The Design and Construction of the Nyren/Patton Portable Rain-Out-Shelter

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Objectives

To design and construct automated, portable enclosures to cover 3.3 X 6.6 meter grazed plots during a rainfall event. These devices have to meet the following requirements.

1. Be able to cover a 3.3 X 6.6 meter plot within 60 to 90 seconds of the start of a rainfall event and retract out of the way sufficiently not to disturb grazing animals.

2. Be small and lightweight enough that they could be disassembled and moved to a new location with a minimum of time and effort.

3. Operate without the use of AC power.

4. Operate automatically in both directions.

5. Be strong enough to withstand sustained 50-60 knot winds.

6. Include an adjustable sensor that would allow a variable amount of precipitation to fall before activating the shelter.

7. Keep the cost within budget.

Figure 1. Three of the cages located on the grazing intensity trial.

Figure 2. The shelters are located on silty range sites on the moderate and extreme treatments of the grazing intensity trial. Each treatment is replicated 3 times.

Figure 3. The hoops are formed from 3/4' square tubing shaped in a shop made tubing bender.

Figure 4. Fastening the tubing bender to the bucket of the Bobcat allows the work to be done at a comfortable height.

1" tubing supports 3/4" hoop

Figure 5. Base frame and upright hoop supports are welded in the Center shop.

Figure 6. Finished frame. The hoops are spaced 5' apart and will be covered with white metal siding.

Frame is offset to allow clearance of moisture tube and exclosure cage

Figure 7. The shelters are covered with steel siding similar to material used on metal pole buildings.

Figure 8. The cage in the open position shows the distance from the research plot. The plastic along the track was trenched to a depth of 2 feet to prevent any lateral groundwater flow. The tracks have been redesigned since

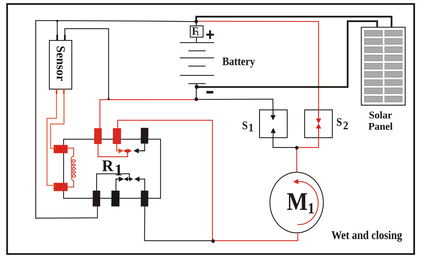

Figure 9. Control unit wiring diagram. The red wires indicate the current path while the sensor is in the wet and closing mode.

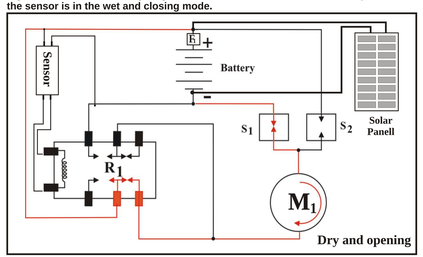

Figure 10. Wiring diagram showing current flow during the opening cycle.

M_1 - Dayton 1/5 Hp DC Gearmotor model 1Z826	Hoops - 75' of 3/4 sq. 14 gauge tubing
R_1 - Siemens Potter & Brumfield K10P-11D15-12	Hoop supports - 6' 1" sq. 12 gauge tubing
Sensor - Liebert Liqui-Tect LT410 Liebert Corp. 1050 Dearborn Dr. Columbus Ohio 43229 614-888-0246	Cage frame - 64' 1 1/2 sq. 12 gauge tubing
S_1 & S_2 - Carling Switch P/N 2FC54-73XG single pole double throw (on-off-on)	Rails - 120' 2" sq. 11 gauge tubing 12 2"X10' garage door track 8 2" X 4" garage door rollers
F_1 - Cooper Bussmann AGX 15 15 amp fuse	Rail supports - 18" 3"X1" channel iron
Solar Panal - Uni-solar Model US-11 .62 amps @ 16.5 volts. United Solar Systems Corp, Troy, MI	Cover - 5 38" X 20' 29 gauge white metal siding

Table 1. Materials list for the construction of the rain-out-shelters.

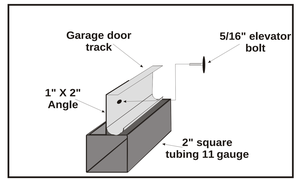

Figure 11. Straight sections of garage door track bolted to 1"x 2" angle iron welded to 2"X2" 11 gauge square tubing form the rails the cages rollers ride on.

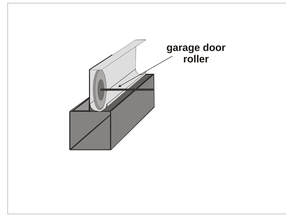

Figure 12. Garage door rollers are inserted in holes drilled in the 1 1/2 "X 1 1/2" square tubing which forms the cage frames.

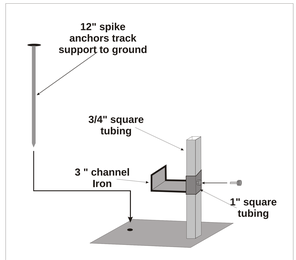

Figure 13. Supports for the rails are constructed out of 3/4" square tubing welded to 3"X6"X1/8 flat plate. A 3" channel iron welded to 1" square tubing which slides on the 3/4" tubing allowing height adjustment. A 12" spike is driven through a hole in the flat plate to anchor the entire rail to the ground.

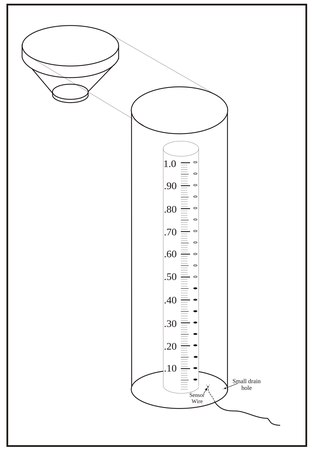

Figure 14. Since 75% of normal rainfall is required for the study, the above adjustable sensor allows a predetermined amount of precipitation on the plot before the shelter closes. The sensor is constructed from a plastic rain gauge. Holes drilled in the inner tube can be plugged to catch a predetermined amount of rainfall. Overflow from the inner tube then wets the sensor wire and trips the automatic shelter. Following the rainfall event, the water slowly drains through the drain hole, the sensor wires dry and the cage returns to the open position.

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