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CONVERSATION WITH A MASTER: ROY G. JOHNSTON

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1. BIOGRAPHY

Roy Johnston grew up in a family that lived and breathed construction since his father was a contractor. As he was growing up, he worked for his dad on construction projects in his spare time. Quickly, he discovered that laboring on construction was not for him and decided to become an engineer.

Roy Johnston attended the University of Southern California where he graduated Magna Cum Laude with his Bachelor of Science degree in Civil Engineering in 1935. At USC, Roy was also elected to Chi Epsilon, Tau Beta Pi, Phi Kappa Phi and Delta Sigma Rho, all honorary societies. Roy is a registered Civil and Structural Engineer in California, and is also currently registered as a Professional Engineer in the states of Washington, Michigan and Florida.

After a short stint with the Los Angeles County Building Department, Roy went to work with Clyde Deul, a consulting engineer, for six years before joining the Los Angeles office of the Lummus Company where he spent five years. In 1945, Roy, along with his former classmate at USC, George Brandow, started the firm of Brandow & Johnston Associates, one of most respected firms in the structural engineering profession. Roy is still active in Brandow & Johnston, only taking off a little time occasionally to pursue relaxation and sport on golf courses. Roy is responsible for client relations, project administration, structural design, supervision of seismic design, and structural systems selection for major institutional and commercial projects. Roy also oversees the structural engineering methodologies used in a wide variety of projects from new construction to seismic mitigation projects and from building evaluations for owners to forensic consultation.

Roy, in over 50 years of structural engineering practice, has been responsible for the structural design of over 10 000 projects including hospitals, office buildings, schools, and government facilities. Among Roy's landmark projects are the Los Angeles Memorial Sports Arena, the Tom Bradley International Terminal at the Los Angeles International Airport, the Los Angeles Central Library Rehabilitation and Expansion, and the Lockheed L1011 facility in Palmdale, California. Roy was also involved in the design of test frames for the Space Shuttle and Stealth Bomber. Roy's

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landmark tall buildings include the Transamerica Tower (originally the Occidental Center), the AT&T Building (originally the Crocker Citizens Plaza) and the 550 South Hope Building, all in downtown Los Angeles.

Roy Johnston is very active in professional societies and associations, as well as serving on numerous boards for public agencies. Roy is an active member of the Structural Engineers' Association of Southern California where he served as Director from 1959 to 1961 and as President in 1961. He was President of the Structural Engineers' Association of California in 1962. He is a fellow in the American Society of Civil Engineers and the American Concrete Institute and has also served as Vice President and Director of the Earthquake Engineering Research Institute; Roy has also represented EERI on delegations to France and the People's Republic of China. He has also served the state of California as a member of the Board of Registration for Professional Engineers, the State Building Standards Commission, and the Building Seismic Safety Council. He has also served on the Board of Trustees of Westmont College in Santa Barbara, California since 1963, and was Chair of the Board of Trustees from 1972 to 1988.

Roy has been honored by the Los Angeles Area Chamber of Commerce with an achievement award in 1981. In 1982, he was honored by his alma mater with the USC Engineering Alumnus Award for outstanding achievement. The Institute for the Advancement of Engineering honored Roy as the Southern California Engineer of the Year in 1985. In 1990, he was also honored as the Engineer of the Year by the Structural Engineers Association of Southern California. In 1994, he received the President's Award from the Los Angeles Tall Buildings Structural Design Council.

Roy Johnston continues to be a mentor, inspiration, and role model for many structural engineers.

2. INTERVIEW

Question: What influenced you to become an engineer, a civil engineer, and a structural engineer?

R.J.: My dad was a contractor and, during my vacation time as a junior and senior in high school, I worked the cement mixer for him. In those days, there was no transit mix. After two summers, I knew this was not for me. I decided to go to school and become an engineer.

Question: Because it has something to do with construction?

R.J.: Yes. I always wanted to be in construction. In those days, Dad, although an excellent pattern maker, in order to find work had started a small contracting firm. It was during the great Depression that he landed the contract for the Palos Verdes Library with a low bid, only $12 below the second bidder.

Jobs were scarce and the margins between bidders were very small, sometimes only $10 or less. In those days, labor was plentiful and on a construction site, there were always people waiting for the chance to work. Some were so undernourished that they could only work four hours. However, there were other people waiting in line who could be hired for the other four hours of the day. So you had one crew in the morning and often another crew in the afternoon. Those were the days before transit mix when all the work was by hand. You had to shovel the rock and the sand into the hopper and add a sack of cement. I ran the mixer, added the cement, and controlled the water. I became skilled at it and handled the 100 pound sacks of cement with ease. I wouldn't want to do it now, even if I could.

Question: So you asked yourself, 'is this something I really want to do for the rest of my life?'

R.J.: I decided that construction labor work was not for me. I was sure there had to be an easier way. Little did I know that engineering was not much different. However, I always wanted to be in construction, most likely because of my relationship with my dad. He taught me many things. In fact, I even learned to hang doors. In those days, a carpenter was required to hang a door in an hour. They were real artisans, experienced and capable.

Question: In the old days, some of the contractors were the engineers.

R.J.: Well, they were practical engineers. I don't think they had much education. It was mostly through trial and error.

Question: What school did you go to?

R.J.: Well, I started at USC in '31 and graduated in '35. In those days, if you had a bachelor's degree, it was probably all that was expected of you. Now, with the increase of knowledge, nobody can do it in four years, possibly five years. If you want a Ph.D., it could take 8 to 10 years, depending on how good you are, and the available time.

Question: What was the emphasis of the courses in school?

R.J.: There were more design courses at USC at that time. Fox and Wilson were two of the faculty and both had come by way of a practical background. Fox had been an old railroad engineer, and did we struggle. He'd give us a problem and we'd work on it for half an hour. He'd go to the blackboard and, with approximations, he'd have an answer in about five minutes. We'd struggle along for some time and maybe the difference was about 10%. That taught me a lesson — very often you don't need four decimal points. If you get within 5–10% of the right answer, you're probably as close as you're going to get because of assumptions, loading differences, material capacities, etc. If you're dealing with horizontal earthquake accelerations and near field pulses, for example, who knows what the exact demand is going to be. The demand side of the equation has been increasing periodically for the last fifty years. If I read the new guidelines correctly, there will soon be another increase. In other words, we will all be doing what Degenkolb did in the design of the Olive View Hospital, and be forced to use steel plate shear walls. With changing demand requirements, inaccuracies in developing a proper building model, material differences and construction deficiencies, if the engineering calculations are within 5 to 10% of the real answer, the design is probably as good as it can be. Today, unlike the old days, with computers and engineering programs, we can obtain ten times more information to aid the engineer in design. However, the same problems remain. It is interesting to me that with the emphasis on pushover calculations and story drifts in new engineering methodologies, the new programs are similar to deformation diagrams we calculated in the design of our high rise buildings completed in the '70s and '80s.

Question: What was your first job after you graduated?

R.J.: My first job was the Administration Building at UCLA.

The architect was John Austin. He was one of the three architects who joint ventured the design of the Los Angeles City Hall. We had worked for him just prior to the World War on several military projects including a large hanger. George Brandow, who later became my partner, and I had been working for structural engineers Win Wilson and Clyde Deul, respectively, engineering friends who had developed the design of the arch-rib wood truss. Because of the war, the only material available for design of the hanger was wood. Although we had designed several wood trusses while working for Wilson & Deul, we had never designed a 300 foot clear span hanger with wood trusses. We did design it, but I'm sure glad it was never built. The history of wood trusses is that they only last about 20–30 years. We have repaired hundreds of trusses through the years because of shrinkage and splitting of the wood.

There is an interesting story about John Austin and his awarding the engineering to our firm, Brandow & Johnston Associates. He said 'you fellows are just starting out (this was right after the war) and I will give you a retainer of \$10 000.00. I think you may need it.' He is the only architect that has ever provided funds in advance, as far as I can recall. That gave us not only the impetus, but the wherewithal to really start our business. I don't know if it is to our credit or not, but we have never been to the bank since that time in order to meet our payroll. We shall be ever grateful for his confidence in us when he said, 'You're a couple of young guys just starting out. Here, take this, we want you to do this job.'

Question: How many people did you have? Were there just two of you?

R.J.: We hired one engineer before we could break loose from the work we were doing. George was Superintendent of Construction for the Union Oil Company and I was in charge of structural engineering for the Lummus Company, Los Angeles Branch. Our work was related to the refinery towers located in the San Pedro area. The Lummus Company was designing the refinery structures for the Union Oil Company and George, in charge of construction, was checking and approving the design. We had known each other in college; however, this shared working experience started our relationship which has lasted more than fifty years. With the completion of our refinery experience and the ending of the war, it was an excellent time to start a new engineering firm for the simple reason that all the loyalties and all the relationships between architects and their structural engineers had more or less disappeared. It was a new ball game. We could present our firm and our proposals to architects knowing that they would be considered. Most of the loyalties within a firm had disappeared during the war. Part of our success was being in the right place at the right time and perhaps enjoying a lot of luck.

That's how we started our structural engineering consulting practice. In fact, I don't know if there was any point in my life that was not connected with construction in some way. Engineering is what I always wanted to do.

Question: You don't regret it now?

R.J.: No, I don't. I really enjoy it. Every day there's a different problem, and problem solving holds your interest. There is definitely nothing routine about it.

There were a couple of engineers who have been really helpful in my career. Steve Barnes was one of them. He was always encouraging. If there was anything he could do for you he'd do it. Even on committees, he was always extending himself beyond what was necessary. I really appreciated everything Steve did. He was a good engineer and he was also very civil towards everyone. He didn't mind if we just called him up to ask him what he would do in a similar situation. If you were in competition, you knew all too well that it would be an honest approach rather than some of the things other people would do. He was a very good influence.

George Housner was the other engineer who has been very helpful to me and the profession as a whole. Although I never had the privilege of being one of his students in the classroom, he was always available and willing to answer any questions. I think he has done more for earthquake engineering than probably any one individual. I don't believe we would have had the response spectra approach in design as soon as we did without his understanding and research. He was the advisor to the City of Los Angeles Building Department and was instrumental in developing the code provisions for earthquake design. Remember how it started as 10% of the mass, then reduced according to the number of stories, and later using the design response spectra. George had an understanding of the problems and the respect of the profession.

What I like about the engineering profession is that structural engineers generally have a straightforward, honest approach to design. They are willing to share their knowledge and work together unlike some professions who have little or no ethics. I have enjoyed my work and the opportunity to design several thousands of all kinds and types of buildings.

Question: What are some of the buildings you remember? Why do you remember them?

R.J.: We designed the California Bank building at 6th and Spring Streets. I remember that structure because it was the first high-rise building constructed after the ordinance was changed to allow buildings taller than the original 150 feet limit. I had previously served on the Mayor's Committee with Steve Barnes, the Superintendent, and others that concluded that 'height limits' although useful in changing the façade of a city did not lessen the risk from earthquakes. Buildings properly designed, without height limits, would be acceptable.

The building was 18 stories, constructed with a load carrying steel frame and a concrete shear wall façade. There were five levels of parking below grade adjacent to the Stock Exchange Building. Therefore, it was necessary to underpin that 150 foot building before any construction could begin. We developed a scheme of slant drilling, and pouring straight reinforced concrete piles under the existing spread footings. By providing a built in jacking device, we accomplished the task without any settlement in the existing building.

Our firm has designed a large number of high-rise buildings, probably 150 or more structures. The tallest building was the 42-story (including five basements) AT&T building at 6th and Grand. The plan was a somewhat symmetrical cross-shape which allowed the special earthquake resisting steel frames to extend through the central common section in both directions. I recall contacting a San Diego firm to provide a computer analysis using large mainframe equipment.

Question: When was this?

R.J.: It would have been in the '60s. We used the outfit in San Diego to make our analysis for us. We did a number of them that way because we just couldn't afford the tools. Now you can put a computer on a desk and do the same thing that they did, only much faster.

It took a couple of weeks to gather the data and wait for the results. We used that process for a number of years until we were able to purchase our own computers.

In the same general area as the AT&T building, we have designed several buildings — the Checkers Hotel redesign, the Los Angeles Public Library remodel and addition, the Keck Building and the 550 South Hope 30-Story Office Tower. Each building had its special problem. The Checkers Hotel was a historical building in which the exterior façade could not be changed. The interior structural elements were completely gutted and new floors constructed on strengthened columns and foundations to accommodate the enlarged luxury hotel rooms.

The Los Angeles Library had been damaged by two fires and was too small to house their enlarged book collection. The older portion was repaired and strengthened and the new addition was blended into the historical building.

The Keck Building, originally the home of the Superior Oil Company, was the first all welded steel frame structure in Los Angeles. The 15-story building was located at the corner of Flower and 6th Streets. I recall one day receiving a phone call from the contractor saying that the concrete which had been poured two weeks earlier was still fluid and had not set. They had removed a form and lost that portion of the wall. After an investigation, we determined that the mix had been overloaded with an admixture retarder when a gage in the transit mix plant had failed. When it finally hardened, it was like flint.

The 550 South Hope Building is relatively new, designed in the late ’80s. It has an elaborate helicopter landing area above the roof and a couple of sloping interior columns to accommodate an architectural feature.

Those are some of the buildings we have designed in the downtown area and the kind of features and incidents you remember. We have designed all the structures within those two blocks with the exception of the California Club.

Question: When did you lay down your slide rule and pick up a calculator?

R.J.: I remember back in the late ’30s working with another engineer on the design of a department store on Wilshire Boulevard just north of Vermont Avenue. We calculated the stress in the steel frame using a slide rule following Hardy Cross procedures. One would run the slide rule, the other would record the results. It took us two to three days to run one frame. Shortly thereafter, we used Monroe calculators.

Question: As far as the practice is structured, running your business and doing your professional activities, what are the biggest changes that come to mind from when you and George first started?

R.J.: Tools for one thing have changed for the better. My only caution would be that we provide a ‘realty check’ to all our calculations.

It has always been my opinion that young engineers should develop their own experience by making a plan and estimating the sizes of the members before they start the calculations. Over time they will learn what sizes are within the ball park, and their estimating will become more and more accurate. Consequently, when you finish your design, if it looks reasonable, you have made your own realty check. The danger in complex and long calculations is that you have a desire to believe the numbers. Remember, you must use the correct program, make the proper model for the particular building, and punch the correct figures in the computer in order to have a correct solution. It’s easy to make a case for the need of a realty check.

Computers must be used for an efficient and proper analysis. Consequently, one of the best solutions for an efficient use of personnel is to blend an older, experienced designer with a younger engineer trained in the use of modern computers. The one is less familiar with the new tools, the other lacks the experience to know what to expect from the computer, by working the two together, you have the best of both worlds. Buildings designed in offices without the proper experience background can sometimes be deficient. In our office, we have checked and retrofitted several of these cases.

The use of computers has been a big change. It can change for better or it can change for worse depending on how it is used.

I think the codes and methodologies are getting too complicated. Only a specialist can understand and make some sense out of the written requirements. Young engineers who understand the use of the computer often have difficulty deciphering many of the nuances in the code or understanding the limits of many of the provisions.

Question: It seems to many engineers that the code changes are driven by material suppliers who are trying to get a bigger piece of the market.

R.J.: There is a lot of that. The tug of war between the steel materials and the concrete materials people is still going on. It may be a refined tussle with each trying to get a little advantage over the other. This has been going on for a long time. I think the competition has been very healthy. Back in the late ’60s and early ’70s, when we were talking about ductile detailing of concrete, those of us that were on the committee really pushed the concrete people purposely when we recommended that the code requirement for ductility should be similar to the provision for steel.

The Portland Cement Association convened a Blue Ribbon Task Force — John Blume, Nathan Newmark and Leo Corning, to examine and develop a scheme for providing the proper ductility in concrete. The result was a landmark book entitled 'Design of Multistory Reinforced Concrete Buildings for Earthquake Motions' from which the concrete ductility requirements were codified. As a result of this effort, concrete frame structures built after 1970 are better able to resist lateral deformation caused by ground shaking. Those buildings which do not have the benefit of ductile detailing confining the reinforcing bars are at risk and should be carefully examined and evaluated.

We have always tried to design our buildings in accordance with the latest available information, regardless of the code requirement. However, we, like many engineers, would welcome a second chance to retrofit some of the older pre-1970 structures because of changing technology and more accurate code requirements.

Question: What about the inspection that used to take place versus what's taking place today as far as quality control in the field, the engineer's role, etc.?

R.J.: I've always felt that the person who designed the building should at least have a chance to inspect the building during construction. We've always made a practice of allowing the engineers to go out and make at least a few inspections for two reasons: one, to find out whether the structure is being built according to plan; and two, to give the engineer an opportunity to visualize what he designed. I have always believed that if you can't visualize what you're doing, then there are going to be some errors. Hardy Cross wrote a chapter in his original book on being able to visualize the action that's taking place in the members. In my view, that's one of the best chapters ever written. If you can't visualize what is happening, you're going to make a lot of mistakes. I'm a firm believer than an engineer should not take a job unless he can have a measure of quality control and also inspections.

Question: Do you think the engineers should be accountable to the owner that the building is constructed according to its plans and hire the inspector?

R.J.: I appreciate the fact that with the legal system the way it is, you have to be a little careful. I think there is certainly a balance where the engineer should be able to say that he has observed the construction and, in general, it fits the design. I don't think it's possible for him to certify that every bar, every beam, every element in that building is exactly according to the plans.

I recall a situation which illustrates the difficulties in certifying total compliance with the design plans. After the Sylmar earthquake, we were called out to the Patrick High School because a few of the columns supporting the covered walkway had failed. What we found was that for the columns involved, the vertical reinforcing steel during construction had been located outside of the cage. If the on-site inspector was not able to observe this type of construction departure from the plans, the engineer should not be charged or expected to sign a certificate of total compliance.

The plans were drawn correctly, but the workmanship was deficient. The contractor has the ultimate responsibility to build according to his contract and the construction plans. The engineer should make periodic inspections, however, he can only certify as to what he observed and must depend on others, beyond his control, for the continuous inspection. Therefore, the certificate of compliance should first be signed by the contractor and the inspectors before it is reviewed by the engineer.

Question: Do you think that we're getting any better at inspections now than we were in the past?

R.J.: Not really. Proper inspection procedures do bring results. The function of an inspector is to observe and approve the construction for compliance with the contract plans and documents. He should not second guess the design or stop construction because he does not agree with the design. He should work under the control of the responsible engineer and communicate directly with him on all matters. Too often, some inspectors attempt to take matters into their own hands which leads to disaster. Either the contractor thinks he is abused or the engineer is placed in a compromising position. Neither attitude is good for the proper handling of a construction project.

Question: Do you believe the legal system is better the way it is today or as it was? Do you think it's doing society any good?

R.J.: I'm totally prejudiced. Sometimes I wonder whether there is any kind of justice. On occasion we are sued in what I call a frivolous case — one occurring on the construction site in which the engineer has no control or involvement. The court, in a mediation effort to avoid a costly trial, arbitrarily assigns a certain sum for each party to pay regardless of guilt. This unjust process begins because the plaintiff's lawyer does not do his homework and shotguns all parties irrespective of their possible guilt or innocence. The legal system needs to be overhauled.

In past years, very few, if any, engineers required insurance. There was a mutual understanding that the various parties would work together for the common goal. Not so today, the first questions are, Do you have insurance? How much? This attitude in the industry does not bode well for all concerned and is not doing society any good.

Question: Do you know of any solution to it?

R.J.: There are no easy solutions. However, it would help to prohibit contingency fees and require the losing party and his lawyer in the suit to pay all legal fees and costs. It would help to rework the Workmens Compensation program to make it more realistic and prohibit other suits which compensate for the program's failure to be filed.

Question: Looking for deep pockets?

R.J.: Yes. The collective deep pocket. They sue the kitchen consultant, the landscape architect, the architect, all the engineers, etc., because a construction worker falls off the roof. It's ridiculous.

Question: Are there any other things that concern you about looking forward that you'd like to see addressed or that you'd like us to be aware of?

R.J.: I would like to see more buildings constructed, to see a standard of care defined to the point that all engineers would be able to provide services for a complete project including proper analysis, their own drawings and construction supervision as required.

Question: What about research?

R.J.: Maybe this is wishful thinking. There needs to be a more simple methodology developed for an inelastic approach to design. I realize there are several groups working on the issue — the FEMA, the NEHRP, the Seismic Safety Commission and others. To be useable, the analysis must consider several practical limits. The geotechnical data is approximate and defined in terms of 10% exceedance in 50 or 100 years. The modeling of a real building is difficult and subject to individual judgements of the analysts. The materials are not uniform and vary in a wide spectrum. The construction is less than perfect. Other practical limits need to be addressed such as fees, peer review, etc.

Question: What about codes? Do you think they're pointing in the right direction or do you think they need an overhaul?

R.J.: I think they need an overhaul. Directions, I don't know. In the first place, they're too complicated and voluminous. No one really knows all of the nuances in the various sections of the code. That's why, unfortunately, larger offices tend to specialize. One group becomes an expert in steel design, another in concrete work and others in posttension design, wood buildings, etc. The design of concrete shear walls is a good example of changing code requirements through the years. The criteria first emphasized the strength of the concrete, then the steel reinforcing bars, later a combination of both. More recently, boundary elements have been an important addition, as have aspect ratios. Research and adequate testing programs may be an answer.

Question: How do you fund the research, say on a concrete shear wall, to do the test to form a basis for the design or reality check?

R.J.: I don't know. How do you fund any research these days with so many restrictions and demands for the money that can be spent. The engineering profession by and large has never been able to generate funds for the purpose. In the past, most research has been provided by the university or by the material interest.

There are some recent signs of change. The Federal Government through the FEMA has provided funding for new guidelines, including testing programs, analytical procedures and reliability studies. The Seismic Safety Commission, in the State of California, have also participated in funding needed research.

The CUREe, in some instances, has accepted funds for specific practical programs — a departure from pure research. The motivation may begin from a vested interest; none the less, it is serving a need and may solve some of the engineer's problems.

The structural engineer has also contributed to these research needs by contributing unknown thousands of hours of free consultation and review. A great number serve on City Building Department Committees and State Agencies advising and developing design requirements for the public good without any compensation. Whether this caliber of participation can be maintained in the years to come, only time will tell.

One state program with which I am familiar and in which I have had a part as an advisory member is the Strong Motion Instrumentation Program (SMIP).

The SMIP involves both research and data collection in the geotechnical area of earthquake engineering. The funding comes from a surcharge of 0·13 cents from every dollar spent on building projects in the state. The benefits and the cost are shared proportionally by all.

Question: What about design–build? Have you had good experience? Bad? What's your impression about that for the future?

R.J.: I hope it doesn't take the place of an independent engineer. There are some advantages in having a third party design or review the project acting as the interpreter of the contract between the builder and the owner. However, I believe there will be a greater number of design–build projects in the future than we have had in the past.

Question: Why do you think there's going to be more of it?

R.J.: The number of design–build projects will increase because building owners are engaging management consultants to prevent large overruns in the cost of new buildings. Usually management firms are contractors who have a knowledge of budgets and cost control. When used wisely, their expertise adds a necessary component to the design process. When used as a cost cutting tool, as was sometimes done in the construction of parking structures, the results, particularly demonstrated by the Northridge earthquake, proved to be flawed. Several parking structures were severely damaged and some collapsed from ground shaking.

Question: What's your experience with the peer review process?

R.J.: I think it's very worthwhile. It should start from the very beginning because if your scheme is flawed, then no matter what you do, you cannot get the most out of the process. It will catch any mistakes, but may not achieve the best engineering scheme.

One way of doing it is to use a process that works in stages: a preliminary stage to review the design development scheme; consultation, as required, as the design matures; and a final peer review when completed.

In fact, the design of all buildings would profit, whether peer reviewed or not, if the structural engineer were consulted by the architect before the design is cast in cement. With the new guidelines and code changes, it will be necessary to develop more symmetrical schemes with more redundancy and less torsion in the design. Shear walls should extend to the foundations avoiding undesirable discontinuous elements. The design team should work together from the beginning of the project.

Question: How do you see independent structural engineers such as your company dealing with overseas buildings in, for example, the Pacific Rim and outside the United States in, say, Mexico?

R.J.: The problems for our firm in working on overseas projects revolves around the cost of engineering. The salaries in many countries beyond the borders of the U.S. are much lower than what we have to pay in the States. As a consequence, many projects may be started and carried through schematic plans before turning over to overseas engineers for completion.

