Advanced Topics in the Science and Technology of Concrete
Indian Institute of Technology, Madras
Professor Mark Alexander Emeritus
University of Cape Town, South Africa
Interview with Prof Alexander

So we have Professor Mark Alexander from the University of Cape Town. He has visited often as and has been at IIT Madras very much. He got his PhD from the University of Witwatersrand and his renowned expert in many aspects related to concrete science and technology, he has done lot of work on aggregate for concrete, on aggregate reactivity and has spent a lot of time working on durability. And we are very grateful to him for pushing durability based design. He has been a strong proponent of design for durability and the need to do test at the site for ensuring that the durability is achieved as per the requirements not just restricting to test results.

He is a fellow of the University of Cape Town and also a fellow of RILEM. RILEM is a place where researchers meet, it is sort of an association that researchers in construction materials and structures and systems meet, work together to bring about new reports, bring about recommendations that could lead to standards. And Mark has been instrumental in many groups within RILEM and elsewhere that work together on durability of concrete. So we are very grateful to you, Mark that you are here.

And couple of things that come to mind to ask you is that it is very difficult to talk about durability to practicing engineers. And you have gone one step further and you have said that all structures should be tested after construction. Now it must have been uphill struggle. So what would be word of advice to those of us who want to emulate what you have done and take this all over the world?

Mark Alexander: Not all structures need to be tested. I think critical structures need to be tested. But anyway I think there are two things that we have to do. The first thing you got is good science. You have to be sure of your science. You have to do good, you have to be able to show that the work you do is robust, is supportable and it is also practical. Second thing is that you have to establish your credibility. And credibility is established by rubbing shoulders with people in the industry, by getting out to the forums where they meet, like meeting them on site by

discussing their concerns with them, by being involved in the problems of they are involved in so that they learn to trust you.

And then when you sought to talk with some voice of authority, and we found that it took us about 10 or 15 years to establish that credibility. Because when you first came along these young stout engineers, these researchers, they are trying to tell us how to do our job and they were very resistant. But after a while and with slow work done or the work done that we did, they slowly began to accept that what we were trying to do is actually improve concrete construction for everybody. But it did take quite a while. But I think we sort of got there now.

Professor: Well, Mark is a certified professional engineer. And that explains why you feel that there is a need to keep, talk to same language as the industry does. This often does not happen because lot of the university professors or the university researchers are confined to the university. And many of us may be aware to actually going to the field and we feel that that would dilute research when we come down to what can be actually used in the field. So what would you say to someone who feels that it is not necessary to dilute or to bring down the level of how you communicate your work to someone in the field.

Mark Alexander: I often had this dilemma. I asked myself, am I an academic first and an engineer second? Or am I an engineer first and an academic second? It depends exactly where I am but IITM I am an academic first. But when I am at home and I am on the construction site, I am an engineer first. So I think you have to learn to wear two hats at least. And I think one has to realize you get different kinds of engineers. Let just be honest about that you get engineers who, you get engineering scientists. People who delve into the science and make sense of it, and who have done extremely good work and help us to develop the knowledge and song that we need, and then you get engineering more the research practitioners, people who put that into practice.

And I think the danger here is that in the university environment, we have judged really on criteria that have very little to do with implementation, with practical carrying out, carrying over our work into the industry. And so we tend because of the environment within which we work to concentrate more on just developing the knowledge and living into that. But we always felt in our research unit that if we cannot make an impact on engineering practice, then what do we

really here for? So we have taken that as an absolute starting point from our work. We want to influence engineering practice.

And if you go and look at the sort of principles or the guiding principles behind our research unit, COMSIRU, that is clearly stated there. And so we make sure that we are interacting constantly with people in the industry. We have the men on our forums, we have the men on our seminars. We sit them annually and talk to them about progress and things like that. I am sure you do some of the things here but we have made that an absolute guiding principle of what we do.

Professor: Well, you have been acclaimed as an excellent teacher, educator and mentor. We find that in our usual curriculum you do not spend a lot of effort on materials durability that should be taught to all engineers. Often it is just an optional subject to learn about concrete. And durability is may be just a few lectures and some students might not even take it. And what they spend more time is the design aspects where we are looking at design for loads and serviceability. And durability sort of gets mentioned but there is not much emphasis. Do you think this should change and or has it changed enough?

Mark Alexander: Well, if we look at the problems we have in real construction, then it has not changed. That is the reality. And the problem is that the curriculum is always under pressure. Everybody in the department wants to strive for their place in the curriculum. They say my subject is much more important than your subject, so I need more lectures than you need. And somebody else says no, no but my subject is actually really important one. And of course, everybody's subject is important, that we have to acknowledge that.

So it is a question of where the department sees its role, I think that is one thing. Department must take a view on how this should be divided but also it is a question of whether we should be saying to our graduating students and to young practitioners, listen, what you have got now is just the ticket out the door. Now you can go and pretend to be an engineer. You are going to take a while to be one but you can at least pretend now. But you need lot more information and knowledge if you really want to become a good engineer and start inculcate the idea of continuing education, continuing development.

So lot of what we teach in durability only comes at the post-graduate level. I would love to have it in the under-graduate. But then I am fighting with the water engineers and the traffic engineers and the structural engineers and the management guys and that often does not lead to the best relationships. So we realized the need to, if you upload the curriculum at the post-graduate level and that is achieving quite well.

Professor: You have visited India several times. What would you advise us on the way forward and bringing about this change that we will require to design for longer durability and to get the most efficiency out of our materials?

Mark Alexander: Now that is a really big question. And I would not be very foolish to even begin to think when I answer that question, because I mean I have observed your construction just travelling around. I have not had much opportunity to sites, I have been on a few. But it seems to me and we have much the same problem in South Africa with being a developing country that we span the entire range of concrete application right from the very sophisticated stuff at the top end, right down to the very basic stuff.

But it is in that middle region that I think we can do a lot of work. And here I think we need to be developing the performance approaches. But it is also around just helping the average concrete contractor to do a good job on site. I mean understanding about how much water to put in the mix, how to mix it properly, how to compact, how to cure, just doing those things well. And I think if we just do those things well, we would make a huge impact on the quality of our construction.

Professor: Well, I first met Professor Mark Alexander in 1987 and at that time he was doing a lot of interesting work on aggregates. Now when we talk about aggregates today, we are finding that we are not having good aggregates. Places like south of India we generally expected that all aggregates available for concrete would be good. We are running out of such good aggregates in many parts of India. We are not getting good aggregates. So there could be a compulsion to use aggregates which are not really ideal in terms of mineralogy.

You have done a lot of work also on alkali aggregate reactivity. Now how do we prepare ourselves? And what should be we doing more of?

Mark Alexander: Well, we have the same problem. We used to have natural aggregates in the Western Cape. In the last 10 years we have run out of them mostly. So now we have moved to crust sands. So all of a sudden we have a shift and these are reactive aggregates. These are alkali reactive materials. So we have put more reactive material into the mix and I was a little bit surprised when the industry made this shift to crust aggregates without even thinking about whether this might influence alkali reactivity.

So we have recently been looking into that and it turns out that maybe it is not a problem. But we did know that until we looked into it. So I think the thing, I think what engineers do not appreciate is the huge role that aggregates play in concrete. And they occupy 70 percent at least usually of the concrete by volume. And therefore, their properties in many ways determine the properties of the concrete itself. We love to think about the pace, we love to think about cements and binders because they are the exciting stuff.

But the aggregates actually have a huge influence on the properties. So I guess what I am saying is that we should also not forget that aggregates are important part, understand how they work in concrete itself. We do aggregate testing but it is bringing them together into that composite material. And how does that work? And that is a debate that I had with many of the people here at IIT is what should we be testing. Should we be testing pests? Should we be testing motor? Should we be testing concretes? I think you test what you need to test for why you need to test it.

But I would make a general case for is that if it is all possible, let us test the real material because until we do that, we will not pick all the effects, in particular the effects of the aggregates.

Professor: Well, one last question. We have been talking about problems with concrete and we know we have difficulties with concrete. Then why concrete? Is concrete here to stay or will there be a new material that is going to replace concrete? What do you expect the future to hold?

Mark Alexander: I may not be here for that much long but to see what the future holds that I think this material concrete is just absolutely essential to modern life, to development of the planet. What we have to do is do it a lot better because we waste a lot of it, we do not use it very sustainably. But to be honest what are the materials is there that can fulfill those. I am sure there

will be many developments. This is immense change, at least they will change in ways that we will have to learn to manage. As we run out of aggregates, what can we use in their place?

And many of these things will change but ultimately if one thinks that the developmental needs of places like India, of Africa which are the continents that are rising at the moment, this is the material that is going to have to take us through the next certainly several decades. And then who knows, I will not be around to worry about that but some of you will.