## Nonimaging reflector concentrator thru-wall trough solar kitchens and stand-alone cooker studies

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**Abstract:** Schematic studies are presented for: thru reflector wall building-size nonimaging CPC-type fixed trough (1 and 2 sided) concentrator solar kitchens; and stand-alone reflector cooker LED lantern sets.

**Thru-reflector-wall building size nonimaging CPC-type fixed trough concentrator solar kitchens:** Configurations include: slide in-out food container cookware at counter height (Fig.1a); and concentrated sunlight thru-wall up to underside of food container cookware at counter height (Fig.1b). Building materials for the CPC type reflector walls include: reflectors (flat glass mirror, etc.) glued to stabilized masonry (Fig.1c) and wood (ply, sawn)(Fig.1e); thin reflector sheet (metal, etc.) attached to round wood (bamboo, etc.)(Fig.1f,g); reflector film attached to substrates; and reflectors attached to trailers and used steel containers. Sheet metal reflector walls and reflector facets on cable-nets are suitable for seismic regions. Overhanging reflector upper trough side walls for higher latitudes in cold climates with insulation have design aspects that include reflector replacement. Exterior reflector trough sides can augment BIETR thermal collectors (Fig.1h). Large area reflector troughs (upper side) building integrated have been demonstrated by Lambeth (1). Selecting food container cookware shapes and sizes as target of nonimaging solar concentration (2) is part of beginning design, e.g., solar box cookers (Fig.1e). And plastics (polycarbonate, etc.) with radiation-heat tolerant glazing parts for high transmittance is a research issue. Related building configuration applications include: stills, dryers, and augmented evacuated tube collectors for refrigeration and cooling.

**Solar Concentrating Cooker LED Lantern Set**: Aims include improving reflector concentrating cookers with more durable materials, and reflector multi-use with a LED PV lantern. The concentrator box-tray has four attached lightweight reflector segments with an open bottom square (about 6.5” x 6.5”) for a reflector pyramid-shape heavy base. A lightweight concentrating cooking reflector outside by day, is an inside light reflector at night by hanging it inverted around an LED lantern. When the four sided lightweight reflector concentrator box-tray is removed from the center square pyramid-shape reflector heavy base that supports the food container, a hook for an LED lantern fits with the square opening of the inverted lightweight reflector hung in a house (Fig.1bb). A target cooker is a steel 3-Pound Roaster (9.75 inches/24.77 cm diameter x 5.75 inches height) with improved cooker-bag cover-glazing (Fig.1p). The nonimaging reflector is around the size of a small wheelbarrow box-tray. A full size mock-up model of a preliminary design was fabricated with anodized aluminum reflector metal sheet (Fig.1w-aa). The cook-pot is above the reflector base for under pot reflections, and within the fixed reflector box-tray to reduce wind losses. Horizontal inlet aperture cookers are with four identical reflector segments, or with sloped and shorter reflector segments for sloped inlet apertures (Fig.1r-u). Modified reflector segments with ridged-pyramid-shape wall brackets are for thru-wall cookers (Fig.1q). Mass produced pyramid-shape base plastic forms, similar to plastic fence post caps, may have advantages (for adhering reflector materials, etc.). The full size mock-up fabrication with lightweight anodized aluminum reflector sheet (about 0.020 inch thick) used: scissors, pliers, and clamps. After cutting out patterns, bending, and making tab holes (Fig.1w), quarter segments were clamped together and bolted. A pyramid base with four support bolts was cast with concrete in a wood form (Fig.1y), and after curing, metal reflector was glued on. The bolts support horizontal bent tubes sized for cook-pot diameters (9.75 inches/24.77 cm, etc.)(Fig.1z). Reflector prototype flat pattern schematic dimensions are: Quarter segment - Wq = 24”; Hq = 18”; E = 25”; L = 6” and pyramid base segment - S = 5”; H = 3.5”; L = 6” (Fig.1r-v). A local jobs idea is: flat lightweight anodized aluminum cutouts are transported to local workshops for assembly (bending, pop rivets, etc.), pyramid-shape base casting (with local sand and stones), reflector gluing, and distribution. Stackable (for compact shipping volume) plastic molded box-tray substrates shipped to workshops for adhering reflectors (flat glass, metal, film) are to be compared.

References:

(1) Hunbae and C. Lambeth, 1993, Sundancing, The Art and Architecture of James Lambeth, Miami Dog Press
(2) O’Gallagher, Joseph J., Nonimaging Optics in Solar Energy, (Synthesis Lectures on Energy and the Environment: Technology, Science, and Society), Morgan and Claypool, 2008
(3) Goodman, Joel H., Building Size Fixed Reflector CPC Troughs and Bowls for Food Processing Facilities, International Solar Food Processing Conference, ISES, 1-2009, Indore, India

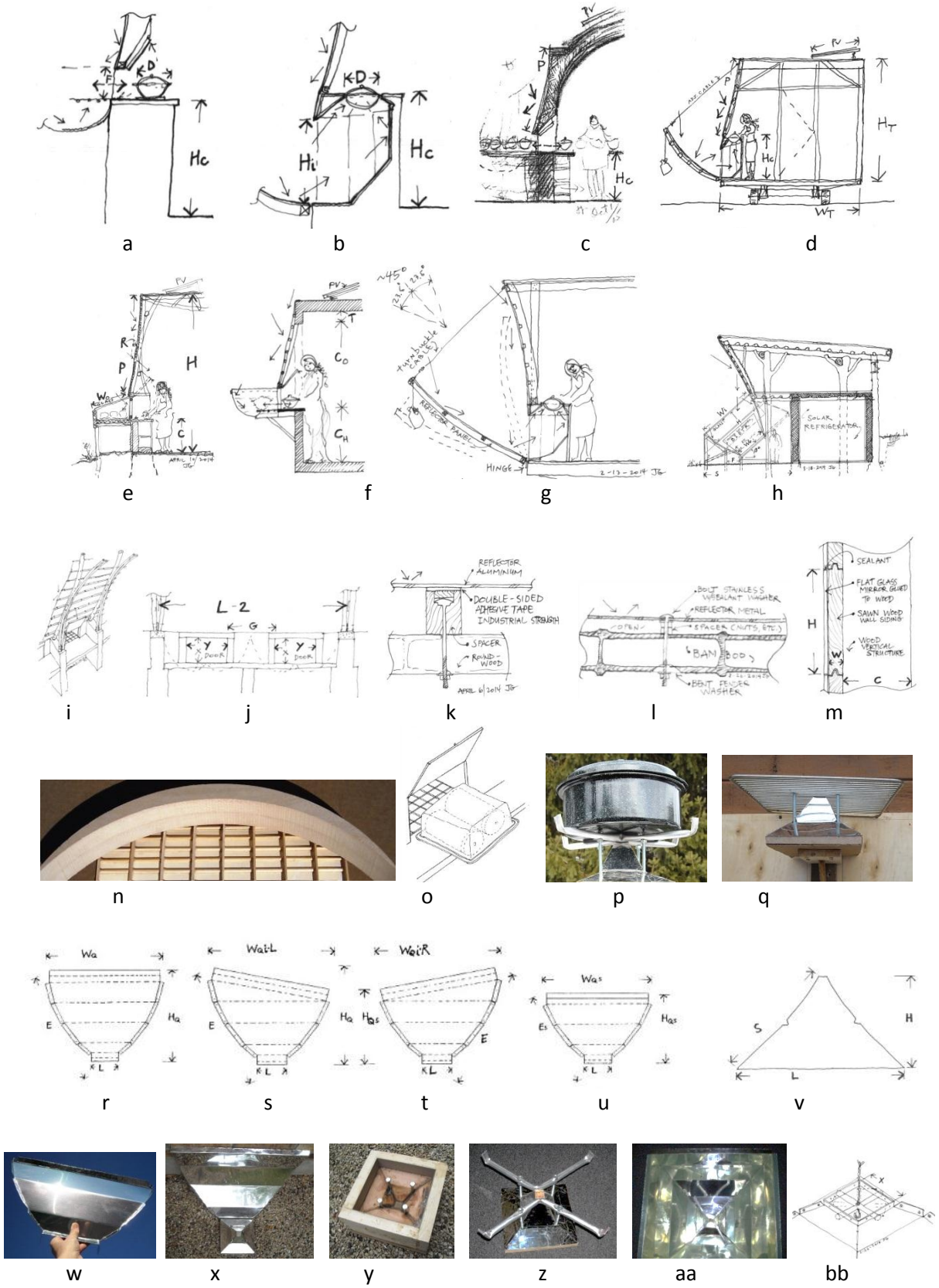


**Fig. 1- Nonimaging reflector concentrator thru-wall trough solar kitchens and stand-alone cooker studies** Joel H. Goodman 4-2014