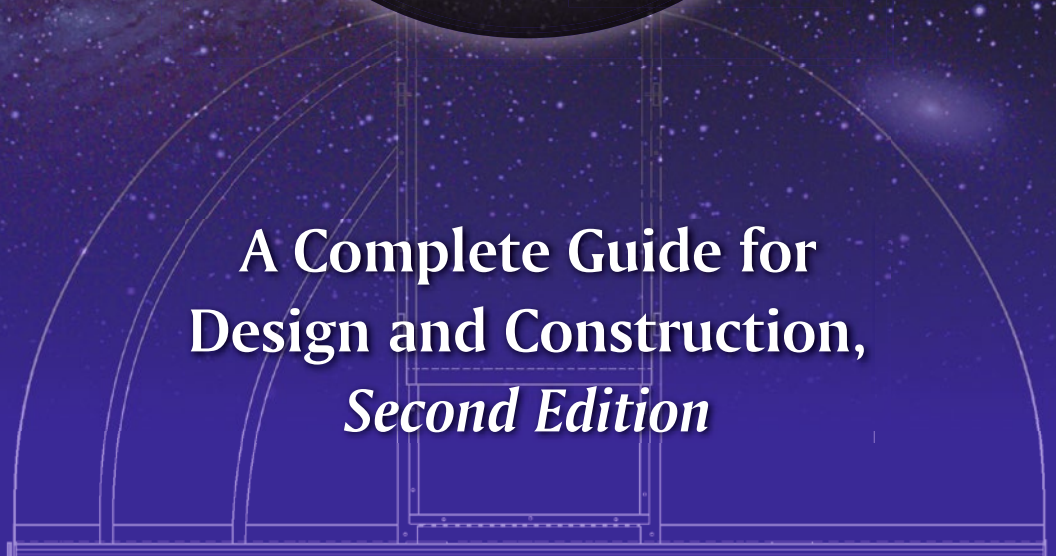
John Stephen Hicks

Building a Roll-Off Roof or Dome Observatory

A Complete Guide for Design and Construction, *Second Edition*



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This second edition, including dome observatories, is dedicated to my longtime friend and mentor in astronomy, Jack Newton. Jack is to be credited with introducing me to the fascinating study of astronomy and the long journey over 35 years I have had in discovering the wonders of the night and daytime sky. The study of astronomy has opened windows to new friends, star parties, and eclipse travels that have enriched my life. This book is the culmination of 35 years of progressive design of observatories, by trial and error, to what I believe are the two most popular designs, most sought-for by amateur astronomers.

Preface

Building a Roll-Off Roof or Dome Observatory has required several years in all to write, redrafting many diagrams and descriptions to arrive at the most practical and universal model illustrated in this book. At various stages, it was delayed for want of more information on existing observatories and at others carried forward again by a rush of newfound techniques. The prevailing private observatory models you see today involve the roll-off roof mechanism, but the ultimate goal in observatory ownership is the dome observatory—the historically recognized structure. There are a multitude of designs invented to achieve the same result, but only a few good ones, which consumed most of my research effort. Also, all things considered, no one writes a technical book on his own, and at various stages I happily reflect on the people who inspired me to undertake this work.

My beginnings in astronomy were unquestionably launched by the Royal Astronomical Society, Toronto Centre, almost 20 years ago, and by a single individual, Jack Newton, whose extraordinary enthusiasm for astrophotography and observatory building swept me up into a new pursuit. As years went on, attending the annual—Starfest—astronomy convention hosted by the North York Astronomical Association, and the Huronia Star Party Convention in Ontario, Canada, I was an occasional speaker talking about the design of observatories. Various refinements in the construction of these prototypes led to the ultimate design and creation of my own models that have stood the test of time. My wife, conscripted to help in construction, was indeed patient and understanding to put up with the countless hours of diagrams produced at the dinner table, and the geometry that was required to design such structures. As the observatory dome took shape from a skeleton of curved aluminum angle, she was always there to hold a wrench or brace a rib while it was riveted to the curved panels. Many a wrench or rivet gun found its way into the forest, hurled in frustration well into its interior from the lofty dome. It has always been a mystery to me how she endured those hot humid worksessions with the sun's reflection so strong it burnt our eyelids. She rightly deserves my fullest respect for her devotion to a task that was essentially only in "my mind's eye." My first observatory was a domed observatory, entirely self-designed. We named it "New Forest Observatory" because of its location in the center of our magnificent pine forest (Figs. P.1 and P.2).

The "prototype" turned out so well that in fact it became an extension of the telescope you might say. Inside, on sunny mornings, searching the surface of the Sun with my Lunt and Coronado hydrogen filters, I felt quite removed from the clamor of the rest of the world and found real adventure surrounded by the "machinery" of the observatory. Lured by its presence against the forest backdrop,

Fig. P.1 John Hicks beside his observatory within a 20 acre pine forest. (Photo by John Hicks)

I found it hard to do my usual work, and many a client took second place to an observing run in my beautiful observatory. As time went on with improvements, I felt compelled to share the design with others, so I embarked on selling plans for the structure far and wide. Little did I know that hundreds of plan sets would find their way around the world to places like Iceland, Africa, India, and even Australia. It was a real pleasure to share my inspiration with others just starting on the same journey. My first design for a real customer was a request from Don Trombino in Deltona, Florida, who asked me to design a Roll-Off Roof Observatory for solar astronomy.

Don and I were both avid solar astronomers with special requirements for refractors, especially long-focus refractors, which suited the incredible hydrogen alpha filters produced by Daystar Corporation, then in California. The model in this book closely mirrors that which I designed for

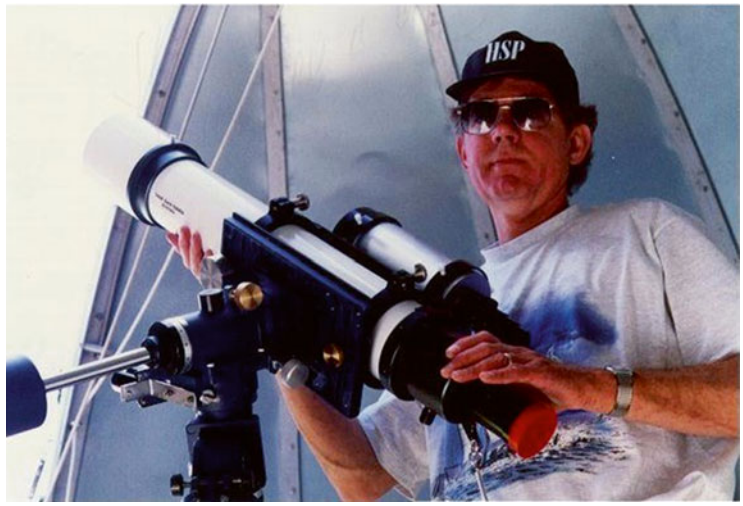

Fig. P.2 John Hicks inside the dome beside the main instrument—a 102 mm refractor. (Photo by John Hicks)

Don, which he dedicated as the "Davis Memorial Observatory" in memory of a close friend. We wrote articles together on "Shooting The Sun" and published articles and photos over the years in *Astronomy* Magazine (Figs. P.3 and P.4).

Don Trombino passed away in 1995, and I must believe his observatory still stands even as an elaborate garden pergola. I say this because he had self-designed an attractive patio under the gantry which held the rolled-off roof. He entertained many prominent guests under this enclosure celebrating his new observatory. Among them was Sir Patrick Moore. The most satisfying aspect of promoting a design is the conversations with clients who seek your help. Many situations arise that one never expects. Take the case of a Manhattan astronomer who had cut a hole in his roof for the observatory.

He called me in desperation with the building inspector and fire marshal at his door. They were demanding to know just what he was up to, perforating a large part of his roof. In a hysterical mood, he passed the telephone over to the fire marshal who inquired of me just what kind of structure the man was adding to his roof. I replied "an observatory of course!" I explained that I was a designer and supplier of plan kits for observatory structures all over the world. The "all over the world part" seemed to appease him somewhat, but he still wanted to know what qualifications I had. He was of course concerned over the draught potential created by the open roof in case of a fire. But I quickly informed him that it had to be sealed with a floor and trap door, in order for it to function properly anyway, as it must remain at ambient air temperature. This precaution seemed to provide him with the confidence he needed, and he left the telephone.

I presume all went well from there on as I was never asked for a set of plans by the fire marshal, or any other Manhattan agency.

I cannot overlook the inspiration which followed, from my good friend Walter Wrightman, endowed with a talent in both craftsmanship and inventiveness. Walter walked into my life after I had completed my first domed observatory, wanting to build one of his own. He was well on into old age, suffered from diabetes, and some disability in walking. Yet bounded by these restrictions he designed and built, by himself, a most unique domed observatory. Walter had no formal education past grade 8, drove a cement truck most of his later working life, and took up the science of astronomy like no one I have ever met. Walter and I spent luncheons and coffee breaks for the next few years discussing ways

Fig. P.3 Sir Patrick Moore visits Don Trombino's Observatory in Deltona, Florida. (Courtesy of Jeff Pettitt)

and means of creating better observatories. We went to star parties far and wide to glean ideas, studied the night sky together, and were both so proud of the two observatories we had created. We became known locally, at least around the Town of Newmarket, Ontario, as the Observatory Specialists. We even talked about prefabricating the domes worldwide and traveling to exotic places to site them, all the while meeting the enthusiastic people caught up in a similar rapture. It never happened. Walter eventually died almost blind and unable to move outside the room that imprisoned him. He never stopped talking about observatories nor the various ways to improve the structures. Eventually, his observatory was sold to a friend, who was happy to buy such an exceptional model. I miss his friendship, and his overwhelming devotion to astronomy and the building of observatories.

Fig. P.4 Don seated in the observatory finishing a solar observation and reading his notes. (Courtesy of Jeff Pettitt)

I cannot help but credit him with being the second most influential person toward the writing of this book. I hope such inspiration spreads over to you, the prospective—inventor—of such a structure, for inventor you will be, certainly in the eyes of others who may watch you build it. And remember, before you dedicate its use to just an observatory, it will also serve as a great garden patio enclosure, thanks to my innovative friend, Don Trombino. I credit Don also for most of my inspiration for writing and the idea of launching a book. My only regret is that he is not alive to finally see it. He would have been really proud to see his observatory that he treasured so well, finally in print.

Keswick, ON, Canada John Stephen Hicks

Acknowledgments

Photo Credits

Throughout the United States and Canada, I searched for owners of Roll-Off and Dome Observatories who had applied their skills to create designs that I would recommend to readers. In the Second Edition that search expanded to retail suppliers of Roll-Off Roof and Dome Observatories to provide options for those astronomers who felt reluctant to build their own observatory, or at least all of it. That search consumed most of my time in the process of writing this book, and proved to be a necessity. A design/build book would be uninteresting without images of actual observatories owned mostly by amateurs—people who are not by profession carpenters, builders, or contractors. Their innovative ideas sparked a lot of my enthusiasm for the task that lay ahead of me. Frankly, their creativity opened paths for many new ideas on techniques that I will use in future designs. For their generosity in supplying photos and descriptions I am most thankful. I know they will feel gratified seeing their particular model exhibited in the book, inspiring others with new construction ideas.

The following observatory owners and suppliers offered photos and/or assistance:

Jack Newton (Arizona Sky Village), Arizona
Donald Trombino (1998), Florida, USA
Richard Kelsch, Ontario, Canada
Gordon Rife (Cover Photo) Ontario, Canada
Mike Hood, Georgia, USA
Bob Luffel, IDAHO, USA
Jay Ballauer, Texas, USA
Greg Mort, Maryland, USA
Larry McHenry, Pennsylvania, USA
Rob Bower, Keswick, Ontario
Gerald Dyck, Massachusetts, USA
Jeff Pettitt, Florida, USA
Terry Ussher, Ontario, Canada
Guy Boily, Quebec, Canada

Doug Clapp, Ontario, Canada
Dave Petherick, Ontario, Canada
Paul Smith (1995), Ontario, Canada
Danny Driscoll, Ontario, Canada
Andreas Gada, North York Astronomical Association (NYAA), Ontario, Canada
Calvin Cassel Jr. USA
Alan Otterson (Albuquerque Astronomy Society, USA)
Walter Wrightman, Ontario, Canada
Brian Colville, Maple Ridge Observatory, Ontario, Canada
Art Whipple, Maryland, USA
Tatsuro Matsumoto, Japan
Jerry Smith, Home Dome Observatories, USA
Gary Walker, Pulsar Observatories, Norfolk, UK, and USA
Wayne Parker, Sky shed Observatories

Products

Companies and Suppliers that offered brochures and advice on their products include:

Andex Metal Products, Suppliers of Sheet Steel Roofing, Exeter, Ontario
Layton Roofing, Keswick, Ontario, Canada
Bestway Casters, Gormley, Ontario, Canada
Harken (Sailing Blocks, etc.) Wisconsin, USA
Schell-Ace Building Centre, Sutton, Ontario
Sky Shed Observatories, Ontario, Canada
Pulsar Observatories, Norfolk, UK, and USA
Home Dome Observatories, USA
Astro Engineering USA
Skywatcher Telescopes Ontario, Canada
Losmandy Astronomical Products, USA
DeMuth Steel Products (Domes), Ontario, Canada and USA
Arizona Sky Village, Portal, USA
Canadian Wood Frame Construction, Central Mortgage and Housing Corporation, Ontario, Canada
Home Renovations, Francis D.K. Ching & Dale E. Miller, Van Nostrand Reinhold, New Jersey, USA

Disclaimer

The author has made every effort to insure that all instructions given in this book are accurate and safe, but cannot accept liability for any injury, damage, or loss to either person or property—whether direct or consequential—resulting from the use of these plans and instructions. The author, however, will be grateful for any information that will assist him in improving the clarity and use of these instructions.

Jobsite Safety Provision

The author's instructions as written in the book, carried out on the construction site, shall not relieve the owner, or General Contractor of its obligations, duties, and responsibilities, including, but not limited to construction means, methods, sequence, techniques, or procedures, necessary for performing, superintending, and coordinating the Work in accordance with the plans, diagrams, and text in the book, and any health or safety procedures required by any regulatory agency. The author has no authority to exercise any control over any construction contractor or its employees in connection with their work or any health or safety programs or procedures. The owner agrees that he or his General Contractor shall be solely responsible for jobsite safety, and warrants that this intent shall be carried out in any contract he has with the General Contractor. The owner also agrees that the Author and the Publisher shall be indemnified by the General Contractor, if any, and shall be made additional insureds under the General Contractor's Policies of General Liability Insurance.

Full-Size Construction Plans are available from the author – please send e-mail or request To: John Hicks, P.O. Box 75, Keswick, ONT L4P 3E1, Canada jsh@interhop.net

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Part II The Dome Observatory

About the Author

John Stephen Hicksis a senior Landscape Architect specializing in Provincial Park Site Planning and environmental assessment. His spare time is spent managing his own forest and wildlife area, along with studying the surface of the Sun in his private observatory on his home property. Through the design and construction of his own observatory, he developed a complete package of construction plans which he has marketed worldwide.

Guest speaker at astronomy conventions in Ontario, Canada, John has for many years promoted the idea of building your own observatory, refining the process to the steps outlined in this book. He also designs and builds his own refracting and reflecting telescopes, again with plans to follow.

His special interest in astronomy is in the realm of solar observing and photography. For 25 years he has employed various Hydrogen alpha filters to examine the solar chromosphere, all the while improving photographic techniques toward capturing what the eye actually sees. He photographs flares, activity areas, and prominence dancing on the edge of the Sun. His astronomical presentations to astronomers are split between solar H-alpha techniques and observatory design and construction. He welcomes any inquiry on either subject, always interested in assisting people involved in astronomy.

Part I
The Roll-Off Roof Observatory

Chapter 1

The Benefits of a Permanent Observatory

Any astronomer familiar with setting up an equatorial telescope will realize the time required to level, polar align, and prepare an instrument for an observing session. In the case of a non-computerized system, the tasks involved with centering Polaris with its required off-set for the North Celestial Pole is daunting enough night after night. Even with a computer-assisted "scope," set-up time still involves the usual lugging of equipment out-of-doors from either residence or vehicle (although polar alignment is greatly reduced with computer alignment hardware). Final assembly can still stretch patience with the attachment of battery, dew heaters, and a myriad of wires connecting all the apparatus. Additional to all of this, many observers still have to carry out and assemble an observing table complete with sky charts, red light, lens case, camera and film. After completing this Herculean effort, particularly in northern latitudes, an astronomer usually begins to feel cold and exhausted while a degree of anxiety increases to finally use the instrument. This is often the prelude to damaging equipment or injury through acting too hastily with impatience. Repetition of such set-up experiences eventually discourages most observers who eventually reduce the frequency of their observing sessions, or trade the heavy equipment for lighter instruments with less aperture. The "lightening up" process works opposite to the usual "aperture-fever" affliction that burdens most astronomers with greater diameter lenses and mirrors and their subsequent weight increase. Under normal circumstances, amateur astronomers also find themselves observing out in the wind, in the cold, and eventually using an instrument that is covered with dew. In order to eliminate the majority of these unwanted effects, one really needs a permanent observatory. Simple forms of observatories are available, but almost of them also require a set-up time, offer little weather protection, and are not quite as "portable" as advertised. The primary decision involved with observatory design rests between choosing either a domed-type or a roll-off roof type structure. Both have distinct advantages however, depending on your personal observing needs—including the requirement for an all-sky view, protection from the environment, and degree of privacy. There are other design options for simple observatories such as the "clam shell roof," the new cylindrical domes, and various types of shelters or housings that roll away to expose the telescope. Although these may be simpler to construct, they most often expose the observer to the elements, and are more difficult to weather-seal when not in use.

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Pros and Cons: The Dome Versus the Roll-Off Roof

Many owners of the roll-off roof type prefer an all-sky view, and are willing to tolerate the residual effects of wind, cold, and less control over light pollution (without the benefit of being able to select specific sky segments as with the dome slot). They also may be interested in hosting large groups, which of course demands the more spacious accommodation offered by the roll-off model. The person demanding a high degree of privacy in his viewing may appreciate the canopy provided by the dome, although the side walls of a roll-off type observatory still afford a reasonable degree of privacy. It is hard to concentrate on solar viewing for example when a host of neighbors watch you set up and enjoy your fumbles. Solitude is important for concentration and speculation. Admittedly, the roll-off roof offers a substantial improvement over just an open observing site, while the domed observatory may further reduce most annoyances, achieving a completely sheltered structure. The crucial decision to make in selecting either is one of sky view. If you want to see the whole sky dome at once, the roll-off is the better choice (Fig. 1.1).

In addition, the roll-off roof type quickly cools down to ambient temperature with the entire roof rolled off and the instrument(s) entirely exposed to the open sky. Fast cool down is not as easily attained with a dome-type structure.

However, on the other hand one need only step outside to see the heavens, and concentrate on a portion of it inside. Cost factors and degree of skill enter into the equation also. The roll-off will be simpler to build (wood construction and no curved sections) and less expensive in parts and labor. But in terms of durability, the all-metal dome will outlast it.

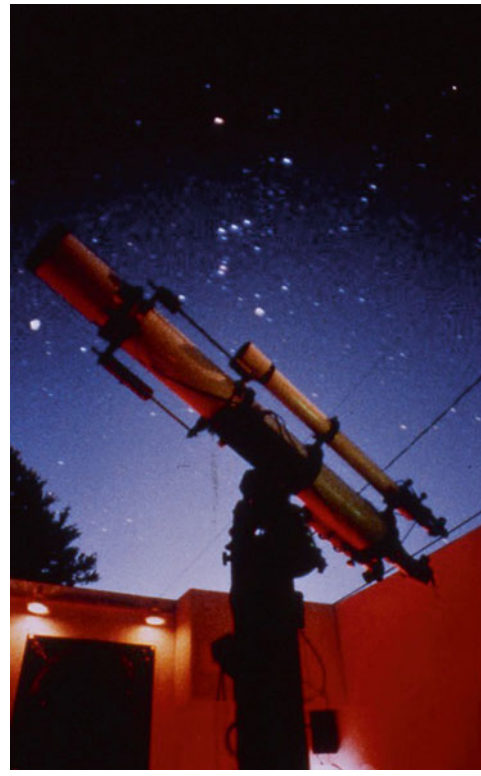

Fig. 1.1 The advantage of a completely open observatory—the glorious night sky dome (Courtesy of Jeff Pettitt)

Fig. 1.2 The author's domed observatory—while the sky is largely obscured except through the observing slot, its advantages are largely shelter from the wind and to some degree, the sun (Photo by John Hicks)

Identification of the dome as the "symbolic" structure used by astronomers may also be an asset to someone who wants to advertise to the community that their hobby is astronomy (Fig. 1.2).

On the other hand, one may want to maintain a lower profile in high crime areas, preferring to "hide" the facility as a garden shed. In essence, the choice is dependent on many factors, including site constraints and budget, along with the particular objectives and skills of the observer.

Roll-Off Roof Variations: The Sky Is the Limit

The observatory I designed for Don Trombino in Florida, fulfills both astronomical and landscape functions. With its exquisitely finished interior, and practical outdoor patio under the gantry, this observatory stands out prominently.

The owner, the late Don Trombino, was so proud of his achievement, that he spent almost all his waking hours either inside it or under the patio. He further extended the observatory feature out into the garden with a stone paver walkway leading across the yard terminating with a sundial monument. The floor under the roof gantry was also set in stone pavers and the underside of the gantry "ceiling" covered in a prefab wooden lattice. When not solar observing, Don spent many hours on the patio, examining the results of his photography, or writing. He dedicated the structure "The Davis Memorial Observatory" and symbolized the dedication with various artifacts and historical items placed in the garden and on walls of the structure (Figs. 1.3 and 1.4).

Once and a while certain observatories stand out as truly professional structures, finished to the point excellence. Such a model is Mike Hood's observatory, complete with outside porch under the gantry, featuring a door on the gable end. Mike has put extra effort into tapering the hip roof back from the gable ends, adding a small "cottage look" to his observatory. Very tastefully finished, it has an interior just as spectacular. His structure is long enough to hold a complete control room with desks, cupboards, an air-conditioning unit, and a window. Overall the control room has the appearance of a high-tech whiteroom, temperature-controlled and very well designed. Apparently the observatory was from an original model by "Backyard Observatories" (Figs. 1.5 and 1.6).