SOME COMMENTS ON SOLAR WATER HEATING

by Edward Gosschalk

Basically a solar heating system consists of a collector which is designed to absorb heat from the sun and to minimise heat losses. Water passes through the collector at an appropriate rate through tubes or grooves. This water may be fed into the hot water system directly (direct system) or used to preheat the water in a tank by circulation in coils (indirect system). In U.K. the system is normally operated in conjunction with a well controlled well insulated conventional heating system. Figure 1 shows an indirect system suitable for tropical countries with natural circulation and a vented collector circuit. In Europe more complicated arrangements are generally required to avoid problems of freezing. The tank has usually to be kept below roof and collector level, requiring a pump, thermal control and provisions for easy drainage.

The collector should be inclined to avoid air locks but thermal performance is not very sensitive to tilt angles between 5° and 65° to the horizontal and attitude to the sun within, say, a 90° limit.

The sales of collectors in the U.K. are shown on Figure 2. In 1982 and 1983 there was a marked reduction in business due to world recession. There are about 20 manufactuers in U.K. It would not be sensible for Sri Lanka to import systems designed for high latitudes. The system must be designed to resist corrosion, insect attack and excessive temperatures with no flow. Water quality has to be preserved if the system is direct.

The thermal performance of collectors in U.K. is indicated in figure 3.

The ordinate is collector efficiency - the product of absorption efficiency and heat retention efficiency. The abscissa is heat loss coefficient per square meter per degree Kelvin. The direction of improved performance is from bottom right to top left. Classes I and II would require concentrating collectors with lenses and reflectors and would often need directional control to follow the sun.

Figure 4 compares the collector area required in U.K. for unit draw off per day for different classes of collector. Performance in Sri Lanka should be better than shown for U.K. in Figure 3 and 4 because of the higher solar irradiation levels available.

Table 1 compares typical systems, capacities and costs in European countries.

E.M. Gosschalk, M.A. Hons. Mechanical Sciences, Cambridge, F.I.C.E., F.I.E.S.L., Director of Halcrow Water and Associate of Sir William Halcrow and Partners. He is currently Halcrows Resident Director for the Kotmale Hydropower Project and responsible for services on the Canyon Power Project and Matara Water Supply Project.

He is the author of some 19 papers and invited talks, mainly on the subject of dams, tunnelling, geotechnical and geomorphological problems and of measuring long term stress in concrete. One of his particular intersts is means of alternative renewable energy generation.

Besides Sri Lanka he has worked in West Africa, Indonesia, Malayasia, Bangladesh, Burma, Cyprus, Ecuador and U.K.

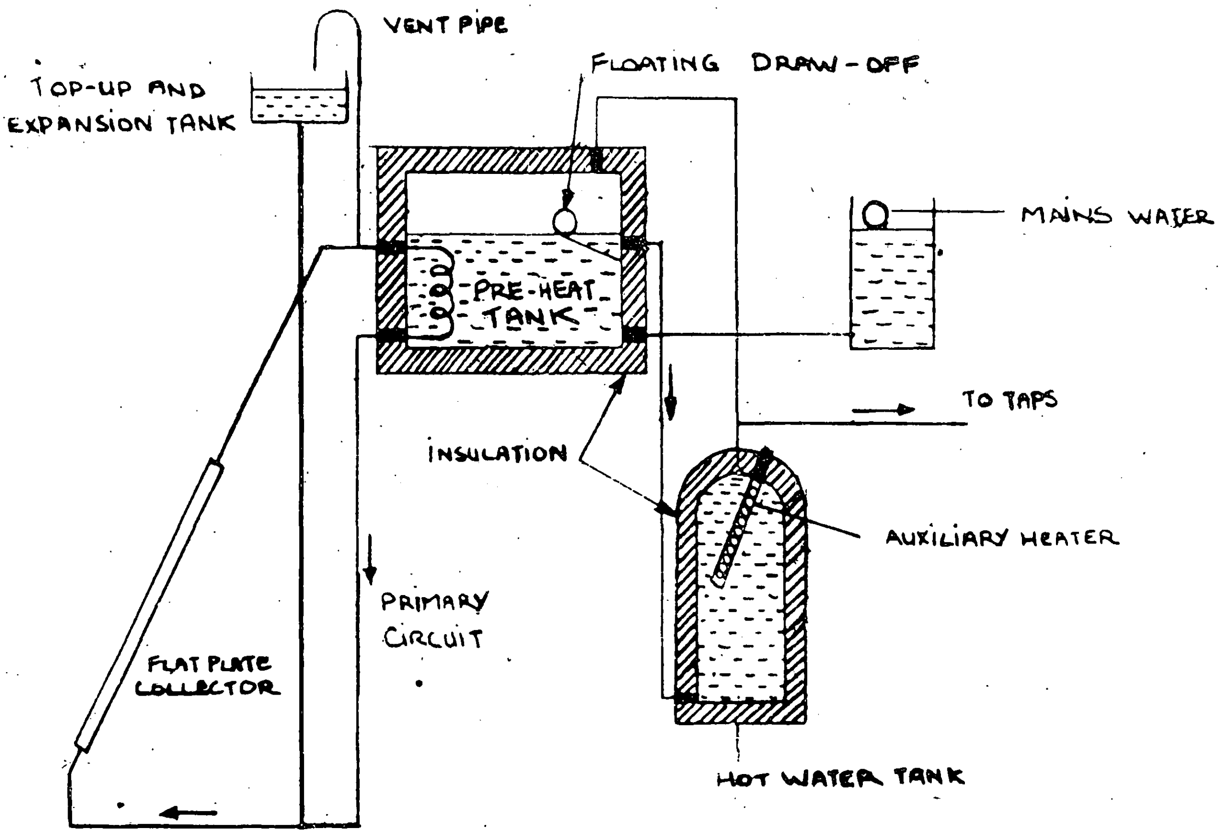

FIGURE 1. — AN INDIRECT NATURAL CIRCULATION SYSTEM WITH VENTED COLLECTOR CIRCUIT.

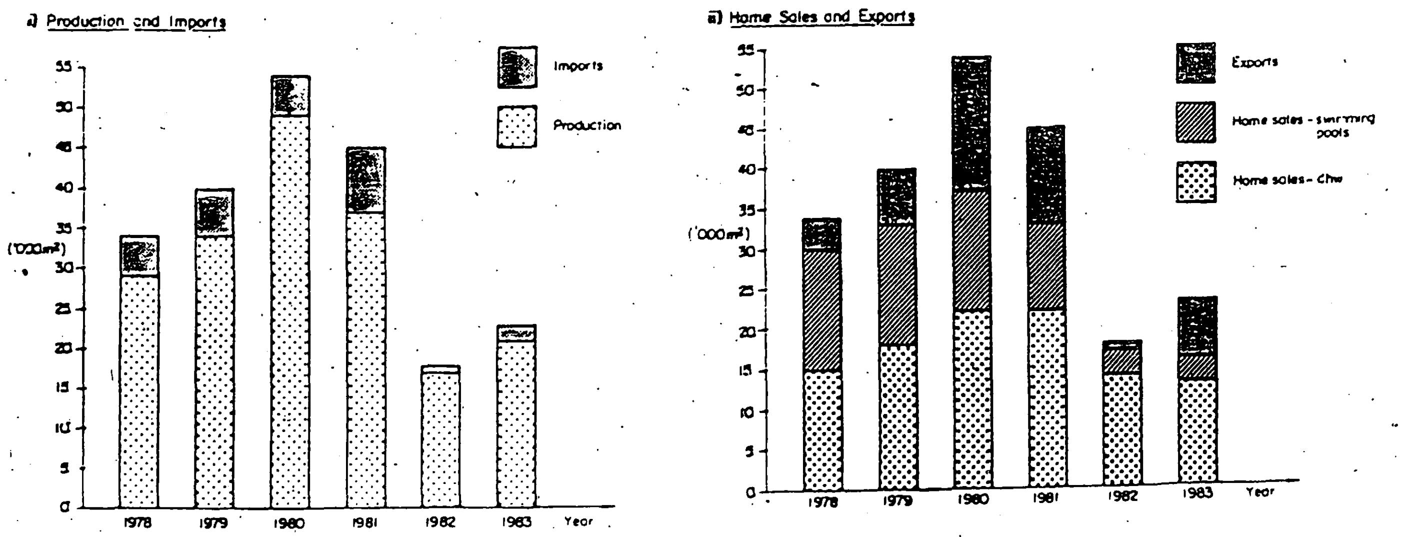

FIGURE 2 - UK Solar Collector Industry

	Collectors m^2	Stores litres	Typical price £
Greece	2 - 3	120 - 160	350 - 520
France	3	200	700 - 1500
Italy	4	150 - 200	900 - 1700
Spain	3	300	1000
Netherlands	3 - 4	120 - 200	1000 - 1300
Protugal	4	200	1250
Belgium	6	300	1400
Sweeden	6 - 8	300 - 500	1800 - 2700
U.K.	4 - 5	130 - 225	2000
Denmark	8	300	2500
W Germany	8	380	2500 - 3200

Typical Solar domestic hot water systems Table 1

A successful development is the production of collectors which replace conventional roofing components.

Details necessary for successful design are

provision for thermal expansion and contraction

weather resistance

ventilation and drainage of condensation

corrosion resistance

cover designed for high solar transmittance and low radiation transmittance

sound design of absorber

small back and side heat losses from collector (good insulation needed)

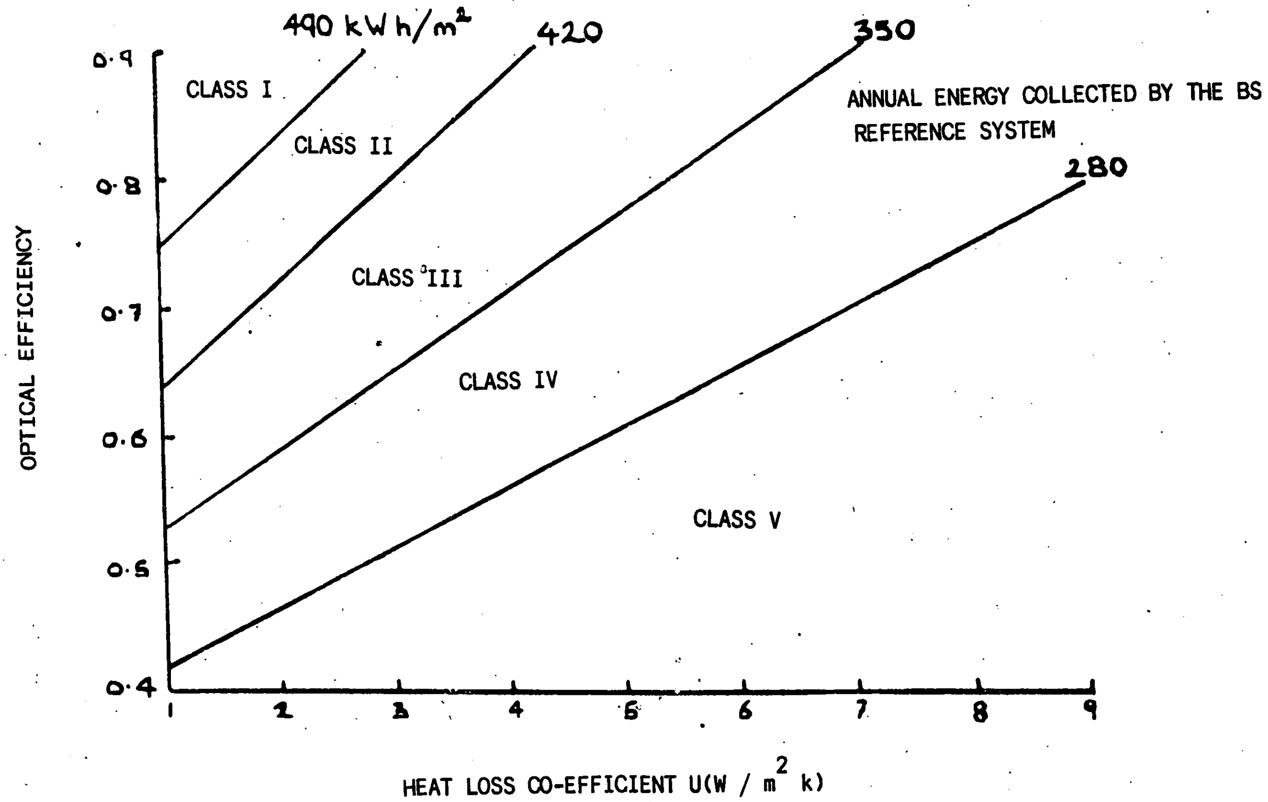

FIGURE 3 - COLLECTOR CLASSIFICATION (FROM BS 5918) ON THE BASIS OF PERFORMANCE IN A REFERENCE DOMESTIC WATER HEATING SYSTEM FOR TYPICAL U.K. COLD WATER AT 12°C AND GLOBAL IRRADIATION ABOUT 1000 k WH/YR/M^2

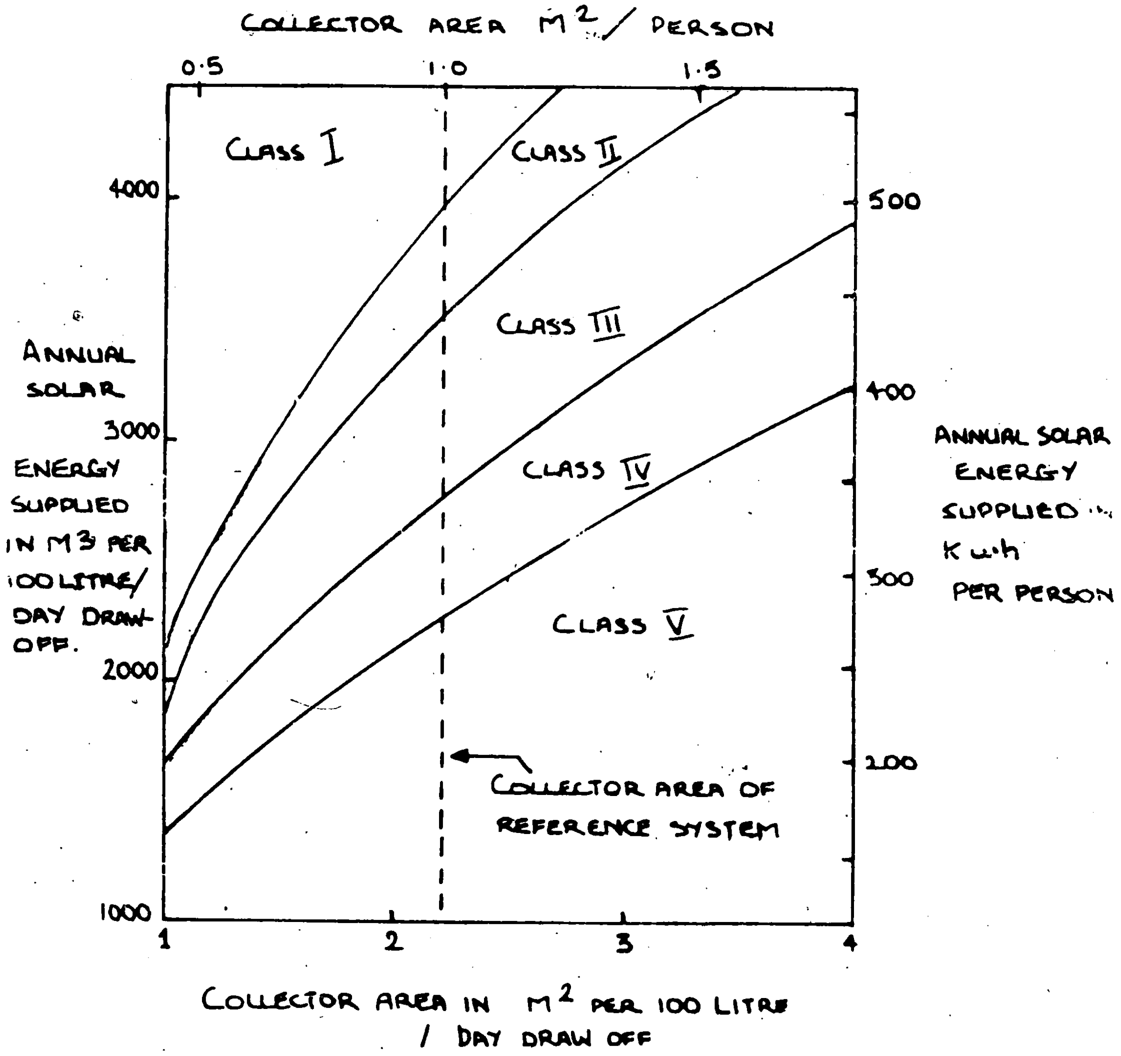

FIGURE 4 - ANNUAL SOLAR ENERGY CONTRIBUTIONS FROM TYPICAL SOLAR WATER HEATING SYSTEMS WITH DEMAND AT 60°C SEE ALSO FIGURE 3

Conclusions

Solar heating systems do work well

An objective should be to reduce system costs to about f 500, i.e. Rs. 15,000.

Hot water demand temperatures should not be designed unnecessarily high - 55°C seems acceptable.

Hot water demands of 100 l/day per house (in U.K.) seem usual, leading to a hot water energy requirement of about 7 kW hr/day.

Capital costs should come down. The possible value of solar heating in Sri Lanka is obvious from the sunshine and its economic merits in the case of hotels, factories and high cost housing should be considered case by case.

Applications must be very selective if they are to be economic - the ecomomics in Sri Lanka look marginal at the present time except for the applications mentioned above.

Acknowledgment

All and any credit for the information provided in this note is due to the Author's colleagues Ivor Price and Bill Gillett and also to the Solar Energy Unit, University College Cardiff and to Mr. J.R. Stammers, Private Consultant.