This is the unedited version of the article that appeared in Plumbing Engineer and Plumbing and Hydronics Contractor in May 2013. It is the 59th article by Bristol Stickney, Chief Technical Officer of SolarLogic LLC, in the monthly series under the title "Solar Solutions"

Bristol's Six Principles for Good Solar Hydronic Design

SLASH-D: Software for Solar Heating Design

The Prime Directive for Solar Heating:

Always design and install solar heating equipment that is *at least as reliable* and trouble-free as the conventional system it replaces. Whenever possible, provide performance, longevity and controls that *surpass* the conventional alternatives. To meet the prime directive, try following these Six Principles.

(In this series of articles, I have been making the case that the key ingredients for solar/hydronic design and installation can be divided into six categories, listed below, roughly in order of their importance.)

RELIABLE, EFFECTIVE, COMPATIBLE, ELEGANT, SERVICEABLE & EFFICIENT

The success of any solar hydronic home heating installation depends on the often-conflicting balance between any of these six principles. Finding the balance between them defines the art of solar heating design.

SLASH-D Software (SolarLogic Assisted Solar Heating Design)

In previous articles I have often discussed the benefits of using the primary-loop piping configuration to streamline the design and installation of Solar Combisystems. When I began using this approach exclusively about 15 years ago I realized that the similarities from one heating job to the next allows a rapid and modular approach to design. This eventually led to the development of the SLASH-D software a few years ago. Using this software, I can now develop a new solar combisystem heating design in a few minutes that might have taken days in the past when working with drawing templates, parts lists and energy calculations.

In many cases, I have run the software while the architect or heating contractor is watching. Together we quickly enter information about the job. We try different options and watch as the energy savings increases or decreases. When we are done, we have a plumbing diagram, a generalized list of components and an evaluation of the energy savings. This is enough information to produce an accurate proposal for an entire heating system. It also becomes the basic installation plan for the installer. Also, the standard piping diagram is completely compatible with a standard SLIC (SolarLogic Integrated Control) control system. So, in many cases, when the SLASH-D plumbing design is done, so is the control system design.

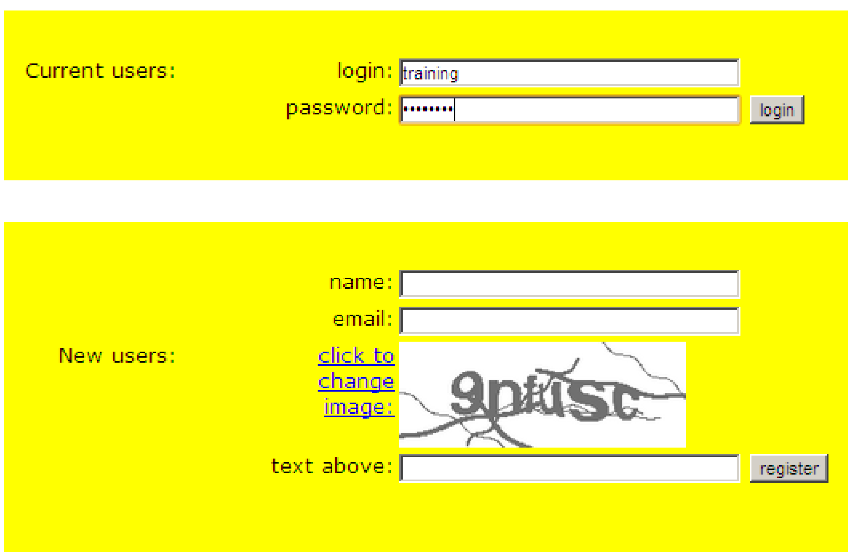
Log In and Start Up

This software is available free to use on the internet. The program runs entirely within the web browser, so there is no software to download or setup and is available for immediate use. The SLASH-D website works with IE version 8 or later, Chrome or Safari web browsers. Anyone interested in solar combisystem heating design can take a look at this address to begin using the SLASH-D:
https://secure.solarlogicllc.com/sol3/

This link takes you to a log-in screen as seen in Figure 59-1. To take a quick test drive, you can log in as (login:training) and (password:training). The program will be fully functional, but keep in mind that if you want privacy and security for your design work you should register as a new user by entering your name and email with the security text in the spaces provided at the bottom of the log-in screen. You will receive a personal password in your email address, and this allows you to work privately and to save your design work securely.

SolarLogic

FIGURE 59-1: SLASH-D LOG-IN SCREEN



When the program starts up, it contains a sample "Combi 101" solar heating system with a Boiler, one bank of Solar Heat Collectors, a Domestic Hot Water (DHW) tank, and a single radiant floor zone on one heat manifold. The user can change or add components and details to match the needs of job at hand. Basically, the program uses your input to calculate the need for space heat, domestic water heat and other heat loads. It also calculates the heat storage capacity of any concrete radiant heated floors. It then calculates the heat available from solar heat collectors and the size of any additional heat storage tanks required depending on the inputs which are all user interactive.

The program requires a surprisingly small amount of information from the user to begin producing useful hydronic piping diagrams and energy results for comparison. A brief description of some of the highlights are described below.

Job Page - Heat Loss and Local Climate

When you log in, the first thing you see is the “Job” page as shown in Figure 59-2. The design process is divided into pages that can be chosen in any order by clicking on the Tabs that appear across the top of the page. As the user fills in the yellow highlighted data fields, the calculations, diagrams and results begin to appear.

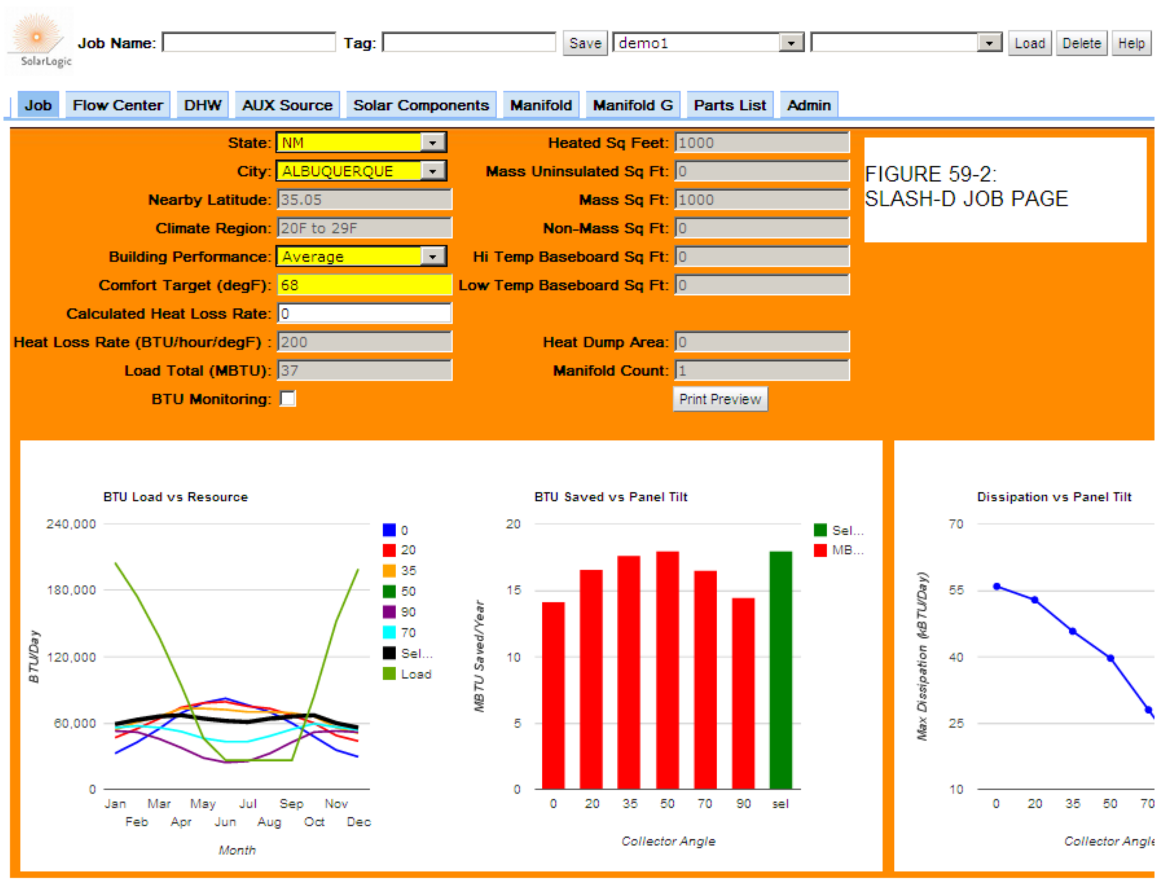


FIGURE 59-2:
SLASH-D JOB PAGE

On the Job page, you chose your climate (weather data) from a drop-down menu that most closely matches your project location. The heat loss from the building is calculated once the “Building Performance” and “Comfort Target” (indoor thermostat) values are entered. Remember to always scroll down to look at the graphics at the bottom of each of the Tab pages. The graphical results will continue to change as you enter data and change data values for comparison.

DHW Page - Domestic Hot Water Load

The DHW Page allows the designer to specify the hot water consumption expected per day, along with the size of the tank and a few other settings that allow the typical hot water heating load to be calculated over the year. A piping diagram and general parts list appears on this page that show how the DHW secondary piping is connected to the primary loop as seen in Figure 59-3.

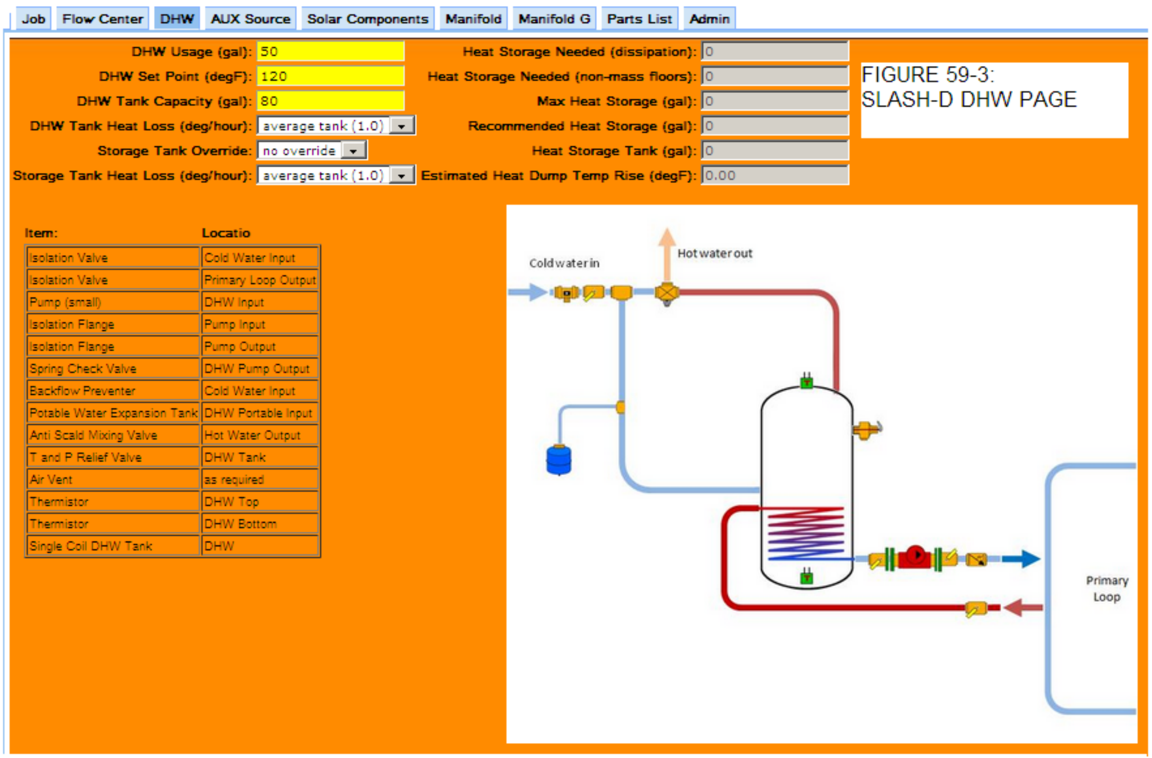


FIGURE 59-3: SLASH-D DHW PAGE

Manifold Page - Heat Distribution Zones

The Manifold Page provides inputs so that each heating zone can be described and assigned to a heating manifold with a circulator pump and zone valves. This is where the square footage of the heating zones is entered and the type of hydronic heat distribution is called out. (The heated areas in the building are calculated here and displayed on the Job page.) Radiant heated "Mass Floors" can be separated from "Radiator" zones or "Non- Mass" zones to allow for different temperatures required and the solar heat storage capacity of the masonry floors.

Solar Components Page - Solar Heat Contribution

The Solar page allows the designer to quickly chose what level of solar heat contribution is desired and the size of the solar heat collectors. Presently only flat plate collectors are on the drop-down menu. (More collectors and other features will be added over time.) The program recommends a reasonable number of collectors and the tilt, based on the inputs from all the Tab pages. Any input can be changed at any time to see what affect it has on the heat savings or plumbing diagrams. The user can over-ride the values recommended by the program if some other configuration needs to be evaluated, such as an existing roof size or a limitation to the collector tilt.

Key Results

The over-all primary loop configuration is seen on the "Flow Center" Tab page seen in Figure 59-4. The Flow Center diagram shows the skeleton of the heating system with details of the primary loop that ties all the major components together. The secondary loops are seen as block diagrams plugged into the primary loop, each with two closely-spaced tees. The plumbing details for each block can be found on the other Tab pages. Each plumbing diagram is accompanied by a general parts list, which changes as the diagram changes.

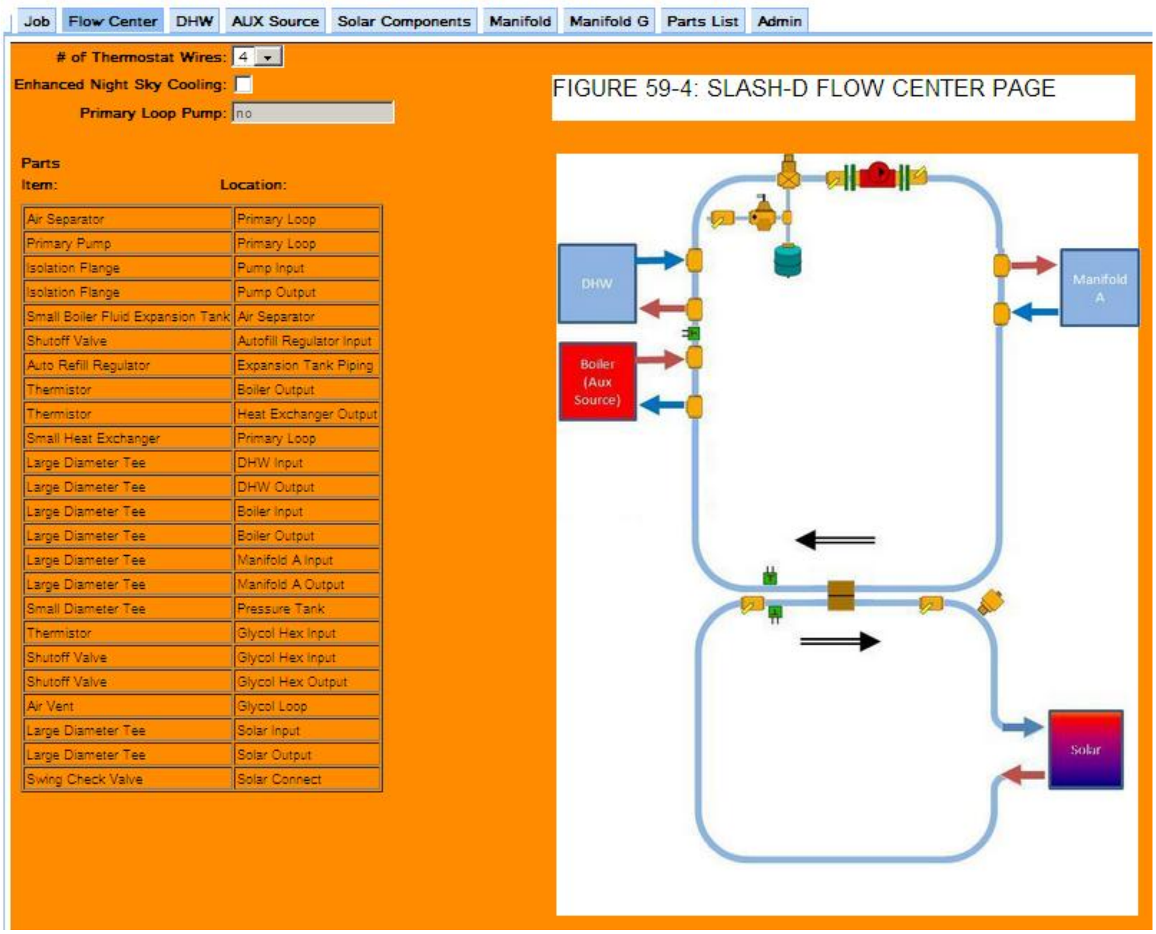


FIGURE 59-4: SLASH-D FLOW CENTER PAGE

Energy savings is calculated on the Solar Components page and is displayed as “MBTU Saved per Year”. This value changes as the number of collectors and their tilt are changed. The savings can be compared to the “Load Total (MBTU)” on the Job page to identify the solar heating fraction. The solar heat versus the heat load can also be seen month by month on the line graph at the bottom of the Job page. Any job can be saved at any time by giving it a Job Name and a Tag at the top of the web page and clicking the “Save” button. Each time a new model of a Job is created, it can be saved with a different Tag for comparison later. So for example, the “Smith” job could be modeled with four collectors and then eight collectors, and each model could be saved with a different Tag such as “4panel” and “8panel”.

This software is intended to provide rapid design assistance for the piping configuration and identification of the critical parts required in a standard primary-loop solar combisystem. It is not an all-encompassing engineering program. A prudent designer may still need to confirm the final pipe sizes, flow rates, heat exchanger specifications and pump sizes by other means. Especially if the SLASH-D results seem unfamiliar or lack the level of detail needed for a confident installation. We have found that after installing a few of these systems, new systems with similar and familiar sizes and configurations can be installed without much further analysis.

There is a lot more to this program than we can discuss here. When first trying the SLASH-D software, some additional helpful "quick start" instructions can be found by following the links to the SLASH-D on this web site: www.solarlogicllc.com. The program is under constant improvement and so you can expect more details and useful features to appear in the program as time goes on.

Final Notes

These articles are targeted toward residential and small commercial buildings smaller than ten thousand square feet. The focus is on pressurized glycol/hydronic systems since these systems can be applied in a wide variety of building geometries and orientations with few limitations. Brand names, organizations, suppliers and manufacturers are mentioned in these articles only to provide examples for illustration and discussion and do not constitute any recommendation or endorsement.

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