Colosseum Sensitivity Analysis, Efficiency Factors and Frictional Coefficients

Efficiency factors		Frictional Coefficients							
		Onsite: 0.01; Onsite 0.03		Onsite: 0.1; Onsite 0.3		Offsite: 0.4; Onsite 0.6		Offsite: 0.8; Onsite 0.99	
		Humans	Oxen	Humans	Oxen	Humans	Oxen	Humans	Oxen
7% (14 x surplus kcal requirement)	Headcount	1,213.90	144.54	2,896.45	1,445.44	6,211.40	5,781.77	10,593.10	11,563.53
	Kilocalories	6,306,275,242.27	1,607,638,704.78	14,811,410,397.28	16,076,387,047.78	31,188,106,491.08	64,305,548,191.13	52,824,138,709.09	128,611,096,382.25
	Square km	11.63	1.67	27.30	16.75	57.49	66.99	97.38	133.99
25% (4 x surplus kcal requirement)	Headcount	903.86	144.54	1,849.19	1,445.44	4,345.01	5,781.77	7,661.84	11,563.53
	Kilocalories	4,687,682,949.25	1,607,638,704.78	9,344,111,325.47	16,076,387,047.78	21,444,466,553.94	64,305,548,191.13	37,521,255,647.03	128,611,096,382.25
	Square km	8.64	1.67	17.23	16.75	39.53	66.99	69.17	133.99
50% (2 x surplus kcal requirement)	Headcount	841.85	144.54	1,639.74	1,445.44	3,971.73	5,781.77	7,075.59	11,563.53
	Kilocalories	4,363,964,490.64	1,607,638,704.78	8,250,651,511.10	16,076,387,047.78	19,495,738,566.51	64,305,548,191.13	34,460,679,034.62	128,611,096,382.25
	Square km	8.04	1.67	15.21	16.75	35.94	66.99	63.53	133.99

A range of sliding and rolling frictional coefficients for various materials can be found at: http://www.roymech.co.uk/Useful_Tables/Tribology/co_of_frict.htm#coef. Based on the sliding coefficients for various materials found here, I think our choice of 0.1 and 0.3 sliding coefficients for off-site and on-site work is reasonable though conservative. However, the page also outlines standard rolling coefficients which are several orders of magnitude less than the ones that we have used. The rolling coefficient means something quite different than the sliding coefficient, though, and I don't think a direct comparison in the context of our approach makes much sense. The rolling coefficients are dependent on wheel size and the weight of the load. To use the rolling coefficients, we would have to use a different system of equations based on radial rather than transverse motion (the understanding of which entails learning a couple of chapters in a first year physics textbook).

I've run the numbers using a range of efficiency factors. We've used the 50% (factor of 2) efficiency rate in our calculations, but my comparison of our physical approach to DeLaine's approach for the foundation yielded an implicit efficiency rate of 7% (factor of 14).