Sustainable Saunders Solar and Wind Demonstration Project

Customer Requirements Document

A collaborative proposal by the following partners:

- **Energy Management Group** (EMG) - Richard Figliuzzi, President
- **Hawaii Energy Connection** (HEC) - Chris DeBone and Steve Godmere
- **UH Manoa Facilities Management Office** (FMO) - David Hafner, Associate Vice Chancellor
- **Hawaii Natural Energy Institute** (HNEI) - Eric Miller, Associate Professor
- **Social Science Public Policy Center** (PPC) - David Nixon, Associate Professor, and *Sustainable Saunders* Faculty Coordinator

Goals

The partners seek to install and operate a small educational, research and demonstration renewable energy testbed on the roof of Saunders Hall. The research and education objectives are to:

(i) assess small-scale solar and wind generating equipment in real-world conditions

(ii) construct and refine appropriate, useful, and reliable data acquisition systems for solar or wind electricity generating systems.

(iii) provide UH students with opportunities to gain real-world and research experience with renewable energy equipment installation, operation, and analysis.

Equipment

Initial Electricity Generating Systems (donated by the partners)

1. A pole-mounted vertical axis wind turbine (donated by EMG)
   - estimated maximum output: 1100 Watts
   - install location: exterior, wall mount near the northeast corner of Saunders, at a height suitable to avoid turbulence.
   - dimensions: 3 ft W (cylinder) x 5 ft H
   - expected height above structure: 3-6 ft from top of structure to bottom of turbine.

2. A 5-panel photovoltaic solar electric panel set (donated by HEC)
   - estimated maximum output: 875 Watts
   - install location: exterior, rack mount across the northern section of Saunders rooftop, fix pitched at 15 degrees
   - dimensions of full array: 5ft D x 16 ft W x 22.9 inches high from rooftop/rack base

Electrical Interconnection Equipment (donated by the partners)

3. One DCtoAC power inverter (donated by EMG).
   Install location: interior, wall mount in the 7th floor NW electrical/mechanical room
   dimensions: 21.8 in. W x 15.5 in. H x 12.75 in. D
   weight: 42.87 lbs
4. Five DCtoAC 'micro' inverters (donated by HEC)
   Install location: one attached to the back of each solar panel
   dimensions: 10.5 W inches x 5.5 H inches x 1.5 D inches
5. Two reference batteries (to smooth the turbine power output prior to the inverter)
   - 24 volt system
   Install location: interior, floor mount in the 7th floor NW electrical/mechanical room
   dimensions: 2 ft W x 1 ft H x 1 ft D
6. One dump-load (to offload excess power from turbine)
7. One charge controller (again, to smooth the turbine power output prior to inverter)
   install location: interior, wall mount in the 7th floor NW electrical/mechanical room
   dimensions: 10inches W x 14 inches H x 5 inches D

Data Acquisition

8. A pole-mounted meteorological station (donated by EMG), capable of logging electronic data for wind speed, wind direction, and solar insolation.

install location: exterior, wall mount near the northeast corner of Saunders, at a height suitable to avoid turbulence.

expected height above structure: 4 ft.

dimensions: (irregular, approximately 2 ft cube)

9. A hardware and software-based Data Aquisition System (Compact Field Point, to be constructed by HNEI), capable of logging data feeds from each power inverter and the meteorological station, and displaying data feeds on a web-based system.

install location: interior, wall mount between the inverters and a TCP/IP connection

requires a standard electrical outlet.

Installation

All equipment is proposed to be interconnected with hard-wire connections. No conduit is available along the rooftop for such wiring, though there does appear to be some spare conduit penetrating the roof vertically, into the 7th floor electrical mechanical room at the NW corner.

We propose to install the mounting systems and electrical connections in a manner that provides the capacity to:

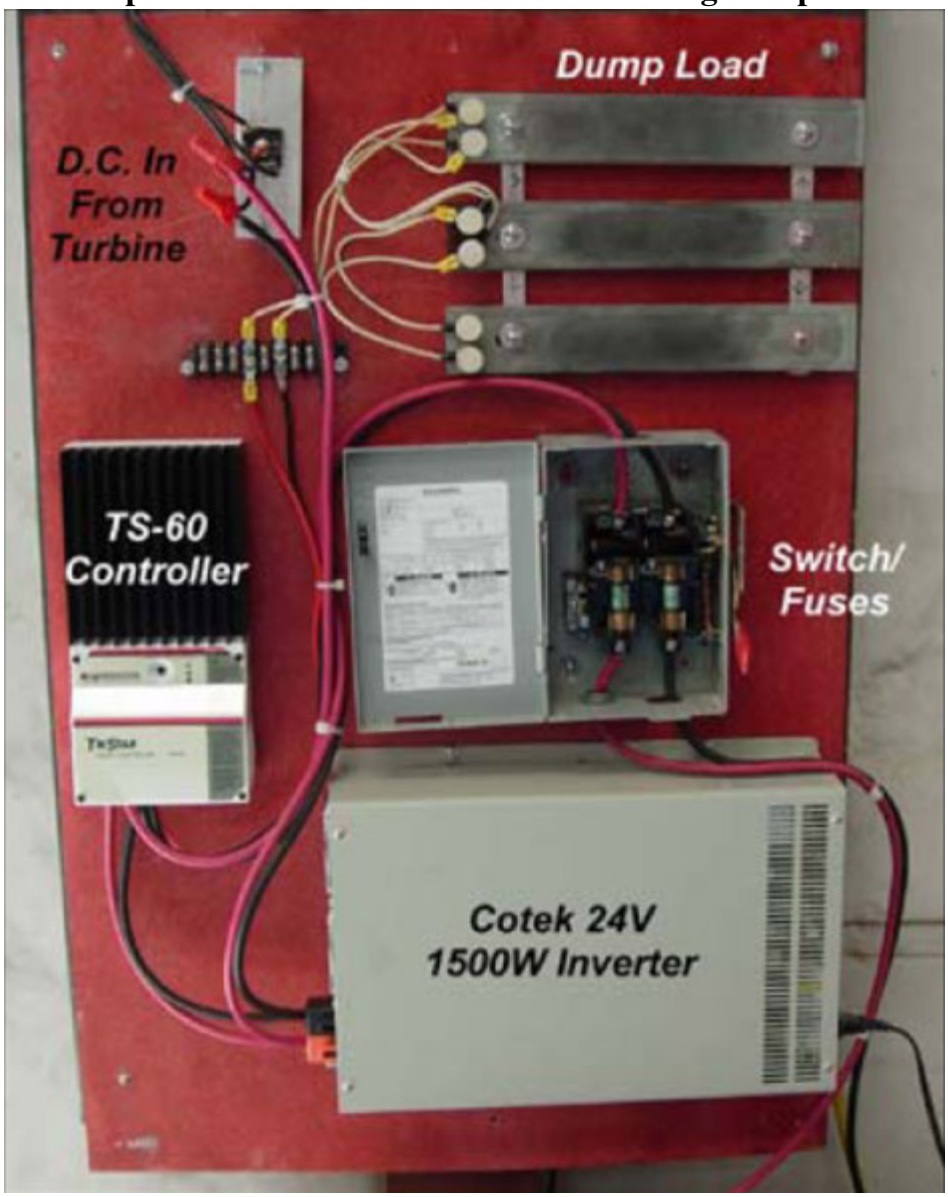
(a) remove, replace, or service individual power-generating systems without disrupting operation of the other systems.

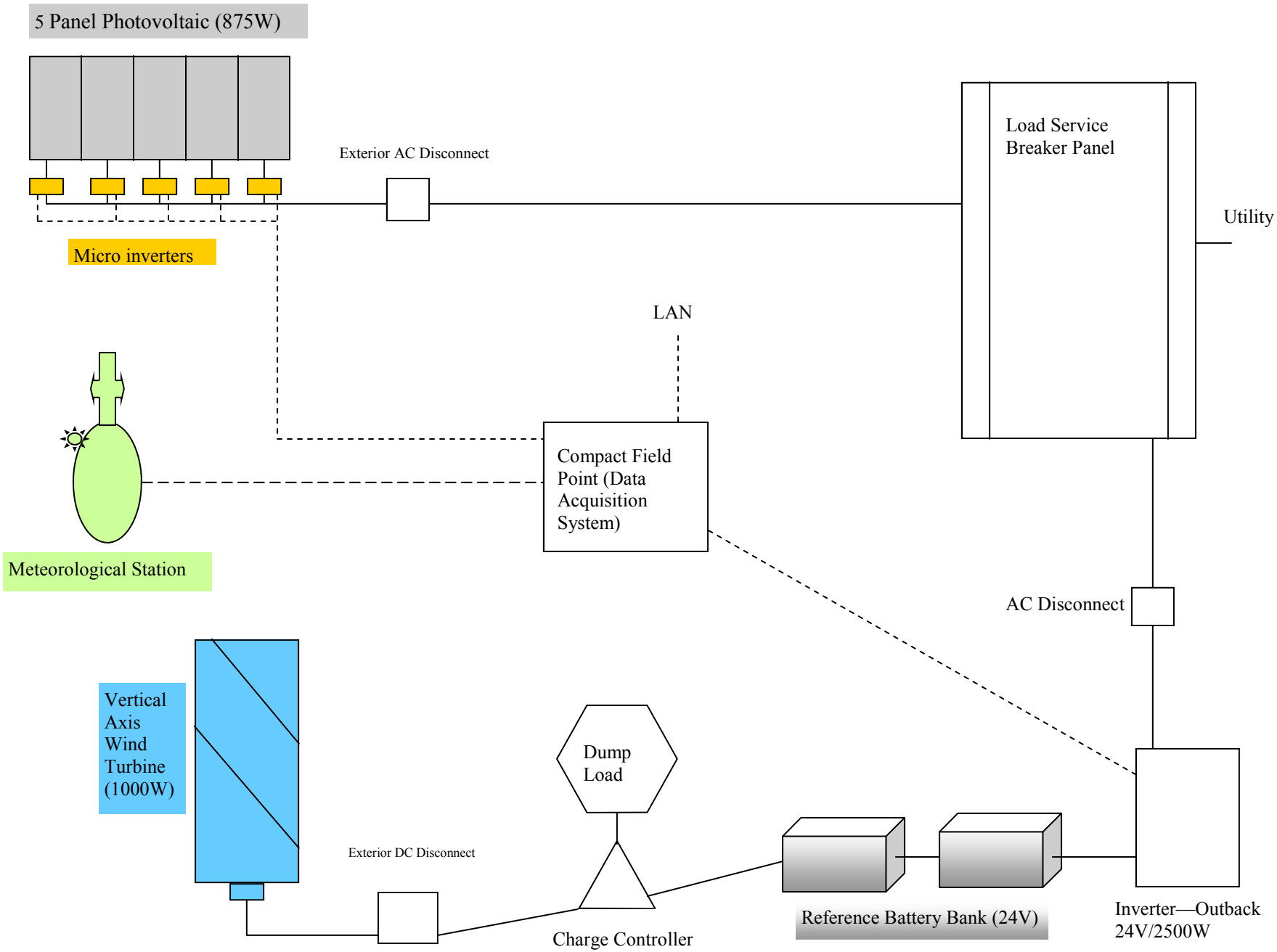
(b) accurately assess power generating efficiencies of individual systems, as a function of observed solar and wind resources in real-time (or nearly real-time)

(c) archive power generation and meteorological data in accessible forms and stored at redundant locations.

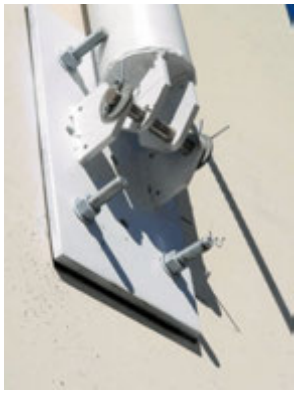
(d) refine the data acquisition system through hardware and software modifications, without disrupting the power flow from the equipment into the grid.

Example Illustration of Wind Turbine Wiring Components

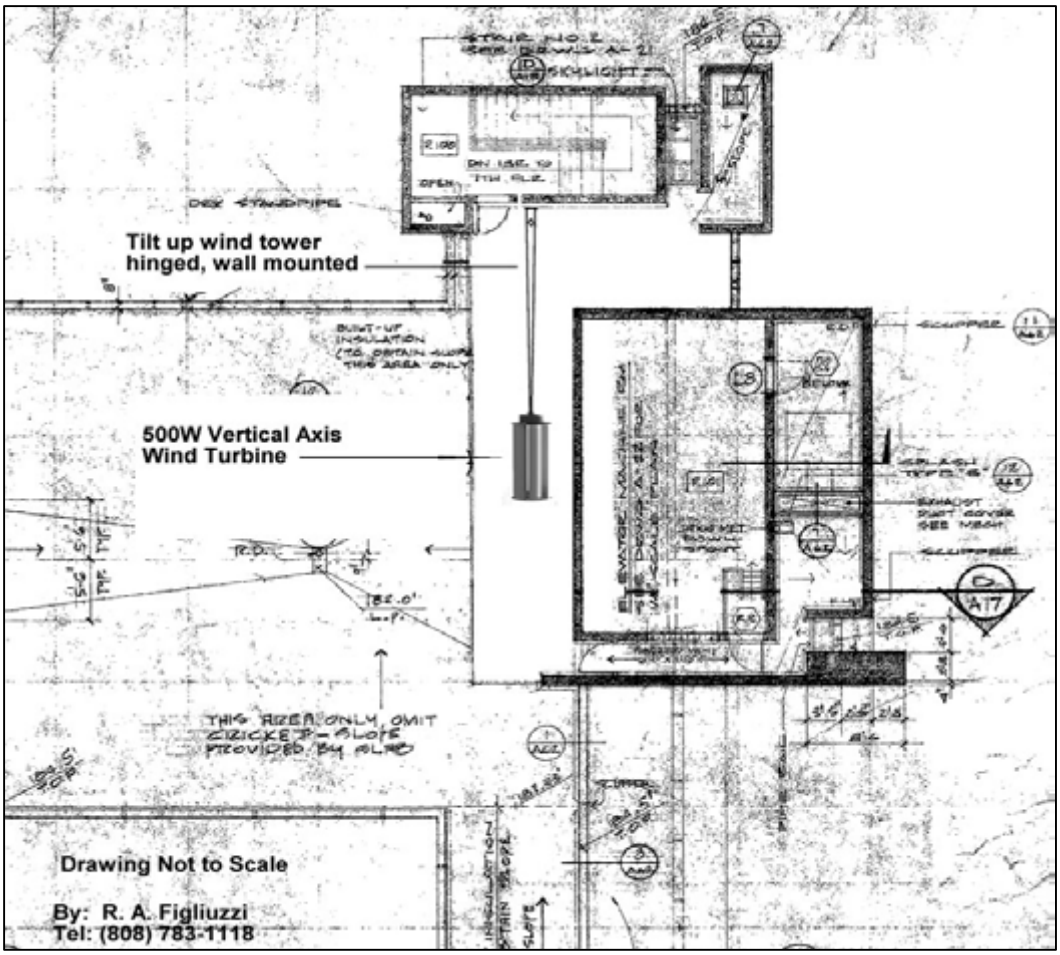



5 Panel Photovoltaic (875W)
Exterior AC Disconnect
Load Service Breaker Panel
Utility
Micro inverters
LAN
Compact Field Point (Data Acquisition System)
Meteorological Station
AC Disconnect
Vertical Axis Wind Turbine (1000W)
Dump Load
Exterior DC Disconnect
Charge Controller
Reference Battery Bank (24V)
Inverter—Outback 24V/2500W

For the wind turbine, we propose a canting pole mount, with a hinge about 3 feet high and a secure but release-able clasp at the top of the building structure, to allow the pole to swing down from vertical to horizontal within the area wind-sheltered by the elevator shaft structure (for equipment access including maintenance, replacement, etc). We anticipate very infrequent use of this swing capability. We propose a pole of 9-12 feet, to allow the bottom of the turbine to clear the building structure by 3-6 feet. The pole is to be an engineered structure, specifically crafted for minimal deflection and other important characteristics. The mounting brackets are to be through-bolted, avoiding the cement rebar, with a metal backing plate.



For the meteorological station, we propose a fixed 1 3/4" pole mounted with c-brackets and concretelead anchors installed to avoid rebar in the concrete walls.. Ideally, the pole for the met station can be attached to the exterior wall of the elevator shaft, near the rooftop door access.



Draft illustration of SeaHawk VAWT installation at Saunders Hall roof top at UH Manoa

By Richard A. Figliuzzi, Tel: (808) 783-1118

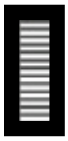
VAWT Components

PacWind "SeaHawk"
VAWT, 500W

Wind Tower
(actual length to be determined)

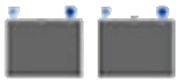
Inverter

Dump Load

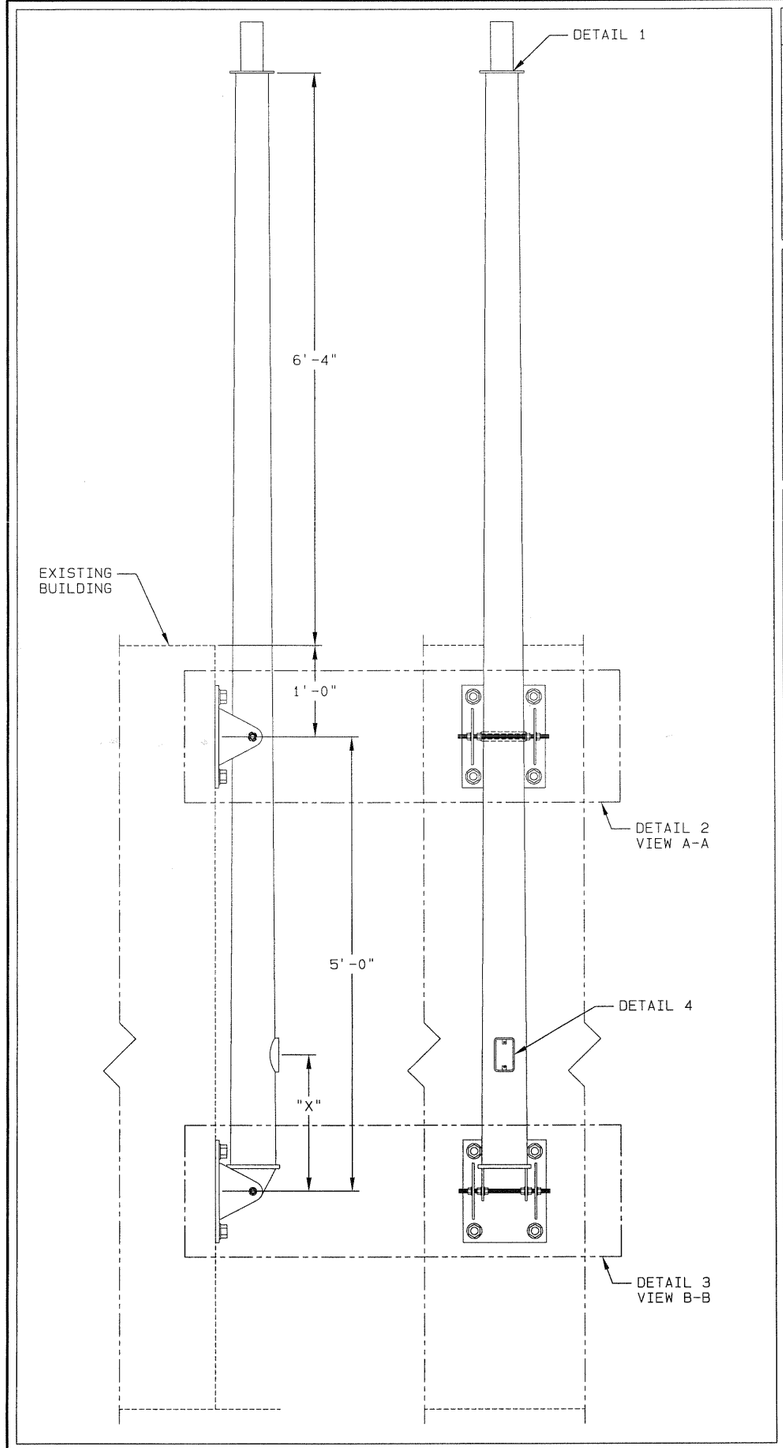


Charge Controller

Reference Batteries



Energy Management Group, Inc.
Tel: (808) 783-1118



POLE DATA

QTY.	POLE TUBE			
	BASE DIA. (IN)	TOP DIA. (IN)	LENGTH (FT)	GAUGE OR THK. (IN)
1	6.00	4.32	12.00	7

MATERIAL DATA

COMPONENT	ASTM DESIGNATION	MIN. YIELD (KSI)
POLE SHAFT	A595 GR.A	55
CONNECTING PLATES	A36	36
HINGE PLATES	A36	36
CONNECTING BOLTS	A325	
CONNECTING RODS	A193	

FINISH DATA

FINISH COAT: TGIC OR URETHANE POLYESTER POWDER

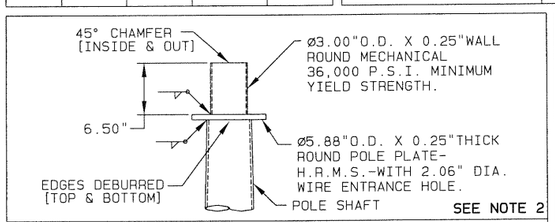
COLOR: SEE NOTE 1

VALMONT SPEC.: F-264

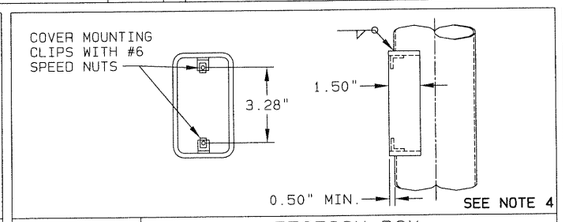
SEE NOTE 1

ALTHOUGH RARE, VIBRATIONS SEVERE ENOUGH TO CAUSE DAMAGE CAN OCCASIONALLY OCCUR IN STRUCTURES OF ALL TYPES. BECAUSE THEY ARE INFLUENCED BY MANY INTERACTING VARIABLES, VIBRATIONS ARE GENERALLY UNPREDICTABLE. THE USER'S MAINTENANCE PROGRAM SHOULD INCLUDE OBSERVATION FOR EXCESSIVE VIBRATION AND EXAMINATION FOR ANY STRUCTURAL DAMAGE OR BOLT LOOSENING. THE VALMONT WARRANTY SPECIFICALLY EXCLUDES FATIGUE FAILURE OR SIMILAR PHENOMENA RESULTING FROM INDUCED VIBRATION, HARMONIC OSCILLATION OR RESONANCE ASSOCIATED WITH MOVEMENT OF AIR CURRENTS AROUND THE PRODUCT.

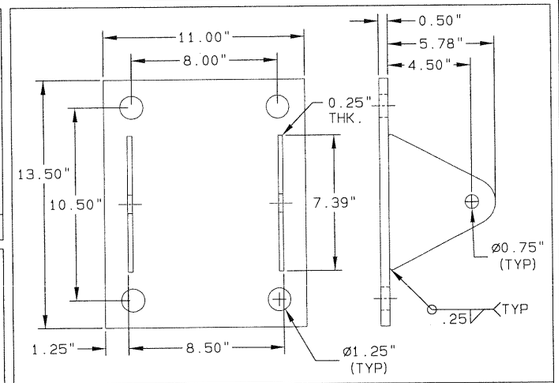
VIBRATION DISCLAIMER



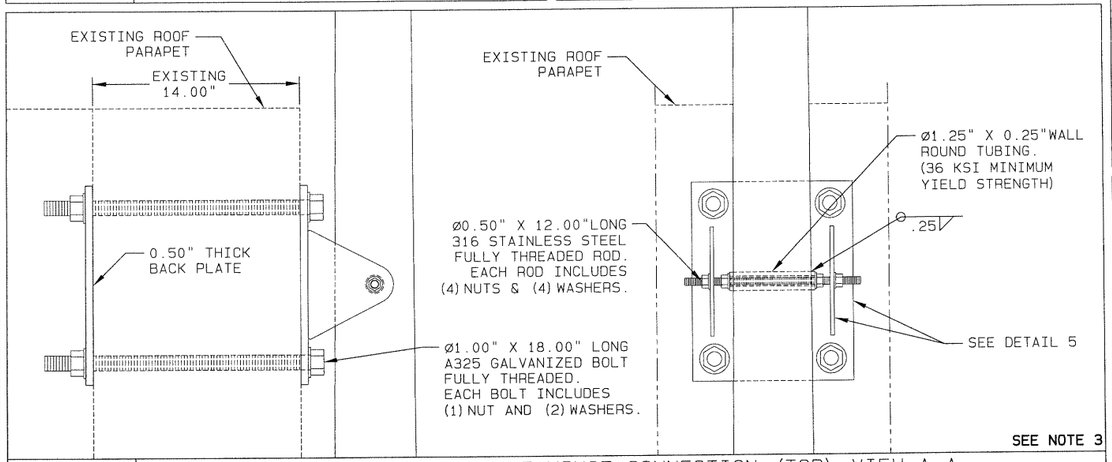
DETAIL 1 | POLE TOP TENON



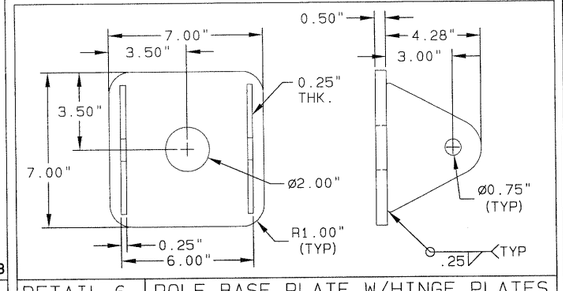
DETAIL 4 | FESTOON BOX



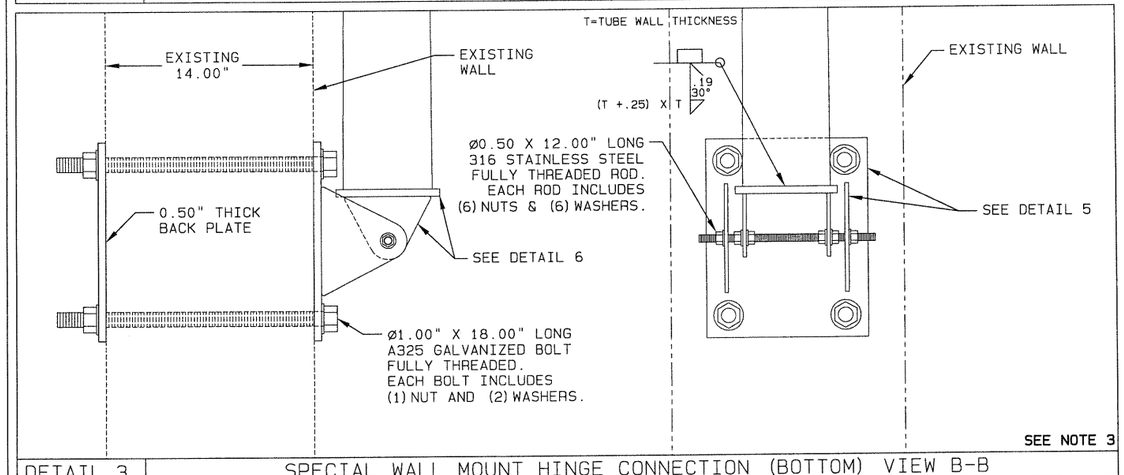
DETAIL 5 | TOP & BOTTOM CONNECTING PLATES



DETAIL 2 | SPECIAL WALL MOUNT HINGE CONNECTION (TOP) VIEW A-A



DETAIL 6 | POLE BASE PLATE W/HINGE PLATES



DETAIL 3 | SPECIAL WALL MOUNT HINGE CONNECTION (BOTTOM) VIEW B-B

NOTE:

1. PLEASE PROVIDE FINISH, RAL#, OR PAINT CHIP PRIOR TO RELEASE FOR PRODUCTION.
2. PLEASE VERIFY POLE TOP TENON MOUNT IS ADEQUATE FOR TURBINE BY OTHERS PRIOR TO RELEASE FOR PRODUCTION.
3. PLEASE VERIFY THAT WALL MOUNT DESIGNS SHOWN IN DETAILS 2 & 3 ARE ADEQUATE PRIOR TO RELEASE FOR PRODUCTION.
4. PLEASE PROVIDE LOCATION FOR FESTOON BOX PRIOR TO RELEASE FOR PRODUCTION.

REV	DRAWN BY-DATE	CHECK BY-DATE	DESCRIPTION
—	CMJ2 06/25/08	RCV 07/01/08	

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JOB UNIVERSITY OF HAWAII AT MONOA WIND DEMONSTRATION PROJECT

TITLE WIND ENERGY STUCTURES

valmont
Valley,NE 68064
(402) 359-2201

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PAGE NUMBER: 1 OF 1
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REV

For the solar PV arrays, we propose a ballasted rack system, such as that by Uni-Rac (G-10 series). Such a system will avoid any roof penetration and is engineered for wind safety. It is both modular and portable, to allow flexibility in future developments of the rooftop testbed. *All other equipment on the Saunders rooftop, including the cell towers and research satellite equipment, is mounted with portable ballasted racks*. The rack system is being provided by the Sustainable Saunders Initiative.