The natures of bone mechanics and traditional implant materials produce a recurring problem for patients of total hip arthroplasty (THA): The bone is “shielded” from its typical loading. In the present work, a methodology is presented which creates an innovative design for the femoral component of hip implants. Internal geometry was optimized in order to better match implanted scenarios with healthy, intact bone conditions. The discovered design reduces extreme changes in stresses within remnant bone such that the implant will remain implanted for greater periods of time without additional surgical attention.