THE UNIVERSITY OF TENNESSEE
AGRICULTURAL EXTENSION SERVICE

High-Tensile Wire, Sign-Post Tobacco Structure

University of Tennessee •Agricultural Experiment Station

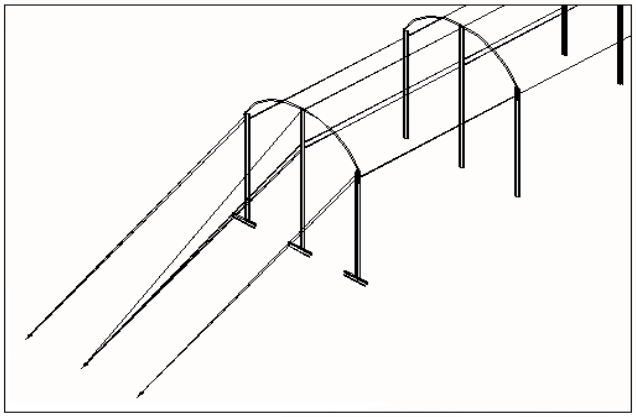
By Darrell Mundy, Don Fowlkes, Brad Gross, and Vickie Witcher

Introduction

The use of field curing structures in burley tobacco operations continues to grow in popularity among burley producers. As usage has grown, new ideas for designs and construction materials have been developed to reduce construction costs, lower labor requirements, increase portability, and extend the useful life of structures. One of the latest designs showing promise is the high-tensile wire, sign-post curing structure. The structure, originally designed by H. Coy Collins, a burley tobacco producer in Clay County, Tennessee, has a low construction cost compared to most other alternatives that are currently available and a projected longer life span than most wooden structures.

Structure Design

The structure consists of three parallel straight rows of street sign posts and smooth high-tensile fence wire (Figures 1 and 2). Spacing between the center row of posts and each side row is 42" in the design plans, but can be built to suit tobacco stick length and personal preference. Posts are driven 1.5' in the ground and can be spaced every 8' to 12' apart in the row. Designs and cost comparisons in this publication are based upon a 10' spacing between posts. All posts are 8' long except the end posts and every fourth line post in the center row. A 16" piece of 1.5” angle iron, sign post, etc. is bolted perpendicular to each end post about 20" from it's bottom end to provide added support against sinking caused by downward pressure on the end posts (Figures 3 and 4). The posts may be purchased new or purchased as refurbished items from an "after-market" distributor. Known locations where the posts can be purchased are discussed in a later section.



The high-tensile wiring is strung through holes near the top of the road-sign posts throughout the length of the structure (Figures 5 and 6). Tobacco is hung similarly as in a conventional barn with each stick end resting on a run of high-tensile wire. A run of wire to support each stick end consists of 2 to 3 strands of 12.5 gauge, 180,000 (minimum) psi high-tensile smooth, class three galvanized wire. There are four runs of wire in the structure; one through each row of side posts and two through the line of center posts. Two runs of wire, one run 4” above the other, are needed in the center posts for support of two stick ends and for ease of hanging with no stick overlap (Figures 7 and 8). Wire requirements based upon post spacing and wire sag are estimated in Table 1.

Ratchet or similar tensioners will be needed at one end of the structure to adjust tension in the high-tensile wire. A tensioner will be necessary for **each** strand of high-tensile wire that supports sticks of tobacco to reduce excessive sag in the wire. For added structure support, a single strand of high-tensile wiring is attached from the ground anchors to each of the end posts (Figure 5 and 8). To minimize friction wear on the high-tensile wire,

a plastic or metal grommet may be needed in each hole in each end post through which the wires supporting tobacco are strung.

The anchors at each end of the structure provide support for the high-tensile wire (Figure 9). An anchor will be needed for each line of posts and at each end, so 6 anchors will be needed for each structure built. The length and metal thickness of the anchors is extremely important. The design in this publication calls for a minimum 4' long auger type anchor with a 6" diameter auger face.

As an option, some farmers have successfully used two large trees (12”or more in diameter) as anchors for structures as long as 300-330'. If trees are used, a horizontal cross beam or brace must be bolted to the tops of the end posts to prevent the end side posts from bending toward the center end post when under load. Another option to using auger anchors is to dig a post hole (9" diameter or greater) and sink a heavy metal pipe, rod, I-beam, or heavy wooden post, 3.5' to 4' in concrete.

The black plastic roofing is supported by 3/4" black plastic PVC plumbing pipe. The pipe is cut into 11' lengths to form bows. The bows are installed from one side post over the wire ridge row of the structure to the opposite side post (Figure 1,6, and 7). The bows can be attached by either black plastic ties strung around the pipe and through the top hole in each post or by using duct tape (preferably with UV inhibitor). For added roof support, a single strand of high tensile wire is used as a ridge row (Figure 10). The wire is strung from the center anchor at one end of the structure, through the top hole of each of the 10' posts in the center row, and down to the center anchor at the other end of the structure. An additional ratchet tensioner for this strand of high-tensile wire is used to adjust for roof sag when the cover is placed on the structure.

To allow for adequate plastic overlap, three 16' x 100' black plastic covers are needed to cover a structure 280' in length. The plastic can be 4 or 6 mil, but 4 mil should be adequate in most situations.

Structure Capacity

The amount of tobacco each structure will hold will depend upon the individual producer's plant population, stick spacing in the structure, the number of stalks per stick, and the degree of wilt at time of hanging. The stick and acre capacities of a 280' structure are outlined below at varying stick spacing and stalks per stick.

Stick & Acre Capacity of A 280' Structure

As Stick Spacing and Stalks Per Stick Changes

Stick Spacing (in.)	5 Stalks Per Stick		6 Stalks Per Stick	
	Sticks	Acres*	Sticks	Acres*
4.0	1680	1.24	1680	1.48
4.5	1493	1.10	1493	1.32
5.0	1344	0.99	1344	1.19
5.5	1222	0.90	1222	1.08
6.0	1120	0.82	1120	0.99

**6,789 Plant Population, 22" X 42" Plant Spacing*

Locating Posts for Construction

Because road-sign posts along highways must be replaced from time to time, limited supplies of used and/or refurbished posts exist. These posts are typically straightened if necessary, repainted or re-galvanized, and then resold. Government regulations generally do not allow refurbished posts to be placed on pubic roads, so the posts are available in limited quantities usually at discount when compared to new price. A list of known new and used/refurbished sign-post distributors is listed on the following page. More sources should be available in other areas.

Several types of posts will often be available from distributors. For this structure, a post that weighs at least 2 lb. per linear foot is recommended. Although unnecessary and

more expensive, a heavier weighted post can be used if desired. Painted (often called "green posts") and galvanized posts will typically be available from new and used distributors. For this structure, painted posts are adequate and are less costly than galvanized posts if bought new.

New Post Distributors

Lojac Safety
Lebanon, TN
(615) 449-1401

Kleem Inc.
Westchester, OH
(513) 755-9000

Interstate Fence Supply Inc.
Mt Sterling, KY
(606)498-1234

Used Post Distributors

Sandusky Metal
Columbia, KY
(502) 384-4716

Hagan & Stone
Tompkinsville, KY
(502) 487-6138

Cost Evaluation

Construction cost will depend mainly on an individual's access to "after-market" posts as compared to new posts. Typically, new painted (2 lb. per foot) road-sign posts will run about 90 cents per linear foot. At this price, construction costs are estimated to total about $818 per acre (includes all materials and construction labor). After-market posts will often be cheaper but may not always be available. These posts normally cost about 40 cents a foot and will reduce construction costs for the structure to $545 per acre.

Compared to previous designs, the all metal structure should also have a longer life span and a lower annual cost as well. Given that the structure should last at least 20 years, the annual cost of this structure is estimated at $227 per acre using new posts and $197 using refurbished posts. The value includes depreciation, annual cover replacement cost, hanging and takedown labor, repairs, and investment interest. Property taxes and insurance were assumed to be zero for this particular structure. A detailed breakdown of all cost components is provided in Table 2.

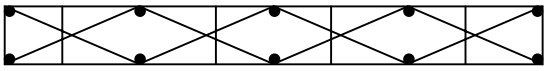
Precautions and Suggestions

Compared to typical post-row field curing structures, the high-tensile sign-post curing structure is different in many aspects. The following considerations should be noted in construction and use of this structure:

- ✓ ***Avoid Excessive Wire Sag***. As a rule of thumb, a 3" to 4" wire sag is a good compromise. More sag may cause the sticks of tobacco to slide together and will increase the chances for house burn. Less sag will require additional wires per run, more expense, and perhaps require boring larger diameter holes in most posts. Post spacing will also affect wire sag. As spacing between posts is increased, more wires may be needed to support the increased weight between the posts for any amount of wire sag.
- ✓ ***Timely Construction***. Because posts must be driven and anchors must be placed four feet in the ground at each end of the structure, construction timing is important. Early spring to early-summer installation is preferable because soil moisture is such that the anchors can usually be twisted in the ground using a piece of steel pipe, anchor drill, or tractor post hole digger (less the auger). Another option when construction is done under hard, dry soil conditions is to dig a post hole or small channel at each end of structure and set a steel or heavy wooden anchors in concrete at more expense.
- ✓ ***Anchor Length and Size***. Anchors that are too small in length and diameter may pull out when the structure is hung with tobacco. Anchors that are minimum 4' in length with a 6" diameter face should be adequate and are available at many farm supply stores.

- ✓ ***Anchor Placement.*** Auger-type anchors should be installed at an angle that lines them up with the high-tensile wire coming down from the end posts. They should not be screwed into the ground in such a way that they will be bent when the force is applied. For steel or wooden anchors sunk in concrete, the hole should be dug slightly off-vertical such that the length of the anchor (at ground level) is leaning away from the structure end post. A minimum of 12' distance between the anchor and the end posts is recommended.
- ✓ ***Driving Posts***. Posts can be driven in the ground by either a hand driver (minimum 3.5" diameter) or by a tractor-mounted front-end loader. Caution should be exercised when using a front-end loader to drive the posts. Posts can break or bend under the weight of the loader and can be dangerous to people working near or around the loader. A 4" diameter schedule 40 PVC pipe slipped over the post when pushing the post into the ground with the loader improves safety and serves as a depth gauge. A 6.5' length can serve as a depth gauge for the 8' posts while an additional 2' length can be added to serve as a depth gauge for the 10' posts.
- ✓ ***Securing High-Tensile Wire***. Any high-tensile ends that must be tied off should be done adequately. Use U-clamps and/or multiple metal crimps to secure the line when tying off.
- ✓ ***Tightening High-Tensile***. Several devices are available for adjusting the tension in the high-tensile wire. A ratchet or similar tensioner is recommended for **each** strand running the length of the structure.
- ✓ ***First In-First Out***. Early winter weather conditions can play havoc on cured tobacco in outside curing structures. When conventional barns are also used in an operation, hang early tobacco in the outside structures and remove the tobacco from these structures as soon as possible after it is cured.
- ✓ ***Hanging***. When hanging the tobacco, hang some tobacco at each end of the structure and move toward the middle. This method will even the amount of wire sag throughout the structure.
- ✓ ***Secure the Cover Properly***. Because the structure design may allow a "ballooning" effect from wind, good tying techniques are needed. A good method is to tie plastic baler twine to the top of an outside post and stretch the twine diagonally over the top of the plastic roofing to the next post on the other side of the structure and tie that length of twine to that post. Keep repeating this process down the length of the structure. Duplicate this procedure so that the twine pattern, as viewed from the top of the structure is x-shaped (criss-crossed) over the plastic between posts. An additional length of twine should be tied over the top of the structure in the center of each post span.

Top View of Section of Structure



- ✓ ***Low Structures***. Tobacco support wires that are 6' off the ground may result in tall tobacco coming in contact with soil or ground cover and may reduce quality. Mow under and around structures prior to hanging tobacco in them and remove cured tobacco as soon as possible to minimize tip leaf deterioration.
- ✓ ***Length of Structure***. There is no maximum length that has been tested. The largest structure of similar design being used by burley growers is 330' in length between supporting anchors. A structure that is 280' long works well for handling 100' rolls of black plastic and allows adequate overlap of plastic.

Table 1. Number of High Tensile Wires Required As Post Spacing and Wire Sag Changes

Using 12.5 Gauge, 180,000 PSI High-Tensile Wiring

Stick Weight (lb)	**35.0**				**Wire Diameter (in)**	**0.095**
Stick Spacing (in)	**4.5**				**Wire PSI**	**180,000**
Stalks Per Stick	**6.0**				**Break Strength (lb)**	**1276**
Post Spacing (ft)	**Wire Sag (in)**	**Weight Supported Between Posts (lb)**	**HCT**	**Wire Tension (lb)**	**No. of Wires Required By Formula**	**No. Wires Actually Needed**
8	1	373	4480	4484	3.51	**4**
8	2	373	2240	2248	1.76	**2**
8	3	373	1493	1505	1.18	**2**
8	4	373	1120	1135	0.89	**1**
8	5	373	896	915	0.72	**1**
8	6	373	747	770	0.60	**1**
10	1	467	7000	7004	5.49	**6**
10	2	467	3500	3508	2.75	**3**
10	3	467	2333	2345	1.84	**2**
10	4	467	1750	1765	1.38	**2**
10	5	467	1400	1419	1.11	**2**
10	6	467	1167	1190	0.93	**1**
12	1	560	10080	10084	7.90	**8**
12	2	560	5040	5048	3.96	**4**
12	3	560	3360	3372	2.64	**3**
12	4	560	2520	2536	1.99	**2**
12	5	560	2016	2035	1.60	**2**
12	6	560	1680	1703	1.33	**2**

Wire Sag: The amount of sag in the high-tensile wire from the post to the center of the span between posts. Consideration should be given that excessive wire sag may cause the sticks to slide closer together between posts which increases the risk of houseburn during the curing process and contribute to tip leaf deterioration if leaves touch the ground.

Weight Supported Between Posts: Amount of weight supported between posts by each run of high-tensile. For this structure, each run will have to support one stick end or roughly 50% of the total weight of tobacco hung between posts. The structure consists of four runs of high-tensile wire, one on each side post and two on the middle post. A run consists of 1 or more strands of high-tensile wire.

Wire Tension: The pounds of tension needed in the run of high-tensile wires to support the weight of the tobacco at a specific post spacing and wire sag.

No. of Wires Required by Formula: The estimated number of wires needed to support the weight of the tobacco given a specific post spacing and wire sag. This value is calculated by dividing the pounds of wire tension by the break strength of the wire.

No. of Wires Actually Required: The number of wires actually required is the number of the wires required by formula rounded up to the next whole number. This is the value that should be used when estimating the number of wires needed in a run.

Table 2. Construction Costs For A High-Tensile Wire Metal Post Curing Structure

Based On New Post Cost

Stick Spacing (in): 4.5				**Plant Population:**	**6,789**	
Stalks Per Stick: 6.0				**Acres of Capacity:**	**1.32**	
Item	**Description**	**Unit**	**Amount**	**$/Unit**	**Total $**	**$/Ac**
Posts and High Tensile Wire						
High Tensile Wire	12.5 gauge, 180,000 PSI	1000 ft	3	$14.00	$42.00	$31.82
Posts*	8' Side Posts	each	79	$7.20	$568.80	$430.98
	10' Center Posts (Every 40 ft.)	each	8	$9.00	$72.00	$54.55
Post, Angle Iron, etc.	16" Endpost Footers (6 total)	ft	8	$0.90	$7.20	$5.46
Roofing Materials						
Bows	Black Plastic 3/4" PVC Pipe	ft	319	$0.25	$78.28	$59.31
Cover	16' X 100' Roll-Black Polyethylene, 4 mill	roll	3	$19.37	$58.11	$44.03
Twine	Black plastic baler twine	ft	1540	$0.002	$3.23	$2.45
Hardware						
Anchors	4' Red Auger Type	each	6	$8.50	$51.00	$38.64
Crimping Sleeves	For tying off high-tensile wire	each	78	$0.15	$11.70	$8.87
Black Plastic Ties (100 Pk)	To attach PVC bows to structure	pack	1.5	$7.95	$11.93	$9.04
Wire Tensioner	To adjust wire tension	each	9	$2.00	$18.00	$13.64
Gromet	Soft Copper 1/4" Tubing**	ft	1	$0.36	$0.36	$0.28
Nuts, Bolts, & Washers	3/16" Diameter (To Fit 1/4" Holes)	each	6	$0.10	$0.60	$0.45
				Total Material Costs	**$923.22**	**$699.52**
				Construction Labor Costs* **	**$156.25**	**$118.39**
				Total Costs	**$1,079.47**	**$817.91**

*This is the cost to purchase new painted posts weighing 2 lbs. per linear foot. After-market posts can be purchased for around 40 cents a foot ,which can reduce the cost of the structure to around $545 per acre.

**One can use a variety of materials for the gromet but the idea is to reduce wear on wire at each end of structure.

***Based Upon 25 Hours of Labor for Construction @ $6.25/hr.

Annual Cost of Structure Including Depreciation, Annual Cover Replacement, Hanging Labor, Takedown Labor, and Investment Interest

	New Posts	**Used Posts**
Depreciation (Over 20 Years)	$40.90	$27.26
Yearly Cover Replacement	$44.03	$44.03
Yearly Hanging Labor (@ $8/hr.)	$67.89	$67.89
Yearly Takedown Labor (@ $6/hr)	$25.46	$25.46
Repairs (1% of New Cost)	$8.18	$5.45
Investment Interest (1/2 New Cost X 10% APR)	$40.90	$27.26
Total	**$227.35**	**$197.34**

FIGURE 1

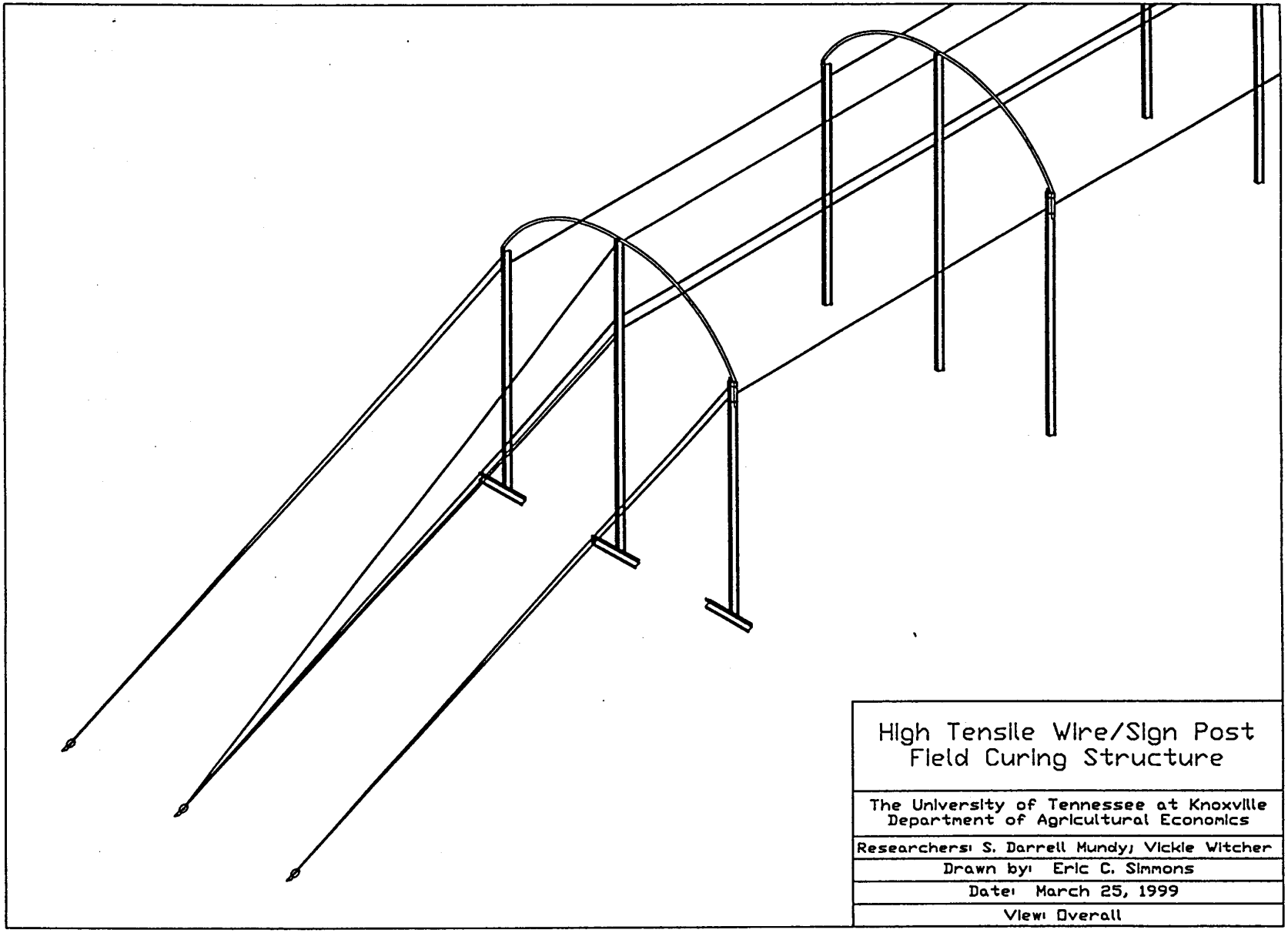
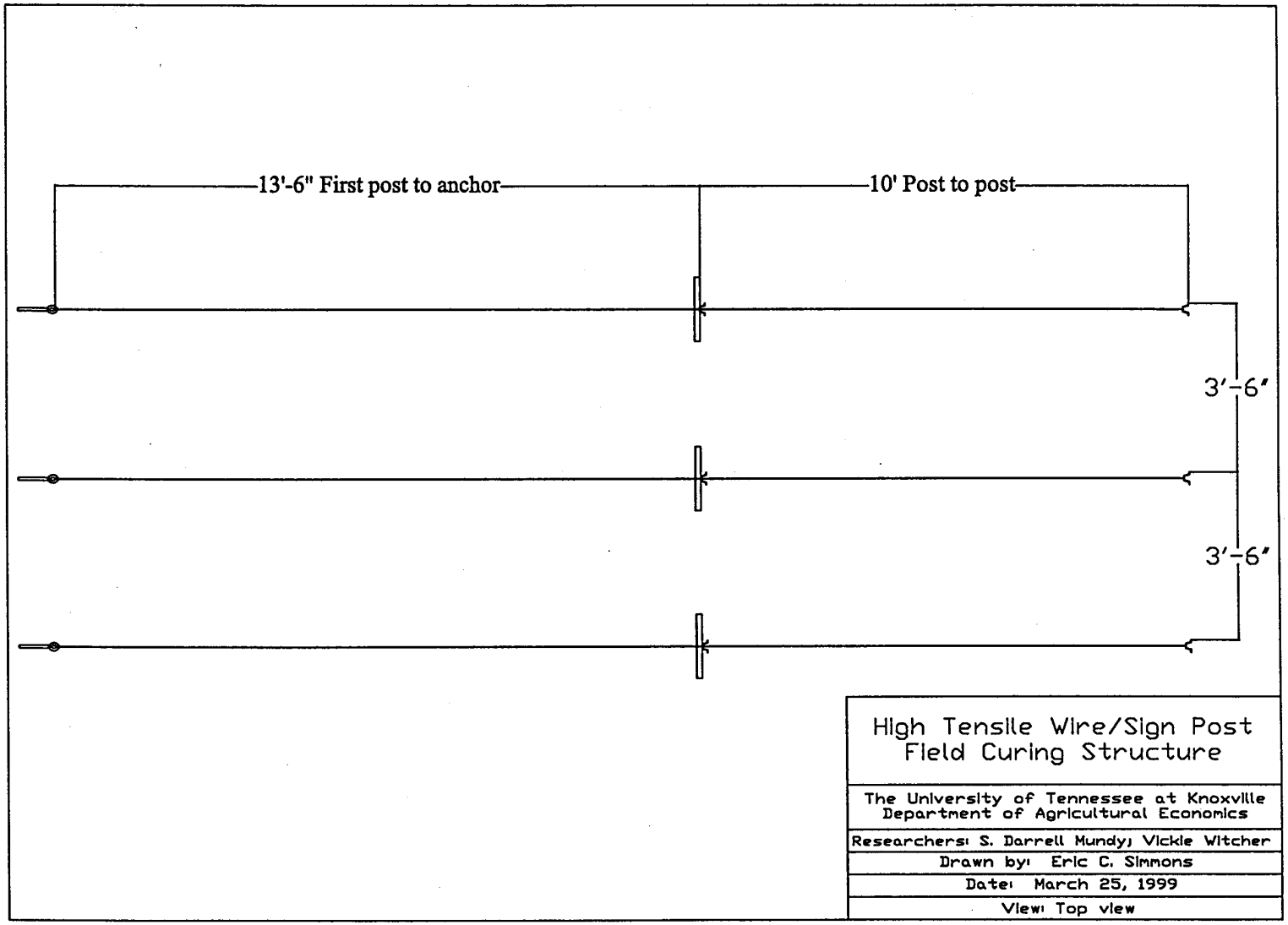

High Tensile Wire/Sign Post
Field Curing Structure
The University of Tennessee at Knoxville
Department of Agricultural Economics
Researchers: S. Darrell Mundy; Vickie Witcher
Drawn by: Eric C. Simmons
Date: March 25, 1999
View: Overall

FIGURE 2


13'-6" First post to anchor
10' Post to post
3'-6"
3'-6"
High Tensile Wire/Sign Post
Field Curing Structure
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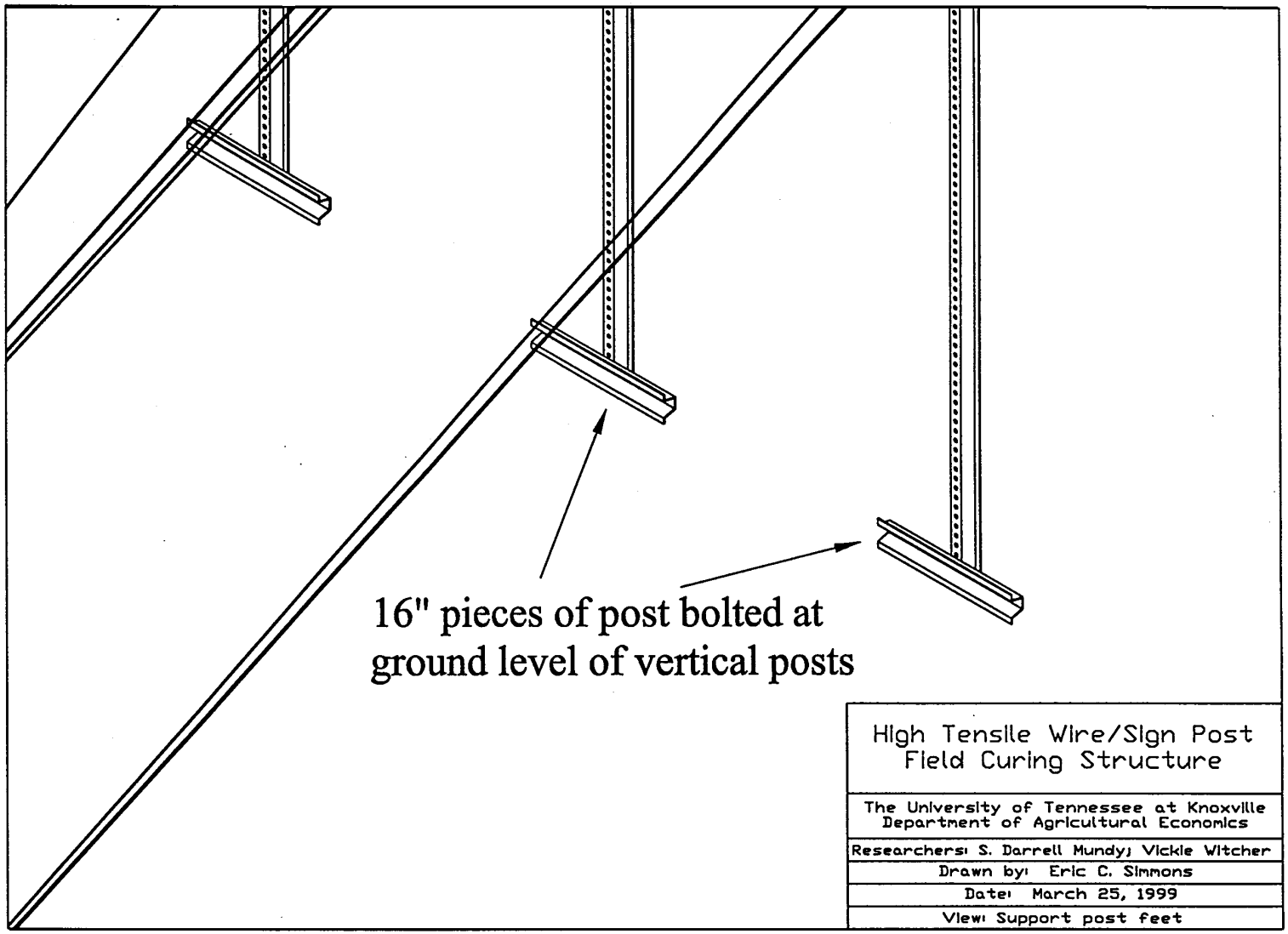
Date: March 25, 1999
View: Top view

FIGURE 3


16" pieces of post bolted at
ground level of vertical posts
High Tensile Wire/Sign Post
Field Curing Structure
The University of Tennessee at Knoxville
Department of Agricultural Economics
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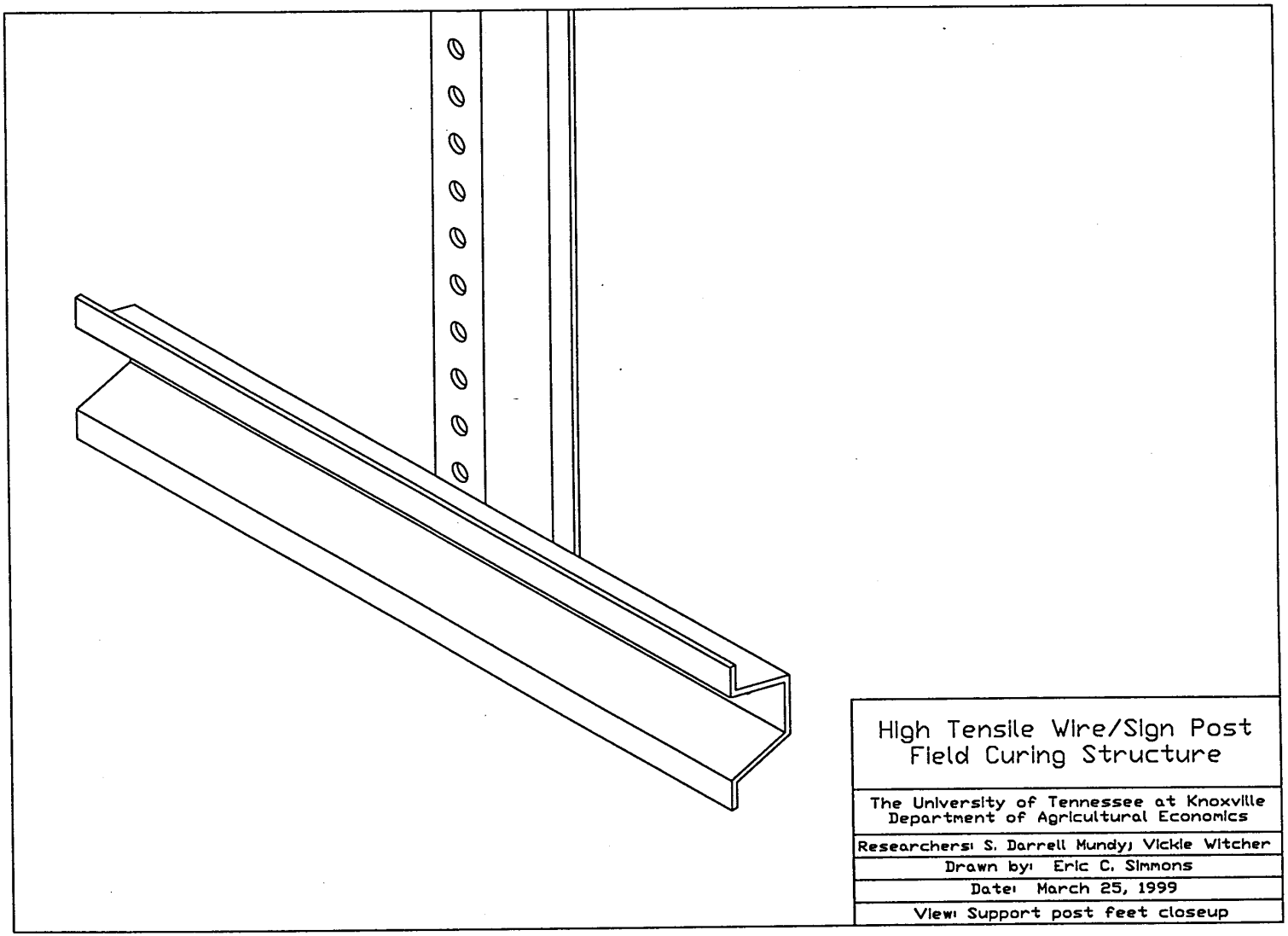
Drawn by: Eric C. Simmons
Date: March 25, 1999
View: Support post feet

FIGURE 4


High Tensile Wire/Sign Post
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Date: March 25, 1999
View: Support post feet closeup

FIGURE 5

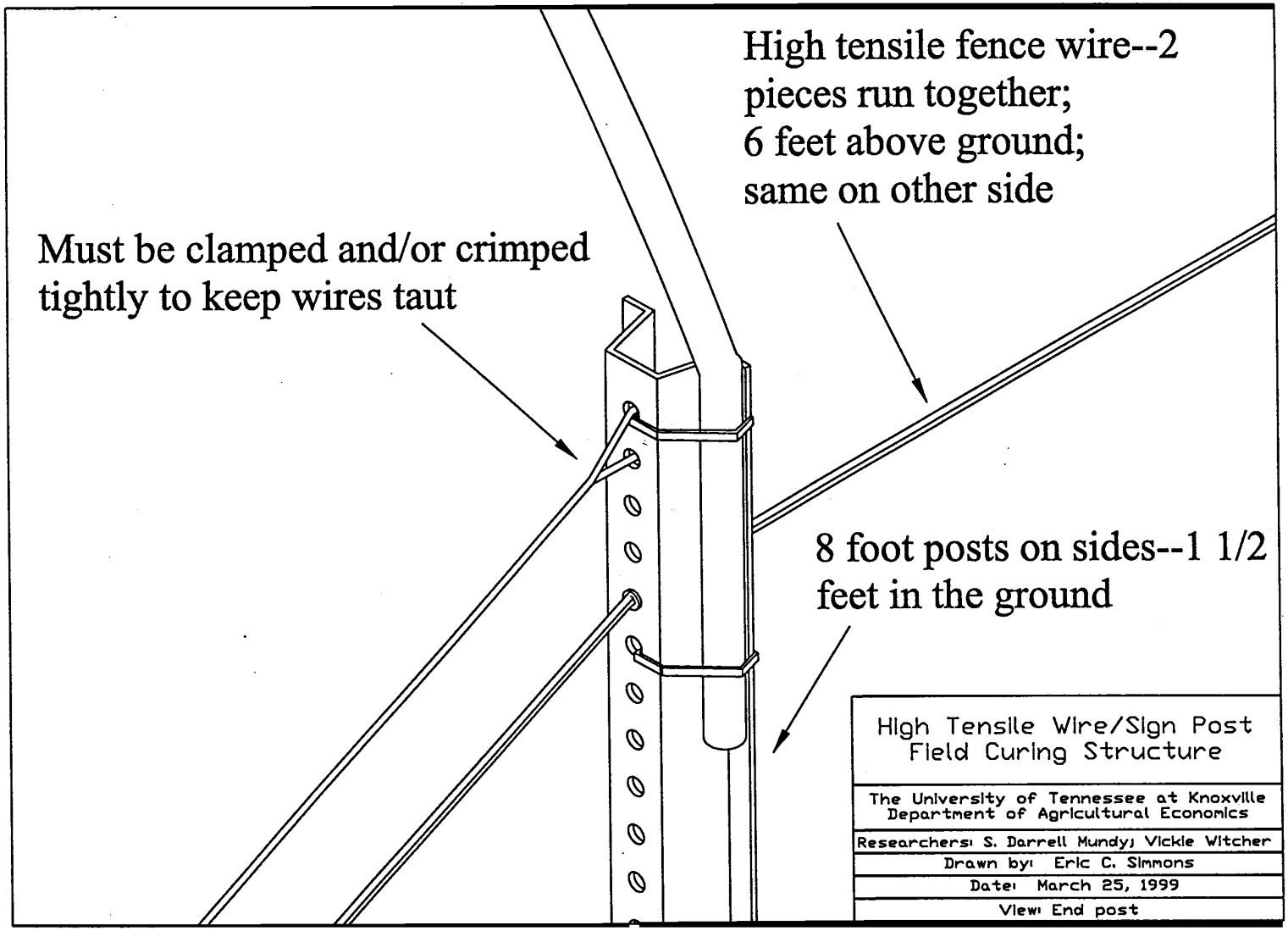
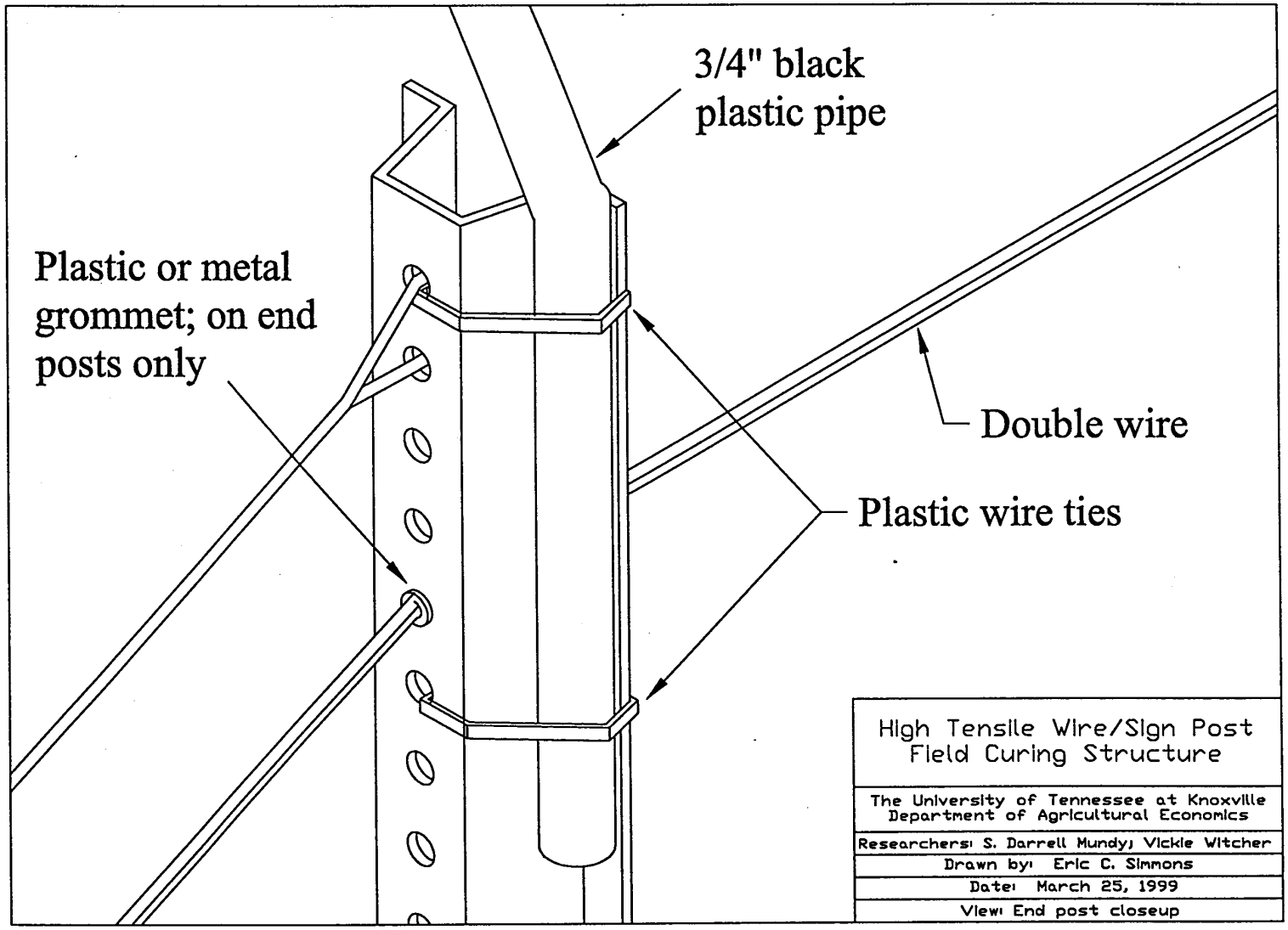

High tensile fence wire--2 pieces run together; 6 feet above ground; same on other side
Must be clamped and/or crimped tightly to keep wires taut
8 foot posts on sides--1 1/2 feet in the ground
High Tensile Wire/Sign Post Field Curing Structure
The University of Tennessee at Knoxville Department of Agricultural Economics
Researchers: S. Darrell Mundy; Vickie Witcher
Drawn by: Eric C. Simmons
Date: March 25, 1999
View: End post

FIGURE 6


3/4" black
plastic pipe
Plastic or metal
grommet; on end
posts only
Double wire
Plastic wire ties
High Tensile Wire/Sign Post
Field Curing Structure
The University of Tennessee at Knoxville
Department of Agricultural Economics
Researchers: S. Darrell Mundy, Vickie Witcher
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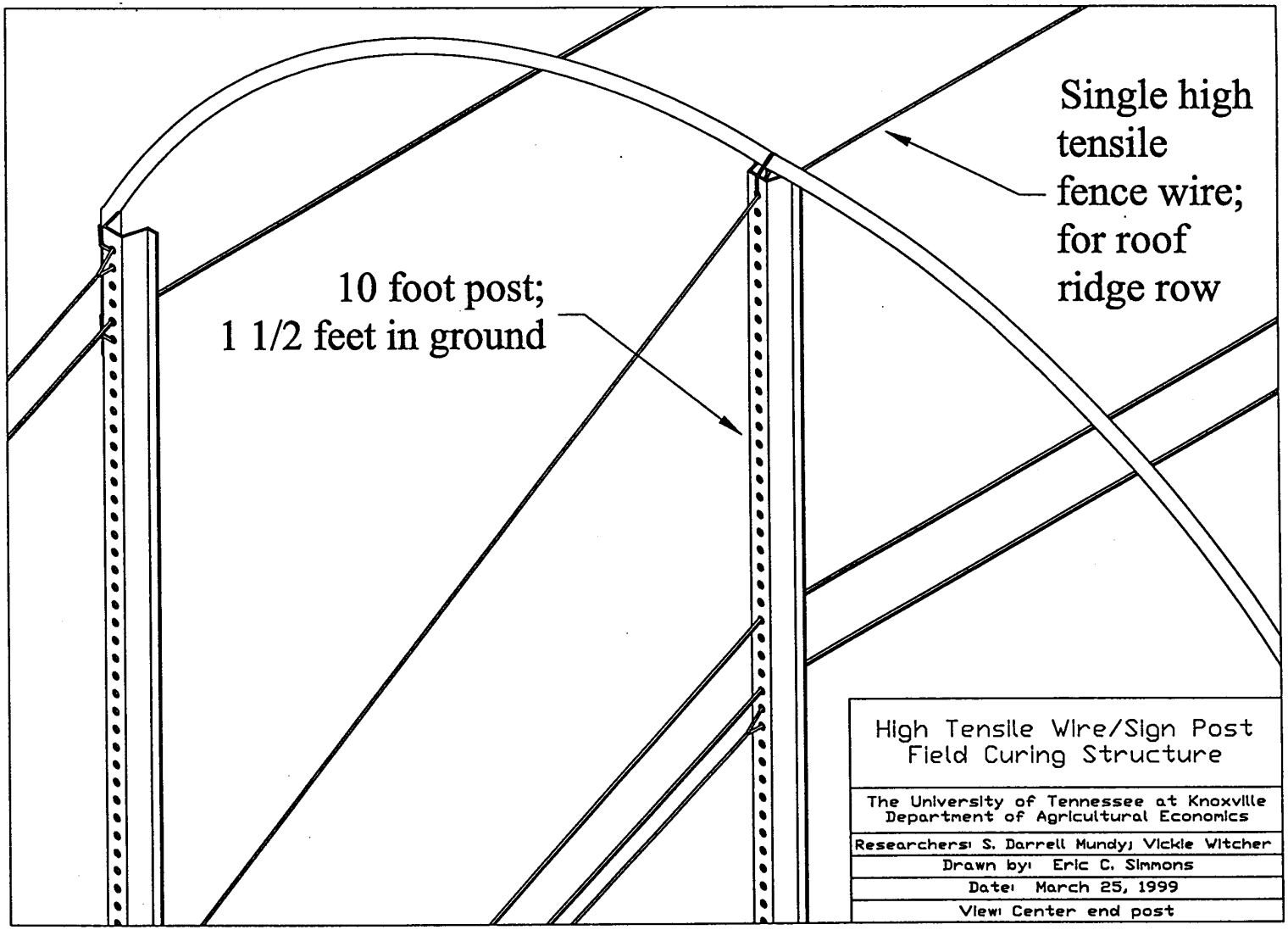
Date: March 25, 1999
View: End post closeup

FIGURE 7


Single high tensile fence wire; for roof ridge row
10 foot post; 1 1/2 feet in ground
High Tensile Wire/Sign Post Field Curing Structure
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View: Center end post

FIGURE 8

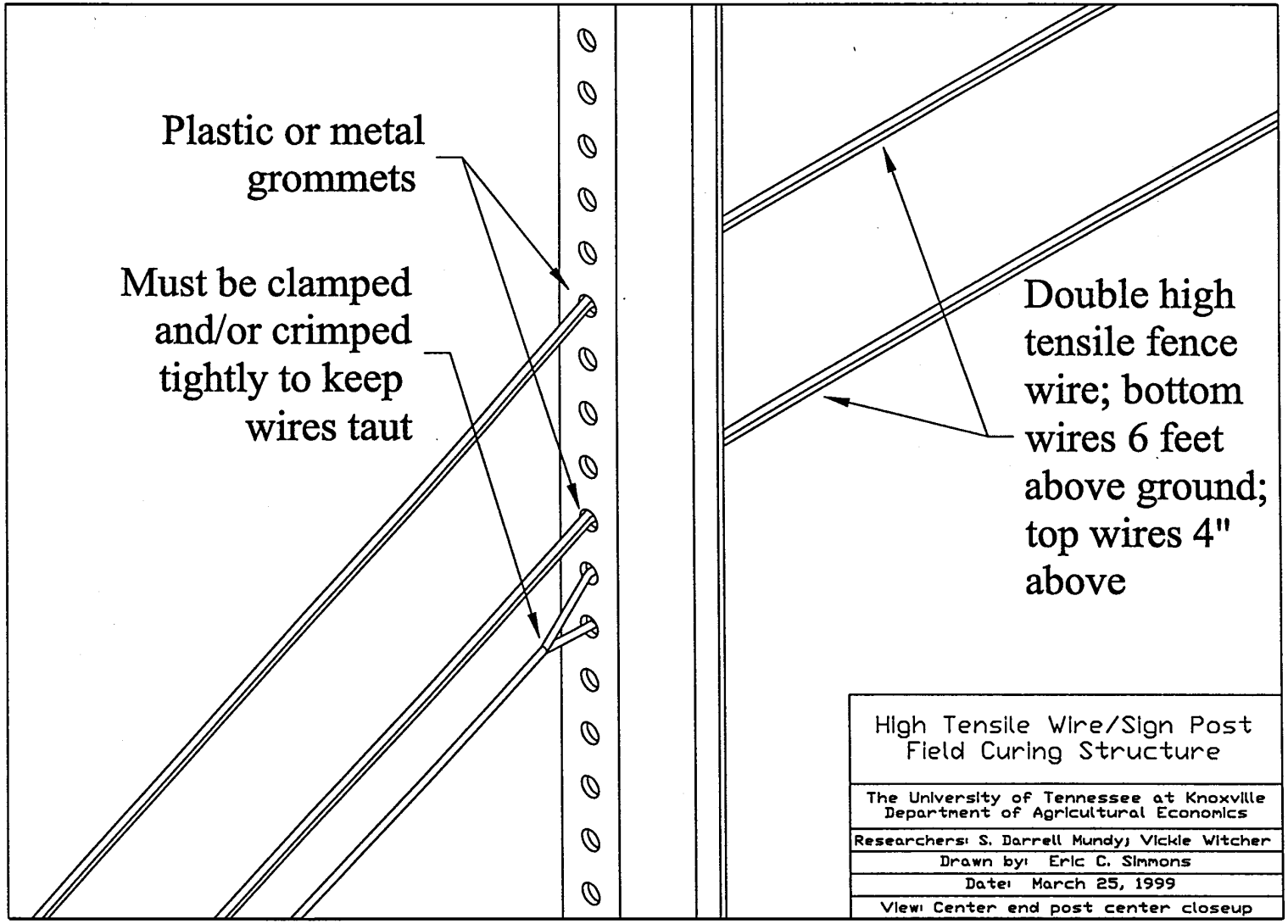
Plastic or metal grommets
Must be clamped and/or crimped tightly to keep wires taut
Double high tensile fence wire; bottom wires 6 feet above ground; top wires 4" above
High Tensile Wire/Sign Post Field Curing Structure
The University of Tennessee at Knoxville Department of Agricultural Economics
Researchers: S. Darrell Mundy; Vickie Witcher
Drawn by: Eric C. Simmons
Date: March 25, 1999
View: Center end post center closeup

FIGURE 9

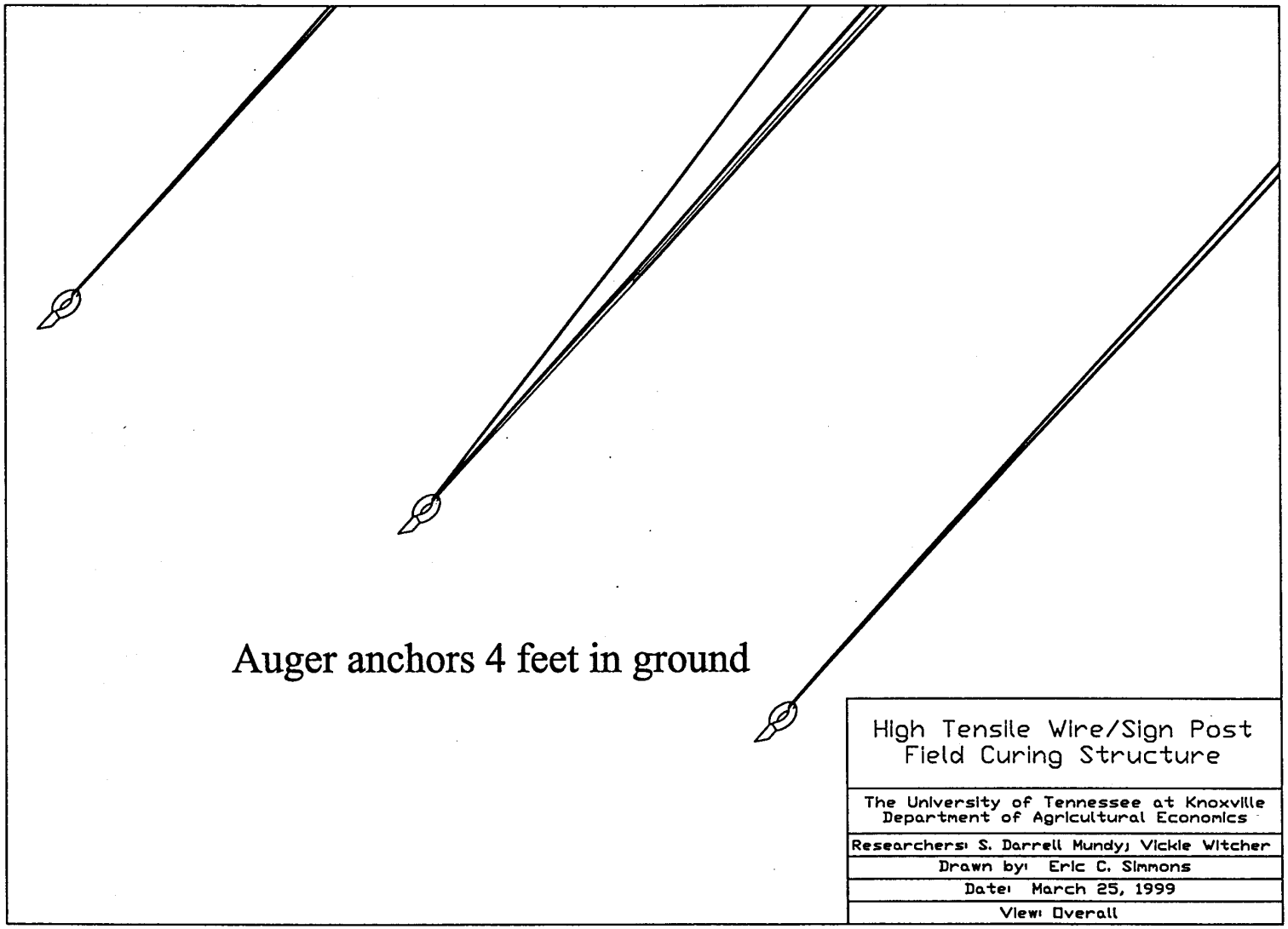
Auger anchors 4 feet in ground
High Tensile Wire/Sign Post
Field Curing Structure
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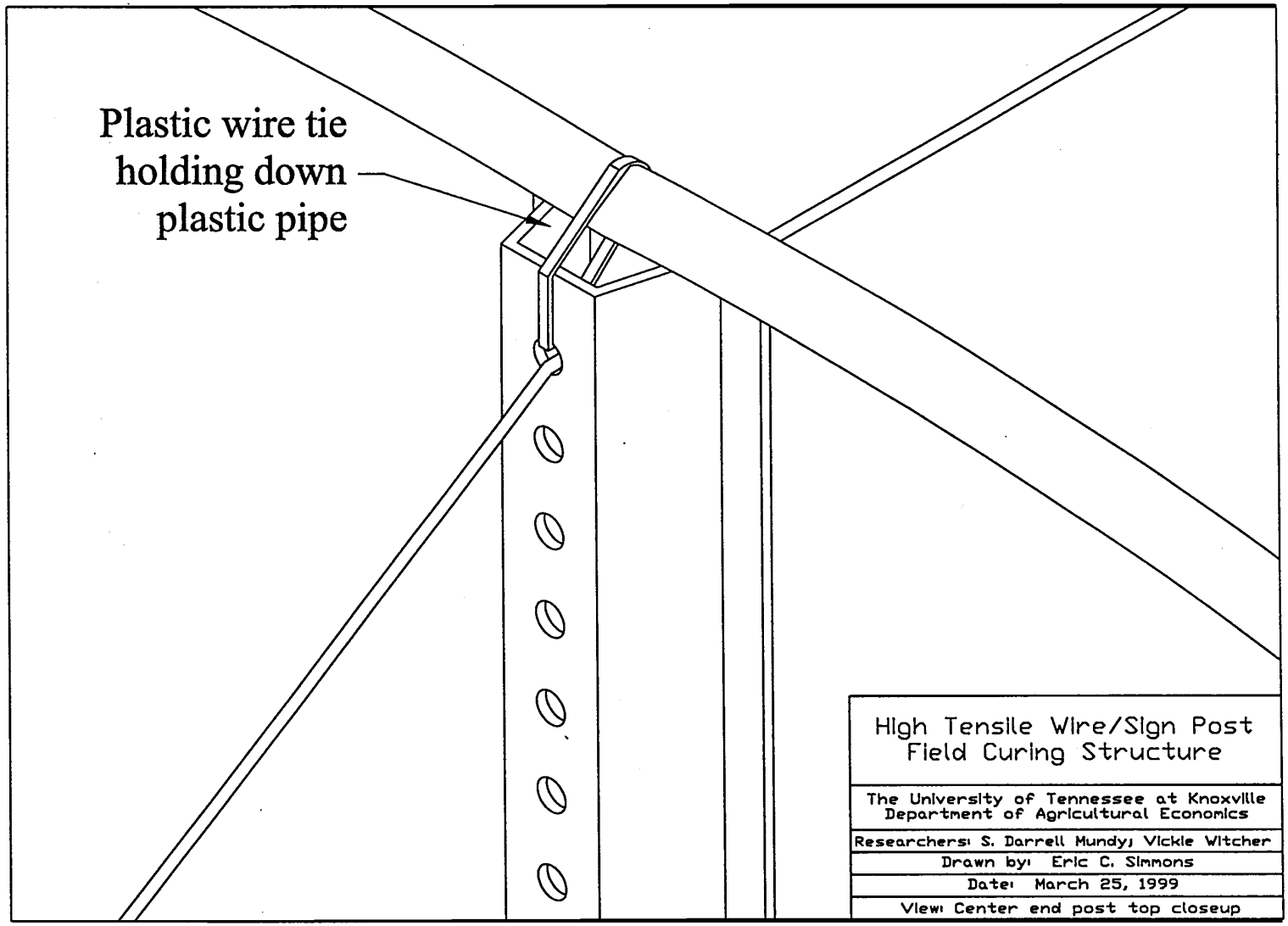
FIGURE 10


Plastic wire tie holding down plastic pipe
High Tensile Wire/Sign Post Field Curing Structure
The University of Tennessee at Knoxville Department of Agricultural Economics
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Drawn by: Eric C. Simmons
Date: March 25, 1999
View: Center end post top closeup