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Building magnetic sand castles GANGA PRASATH S, GAURAV CHAUDHARY, FABIO GIARDINA, MAHADEVAN LAKSHMINARAYANAN, School of Engineering and Applied Sciences, Harvard University — 4D printed structures have recently shown much promise as a strategy for designing complex shapes that can morph from planar prints to 3d structures. However, these approaches require a sophisticated implementation infrastructure, are limited in the number of possible equilibrium configurations, and cannot be easily designed on demand. One way to circumvent these difficulties is to use externally actuated granular systems that are infinitely morphable, and can be easily manipulated using external fields. Using dry magnetic particles made out of Iron filings subject to an externally applied magnetic field, we create structures that can be morphed from one shape to another on demand. A theoretical framework for our observations takes the form of a lubrication equation for magnetic Bingham plastic fluid that explains our results and allows us to pose and solve the inverse problem of calculating the optimal magnetic field required to reach a target shape. We demonstrate this by showing how to create a prototypic magnetic sand castle!

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