

*The story of Prince Riyal*

*It was somewhere in the seventies when the Saudi Government decided to make an end to Iran's claim on the island of Bahrain that lays there just in front of their giant oil fields. They wanted the Iranians to come no nearer than Bandar Abbas. That is very simple in that part of the world - just connect the island with the main land and the claim is off the table. You have only to be the first and the island has to agree and Bahrain was only too happy to agree. So the Saudis decided to be first to build a bridge - money no problem - some 25 kilometres long, that is about 15.5 miles, costs some 5 billion on in 2009 \$. But this is an extremely harsh environment to build such a bridge, with very high temperatures and water with very high salt content. It is unbelievable, but the first design was in steel that would rust in no time – let's say three years bridge gone. So, in the end it was decided for concrete and that is when I got involved, having some years experience in that area. I first studied the design and found that the concrete that was specified was not particularly durable – I calculated that the first kilometre of the bridge would collapse due to chloride attack before the last kilometre was to be finished some three years later. The design needed some rather radical changes - simplicity really but that's always most difficult to explain - and I worked these out. When we discussed this with the Saudis they did not quite understand the problem – they were really confused and this did confuse me as well. I tried to explain and explain, but then it came out that the word durability did not exist in Arabic – yet. For them everything becomes sand in the end - the rule of the desert – and indeed it is difficult to disagree with when you have been wandering around over there for some time. But then they got excited and wanted the bridge to start to become sand not for thirty years – at the earliest. Now I had a problem. I tried to explain that the dilemma*

*was not the concrete but the steel reinforcement that was going to rust because of the high chloride content of the very warm water. The concrete was essentially only there to protect the steel but it is very difficult to make the concrete so dense that chlorides cannot penetrate. Of course it could be done but then very special measures had to be taken and this might cost one or two riyals. The next day a Prince came to the rescue. He had heard about these one or two riyals and had contacted a friend who had a friend and so on – the Americans had a solution as always and this friend of the friend was already on the plane to Riyadh. The second friend arrived the next day or so and presented a wonderful proposal – rustproof steel. I told him that was wood. Some laughing – no sir we are going to provide the steel bars with a plastic coating. Bingo, now I had two problems. They had already made up their mind and undoubtedly the bank account for the one or two riyals had already been arranged for. I had never thought of it but realized immediately that wooden reinforcement was to be preferred. So, I started very carefully to explain that huge reinforcement cages had to be made and that these had to be placed in the formwork, that concrete had to be poured with pumps and vibrating needles and so on. They listened politely, but what was the problem. All I wanted to explain is that it is essentially impossible to avoid that the plastic layer gets damaged. So what? These damaged areas will contact each other and then we have a bridge full of galvanic cells and that will rust like hell. The prince and his friend got a bit nervous but then the American came with a solution - repair and that was so easy and that he could also deliver. That was quite a relief, riyal number three. I did not give up yet and argued that the plasticized bars had to be wired together and damage could not be avoided there. Now I thought I had an argument but the American got excited – he would also deliver coated wire – riyal number four. By now I knew I had to shut up, you can't argue with somebody who is*

*convinced he has hit the jackpot. We agreed to meet again the next day. In the evening we discussed the problem and decided that this had to be stopped and a strategy had to be worked out, what I did. The next day it was agreed that I would go to Baltimore Maryland to visit the magic coating plant in ten days time and a visit would also be arranged to see a similar bridge – a bit shorter – where such coating was applied. First I went to see the bridge that was in Chicago and was quite a surprise and I understand now why there are so many problems with bridges in the US. When I looked into the formwork I noticed that the steel bars were plasticized in longitudinal direction but transversal it was plain steel. This would provide no extra protection whatsoever and then I was told that they had only money for one direction to be coated. I wanted to ask whether they were going to apply the coating afterwards, but thought better not. I was informed that the coated steel was quite expensive but that I knew already. That same evening I was on the plane, and the next morning in a cab to the factory somewhere outside Baltimore. It took the cabdriver about two hours to ask and find out where the hell this place was hidden but then I was there - these were pre-handly times - and indeed it was a bit in the middle of nowhere. But in the US also small offices have always some very big chairs available and we sat down – there were three vice presidents already convinced that I only passed by to sign the contract. I told them that we would like to purchase the coated steel but our engineers – that was me but they did not know – had three simple questions that needed to be answered because these were critical for the design. That's always the trick – three simple questions. I handed over a document – on official paper of the Saudi ministry of Commerce that I had always available - that the engineers had worked out. The first question: how strong was the bonding between the coating and the steel? Second question: how strong was the bonding between the plastic coating and the concrete and the third question:*

*how would the strength of these bonds be influenced by the differences in thermal expansion of the plastic? Reinforced concrete – a composite by the way – is only possible because the concrete and the steel have almost similar thermal expansion. I knew that there were no answers to these questions available at that time and research would take at least two years and cost quite some money. But they did not realize this and would hand over the questions to their engineers who happened to be all in the field – we apologize. Now I asked to see the facility. I wanted to see the coating process but was more interested to see whether there was enough capacity – it was quite a bridge and the hall I had seen behind the office seemed rather small. You are not going to believe this one either. I travelled half the world to find myself in this remote place somewhere at the east coast of the US and now I was told by these three vice presidents that was unfortunately not possible because it was a secret process, intellectual property, patent pending and so on. Now I was flabbergasted. Whatever, they never came up with the answers, we never asked and we never used plastic coated reinforcement. And the bridge? I am proud to tell you that I fulfilled on my promise of thirty years at least. The bridge is still there and in very good condition, that is for sure the only concrete structure from that time that lasted that long. So when you happen to be in Dhahran or Al-Khobar one day and you want a nice cold beer, take the non-plastic composite King Faisal Bridge to Bahrain. Enjoy.*

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