T.Y.

04-00:24:18
Redman: Just briefly, why does that structure never come to fruition? Do you recall what circumstances—

04-00:24:23
Seim: Oh, yeah, that was simple too. There was a dam to be built just downstream from the bridge, and the dam would inundate the little existing short-span

bridge across the river. So it was just a replacement structure when the dam was built and the lake started flooding. As you know, they never built the dam, so the cable-stayed bridge was never built.

04-00:24:51
Redman: My next bridge that I'd like to ask you about is actually—I'm asking as much out of personal interest, to be totally honest, as much for this research project. I was born in St. Paul, and I understand you worked on the Smith Avenue High Bridge, over the Mississippi River, between 1980 and 1983What do you remember about working on the Smith Avenue High Bridge?

04-00:25:59
Seim: The original High Bridge—it was actually High Street—they called it the High Street Bridge, which was kind of High Bridge—across the Mississippi was built in 1889, something like that, all out of wrought iron. It was remodeled in the 1900s for steel. The original structure was wrought iron and steel, which is unusual, because if you go back to metal bridges, the first metal bridges were cast iron. That's brittle when it fractures. Then they improved that and got wrought iron, which is very ductile, but not very strong. Then they went into Bessemer steel, which is much stronger. Now we're into electronic hearth steel, which is even better. The old bridge, two lanes, one in each direction. It just became obsolete in the 1980s, or even before that. I started with T.Y. Lin in the San Francisco office after I left Caltrans in 1980. They actually abolished my position. They didn't fire me, they just abolished my position. Now what am I going to do? But T.Y. heard about that, and he offered me a position as the fortieth employee. I looked at something like twenty or twenty-five different bridge types to replace the old high bridge, to fit in there just to see which one would fit best. We worked with a local consultant, and we had meetings with the public to see what they wanted. We actually then built—the bridge is still there—out of steel. It's a steel tied-arch, and we prestressed the steel. That's something else that T.Y. came up with. He came up and he started with prestressed concrete, and then he developed prestressed steel. One of my first jobs, even before the High Bridge, was a prestressed steel job in Boise, Idaho, Bonners Ferry. That bridge is still there too.

04-00:28:14
Redman: With those experiences, between the early bridge in California, the High Bridge over the Mississippi River in St. Paul, Minnesota, and then the prestressed bridge in Idaho, from there, I start to see more and more international experience starting to appear. I see the Rama Bridge in Bangkok, Thailand as appearing in 1988 on your resume, and I wonder if you could talk about those sorts of early international experiences. You'd mentioned how T.Y. was expanding into South America. You work on a bridge in Venezuela, and the Bridge of the Americas crossing of the Panama Canal in Panama. I wonder if you can talk a little bit, first maybe in Thailand and then we'll move on from there, about these early international experiences, and what was different, and what lessons do you feel like carried over.

04-00:29:22
Seim: Let's start with the Rama IX in Thailand. That was designed by a very famous German engineer, and was open to traffic. The king opened the bridge in about November of the year—when did I go there? Eighty-nine?

04-00:29:53
Redman: I have in '88. I just have '88 marked next to that.

04-00:30:00
Seim: I went there in March or April of the year after it was opened. Anyway, the king opened the bridge, and the first thing that happened as traffic crossed the bridge was the thing was vibrating all over the place, and the wearing surface on the orthotropic steel deck was slipping and sliding and had to be replaced after only a few months of wear. I had some experience with surfacing wearing on the San Mateo and San Diego and Golden Gate Bridges, so they called me over to evaluate. I told you about throwing my leg over the railing of the Golden Gate Bridge. They took me out on the Rama IX Bridge, and then parked, and we got [out]. Here were these big, overloaded trucks, crawling about five or ten miles an hour, and I saw those big wheels moving like this, very slowly, and the pavement was being displaced. It's tough to design just for ordinary loads, and when you have overloads like that, what can you do? That's number one. The number two [problem was] the wearing surface they put down on the deck was just not appropriate at all. If you didn't have overloads, it wouldn't last more than two or three years at that.

04-00:31:36
Redman: So this was a major project. They'd already completed the bridge, but they needed to do much more work to get it up to shape, from the sounds of it.

04-00:31:47
Seim: All they wanted was a report on whether the contractor was at fault or the material. It was the material.

04-00:31:53
Redman: Interesting, okay. How about—

04-00:31:55
Seim: That was done. I've been back and visited the bridge, but I did it on my own. I wasn't paid.

04-00:32:04
Redman: How about the Gibraltar Strait Bridge? As I understand, this is another idea that T.Y. Lin articulates. If I recall correctly, it's one of the better-known, never-built bridge designs, maybe ever, and I wonder if you could tell me about what that project was, what it represented, and who worked on it.

04-00:32:34
Seim: I think Ruck-a-Chucky is more famous to the public. The Gibraltar Bridge might be more famous to bridge engineers.

04-00:32:43
Redman: Is that right? Oh, that's very interesting.

04-00:32:45
Seim: But that's beside the point.

04-00:32:46
Redman: No, that's very interesting. But tell me about why this Gibraltar Bridge is significant.

04-00:32:52
Seim: Again, it illustrates the thinking of T.Y. There were three alignments being studied for a bridge across Gibraltar. One was fourteen kilometers, and the longest one was something like thirty kilometers. One of them was support on floating foundations. The fourteen kilometer was never seriously conducted because of the foundation problem. The Strait at that point was 3,000 feet deep. Huge, very deep. Look at the water that has to flow in and out of the Mediterranean Sea. This was being designed by Bechtel, just kind of preliminary thinking, and so Bechtel called T.Y. and hired him to look at this. T.Y. told me, he said, "You've got all these three bridges. I threw away the other two and I looked at the fourteen kilometer." He said, "I looked at the structure." He said, "Right in the middle, there was a hill, a mound. The water was only 1,000 feet deep. Well, we have offshore drilling platforms in 1,000-foot water, so that's feasible. So I put a tower there, and then I put another tower about 5,000 feet on each side." So he had a 5,000 meter suspension bridges. I said feet, [but I meant to say] meters. The Akashi Bridge in Japan is 3,000 meters—no, 2,000 meters. So he went right from 2,000 meters to 5,000 meters.

04-00:35:04
Redman: That is an amazing leap.

04-00:35:30
Redman: Let me ask for a last word on the Gibraltar idea. This is obviously a major design proposal. It doesn't, in the end, get built, but I wonder if you can tell me, explain, first of all, what your role in working with T.Y. may have been in that project, and then what the influence of that design has been, or how that design is talked about by engineers. Is it merely because it was such a spectacular idea and it seemed feasible, or is there something else that was so influential about it?

04-00:36:11
Seim: Most bridge engineers would never even think about 5,000 meters being a feasible design, except T.Y. He came up with this. His assignment, original assignment, was to just use a traditional suspension bridge, and he did. He designed it as a traditional suspension bridge. He found that, from a size standpoint and construction, you could probably do it. That was just the first crack. But then later, people became interested in it, and T.Y. Lin International actually signed a contract with the consortium between Morocco

and Spain that was responsible for that bridge. It was headquartered in Madrid. I was actually sent over to that headquarters in Madrid to start with the sea bottom. I had a layout of all the contours of the substructure, and we had drills, borings with samples of soils, and we had earthquake values shown around the location of the bridge. They had plotted location of, actual, earthquakes there. So we were starting, at that point, to make a more detailed feasibility study, but that was cancelled for whatever reason shortly after I got back to the S.F. office. It just laid there. There hasn't been anything done since then.

04-00:38:00
Redman: I'm going to jump a little ahead in time, then back in time. First I want to talk about two more international experiences, and then I want to wrap up today talking about the Bay Bridge, and in particular the new Bay Bridge project, if that's all right. But before we do that, can I ask about the Bridge of the Americas crossing of the Panama Canal and your experience in the mid-nineties? It says on your resume '94 to '96. Can you tell me what that experience was like and what the meaning or significance of that bridge was?

04-00:38:36
Seim: That's a wonderful bridge. It was designed by Colonel Sverdrup, who was in the Corps of Engineers as an engineer. Then when he retired from the corps, he established his own firm in St. Louis, Sverdrup Corporation, and he designed a lot of bridges, including the one [fell into the] Mississippi in Minneapolis.

04-00:39:05
Redman: Oh, the I35W Bridge. You did, I understand, in 2009, work on that [aftermath of that] bridge [collapse]. My sister [Elisa Redman] drove over that bridge about fifteen minutes before it collapsed, so I'm very curious about that crossing. You, I understand, did some of the investigation into the Interstate I35W Bridge collapse. Now, as you look back on that incident, what stands out to you?

04-00:39:34
Seim: I was working for an attorney. They were trying to defend themselves. First of all, Sverdrup was an excellent engineer. For some reason, they were working on the Poplar Street Bridge and the Minneapolis Bridge at the same time. I visited the Sverdrup office in St. Louis in 1967, because I was working on the San Mateo-Hayward, and we were both designing bridges with orthotropic decks. I'm at a loss, as every engineer is, why those eight gusset plates were half-inch thick when they should be three-quarters of an inch thick. It's hard to explain. I've followed a lot of that. But anyway, it happened. That was not the sole reason for the collapse. When you have a bridge collapse, there's usually three—and I've investigated the other problems, bridges and collapse and so forth—there's usually three items that line up together. Any one of them by themselves wouldn't do it. In this case, there were three. They increased the weight on the deck, on the bridge, in 1992, '93, somewhere in

that time frame, in the nineties, and didn't do any analysis on the bridge for the added weight. At that time, what happened was these eight gusset plates that eventually failed were supposed to be like so [holding out hands indicating the gusset plates should be flat]; they were bowed like this [holding out hands indicating that the gusset plates were bowed]. They have pictures of the bowing. They have a date on the picture, 1998. And here they are, bowed. They started inspecting the bridge in 2000, every year. Nobody found those bows, except one man. He wasn't an engineer. He was just an inspector. He never reported it. They asked him why after it collapsed, and he said, "I thought it was built that way." They actually found the potential failure and they didn't do anything about it.

04-00:42:13
Redman: Combination of human error—

04-00:42:15
Seim: That's true.

04-00:42:16
Redman: —and those things coming together. What's the third one?

04-00:42:18
Seim: The third one was that they were inspecting the bridge in 2007, the year that it failed, when it came down. They started in the spring. They stopped inspecting because they were going to out bring another contract or to again put more weight on the structure by adding concrete on the deck, to fix the deck. So they stopped the inspection. Maybe if they had continued, they might have found the bowed gusset plates again. The day that it failed was the day that the contractor had arranged to bring out his aggregate and his bags of cement and a concrete mixer so he could mix up—that night, mix it up and pour this concrete on the deck. In the afternoon, he asked an employee of the state, "I've got this aggregate coming out. Is there any place I should put it specially?" The story I was told is that the employee threw up his hands and said, "It's not my responsibility." What should have happened is that the contract should have said, put the aggregate in a certain location, or off the deck, and then you analyze it to make sure that the contractor can do that, or you, Mr. Contractor, hire an engineer and analyze the bridge to support the weight that you're putting on. Neither one of those was not done. So, okay. The contractor was free to put it where it's convenient, and put it right where these four gusset plates on the south side were located. Of course, as soon as they got the aggregate out on the bridge, according to the people that were working on the job, the bridge vibration started changing. You put half a million pounds on there, and then at 6:20 or ten or whatever it was, boom it collapsed. That's a tragic story.

04-00:44:28
Redman: This is my last question about the I35W Bridge. Did that change or influence the conversation about bridge inspections in the United States in a serious

way, or do you think that that's forgotten about largely, that incident? Other than by, say, specialists who work in bridge engineering?

04-00:44:39
Seim: The original start was back in the failure of the Silver Bridge in 1967, which is the same year that the Minneapolis Bridge was opened. It was a suspension bridge across the Ohio River, and it fell. Killed thirty-five people. From that, the federal highway people developed a biannual inspection requirement. Every two years, you go out and inspect the bridge. Because if this Silver Bridge had been inspected frequently, maybe it wouldn't have fallen down. So that's what started frequent inspections.

04-00:45:44
Redman: My last question, internationally, I'd like to talk about China before we move right back to the Bay Area and the Bay Bridge. I see that bridges in Beijing and bridges in Nanjing in particular are areas where you worked in China. You'd mentioned a little bit about the safety considerations of the workers. Can you compare and contrast bridge building in the United States and China as you witnessed it?

04-00:46:19
Seim: I would hope that they have improved their safety issues in China. The first trip I went over on was the Nanjing cable-stayed bridge. I visited China as a tourist in 1985, but then they brought me over to work on this first bridge in Nanjing in 1998. They were building the substructure. Now, the Yangtze River is just as brown as the walls on this room, and it's flowing, and there's ships going back and forth. You stand there long enough, you've got a hundred ships going, or barges, an hour. It's really a difficult place to build something. Well, they built these cofferdams, which are round rings, maybe a hundred feet in diameter, or maybe even bigger. It's steel, and they pour concrete in it. They sink it, similar to what they did on the San Francisco-Oakland Bay Bridge, except they didn't have these domes on top. They took us out on the barge. We climbed up to the top and we looked down, and of course there was water inside. They'd keep the water there, keep it inside to equalize the pressure. There were welders, welding the steel plates inside the coffer dam. They were working on a bamboo platform, about a foot wide and maybe ten feet long, and they were hung by ropes from the top. They had the welding equipment, and they were welding. To weld the they would hold onto one of the ropes holding up the bamboo platforms they would weld as far as they could reach. They didn't have any life vest on. I looked around all over the place, there wasn't even a lifesaver around. If they lost their footing—oh, God. There were half a dozen of these welders down there on these different platforms. That was my first visit.

04-00:48:50
Redman: That surprised you. We can add additional thoughts to China if we decide to, but I want to ask about your time as the chair of a peer review panel for the seismic retrofit and design of toll bridges in California between '94 and '98.

Obviously, 1989 here in the Bay Area was a reminder to everyone as to why that was so important, but I wonder if you can tell me any memories in particular of that peer review process and what that entailed.

04-00:49:29
Seim: The peer review process has grown up recently. I don't know exactly when it came in, but years ago, we didn't have a peer review. Now, recently, on all these big bridges, I would say for maybe the last twenty years or so, the peer review process was brought in. And quite properly, because our technology has become so advanced and so complicated that no one person can see it all. On these older bridges, the technology was such that one person could understand it all. Because no one today can understand all bridge technologies, they brought in these peer reviewers, and it really is worth the cost to pay extra for engineers just to review. That's what I was doing in China. I was over not as a peer reviewer, as a single reviewer, reviewing what they were designing. I found a lot of things to correct. Now when it comes to seismic retrofitting of all these big bridges in California, the ones that I had been maintenance engineer on, so I knew them very well. We were pioneering the seismic retrofit technology as we were going. That was a wonderful situation, because I was in the process of reviewing other people's work, and I didn't have the responsibility for doing the work. That's all the difference in the world. It really releases you to look at the overview. We worked with the consultants on all these bridges, and I actually did the peer review of some work done by Caltrans itself. It was a wonderful experience in total cooperation and a freedom to comment. If we found something, they'd take another look at it.

04-00:51:59
Redman: In a way that's maybe harder as someone who's within the process, especially if you're a junior engineer. Being this peer reviewer seems like it was liberating in the sense that you could say kind of whatever you needed to say, and that it was well-received and in a cooperative environment.

04-00:52:19
Seim: I'm making a comment on that because all of us hate to see our work criticized. But if there is constructive criticism it is usually well received—saying, "Your work is no goddamn good," may not sell very high. It's how it's presented that counts. We weren't out there to criticize for the sake of criticism, but we were trying to get the best technology. We had a soil guy, so we looked at the soils and foundations and all that, and it was just a wonderful experience. I think we got the best we could possibly get with the technology at that time.

04-00:53:14
Redman: I'd like to talk about the new eastern span of the Bay Bridge. I understand you are with the San Francisco Bay Area Metropolitan Transportation Commission, or MTC, working on the engineering and design of the approval panel for the new east span of the San Francisco-Oakland Bay Bridge between

1995 and 1996. A lot has been said about the new east span of the bridge. A lot has been said about the length of time that it's taken to complete, and people have commented one way or another on the design. But I wonder if you could give a little insight into the conversations as they were in 1995 and 1996 about when the bridge would be completed and what it might look like.

04-00:54:05

Seim: I would hope that my comments would be considered as constructive criticism, and I would hope that they would never go again through what they did at that time. In defense of them, these are laypeople that are on the MTC committee. MTC picked out eight members for a task force, I think, and one woman was placed in charge of that taskforce, and they had no experience, but they didn't ask either. I got a call Thursday that there would be a meeting of the committee on Monday, and there would be presenting bridge concepts. People would come in and present what they feel should be a proper bridge. That's four days to prepare. There was a firm in San Francisco that worked over the weekend. [short break in audio] And they spent something like $10,000 building a model and so forth, because the implication was that if you came there and you presented what you would want to build, you would be employed as the engineer to design it. That was never intended, but it was implied. That's a terrible position to put these people in, and it's a terrible situation to allow only four days for a public meeting. We're [running] out of time [for today's interview]. So that [project] started off on the wrong foot. After that, the presentations were listened to and reports were made, but nothing really came out of it. All that happened was that it was narrowed down to either a suspension bridge or a cable-stayed bridge with one tower. Well, okay, it did that. That's maybe worth the effort. But then they advertised for proposals for the consulting engineer to do the actual design. So all that work from these people, and these people spending all weekend building models, was all lost. It so happened that T.Y. Lin International got the job. That's how we wound up with it.

04-00:57:03

Redman: I think my last question today, actually, brings me to two concluding points. Where we are today with the eastern span of the bridge. Part of our project is, of course, comparing the legacy of the original eastern span as it sits to the new eastern span. Then, finally, I'd like you to close by telling us a little bit about forming your own consulting company in 2004.

04-00:57:33

Seim: Let's start with the east bay span. We can dismiss the west bay span, because it's been seismically retrofitted. It was cheaper to do that than to replace it. But on the east bay span, it was just so badly overstressed in earthquakes that it had to be replaced. We talked about geology. Now, on the east bay span, everything is supported on mud, literally mud, and not very good. That mud now shakes like a bowl of jelly in an earthquake. It displaces, and that's what happened. There was a displacement between two piers in 1989 and the deck fell down. It's better to spend the money to get the reliability of a new structure. That was all decided. Fortunately, I was on the peer review panel combined with a separate seismic review. There were about eleven of us that got together. We got together to sign off on that. What we in effect did, said, build a new east bay span, and we'll demolish the old one, because it just can't be reliably retrofitted—

04-00:59:02
Redman: But it was that seismic and peer review committee that pushed it in that direction of getting a new span done, from the sounds of it?

04-00:59:12
Seim: Usually engineers are the last persons in the world to get full agreement. But there were four of us on the peer review panel, and I think there were seven or eight on the seismic review. A couple of them overlapped as they were on both panels. We got together as a joint venture and we talked about it. We spent a couple hours just discussing what way to go. At the end of that, we all agreed and we said, "Let's write a letter and recommend a new structure." I was assigned the task of drafting it. So I did, I drafted it and passed it around, then we polished it all up. Then we sent it through Caltrans, because Caltrans was selected to construct the east bay spans, Caltrans to the governor, and he accepted it. I think that was the correct way to go. I don't think we have much time, but suffice to say, if we had a cable-stayed structure, it would probably be half the cost of what we now see out there. It's a selection process of a very expensive type of structure, because the people wanted the curvature of the cable instead of the straight cables as the curved cables match the curved cables of the Bay Bridge west span and the Golden Gate Bridge.

04-01:00:47
Redman: Is that right?

04-01:00:48
Seim: Well, yes. That's okay. If you know that you're going to pay extra money for it, then that's okay. The problem is that the estimates that we had were so poorly done, because nobody had done this before. We didn't have the proper cost ratios. Anyway, everybody seems to be happy with the suspension bridge, and it's being paid for out of the tolls. Everybody is maybe not going to be happy when you go across and pay the extra toll, but it is going to be a beautiful structure when it's done.

04-01:01:31
Redman: My last question, then, is simply, in light of the experiences that we've talked about, both in our first session and today, can you talk about starting your own consulting office, and what your work has been like since about 2004?

04-01:01:52
Seim: Oh, okay. I retired in 2004, but I said I don't want to retire from engineering, so I just typed in my name and "Consulting Bridge Engineer" on my computer, and passed out a few business cards. I retired on Friday. On Sunday, I was on a plane to Alaska, [to work] on the Million Dollar Bridge.

The Million Dollar Bridge is another famous bridge I worked on. That's a wonderful bridge to talk about. So my retirement was, what, a day? I did a lot of consulting with T.Y. Lin. Of course, when they started the east span, they used me a lot, and then I also got some jobs. Right now I'm working on a job in Vancouver. I just finished last year a job on the Fremont Bridge, the longest steel tied-arch bridge in the United States, resurfacing that. I just pick up these jobs when the phone rings or I get an email.

04-01:03:19
Redman: Chuck, with that, I'd like to say thank you so much for sitting down and really illuminating a lot in the world of bridges for me. Thank you very much.

04-01:03:29
Seim: As you can tell, I hadn't had anybody to talk to. So thank you for coming and letting me talk to you.

04-01:03:35
Redman: This is great. Thank you.

[End of Interview]