UNIVERSITY OF PORTLAND
SCHOOL OF ENGINEERING
MEMORANDUM

DATE: January 15, 2007

TO: All Students, ME 401 – Machine Design

FROM: Dr. K. E. Lulay $\mathcal{KEL}$

SUBJECT: Design of an Easily Transportable Telescope, an Example of a Project Proposal for ME 401

Summary
The purpose of this project is to design and construct an easily transportable telescope. The telescope shall pack in to as small of a volume as is practical. Having designed and built a previous telescope, and having several years of design experience in various fields, the author is qualified to design and construct the new telescope. Expected budget is $200 for materials and 100 hours of design a construction time. See Attachments for schedule and figures.

Introduction
The current telescope designed, built and owned by the author occupies substantial room in a vehicle while transporting it to observing sites. It is desired to have a telescope that is easily assembled and dissembled and can be packed away in a small volume for transport.

Newtonian telescopes consist of a primary mirror which gather and redirect light, a secondary mirror which directs the light from the primary mirror towards the eyepiece, an eyepiece to magnify the image, and structure to hold the optical elements in proper alignment (Figure 1). The optical elements (mirrors and eyepieces) occupy very little volume. Therefore, it is by minimizing the structural elements that volume savings can be realized.

Dobsonian telescopes are Newtonian telescopes that are placed on simple and inexpensive mounts and are the most common design amongst amateur telescope builders. The author's current telescope has a solid tube Dobsonian structure (Figure 2). Truss tube designs generally are more complicated to construct but may be partially dissembled making their volume substantially less during transport (Figure 3). These telescopes use thin tubes (approximately 1 inch diameter) to form a truss work for the structure that aligns the optics.

In addition to the truss work, truss tube telescopes consist of a rocker (to point the scope "up and down" in the sky) and a base/platform (to point the scope "left and right" in the sky). The overall design shown in Figure 4 contains all necessary components.

Proposed Project

As shown in Table 1, the primary criterion of this scope is to have minimal transportation size. Weight and ease of set-up and take-down are also important criteria. A modified truss tube design best meets the criteria. It will use two tubes and a series of strings to hold the secondary holder in place. This will be similar to designs described in various web pages [2, 3]. This design offers minimal structural size and weight. The other elements that will need to be designed and constructed include a rocker and rocker box, the base, the platform and the secondary holder (Figure 4). When disassembled, the entire telescope should be of satisfactory size and weight, as well as satisfy all other criteria in Table 1. The only criterion that may not be fully satisfied is criterion #5 – comfortable to use. See Attachment 3 for detailed schedule.

Since this is not a team project, the author will be responsible for all aspects of design and construction.

Statement of Work

K. Lulay – develop details of overall design concept, produce working drawings for the mirror box, rocker, the base, the platform, and the secondary holder. Determine bearing details, such as materials, between the rocker and the base, and between the base and the platform. Determine specific geometry (length and diameter) of tubes. Create a detailed drawing of the tubes. Select materials for all components. Select hardware to connect strings to rocker box and secondary holder. Construct the telescope.

The help of shop technician will be required for some machining work.

Qualifications, Experience and Facilities

Having designed and built a previous telescope, and having several years of design experience in various fields, the author is qualified to design and construct the new telescope. Facilities at the University are sufficient for the required minimal machining.

Budget

Expected budget is $500 for the mirrors and miscellaneous materials and 100 hours of design a construction time. See Attachment 2 for details.

If you have any questions or would like to discuss this proposal, please contact me at (503) 943-7432 or email me at lulay@up.edu. Thank you for giving this consideration.

References

1. http://members.aol.com/radcash/travelscope.htm
2. http://www.tms-usa.com/grayarea/janes16/jane16.htm
3. http://www.efn.org/~mbartels/osp2003/OSP2003.html

Attachment 1 – Figures and tables

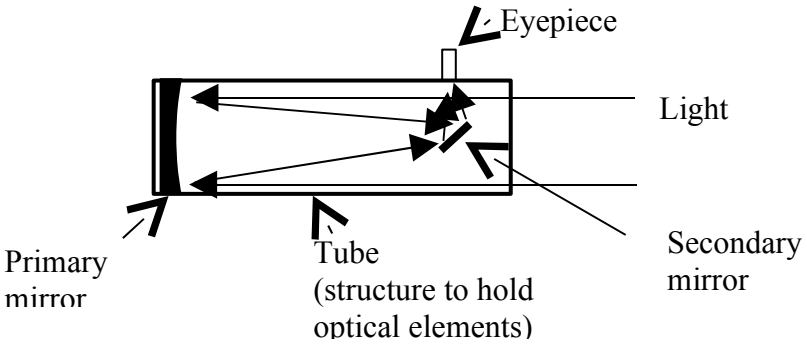
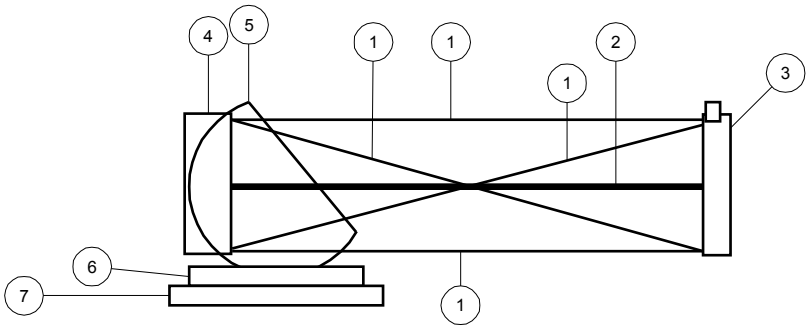


Figure 1 – basic Newtonian telescope elements

Figure 2 – Author's solid tube telescope.

(a) (b)

Figure 3 – (a) truss tube with cloth shroud and fully assembled. (b) The same telescope but disassembled for transport [1].



Item	Qty	Description
1	8	String
2	2	Compression tube
3	1	Secondary holder
4	1	Mirror box
5	1	Rocker
6	1	Base
7	1	Platform

Figure 4 – conceptual sketch of the transportable telescope. Note Items 1 through 4 comprise the main tube.

Table 1 – Criteria for easily transportable telescope

#	**Criteria**	**Priority**	**Description**
1	Use a 12 inch diameter mirror or larger	Essential	Anything smaller is insufficient
2	Fit inside a 15.5X34X11 inch box	High	Smaller is better
3	Easy to set up/take down	High	Easier is better
4	Comfortable to use	High	More comfortable is better
5	Lightweight (less than 40 lbs.)	Medium	Lighter is better
6	Contain innovative ideas	Low	Innovative is better
7	Aesthetically pleasing	Low	Nicer looking is better

Further description of criteria:

3 – Easy to set up/take down – can be done by one person in less than 10 minutes, in the dark, using minimal tools.

4 – Comfortable to use – it should be comfortable to use in all positions (from horizontal to vertical).

Attachment 2 – Budget

Estimated costs:

Item	Qty	Unit Cost	Total Cost
Mirrors (main and secondary)	1 set	$300	$300
Spotting scope	1	$40	$40
Misc. wood for box		$40	$40
Tubes	2	$10	$20
Misc. hardware		$40	$40
Miscellaneous		$60	$60

Attachment 3 – Schedule

(students please note, you will be required to submit a schedule created in ME Project.