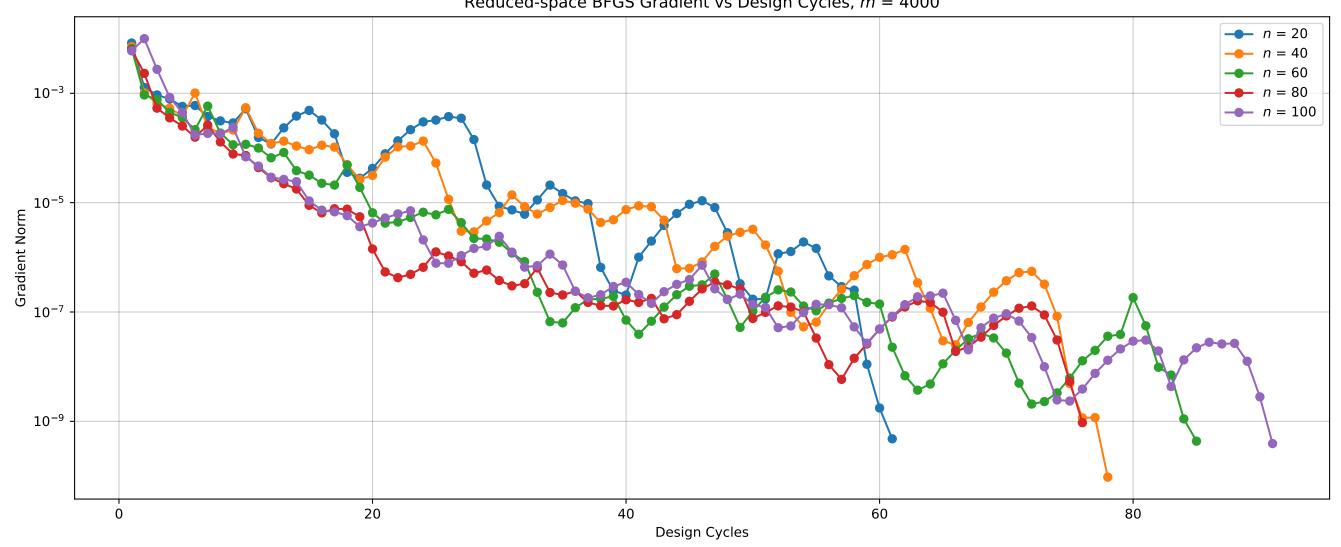
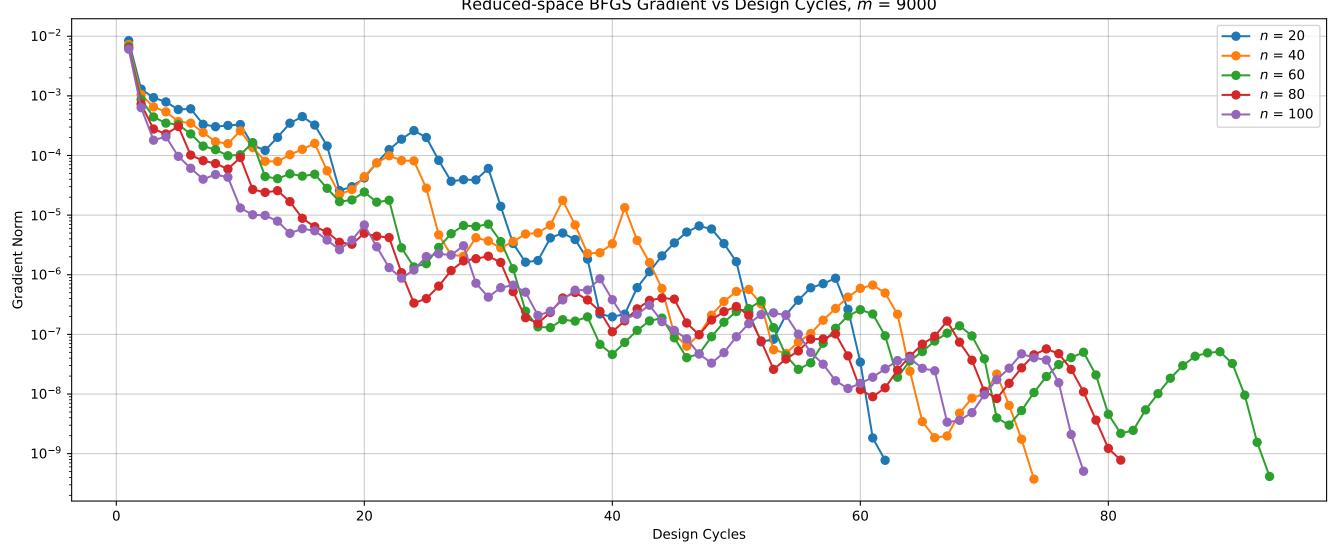
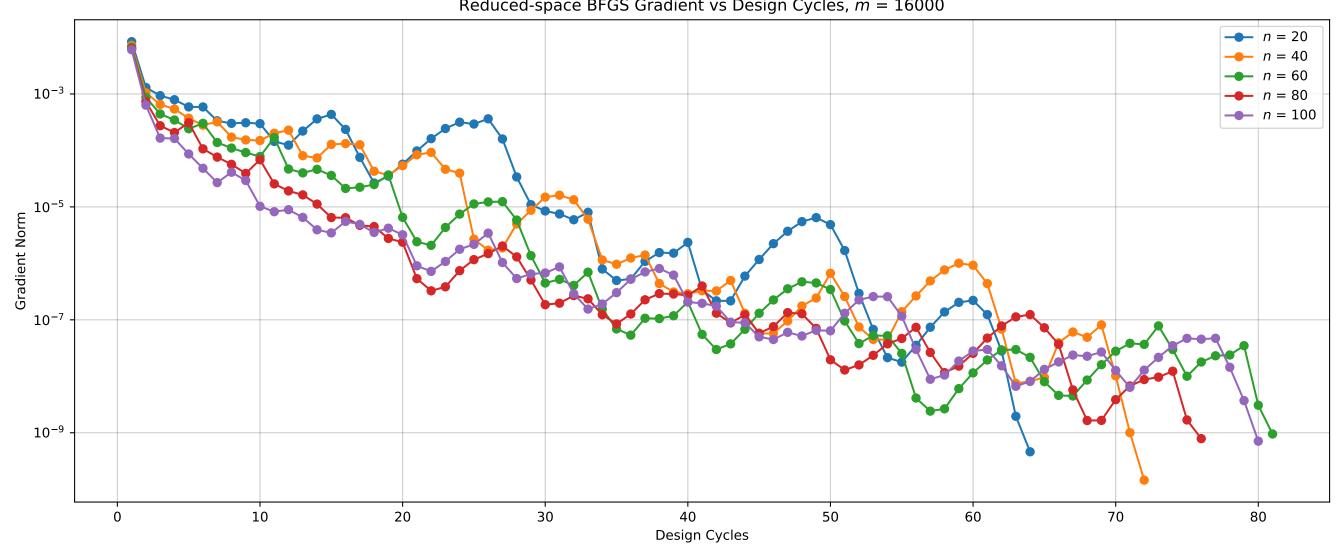
Reduced-space BFGS Gradient vs Design Cycles, m = 4000



Reduced-space BFGS Gradient vs Design Cycles, m = 9000



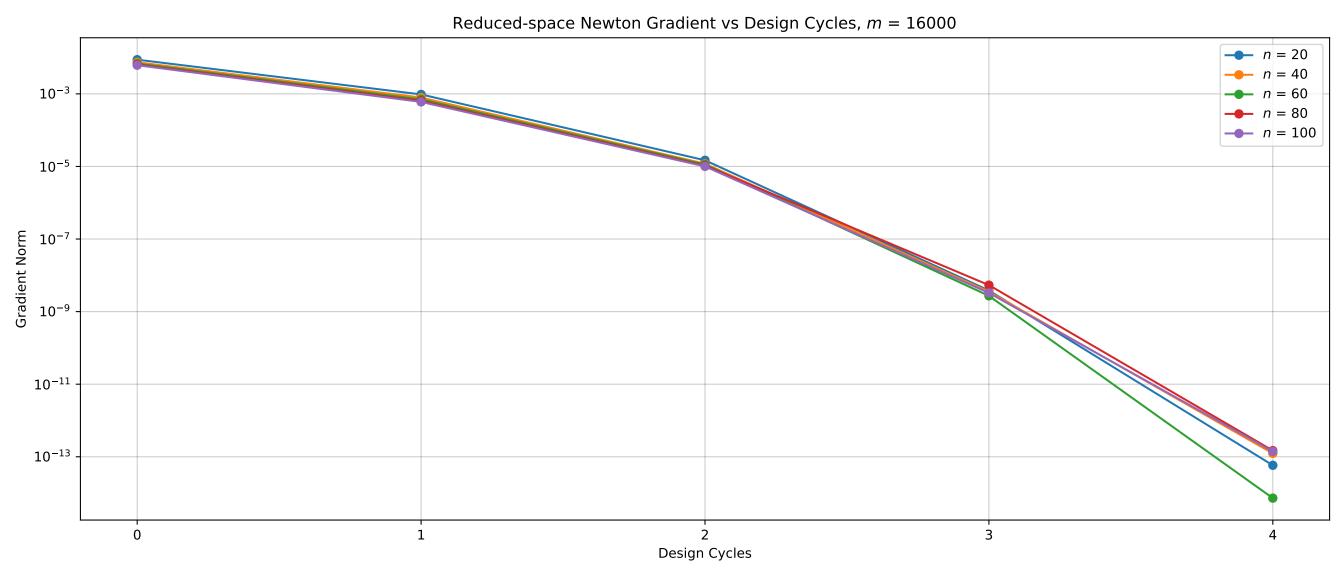
Reduced-space BFGS Gradient vs Design Cycles, m = 16000



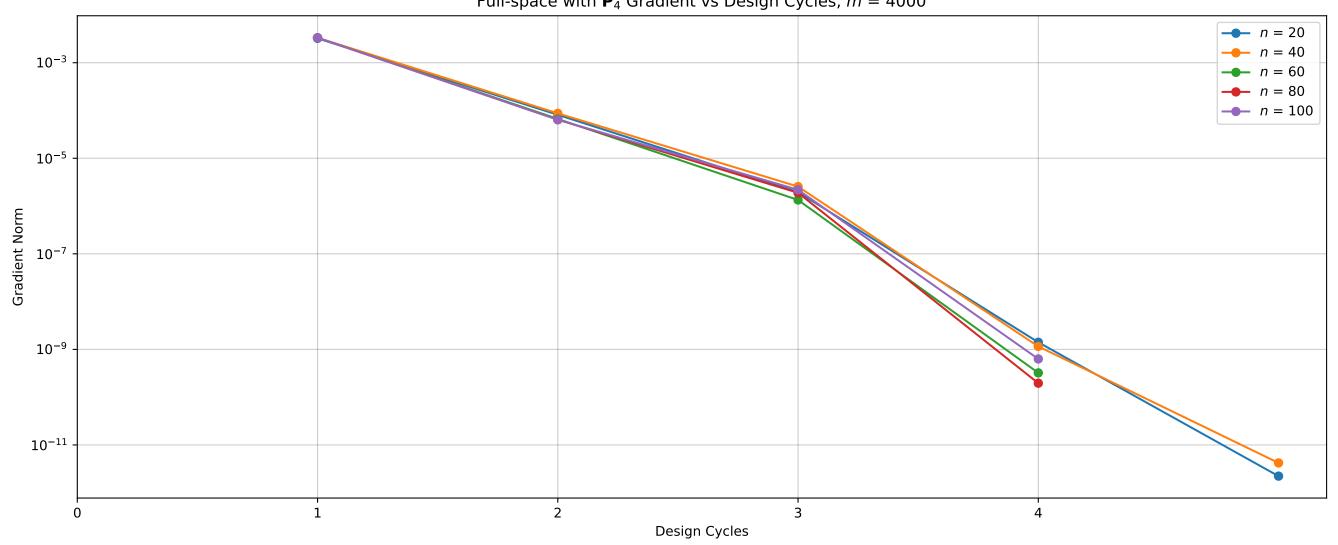
Reduced-space Newton Gradient vs Design Cycles, m = 4000--- n = 20--- n = 40--- n = 6010-3 --- n = 80--- n = 10010-5 **Gradient Norm** 10^{-7} 10^{-9} 10^{-11} Design Cycles

Reduced-space Newton Gradient vs Design Cycles, m = 9000--- n = 2010-2 --- n = 40--- n = 60--- n = 80--- n = 100 10^{-4} 10^{-6} **Gradient Norm** 10-8 10^{-10} 10^{-12}

Design Cycles



Full-space with \mathbf{P}_4 Gradient vs Design Cycles, m = 4000



Full-space with \mathbf{P}_4 Gradient vs Design Cycles, m = 9000--- n = 20--- n = 40 10^{-3} --- n = 60-- n = 80--- n = 100 10^{-5} **Gradient Norm** 10^{-7} 10^{-9} 10^{-11} Design Cycles

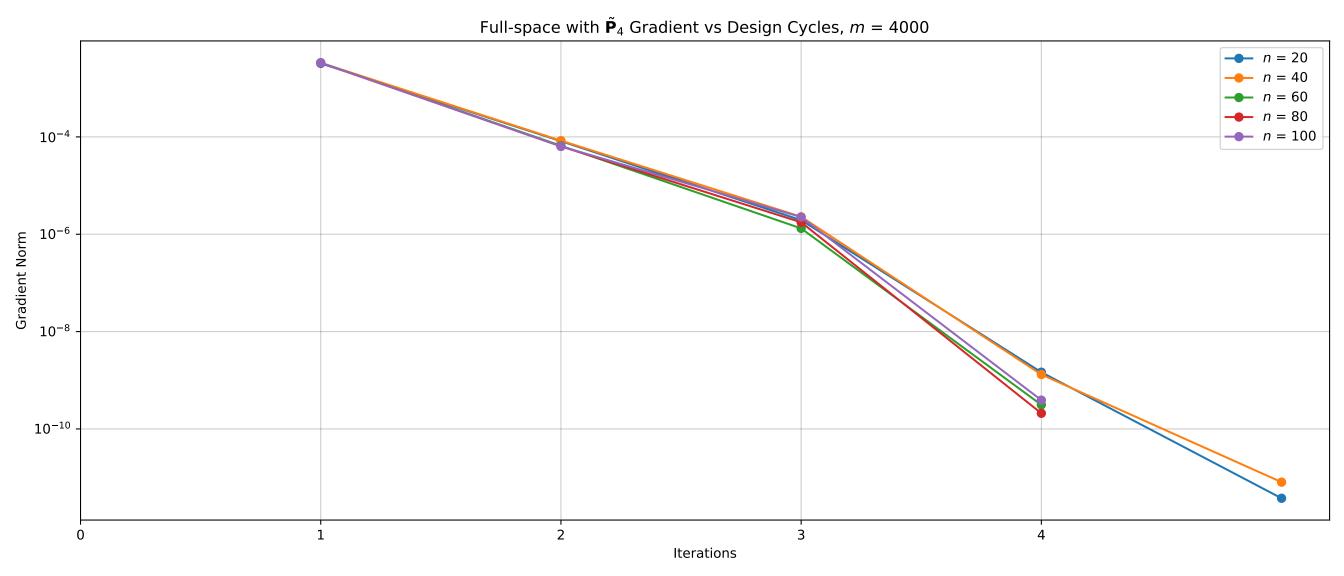
Full-space with \mathbf{P}_4 Gradient vs Design Cycles, m=16000--- n = 20--- n = 40 10^{-3} --- n = 60- n = 80--- n = 100 10^{-5} **Gradient Norm** 10^{-7} 10^{-9} 10^{-11} Design Cycles

Full-space with \mathbf{P}_2 Gradient vs Design Cycles, m = 4000--- n = 20--- n = 4010⁻³ --- n = 60-- n = 80--- n = 10010⁻⁵ **Gradient Norm** 10^{-7} 10^{-9} 10^{-11}

Design Cycles

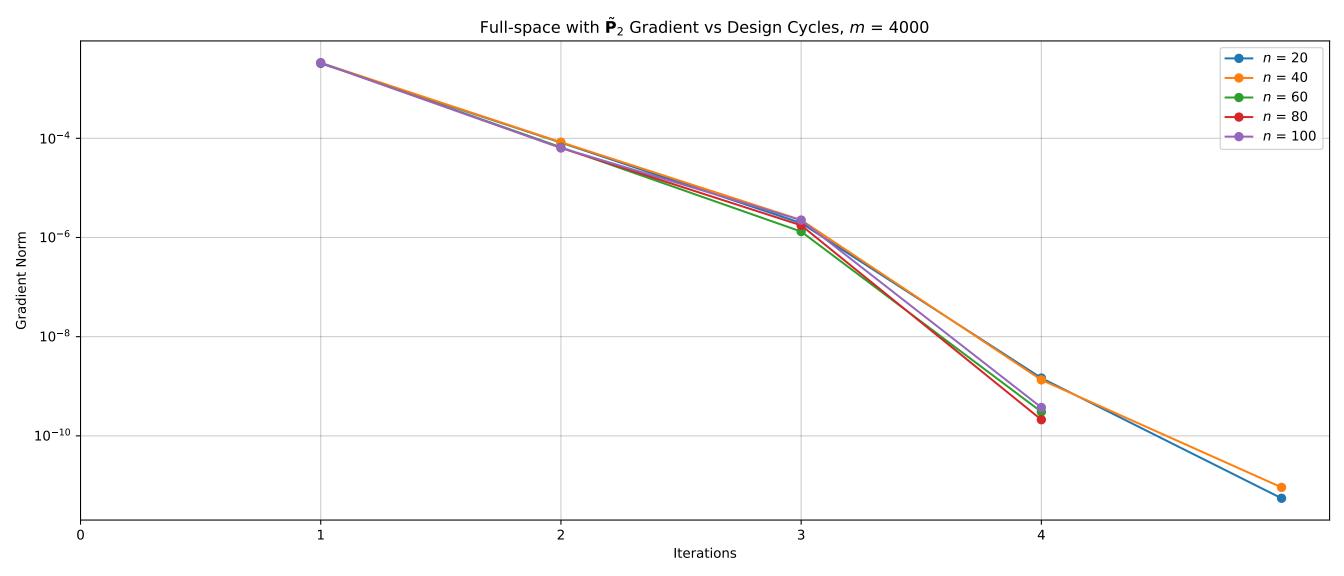
Full-space with \mathbf{P}_2 Gradient vs Design Cycles, m = 9000--- n = 20--- n = 4010⁻³ --- n = 60--- n = 80--- n = 10010⁻⁵ **Gradient Norm** 10^{-7} 10^{-9} 10^{-11} Design Cycles

Full-space with P_2 Gradient vs Design Cycles, m = 16000 10^{-2} --- n = 20-- n = 40--- n = 60--- n = 80--- n = 100 10^{-4} Gradient Norm 10^{-8} 10^{-10} Design Cycles



Full-space with $\tilde{\mathbf{P}}_4$ Gradient vs Design Cycles, m=9000 10^{-2} - n = 80--- n = 100 10^{-4} **Gradient Norm** 10^{-8} 10^{-10} Iterations

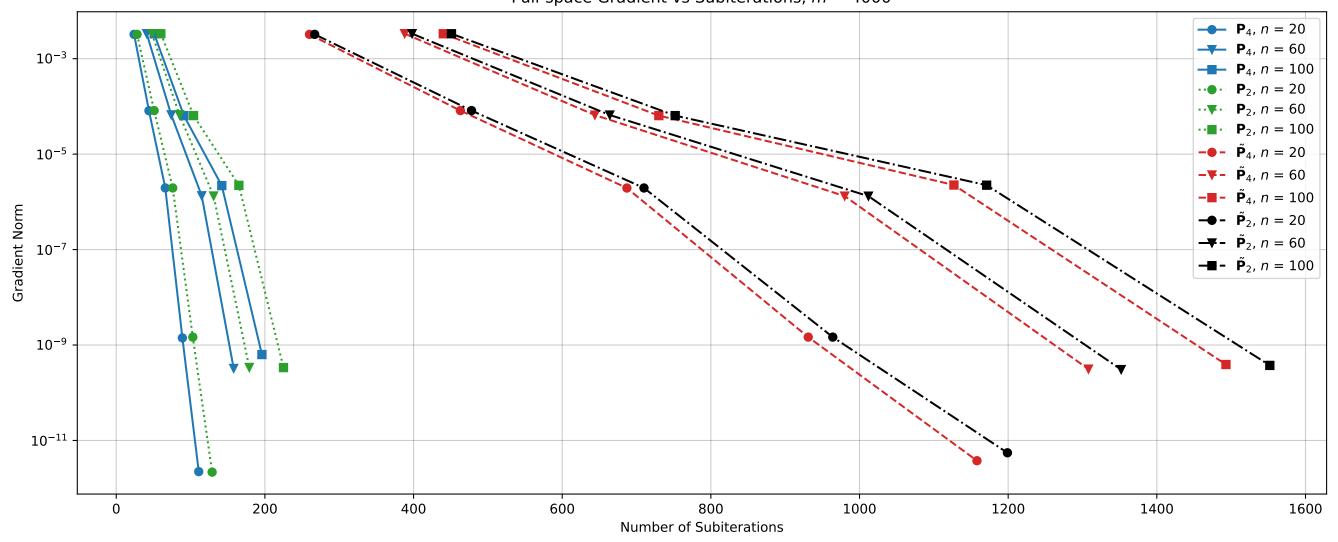
Full-space with $\tilde{\mathbf{P}}_4$ Gradient vs Design Cycles, m=16000 10^{-2} --- n = 20-- n = 80--- n = 100 10^{-4} Gradient Norm 10⁻⁸ 10^{-10} Iterations



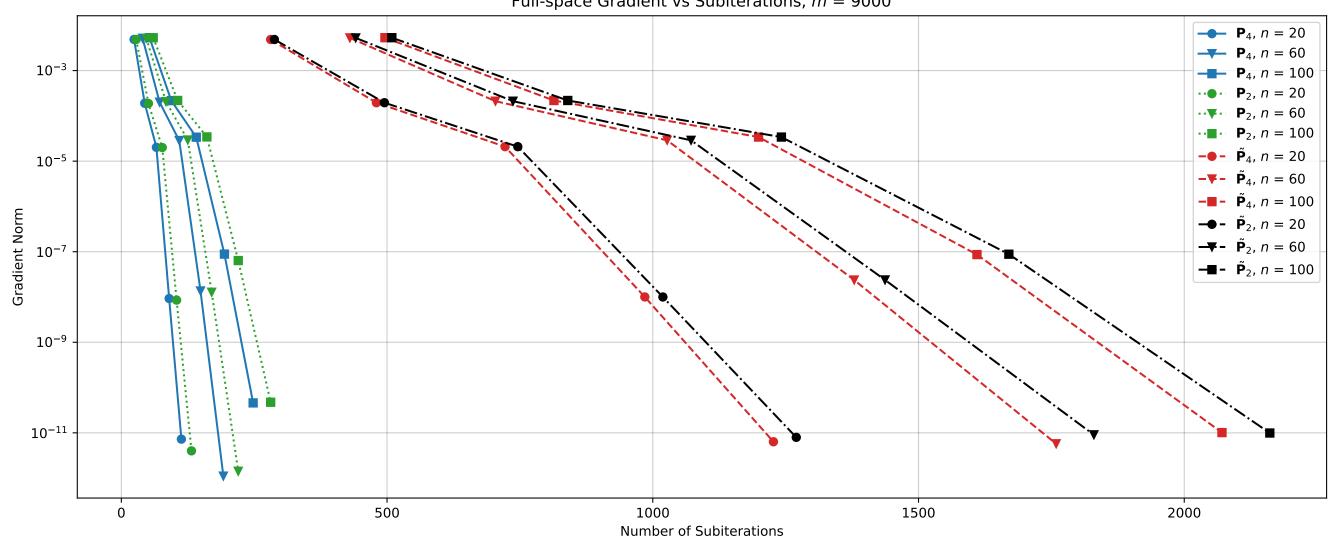
Full-space with $\tilde{\mathbf{P}}_2$ Gradient vs Design Cycles, m=9000 10^{-2} - n = 80--- n = 100 10^{-4} **Gradient Norm** 10^{-6} 10^{-8} 10^{-10} Iterations

Full-space with $\tilde{\mathbf{P}}_2$ Gradient vs Design Cycles, m=16000 10^{-2} - n = 80--- n = 100 10^{-4} **Gradient Norm** 10^{-6} 10^{-8} 10^{-10} Iterations

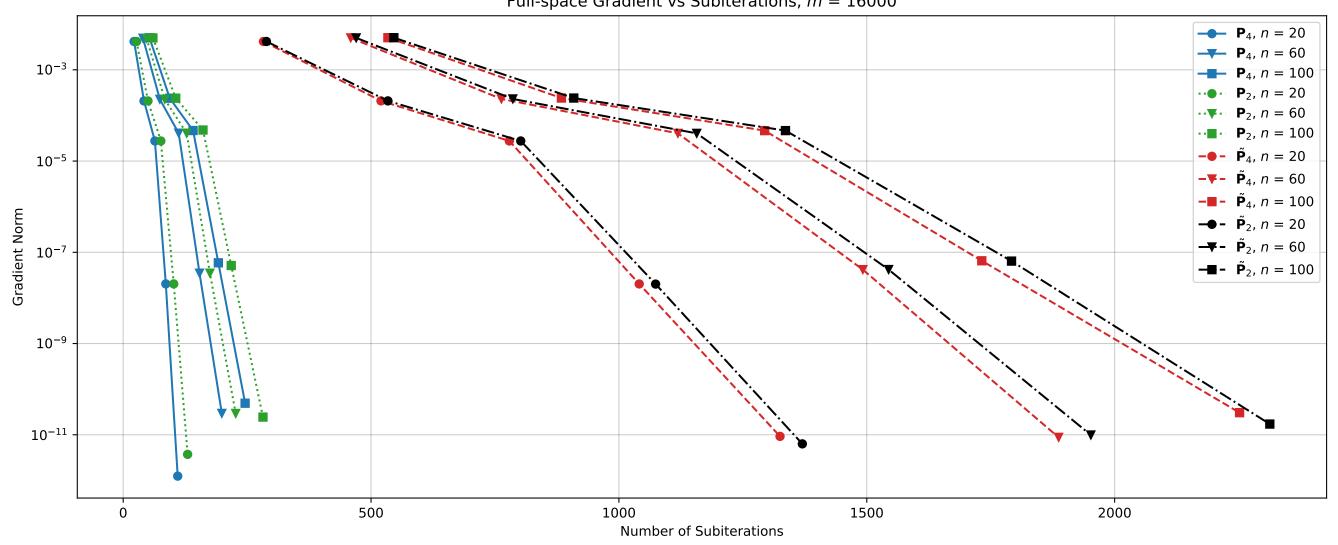
Full-space Gradient vs Subiterations, m = 4000

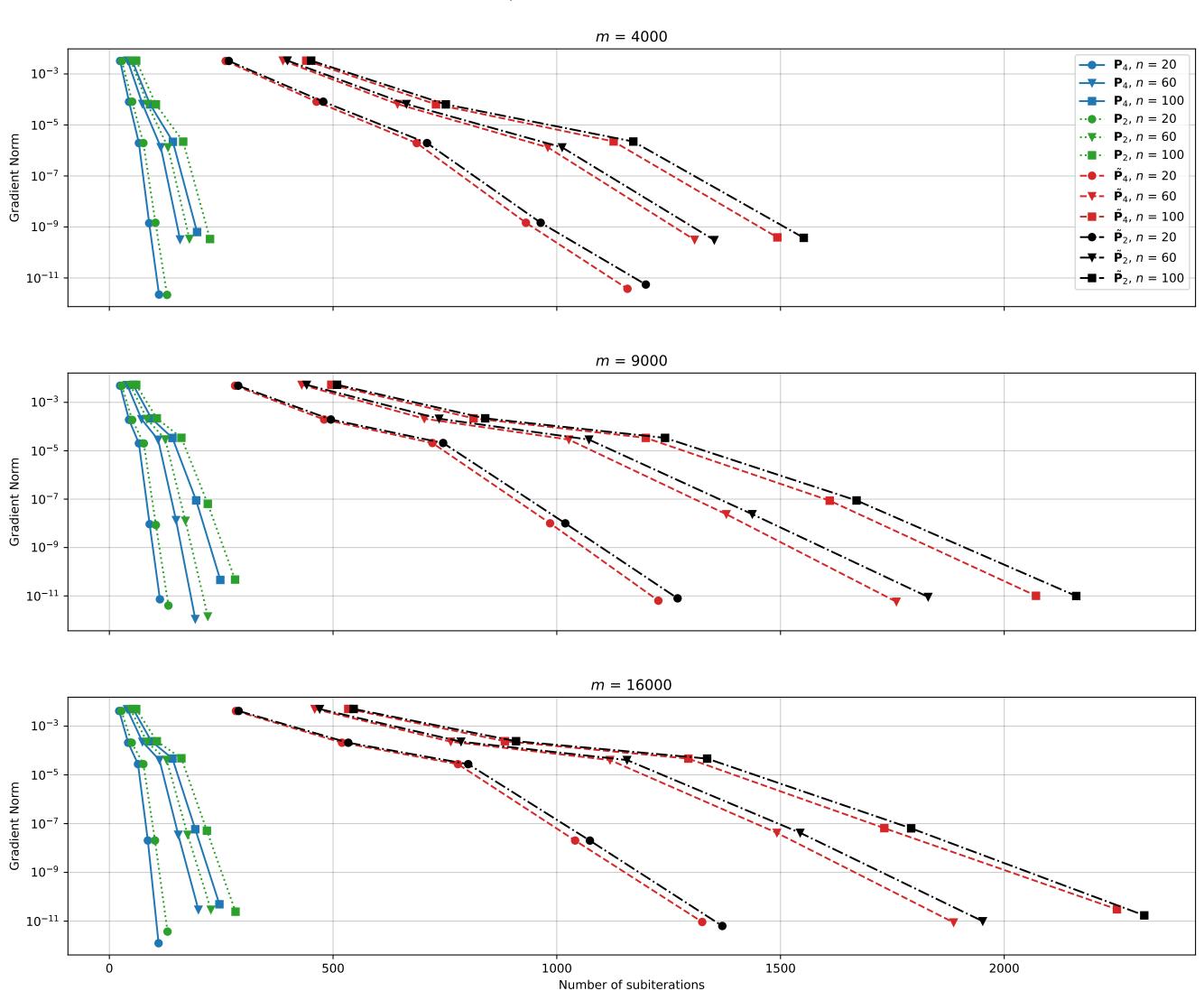


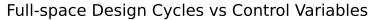
Full-space Gradient vs Subiterations, m = 9000

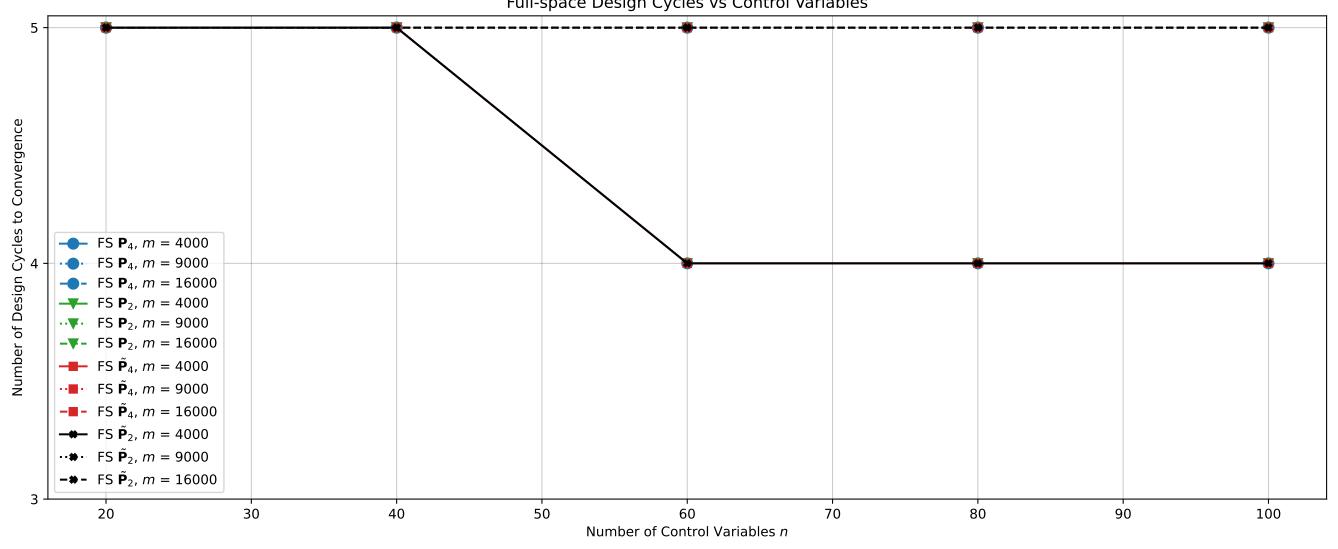


Full-space Gradient vs Subiterations, m = 16000

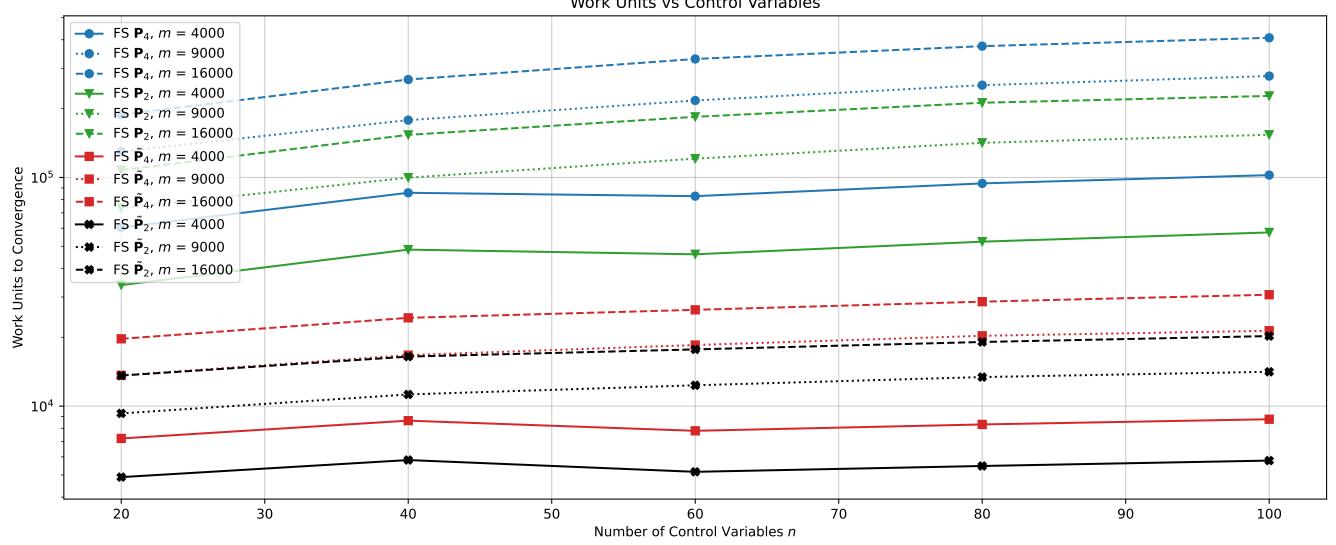




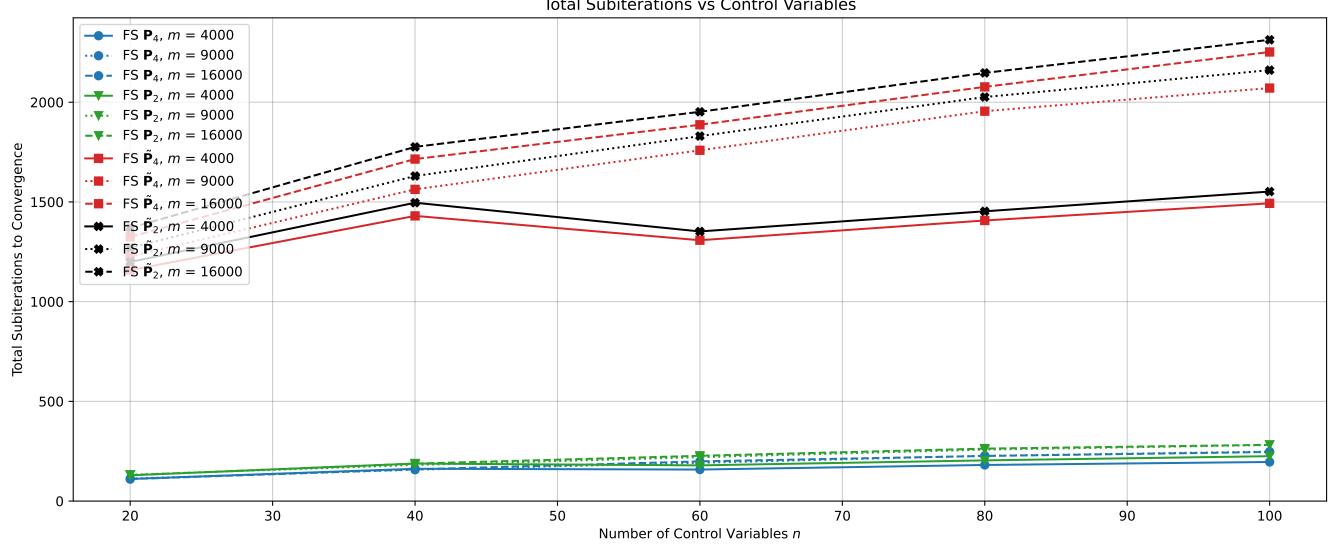


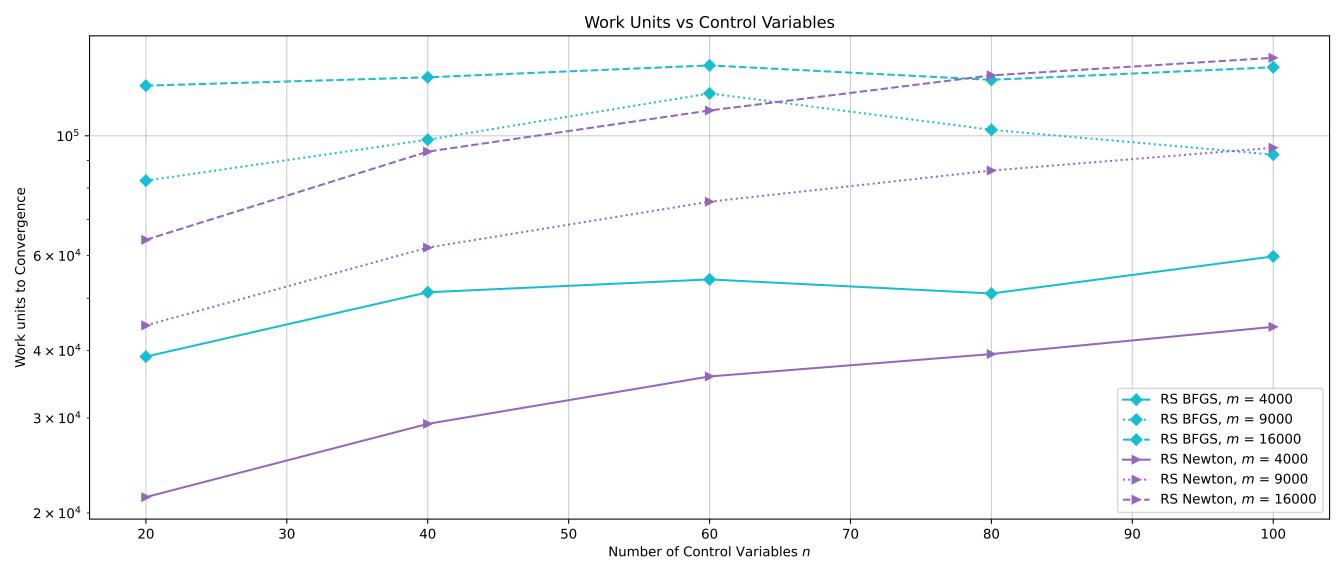


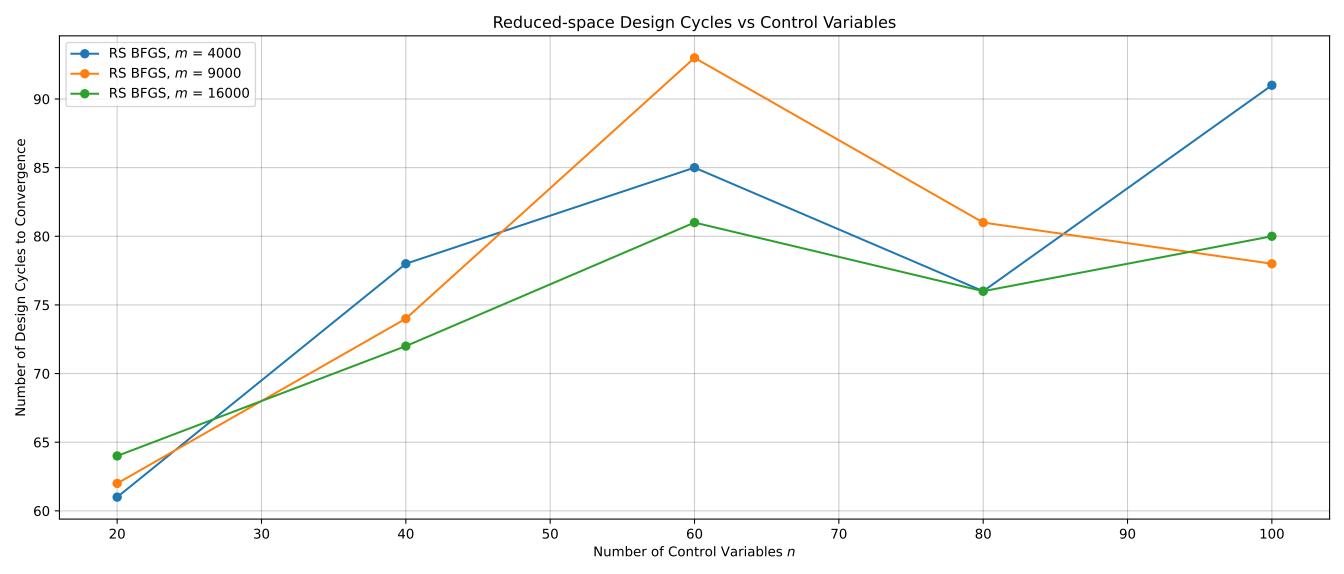
Work Units vs Control Variables

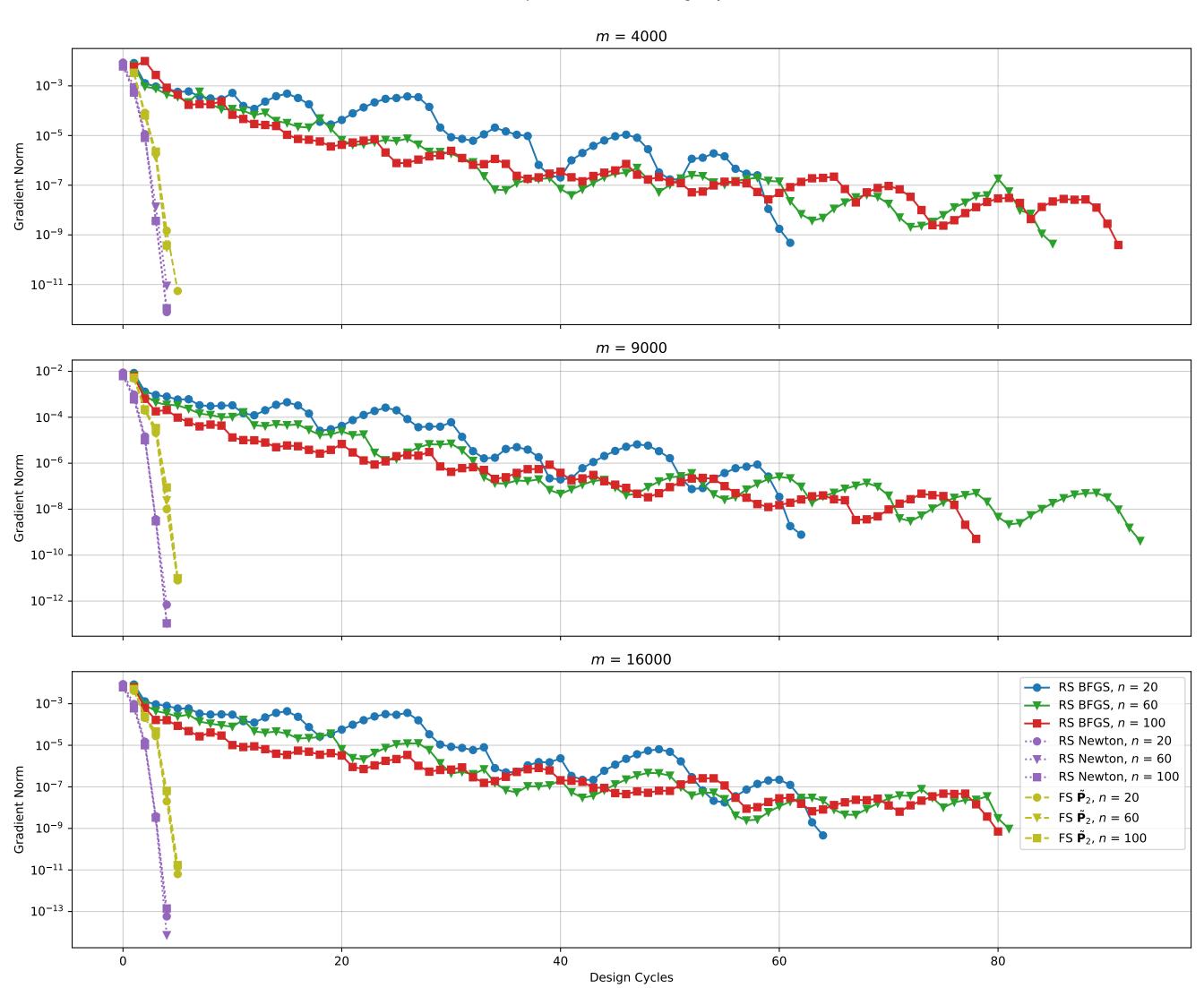


Total Subiterations vs Control Variables

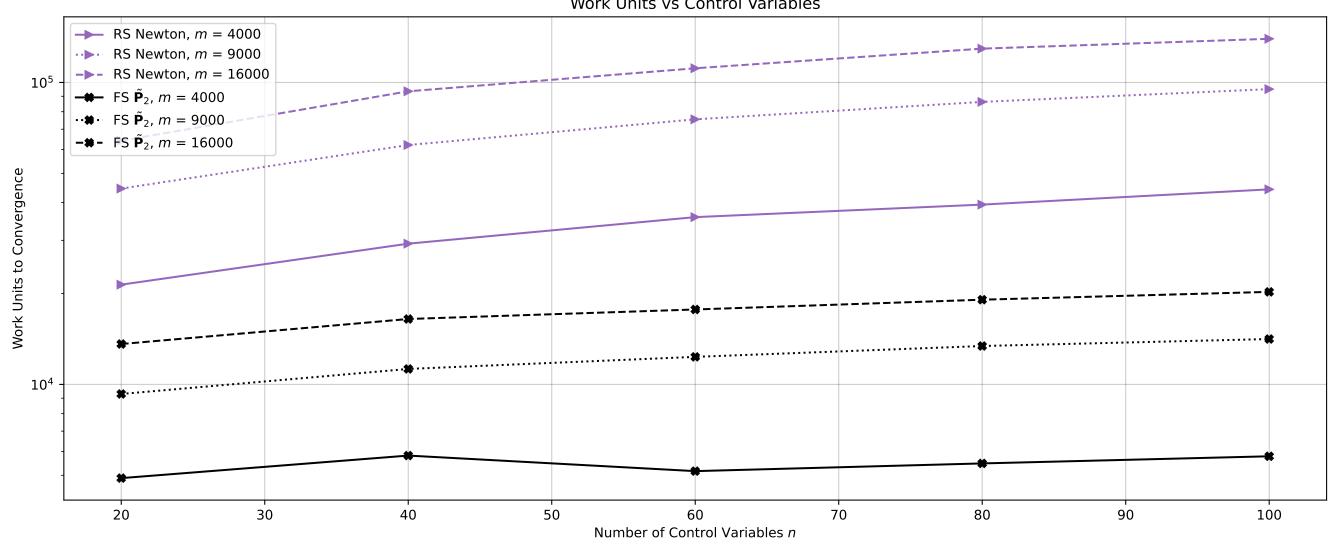




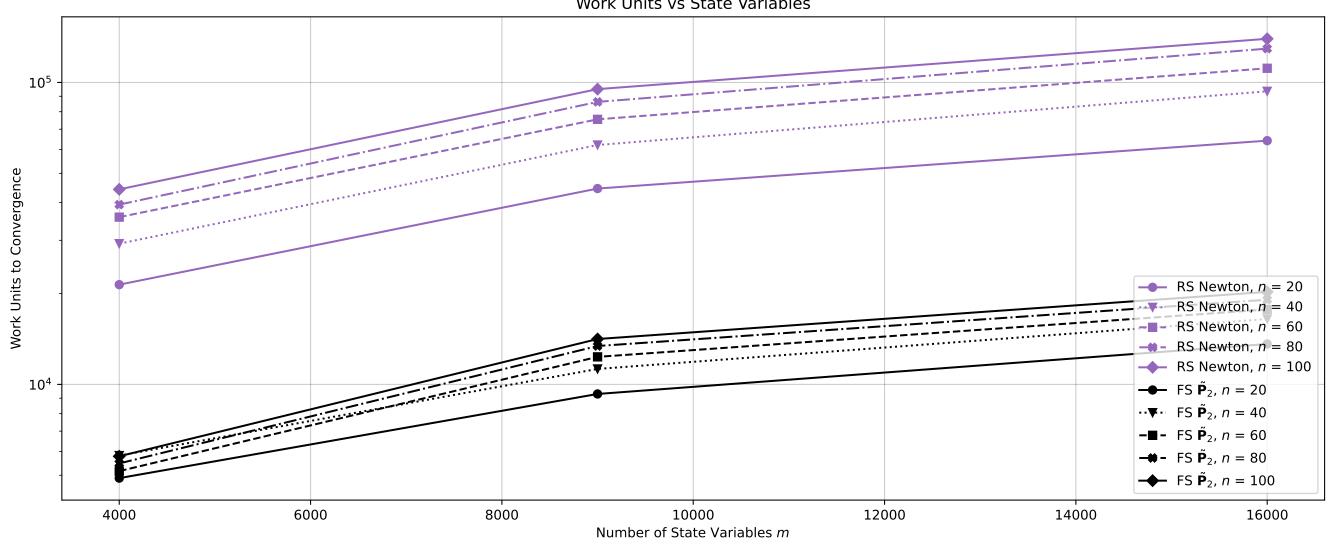




Work Units vs Control Variables







Gradient Norm vs Design Cycles m = 4000

