The Personal Structural System

BY THOMAS E. FORSBERG, P.E.

One engineer's perspective on how a technical background made the choice between repair and replacement a little easier.

I'M NEARING THE 20-YEAR MARK in my career as a structural engineer: still a little "green" by some standards, and a dinosaur by others. During that time I've had the good fortune to work on many projects involving the science of building forensics: determining the cause of a problem and figuring out how to fix it. I'm thankful for these opportunities because I strongly believe that understanding why failures occur makes one a better designer. You develop a unique approach to problem solving that is useful in all aspects of life.

For me, it was a problem I've been working to resolve almost as long as I've been in this profession. A structural problem, for sure, but not the "typical" kind. There was no building to look at, no cracks to observe, no leaks to chase down, no old drawings to review, no facilities staff to consult, and no calculations to check.

If you were to ponder whether similarities exist between buildings and the human body, you would not be wrong to conclude that there are none. Buildings are inanimate objects, consisting of man-made materials (mostly), and not prone to biological reproduction. Consider the opposing view, and comparison is quite simple. Human beings, like buildings, are made of systems: architectural, mechanical, electrical, plumbing, conveyance, and, of course, structural. All systems must work in concert to ensure the performance of the whole. When a system, or portion thereof, breaks down, it must be repaired or replaced, or suffer the consequences of doing neither.

In my case, I had a defective structural element: my left hip. Actually, they're both bad, but the left side was much more so. As a youngster I was diagnosed with "slipped capital femoral epiphysis" where the hip joint ball separates from the upper end of the femur. Painful. Technologically advanced as it was in the 1970s, corrective surgery addressed the immediate problem, but was unable to provide a lifetime solution.

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Fast-forward to the mid-1990s after years of wear-and-tear, and the pain returned. I learned that the corrective surgery essentially stunted future growth. Lacking this early abnormality, I probably would have been two inches taller! In normal hips the joint ball is round, like a golf ball, albeit undimpled. Mine are more like rough-surfaced eggs.

▲ As-built image of prosthetic hip installation.

Understanding support constraints (pinned, fixed, etc.) is an early academic lesson for budding structural engineers. Changing constraints has a profound impact on individual members and overall systems. And further academic advancement leads to the knowledge that varying degrees of fixity exist between the pinned/fixed extremes, to wit, partially restrained connections. My hip joints, intended to function as pins, were now partially restrained. And the degree of restraint was steadily increasing with each passing year.

As a human being, the decision to voluntarily put yourself "under the knife" is difficult to make. Regardless of knowing that relief was a surgical procedure away, my natural reaction was to delay as long as possible. That's probably because I feared, more than anything else, that I would lose my sanity during a six- to eight-week hiatus.

As an engineer, my logical approach was resolution through minimally invasive procedures: repair instead of replace. Unfortunately, a long program of pharmaceutical aids, exercise, and acupuncture did very little. Relief came in short spurts, and I realized that replacement was the only viable option.

After consultations with my surgeon and an education on the procedure and recovery, I finally made my decision. Though having exhausted all other possibilities of relief, it wasn't much of a decision so much as a mere choice between replacing it and moving on, or doing nothing and living with the consequences. From an engineer's perspective, the former was the only logical choice.

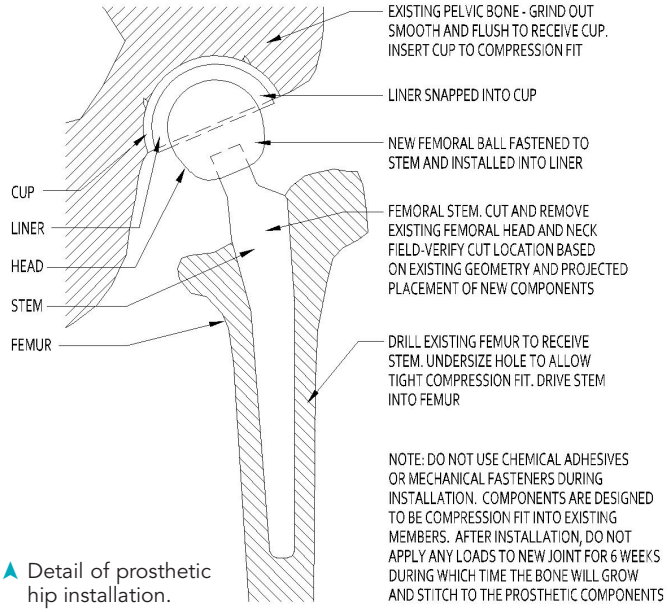
As of October 27, 2010, I have a new hip. Or in engineer-

ing parlance, a new pin joint, free to rotate without fixity or friction, yet sufficiently stable to resist translation along all axes. This foreign object is now a permanent part of my structural system. It will set off every metal detector I ever pass through, and I am a lifetime, card-carrying member of the prosthetic implant club.

Since I have no command of medical jargon, I can only offer this very simple explanation of the hip replacement procedure: using a saw, my orthopedic surgeon cut me in half and then put me back together, just like the old trick in every magician's repertoire. But this is real and it sounds awfully foreboding by this definition. Shown here is my graphic interpretation of this procedure, presented in a format that readers of this magazine will comprehend.

For many years I've known that this change was inevitable. My hope was to prolong it at least until I hit mid-century age. Though I didn't make it that far, I have every confidence that this piece of hardware will last me a very long time. Not many years ago, hip prosthetics were made and implanted in such a way that if they ever wore out, removal and replacement was very difficult. Advancements in technology now allow the cup and stem to remain permanent fixtures. The "wearing" parts, the liner and the ball, can be removed and replaced in a less invasive manner should the need ever arise. Even so, I'm very hopeful that it never will.

Several months have now passed since my surgery, and all is well. Though my right hip is destined for the same fate, I look forward to having it replaced. I already have a proven history showing that temporary relief methods are not sustainable, and that serves to satisfy my engineering curiosity and logic.



▲ Detail of prosthetic hip installation.

I would like to take this opportunity to thank my surgeon, Dr. Paul Lyet, of the Lancaster Orthopedic Group, his exceptional staff, and all the folks at Lancaster General Hospital who literally had a hand in my restoration. And, though not produced by an AISC-certified fabricator, I owe a nod of gratitude to the steel industry for my titanium and cobalt-chromium parts. Mostly, I'd like to thank my home-care nurse, Amy (my wife), for taking such good care of me during my convalescence. MSC