California State University, Sacramento (CSUS)

University of California, Davis (UCD)

California Department of Transportation (Caltrans)

THE DESIGN AND CONSTRUCTION OF A RAINFALL SIMULATOR

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Authors:

Jacqueline Blanquies, California Polytechnic State University, San Luis Obispo
Misty Scharff, Caltrans/CSUS Storm Water Program
Brent Hallock, PhD., California Polytechnic State University, San Luis Obispo

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Caltrans Storm Water Program
Office of Water Programs, CSU, Sacramento
7801 Folsom Boulevard, Suite 102, Sacramento, CA 95826

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ABSTRACT

A reliable, accurate and portable rainfall simulator was needed for vegetative and erosion control research at California Polytechnic State University, San Luis Obispo (Cal Poly) for California Department of Transportation (Caltrans) and California State University Sacramento. This simulator was designed to be easily set up and maintained as well as able to create a variety of rainfall regimes. The nozzle performance tests and lateral spacing tests were performed at Cal Poly's Erosion Research Facility. This simulator was designed and constructed based upon the principles of the Norton Ladder Type Rainfall Simulator. This simulator is the standard for research involving simulated rainfall. Construction took place at Cal Poly's farm shop. The rainfall simulator is a pressurized nozzle type simulator with a cam-operated oscillating boom. It emits uniform rainfall on a plot 1 m (3 ft) wide by 3.56 m (12 ft) long. The nozzles at 47.6 kPa (7 psi), Spraying Systems Company's Floodjet 3/8K SS45, emitted an average drop size of 1.7 mm (0.07 in) and a range of drop sizes of less than 1 mm to 7 mm (0.04 in to 0.3 in), correlating well to storms less than 50 $mm \bullet hr^{-1}$ (2 $in \bullet hr^{-1}$) as is common on California's Central Coast. The structure of the simulator was built from aluminum, supporting the four-nozzle boom. The nozzles are spaced 99 cm (39 inches) apart. A box with an opening of 15 cm by 11 cm (6 by 4.5 inches) was beneath each nozzle to create the proper spray angle, critical for lateral spray uniformity. An additional opening in the box is attached to a system which returns the unused water to the storage tank. Flow meters control the inflow of water from the storage tank, ensuring each nozzle has the same discharge rate, no matter the orientation of the simulator. A computer-driven motor and cam system controls the storm intensity. The number of oscillations per minute of the nozzle across the box opening determines the intensity. Design storms resemble a bell curve, typical of California storms. The support system is collapsible, easy to set up and maintain. The resulting simulator is economical (less than $7,000 to construct), made with commercially available parts, easy to set-up and maintain and highly accurate.

Keywords: rainfall simulation; nozzle; rainfall charactaristics