# INFORMATION ON CABLE HOIST TOBACCO HOUSING SYSTEM

## TABLE OF CONTENTS

1. Results of Farm Evaluations of Cable Hoist Tobacco Housing System ............... 2  
2. Guidelines and Barn Construction Details .................................................. 19  
3. Beam Construction ...................................................................................... 28  
4. Pipe Hangers, Jig Fabrication and Cable Clips ........................................... 32  
5. Bottom Steel for Beams and Jig Fabrication ................................................ 36  
6. Wheeled Beam Support Stand ...................................................................... 38  
7. Two-Wheel Single-Beam Trailer-Carrier ...................................................... 41  
8. Instructions and Precautions on Using the Cable-Hoist Housing System ....... 43  
9. Bill of Materials Estimates ......................................................................... 56  
10. Memorandum on Construction Materials and Procedures ......................... 57

---

By George A. Duncan, Extension Specialist, Agric. Engr. Dept., Univ. of Ky., Coll. Of Agric, Lexington, KY 40546-0276. 11-30-92, updated 4-2005
RESULTS OF FARM EVALUATIONS OF CABLE HOIST TOBACCO HOUSING SYSTEM

By

G. A. Duncan, L. R. Walton, J. H. Casada, L. D. Swetnam and B. Tapp

INTRODUCTION:

The placing of stalk-harvested burley tobacco into an air-cure barn ("housing") continues as the most laborious and timely of all production practices. Even though only approximately 10 percent of the total labor is required for this task (22 of 225 worker-housr/acre), workers must manually handle 1,200-1,400 units of tobacco (wooden sticks containing 6 plants each) several times in loading and transporting from the field and housing in the barn. Each unit can weight 25-35 lb. Much of the laborious work and drudgery involves standing on tier rails in a barn and handling tobacco to 25-30 foot heights which requires 3 to 6 workers.

Timely completion of housing is important. The harvested crop is normally left exposed in the field during favorable weather to "field wilt" for 2-3 days after harvest, thus losing moisture for less weight and initiating good curing processes. However, sudden rains can cause mud and moisture damage, thus reducing quality and market value.

Several labor-saving barn developments have been made and offered to tobacco producers in recent years but none has had meaningful impact on traditional housing methods (Yoder, 1969; Helbling, 1978)

This paper reports a labor-saving and cost-competitive cable-hoist system with many unique features that enable a worker at ground level to elevate and position 1,200-1,800 lb. of stick-harvested tobacco in a modified air-cure barn in two to six minutes with "push-button" effort. Cost and performance data are also reported.

PREVIOUS DEVELOPMENTS:

Many efforts have been made to alleviate the manual labor in housing stalk-harvested burley tobacco. Yoder (1969) developed portable curing frames for handling and housing tobacco with a modified farm tractor loader. The method saved more than 40 percent of the field loading, transport, and housing labor. A tractor operator stacked the frames two or three high into a modified open-interior air-cure barn. The method has had limited producer adoption, apparently due to the cost of equipment additions, barn changes, and reduced capacity of the barn.

---

1Extension Professor, Professor, Research Specialist, Extension Specialist and Research Technician, respectively, Agric. Engr. Dept., Coll. of Agric., Univ. of Ky., Lexington, Ky 40546-0276
Several inventors have proposed and/or patented various housing devices including rope and pulley arrangements, removable tier rails with latches, hanging frames, telescoping lift cylinders, and other forms of fork lift methods. Few practical applications of these devices are known to exist.

An innovation by Helbling (1978) was a cable-hoist type method consisting of a support rail with holes drilled 4 inches apart to receive and support sticks of harvested tobacco in a cantilever manner on alternate and opposite sides. Each beam had a pair of short ropes attached at the quarter points of length which hooked to two corresponding cables in the barn. The cables extended to the top of the barn, through two sets of pulleys, and down a post to connect to a hand-operated or electric drill-operated winch near ground level. Through these connections, a beam of tobacco was raised sufficiently that another beam could be hooked to the first, a third to the second, etc., until 4-5 beams were hoisted vertically in a continuous linkage. After reaching the limits of barn height or system capacity, the winch was locked and the tobacco remained to cure in this hanging position. Other cable, pulley, and winch units were mounted throughout the barn, one set for each 8 x 12 ft. of floor area. The cured tobacco was lowered to the ground in a reverse manner. Considerable labor savings were claimed by the inventor. Only three installations were known to have been made with the primary limitation of this method apparently being the high cost of the cable, pulley, and winch equipment and installation required for barn conversion.

The advantages and limitations of all these innovations and other known methods or concepts were periodically assessed by the authors in hopes of discovering a producer-acceptable system. Several good features of Helbling’s cable system prompted further consideration of significant improvements and development of criteria for a producer acceptable system.

CRITERIA FOR AN IMPROVED STALK TOBACCO HOUSING SYSTEM:

Several criteria for a tobacco housing system to be successful and acceptable were outlined. Included were:

1. Use the conventional barn. There are more than 200,000 such facilities in Kentucky with a replacement value of more than $8,000 each, or $1.6 billion dollars. We estimate any new technology contingent on new facility construction will be limited to only a two percent annual adoption rate corresponding to the normal replacement rate of the 40-50 year life facilities, or must be economical enough to justify forsaking the conventional barn.

2. Require minimum modification. Many existing barns are structurally sound whereas others may collapse with the next high winds. Modifications should be kept as
3. No workers in barn framework. Previous fork-lift, cable-type, and other methods have sought to eliminate the workers having to climb and work in the barn tiers or framework. Any new method should have these convenience and safety considerations.

4. Use only one or two workers. Tobacco housing should strive for a one or two worker system to alleviate the peak crew size and labor costs of conventional methods and be compatible with other mechanized farm operations.

5. Uncluttered barn during the off-season. Tobacco occupies a barn for only 3-4 months each year. Producers wish to use the facility for other storage, work, or livestock uses. A barn full of tobacco frames or special apparatus is objectional.

6. A workable method for the major producers. Tobacco producers include many small and part-time farmers of 0.5 to 1 acre size as well as the larger family and special tobacco farmers growing 10 to 50 acres. The average Kentucky allotment is just over one acre but the producers needing labor relief are the 5 acre size and larger producers. Any new technology should be favorable for the 5-10 acre producer as well as larger allotments and consolidated quotas.

7. Reasonable cost. The actual housing of tobacco involves 20-25 wk-hr/ac. A reduction of 50% offers little economic potential for a capital investment (e.g., 10 mn-hr/ac at $7.00/labor-hr = $70/ac/yr, or roughly $700 investment per acre of capacity over a 10-year period, excluding other economic factors). Thus a producer may have some "reasonable" cost to achieve significant labor and drudgery reduction.

GENERAL DESCRIPTION OF SPECIAL CABLE-HOIST SYSTEM:

The principles of Helbling’s system stimulated ideas on significant modifications and enhancements for a special cable-hoist system. The resulting cable-hoist tobacco housing system evolved from the concept of a portable hoist mechanism which quick-connected to a small cable permanently hanging from the top of the barn. A pair of cables positioned 12 to 14 ft. apart enabled two hoists to engage and lift the ends of a beam loaded with sticks of tobacco. In operation, the hoist wound itself up the cable, "pushing" a beam of tobacco into position in the barn framework, then reversed to descend and engage another filled beam, and repeated the cycle to another barn position. The hoist mechanism was remotely controlled by an operator through electrical "push-to-operate" switches. This hoist operation (hoist moving up and down a fixed cable) was opposite the traditional concept of an overhead hoist mechanism with a dangling cable and hook to engage and lift a load. The maneuvering of a top-mounted hoist mechanism in the top of a barn to align with structural members and have simple maneuverability plagued many a good idea previously.
The overall concept of the tobacco cable-hoist system is illustrated by Figure 1.

FIGURE 1: Schematic of cable-hoist tobacco housing system showing special beam, cables, cable attachment, hoists, controls, and cross-supports.
The wooden beam that received and supported the sticks of tobacco in a cantilever position on opposite sides was similar to Helbling's. However, it was distinctly different in that two wooden members were bolted together with spacer blocks to provide a slot for variable stick spacing and adequate stick support. The beams were built of such length to span the same distance as normal tier rails in a barn, 12 or 14 ft., and were supported in the barn by the same cross-supports (tier rail supports). The 14-ft beam was designed to support a load of 50 sticks of tobacco averaging 35 lbs each for a 1,750 lb uniform load. The 12-ft beam was designed to support 40 sticks for a 1400 lb uniform load.

The ends of the wooden beam had special bolted steel strap reinforcement for strength and safety. A sloped end of the beam (Figure 2) guided the beam past the cross-members on vertical ascent in the barn. Short 1-inch steel "cleat" extensions hook behind a safety block to more securely anchor and hold the beam safely in the barn when positioned on the cross-supports (Figure 3). Another set of steel "cleat" extensions interior to the beam ends provides more secure anchorage of the hoist when it engages the beam and prevents the hoist from slipping from under the beam during operation.

FIGURE 2: End fabrication and steel reinforcement of wooden stick-holding beams.
FIGURE 3: Modifications of barn tier-rail support to support beams and provide safety.

A chain-saw slit in the end of the beam allowed the cable to be readily slipped into and out of the slot to position the hoist underneath the beam for engaging and lifting the beam with the hoist attached to the cable (Figure 2).

The cables were required to have a safe working load rating above 700-800 pounds (5/32-inch 7x19 strand galvanized aircraft type chosen). The cables were permanently anchored to a 2-inch steel pipe at the top of the barn (under the rafters). The steel pipe spaned across and was attached to at least three rafters with strap hangers nailed to the rafters. One or all rafters were given supplemental support, when needed, by a brace to the stronger cross-support.

The cables were of sufficient length to hang within 24- to 30-inches of ground level to allow hook-up to the hoist units.

The hoists were required to be as compact as possible but with sufficient power to lift the load at the desired rate and have appropriate safety features. The desired lift rate
was set at 30 ft/min to provide desired user capacity. The power requirement for this rate and the 750 lb. load was computed as nearly 1.5 hp. After consideration of several design features including this power requirement, the need for near-instant reverse operation, safety overload provisions, portability, and compact size, a hydraulic-powered system was chosen.

No commercially available hoist units could fulfill the requirements for this tobacco hoisting system. Consequently, a special hoist was designed and fabricated (Figure 4). The hoist consisted of an aluminum frame for light weight, a drum for the cable, a gear reducer for speed and torque control, a hydraulic motor and hoses. Hydraulic power could be provided by either a portable 8 hp gasoline engine powered hydraulic system or appropriate tractor hydraulics. Subsequent producer operation proved the portable power system to be most convenient as tractor hydraulic systems were quite varied which necessitated almost an individual adaptation to each tractor. Besides, tractors proved to be too big and inconvenient to move around the crowded driveways during the hurried housing operations.

The first controls for the hydraulic system were a pair of 4-way manual valves on a moveable stand but operator position and visibility were limited. A conversion was subsequently made to a 12-volt electrically operated control valve with momentary-make toggle switches on a cable which allowed the operator to move around freely for hoist hookup and visibility.

In operation, the ends of the beam were maneuvered to different elevations (one end higher than the other) so the beam would pass between the barn cross-supports during ascent (or descent), then leveled and lowered to position safely onto the supporting members and blocks. Supplemental blocks (one or more) were used to establish a width sufficient for two beams to set end-to-end (Figure 3) and to provide a standard dimension for barn modification.

The special wooden beam that received and supported the sticks of tobacco in a cantilever position was filled either in the barn or the field. In the barn, a metal stand with small pneumatic wheels (Figure 5) was used to support the beam in the approximate position from which it was lifted up into the barn. Harvested and field wilted tobacco was transported to the barn by conventional vehicles (wagon, truck, etc.) and manually placed into the beam. The sticks were spaced about 6 inches apart on each side of the beam in an alternating sequence with one end of the wooden tobacco stick (size approximately 3/4 x 1 x 52 inches) extending through the beam about 4-6 inches. The plants were spread uniformly on the remaining 40-42 inches portion of the stick. A filled beam was lifted into the barn and positioned on the cross-supports by moving a cable with connected hoist into the sawed slit of each beam end (Figure 2), powering the hoist until it wound up the cable engaging the beam and locking behind the metal cleats, then further powering the two hoists to lift and maneuver the beam into position.
Note: This tobacco apparatus covered by Patent No. 4,508,482

FIGURE 4: Schematic of hydraulic-powered hoist.
An alternative means of filling the beams with tobacco was to transport the empty beams to the field with two-wheel trailer-carriers (Figure 6) and place the tobacco into the beam directly from the harvested stick-row. The beams remained on the trailers throughout the filling process and are transported back to the barn for hoisting directly into the barn from the trailers. This method saved the one extra manual handling and considerable labor at the barn. Several trailer-carriers could be hitched together for greater transport capacity per trip.

After curing, the beams of tobacco were removed from the barn in a reverse manner and lowered to the ground so the tobacco could be easily removed and handled for the subsequent leaf removal process ("stripping").

Two methods of positioning the beam for removal of the cured tobacco were evaluated. One method was to lower the beam so the tobacco tip leaves barely touched the ground and leave the hoists stopped in that position. The workers then removed the sticks from the beam and bulked the tobacco. This method resulted in the extra worker(s) being essentially idle while the next beam of tobacco was engaged and removed from the barn by the hoists and the operator. Considerable idle time occurred with this method.

Improvements resulted in a more efficient method. The metal stand of Figure 5 was modified by adding 4 small (10-inch) rubber tires with ball-bearings at the ends of the bottom support bars. This wheel-stand then permitted the beam of cured tobacco to be supported and rolled from the hoist area so the workers could be removing the cured tobacco while the hoist operator retrieved and lowered another beam. Workers were prohibited from being under a beam while in transit. In this manner, two independent operations continued simultaneously and essentially eliminated the idle time.

EXPERIMENTAL EVALUATION:

The cable hoist system was tested for two seasons at the Kentucky Agricultural Experiment Station farm, two seasons with six farm cooperators (5 in KY and 1 in TN); a demonstrational installation at the West Kentucky Research and Education Center, Princeton; the Tennessee Tobacco Experiment Station, Greenville; the Southwest Virginia Tobacco Research Station, Glade Spring and the Upper Marlboro Tobacco Research Farm, Upper Marlboro, MD.

Timed data were recorded on various operations at several of these locations and curing observations made. A survey questionnaire was presented to several hundred individuals who attended various demonstrations.

Labor comparisons were made between conventional housing and bulking methods and the cable-hoist procedures described above. Costs and economic comparisons were also made.
FIGURE 5: Metal stand to support beam in barn while filling.

FIGURE 6: Two-wheel trailer-carrier to transport beams to field for filling and return to barn to hoist beam directly into barn.
The data for the conventional housing method with 2-4 workers in the tier-rails and 1-2 workers on the wagon were summarized from data sheets completed by several farmer-cooperators for the time and labor required to handle tobacco directly from the wagons into the tier-rails. This procedure corresponded to the same techniques used for the cable-hoist data but does involve different barn types and crews.

RESULTS:

A summary of the labor comparisons for the combined housing and bulking operations showed the cable-hoist method reduced the labor requirements up to 45% percent depending on the procedure used (Table 1).

The procedure for transferring the tobacco from an adjacent wagon to the tobacco beam on the metal support stand and then hoisting the beam into the barn actually increased the worker-hours slightly, 0.4 worker-hour/acre or 3.1 percent. However, by using the trailer-carriers with the beams filled in the field and thereby ready to hoist directly into the barn which eliminated the extra handling in the barn and inherent idle time of the extra workers, worker-hours in the barn were reduced by 73 percent (9.5 wk-hr/ac or 73.1 percent).

Another procedure using the modified metal stand with the wheels which permitted filling a beam from the adjacent wagon while another beam was being hoisted was tried with results between the above two procedures.

The procedure of removing the beam of cured tobacco and leaving it suspended at ground level for bulking was slightly more laborious (1 wk-hr/ac or 8.3 percent) than data for conventional methods of dropping the cured tobacco from the various tier levels, then picking it up and bulking. This beam removal procedure had the inherent lost time of some workers being idle while a beam was being lowered form the barn.

Again, when an alternate method was used - the wheel-stand - where the workers were removing the tobacco while another beam was being lowered, the idle time was essentially eliminated and a reduction of 14 percent (1.7 wk-hr/ac) resulted for bulking.

Overall, the least efficient combination of cable-hoist housing and bulking (fill beam on stand and hoist up, and remove cured tobacco from the suspended beam) actually increased the worker hours by 0.6 wk-hr/ac or 2.4 percent. The use of the improved wheel-stand for bulking resulted in a decrease of 8.4 percent (2.1 wk-hr/ac).

The most efficient combination of hoisting directly from the trailer-carriers and using the wheel-stand for bulking gave a reduction of 44.8 percent (11.2 wk-hr/ac).
### TABLE 1: LABOR COMPARISONS FOR CABLE-HOIST AND CONVENTIONAL HOUSING METHODS.

<table>
<thead>
<tr>
<th>METHOD</th>
<th>W-H/AC&lt;sup&gt;a&lt;/sup&gt;</th>
<th>COMPARISONS</th>
<th>W-H/AC</th>
<th>% CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONVENTIONAL:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-barn Housing:</td>
<td>13.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remove &amp; Bulk:</td>
<td>12.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-Total:</td>
<td>25.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CABLE-HOIST:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method A:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fill Beam &amp; Hoist Up</td>
<td>12.6&lt;sup&gt;d&lt;/sup&gt;</td>
<td>-0.4</td>
<td>-3.1</td>
<td></td>
</tr>
<tr>
<td>Remove &amp; Bulk</td>
<td>13.0&lt;sup&gt;e&lt;/sup&gt;</td>
<td>1.0</td>
<td>+8.3</td>
<td></td>
</tr>
<tr>
<td>Sub-Total:</td>
<td>25.6</td>
<td>0.6</td>
<td>+2.4</td>
<td></td>
</tr>
<tr>
<td>Method B:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fill Beam &amp; Hoist Up</td>
<td>12.6&lt;sup&gt;d&lt;/sup&gt;</td>
<td>-0.4</td>
<td>-3.1</td>
<td></td>
</tr>
<tr>
<td>Remove &amp; Bulk w/whl. stand</td>
<td>10.3&lt;sup&gt;f&lt;/sup&gt;</td>
<td>-1.7</td>
<td>-14.2</td>
<td></td>
</tr>
<tr>
<td>Sub-Total:</td>
<td>22.9</td>
<td>-2.1</td>
<td>-8.4</td>
<td></td>
</tr>
<tr>
<td>Method C:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hoist Beam from Trailer</td>
<td>3.5&lt;sup&gt;g&lt;/sup&gt;</td>
<td>-9.5</td>
<td>-73.1</td>
<td></td>
</tr>
<tr>
<td>Remove &amp; Bulk w/whl. stand</td>
<td>10.3&lt;sup&gt;f&lt;/sup&gt;</td>
<td>-1.7</td>
<td>-14.2</td>
<td></td>
</tr>
<tr>
<td>Sub-Total:</td>
<td>13.8</td>
<td>-11.2</td>
<td>-44.8</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Worker-hours per acre, based on 1300 sticks of harvested tobacco per acre, actual work time in barn for handling tobacco from wagon to tiers, no idle time included.

<sup>b</sup>Timed data from 83 wagon loads on 10 different farms, 90-350 sticks per load, 3-6 tier barn height. Data provided by 10 farmer-cooperators.

<sup>c</sup>Published data, Maclin, et al., 1982.

<sup>d</sup>Timed data from 27 beam cycles, 2 farms, 3- and 5-tier heights.

<sup>e</sup>Timed data from 17 beam cycles, 1 farm, 5-tier height, removed tobacco directly from barn at ground level, hoist operation delayed.

<sup>f</sup>Timed data from 21 beam cycles, 1 farm, 3-tier height, beam shuttled 15-ft. on wheeled stand, hoist operation continuous.

<sup>g</sup>Timed data from 15 beam cycles, 3 farms, 3-tier height.
These data and results cannot realistically assess and enumerate the reduction in drudgery and consequent advantages of the cable-hoist method, especially safety, where no workers are in the barn and these workers not having to manually handle 30,000 to 40,000 pounds per acre of harvested tobacco 20-30 ft up into the barn. Also, the conventional barn data does not account for idle and lost time of the crew climbing into and from the barn and other typical delays. Consideration of this lost time would increase the margins of the cable hoist methods.

Curing observations indicated no noticeable differences due to the cable-hoist system in normal curing situations. Inadequate barn ventilation for curing and/or poor spacing and untangling of leaves at housing time have shown occasional signs of high moisture damage but these problems occurred with conventional tobacco under the same conditions.

Data on materials costs for a typical barn modification were estimated to be $300-$350 per acre of capacity (1300 sticks) and corresponding labor to be approximately 50 worker-hours for an added value of $250-$350 (Table 2). The total barn modification cost of $550-$700/ac was a one-time cost.

Fabrication of the wooden beams required $18-$20 each for wood, bolts, etc., and 1.25 to 1.5 worker-hour of labor for another $7-$10, thus giving a $25-$30 cost for each beam, or $750-$900 for 30 beams to hold 1,300 sticks of tobacco. The possible use of existing 3 x 4-inch or 4 x 4-inch tier rails for half of the beam lumber could reduce the beam costs by $200/ac. These costs were also a one-time investment.

The barn changes and beam construction can be done by farm or carpenter labor using plans and guidelines provided by the authors through the Agricultural Engineering Plan Service.

Note that the cash costs for the above required materials (excluding the labor and using existing tier rails) would be approximately $700-$800 per acre of barn capacity if a farmer did all the work himself or with available farm workers. This could reduce the cash costs of conversion.

The manufacture of the hydraulic hoist and electrical controls was licensed in 1990 to two firms through agreement with the University of Kentucky Research Foundation in accordance with a patent obtained on the system. A commercial market value of $3,400 to $3,500 per unit has been quoted for the self-contained unit which includes an 8-hp gasoline-engine-powered hydraulic pump, 12-volt solenoid operated hydraulic valves and tank mounted on a small two-wheel frame for maneuverability and portability.

The trailer-carriers required approximately $75-$100 of salvage steel and wheels.

The wheel-stand required $15-$20 of steel and 4 wheels of $40-$60 total.
### TABLE 2: ESTIMATED COSTS OF CABLE-HOIST SYSTEM AND BARN MODIFICATIONS.

<table>
<thead>
<tr>
<th>ITEM</th>
<th>COST/ACRE OF BARN CAPACITY</th>
<th>AMORTIZED COST/ACRE/YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Barn Modifications:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials</td>
<td>$300-$350</td>
<td></td>
</tr>
<tr>
<td>Labor</td>
<td>$250-$350</td>
<td></td>
</tr>
<tr>
<td><strong>Beams:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials</td>
<td>$600-$650</td>
<td>$183.00a</td>
</tr>
<tr>
<td>Labor</td>
<td>$250-$300</td>
<td></td>
</tr>
<tr>
<td>TOTAL (Materials + Labor)</td>
<td>$1,400-$1,650</td>
<td>$183.00a</td>
</tr>
<tr>
<td>TOTAL (Materials only, reuse tier rails)</td>
<td>$700-$800</td>
<td>$90.00a</td>
</tr>
<tr>
<td><strong>OTHER COSTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trailer-Carrier ($100-$130 each, use 3)</td>
<td>$300-$390</td>
<td>$8.28a</td>
</tr>
<tr>
<td>Wheel-Stand</td>
<td>$75-$120</td>
<td>$11.71a</td>
</tr>
<tr>
<td>Cable Hoist Hyd. Unit:</td>
<td>$3,400-$3,500</td>
<td>$119.00b</td>
</tr>
<tr>
<td>TOTAL (Materials, Labor, Equip.)</td>
<td>$321.99 (5 ac/yr)</td>
<td>$262.49 (10 ac/yr)</td>
</tr>
<tr>
<td>TOTAL (Materials only, reuse tier rails)</td>
<td>$228.99</td>
<td>$169.09</td>
</tr>
</tbody>
</table>

*aBased on 20-year amortization period with an annual charge of 11% on the average investment for interest, 0.5% for insurance, 1.0% for repairs.

*bBased on 10-year amortization period with an annual charge of 11% on the average investment for interest, 0.5% for insurance, 1.0% for repairs and for 5 acres/year or 10 acres/year.

The hoist and trailer equipment could be used in numerous barns on several farms per season depending on the size and effective utilization, thus reducing the per acre-year costs.

The amortization of this equipment, barn modification, and beam construction depended on the useful life and other pertinent criteria. A useful life could well be 20-30 years for the barn and beam components and 10-15 years for the hydraulic system.

*Note: 1990 Cost Data*
Sample economic computations of Table 2 use the assumptions noted in the footnotes.

Assuming an oft-quoted tobacco housing labor charge of $7.00/hr, the 11.2 wk-hr/ac savings of Table 1 results in a reduction of $78.40/ac. Thus the dollar value of labor savings did not compensate for the cost of converting a typical barn. The closest compensation is a producer reusing tier rails for part of the materials and not having hired labor costs which results in the estimated conversion costs of $169/ac/yr for 10 acres and 10 year amortization. A new barn system of 5 acres has been shown to be economically competitive with the traditional method. (Duncan and Swetnam, 1991) Other beneficial features such as the elimination of major drudgery or reduction of crew size are important reasons for producers to consider the cable hoist system.

Results of the questionnaire completed by persons attending various demonstrations showed generally favorable responses by the evaluators and some preferences for system features. In response to a question on the potential for adoption by producers, 11% gave an excellent rating, 65% gave a good rating, 24% gave a fair rating, and none gave a poor rating. The main objections were the high cost, small allotments and old barn difficult to convert.

General equipment preferences were for tractor hydraulic power (56%) but the portable gasoline engine was a close choice (40%).

A majority of the respondents preferred the manufactured power unit (77%) over a build-your-own choice (23%).

However, the beam construction was more of a compromise with 62% wishing to buy a hardware kit of the main steel items and then complete the wooden construction.

The method of hauling was rather evenly divided with 53% favoring the trailer-carrier method and 47% favoring the hauling and filling of the beam in the barn.

Several farm demonstrations and cooperative work have continued with producers to further evaluate and introduce the system.

SUMMARY:

A unique cable-hoist system has been developed that can reduce the labor by up to 45% for placing stalk-harvested tobacco in a barn for curing and later removing it for stripping. No workers have to climb and work in the barn, thus improving safety and reducing potential liability. Most of the physical drudgery is eliminated, thus offering desirable benefits to tobacco producers. Safety of operation has been a prime consideration in the development and evaluation of the method. A crew size of one or two workers can accomplish the same housing and bulking tasks of 3-5 workers by conventional methods.
The labor savings do not compensate for the amortized cost of the system over a 10-year period which has been typical of several past housing innovations. However, this method eliminates the drudgery of manually housing and has more desirable features than most previous methods. Also, it has been favorably evaluated by producers in several demonstrations. Commercial manufacture and producer adoption of the system is being pursued for the benefit of burley producers.

ACKNOWLEDGEMENTS

The authors wish to acknowledge and thank the following colleagues and tobacco farmers for significant contributions and cooperation in the early development and evaluation of the cable hoist system:

Mr. Carl King, Agricultural Engineer, Agric. Engr. Dept.
Mr. Jimmie Calvert, Research Specialist, Agronomy Dept.
Dr. Paul Legg, Professor, Agronomy Dept.
Dr. Phil Hunter, Superintendent, Tennessee Tobacco Exp. Station
Mr. Leo Link, Agronomist (Deceased), SW Virginia Tobacco Research Station
Mr. Claude McKee, Agronomist, Upper Marlboro Tobacco Research Farm
Mr. Evan and John McCord, Tobacco Farmers, Richmond (Madison Co.) KY
Mr. Steve Isaacs, (formerly) Farm Manager, Mountain City, TN

REFERENCES


48 FT. WIDE    3-DRIVEWAY BARN
FOR CABLE HOIST SYSTEM

(Option is 32-ft. Plan)
GUIDELINES & CONSTRUCTION DETAILS

FOR

CABLE INSTALLATION

AND

BUILDING BEAMS

FOR

CONVENTIONAL & NEW BARNs

USING THE

CABLE-HOIST TOBACCO HOUSING SYSTEM

by

George A. Duncan
Buren E. Plaster

Agric. Engr. Dept.
Univ. of Kentucky
Lexington, Ky. 40506-0075
March 20, 1989
Rev. 10-92
BARN CONSTRUCTION FEATURE,
FOR CABLE HOIST OPERATION

28" MINIMUM, MORE PREFERRED

BRACES ADDED AS REQUIRED

46" (-) 7'-6" TO 8'-0" 46" (-)

BRACE

SUPPORT BLOCKS ON SIDE WITH BRACES

SAFETY SCABS OR ANGLE

HOIST CABLES

11'-10" TO 12' OR "SWING" BEAM TO BE USED

24" TO 30"

END VIEW

TYPICAL POST-PIER-TYPE BARN

16 FT.
HOW TO DETERMINE BEAM LENGTH:

1. MEASURE CLEAR DISTANCE BETWEEN SEVERAL EXISTING TIER RAIL SUPPORTS, USE SMALLER DIMENSION (SHORTEST) AS A "BASE" DIMENSION.

2. MAKE BEAMS THIS LENGTH + MAYBE 1/2" TO 1"

3. ADD 2" BLOCKS AND SPACER SHIMS TO BRACE SIDE OF SUPPORTS SO BEAM HAS 1" + OF BEARING ON EACH END.

* NOTE: USE ONE OR MORE 1/2" TO 1" SPACER PLYWOOD SHIMS OR BOARDS UNDER BLOCKS ON WIDER SPANS TO MAKE ALL DIMENSIONS THROUGHOUT BARN THE SAME TO SUPPORT THE STANDARD BEAM LENGTH WITH 1 INCH OF BEARING ON EACH END.
INSTALLING HANGERS, PIPE, & CABLE

RAFTERS

DOUBLE WRAP CABLE
(Do not cross cable on top)

2" x 6" x 18" SUPPORT BLOCK
SUPPORT BEAM

7" x 10" x 5/8" PLYWOOD SAFETY SCABS W/ BEVELED EDGE OR ANGLE

RAFTER

SPECIAL GALVANIZED HANGERS W/ 6-1.5" PALLET NAILS

2" DIA. SUPPORT PIPE

2- 3/16" U-BOLT CLAMPS
SAFETY SCABS W/ 5-6 8d NAILS OR ANGLE

2" x 6" x 18" SUPPORT BLOCK W/ 7-8 4" RING SHANK NAILS

EXISTING SUPPORT BEAM

FRONT VIEW

SIDE VIEW

SEE DETAIL "A"

ROOF

PURLIN

© BAE Dept., U.Ky., 2005
1. ALIGN A PIPE-SUPPORT BRACKET DIRECTLY OVER APPROPRIATE TIER RAIL OR MEASURE DISTANCE AND NAIL LOOSELY TO HOLD PIPE. KEEP HANGER VERTICAL.

2. INSERT PIPE, ALIGN STRAIGHT, USE ANOTHER BRACKET TO PULL SNUG AND NAIL SECURELY. NAIL OTHER BRACKETS. LASTLY, LOOSEN AND RENAIL FIRST BRACKET, USE 6 NAILS IN EVERY BRACKET, 1/2" OR MORE FROM EDGE OF RAFTERS, NO BENDS, SPLITS, ETC.

© BAE Dept., U.Ky., 2005
3. FOR PIPE AT END OF BARN, USE 2 BRACKETS AS BELOW ON END RAFTER

4. MOUNT CABLE 7" FROM EDGE OF SCABS, 2 WRAPS AROUND PIPE, 2 CLAMPS:

5. REMOVE TIER RAILS ( OR "POLES" ) IF CONVERTING AN OLD BARN:
   A) ALL AT ONCE AND USE LADDER TO NAIL BLOCKS, OR
   B) USE TIER RAILS ( POLES ) TO STAND ON AND NAIL BLOCKS IN VERTICAL ALIGNMENT, CENTERED BEHIND CABLE.

6. NAIL OR BOLT SUPPORT BLOCKS: ( 2 x 6 x 18" )
   A) TO SUPPORT BEAMS.
   B) ON SAME SIDE AS BRACES.
   C) WITH PLYWOOD SPACERS AS REQUIRED.
   D) SPAN 2"-2 1/2" LESS THAN BEAM LENGTH.
7. NAIL "SAFETY" PLYWOOD SCABS OR METAL ANGLES:
BEAM 2" LONGER THAN CLEAR SPACE BETWEEN 2x10 SUPPORTS

3/4" x 1 1/2" x 1/8" ANGLE (91#/L.F.) OR 16 GA. BENT METAL

NAIL OR SCREW ATTACHMENT (3 HEAVY DUTY, 1 1/2 TO 2" LONG)

2x10 OR EQUAL.

ADV.:
SHORTEST LENGTH...
PROTECTS WOOD...
SIMPLE,EASY.....
EASIER BEAM PASSAGE....

DISADV:
MORE COSTLY THAN PLWOOD......

TOP VIEW - ANGLE ATTACHMENT
BUILDING BEAMS:

1. CUT A 2 x 6 OR 2 x 8 TO LENGTH W/ 15° BEVELED ENDS. (2 x 6 FOR 12', 2 x 8 FOR 14' SPANS)

   **STEP 1**

   ![Diagram of step 1]

   CUT TO REQUIRED LENGTH PER SHEET 2

   (Typical Smallest Dimension Between Barn Cross-Supports + 1/2"

2. CUT SPACER BLOCKS: W/ 15° END AND SQUARE END (1 1/4" OR 1 5/16" SPACER BLOCK ASSUMES 1" MAX. STICK THICKNESS. USE POWER PLANER TO DIMENSION BOARDS TO THICKNESS, THEN CUT BLOCKS TO LENGTH)

   **STEP 2**

   ![Diagram of step 2]

   1 1/4" OR 1 5/16"

   1 1/4" OR 1 5/16"+ IF THICK STICKS EXIST- x 11" SPACER, WIDTH SAME AS BEAM ABOVE

3. NAIL SPACER TO BEAM WITH ONE 3.5" OR 4" NAIL ALONG EDGE AWAY FROM BOLT HOLE OR CENTER SAW SLIT.

   **STEP 3**

   ![Diagram of step 3]

   3.5" OR 4" NAIL
4. MARK AND CUT A TOP MEMBER WHICH CAN BE A 3 x 4 OR 2 x 6 FOR 2 x 6 BEAM OR 4 x 4 OR 2 x 8 FOR 2 x 8 BEAM. MEASURE THIS TOP MEMBER AS A STANDARD LENGTH FOR ALL OTHER MEMBERS, THEN PRE-CUT ALL BOTTOM AND TOP MEMBERS TO THESE LENGTHS.

**STEP 4**

![Diagram showing top member with spacer blocks and bottom member at 15° angles.]

5. OBTAIN TWO LENGTHS OF HEX OR MACHINE BOLTS AS FOLLOWS:
   - 8 PER BEAM OF LENGTH EQUAL TO ALL WOOD PLUS 1", WITH HEX NUT EACH.
   - 3 PER BEAM OF LENGTH EQUAL TO ALL WOOD PLUS 1/2", WITH 2 FLAT WASHERS AND HEX NUT EACH.

6. POSITION STEEL, CLAMP, ALIGN, DRILL AND BOLT:
   SPACE STEEL 1/2" TO 1" FROM EDGE OF WOOD, END FLUSH. CLAMP LIGHTLY, OBTAIN AND USE 25/64" BIT, 6" LONG. ALIGN AND DRILL HOLE FROM STEEL SIDE 2/3 WAY THROUGH WOOD, THEN DRILL FROM OTHER SIDE TO "HIT" HOLE & REAM FOR BOLT TO FIT SMOOTHLY. DO NOT OVERSIZE HOLES AS BEAM TIGHTNESS AND STRENGTH WILL BE REDUCED. INSERT AND TIGHTEN BOLTS WITH NUTS AND FLAT WASHER ON TOP SIDE. THEN COMPLETE THE OTHER END OF THE BEAM IN THE SAME WAY.

![Diagram showing side view and top view of steel strap with holes for 3/8" bolts and "C" clamp.]

1/2" TO 1"

3/8" BOLTS, LENGTH AS REQ'D

1.5" - 2" MIN.
7. ADD INNER SPACER BLOCKS, USE ONE 3/8" BOLT, LENGTH AS REQ'D W/2 FLAT WASHERS EACH, AND 1-40d NAIL, BOLT OFFSET PER TOP VIEW BELOW

3 1/2" TO 4" WIDE BLOCKS, LENGTH SAME AS BOARD WIDTH, GRAIN LONG DIMENSION
ALL NUTS ON TOP SIDE

3'-3" 3'-3"
CENTER OF BEAM LENGTH

SIDE VIEW

END OF SPACER BLOCK
CHAIN SAW CUT

3/8" BOLTS, LENGTH AS REQ'D

40d NAIL

USE "FURNITURE" CLAMP TO ALIGN CROOKED MEMBERS PRIOR TO BOLTING MID-BOLTS

TOP VIEW

8. SAW SLIT TO END OF BLOCK. (USE CHAIN SAW)

B.E.P./G.A.D.
UNIV. KY. 11/92
12' (OR LESS) BEAM

ALL 3/8" HEX BOLTS W/FLAT WASHERS ON WOOD AS ABOVE

14' (OR LESS) BEAM

EXACT LENGTHS PER BARN & SEPARATE INSTRUCTIONS

SIDE VIEWS

NOTE: ALL WOOD FULL DIMENSION ROUGHSAWN S. YEL. PINE FREE OF KNOTS & DEFECTS OR EQUAL

12' BEAM END VIEWS 14' BEAM

CHAIN SAW SLIT TO END OF SPACER BLOCK

CHAIN SAW SLIT TO END OF SPACER BLOCK

BEAM MATERIALS & CONSTRUCTION © BAE Dept., U.Ky., 2005

11-97
UKY
REV 4-91
BELOW IS AN EXACT COPY OF THE
PIPE HANGER STRAP
AND NAIL (USE 6 NAILS)

$\frac{7}{8}'' \times 15'' \times 16$ GAUGE STEEL (OR
THICKER) WITH 6 HOLES DRILLED
OR PUNCHED ($\frac{1}{8}''$ EACH)
PIPE HANGER STRAP FABRICATION DETAILS

UNBENT HANGER STRAP, 3/8" x 15" x 16 GAUGE STEEL, BLACK & GALV.

HAND-JIG FOR BENDING STRAP

1/8" x 1/4" x 4" STEEL

3/4" x 1/4" BOLT

7/8" x 3/4" BOLT

METAL "STOP" FOR ALIGNMENT

2" dia. (Nominal) STEEL PIPE, 3" long

Steel Pipe w/ notches

1" wide x 3/8" deep for strap alignment

SLOTTED BAR
(FOR MAKING TWISTS)

1/4" x 3/8" METAL

SLOT MADE TO SLIP ON END OF HANGER STRAP TO BEND

To Use:
1) Lay unbent strap in hand-jig, 1/4" off center
2) Press handle down and bend hanger into U-shape
3) Use "SLOTTED BAR" to put half-twist (Do not kink or fatigue metal in bend) on hanger ends
4) One end longer to fit slover, rafters properly

Completed Hanger

G.A.D.
U.KY.
3/19/90
BELOW IS AN EXACT COPY OF THE 2-INCH PIPE, CABLE, AND CLIP ATTACHMENT AT TOP OF BARN AND CLAMPED SLEEVE-LOOP FOR BOTTOM END OF CABLE

PIPE

2 WRAPS OF CABLE

CLIPS (BAR AGAINST TENSION CABLE)

NO 'WIRE' ENDS EXPOSED TO ‘PORE’ FINGERS

SLEEVE

LOOP AT END
BELOW IS AN EXACT COPY OF THE 3/16" U-BOLT "CABLE CLIPS" REQUIRED FOR THE CABLE FASTENING: A SIZE LARGER OR SMALLER MAY NOT GRIP TIGHTLY AND PROVIDE THE STRENGTH REQUIRED. OBTAIN THIS SIZE:

3/16" MALLEABLE GALVANIZED WIRE ROPE CLIPS
BOTTOM STEEL for BEAM (4 REQD/BEAM) GAD
FULL SCALE

© BAE Dept., U.Ky., 2005
REV 4-91
HAND BENDER for 1/4" x 1" STEEL STRAP
for Cable Hose, Tobacco, Beams

TOP VIEW - BASE

SIDE VIEW - BASE

HANDLE 1 1/2" x 1 1/2" x 24" HANDLE
w/ 3" LAP WELD
1/4" x 1 1/2" x 5" (2 EA)

METAL TO BEND INSERTED FROM END

1/2" BOLT TO ANCHOR TO TABLE, ETC.
GRIND SMOOTH

Full Scale

© BAE Dept., U.Ky., 2005
Rev. 7-30-90
WHEELED BEAM SUPPORT STAND

Scale 3/4" - 1'-0"
Unless otherwise stated

FRONT VIEW
Scale 3/4" = 1'-0"

PERSPECTIVE VIEW
No Scale

G.A.D.
U. KY.  3/19/90
**Side View**
Scale $\frac{3}{4}'' = 1' - 0''$

**Top View**
Scale $\frac{3}{4}'' = 1' - 0''$
## BILL OF MATERIALS

<table>
<thead>
<tr>
<th>ITEM</th>
<th>SIZE</th>
<th>LENGTH</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>UPRIGHT</td>
<td>*1&quot; NOMINAL PIPE</td>
<td>5'-10&quot;</td>
</tr>
<tr>
<td>B</td>
<td>BOTTOM TIE &amp; STIFFENER</td>
<td>*1&quot; NOMINAL PIPE</td>
<td>6'-7&quot; &amp; 2'-5&quot;</td>
</tr>
<tr>
<td>C</td>
<td>BRACES</td>
<td>*1&quot; OR 3/4&quot; NOMINAL PIPE</td>
<td>5'-9&quot;</td>
</tr>
<tr>
<td>D</td>
<td>CROSS SUPPORT</td>
<td>*1&quot; NOMINAL PIPE</td>
<td>6-1/2&quot; OR 8-1/2&quot;</td>
</tr>
<tr>
<td>E</td>
<td>BASE SUPPORT</td>
<td>2&quot; X 2&quot; X 1/4&quot; ANGLE</td>
<td>42&quot;</td>
</tr>
<tr>
<td>F</td>
<td>AXLE</td>
<td>5/8&quot; OR 3/4&quot; ROD TO FIT WHEEL</td>
<td>10&quot;</td>
</tr>
<tr>
<td>G</td>
<td>WHEELS &amp; TIRES</td>
<td>8&quot;-12&quot; PNEUMATIC RATED &amp; 400#</td>
<td>-----</td>
</tr>
</tbody>
</table>

*1" PIPE MAY BE SUBSTITUTED WITH 1" STEEL TUBING, 11 GAUGE.

G.A.D.
U. KY.
3/19/90
TRAILER WITH PIVOTED UPRIGHTS FOR BEAMS
<table>
<thead>
<tr>
<th>Item</th>
<th>Size</th>
<th>Length</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>UPRIGHT 3&quot; Pipe, Sq. Tubing or 'box' of Channel</td>
<td>3'-6&quot; to 4' Cut to Length for proper height of beam</td>
<td>2 Ea.</td>
</tr>
<tr>
<td>B</td>
<td>MAIN 'TONGUE' As above</td>
<td>14'-6&quot;</td>
<td>1 Ea.</td>
</tr>
<tr>
<td>C</td>
<td>BRACES &amp; LATCH 1/4&quot;x1-1/2&quot; flat, w/5/8&quot; hole 32&quot;</td>
<td>3&quot; &amp; 4&quot; 2 Ea.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/4&quot;x1-1/2&quot; flat, w/5/8&quot; hole 3&quot; &amp; 4&quot; 2 Ea.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5/16&quot;x1-1/2&quot; flat, spacer 1-1/2&quot; 2 Ea.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9/16&quot; bolt w/ring 3&quot; 2 Ea.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5/8&quot; bolt w/nut 5&quot; 2 Ea.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>BEAM HOLDER 1/4&quot;x3&quot; flat, bend to shape 18-1/2&quot; or 20-1/2&quot;</td>
<td>18-1/2&quot; or 20-1/2&quot;</td>
<td>2 Ea.</td>
</tr>
<tr>
<td>E</td>
<td>AXLE 3&quot; or 4&quot; pipe, tubing or channel (or axle from car)</td>
<td>60&quot;</td>
<td>1 Ea.</td>
</tr>
<tr>
<td>F</td>
<td>HITCH 1/4&quot;x3&quot; flat w/3/4&quot; hole 10&quot;</td>
<td>10&quot;</td>
<td>3 Ea.</td>
</tr>
<tr>
<td>G</td>
<td>AXLE ANCHORS 1/4&quot;x3&quot; angle 3&quot;</td>
<td>3&quot;</td>
<td>2 Ea.</td>
</tr>
<tr>
<td>H</td>
<td>WHEELS &amp; TIRES Salvage from vehicle 13&quot; or 14&quot;</td>
<td>13&quot; or 14&quot;</td>
<td>2 Ea.</td>
</tr>
<tr>
<td>I</td>
<td>AXLE BRACES 1/4&quot;x1-1/2&quot; 18&quot;</td>
<td>18&quot;</td>
<td>2 Ea.</td>
</tr>
<tr>
<td>J</td>
<td>FENDER ITEMS 1&quot; tubing, pipe or angle 32&quot;</td>
<td>32&quot;</td>
<td>2 Ea.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14&quot;</td>
<td>2 Ea.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8&quot;</td>
<td>6 Ea.</td>
</tr>
<tr>
<td></td>
<td>16 Ga. sheet metal 9&quot;x48&quot; 2 Ea.</td>
<td>9&quot;x48&quot;</td>
<td>2 Ea.</td>
</tr>
<tr>
<td></td>
<td>1/4&quot; or 5/16&quot; bolts 3/4&quot; or 1-1/4&quot; 12 Ea.</td>
<td>3/4&quot; or 1-1/4&quot;</td>
<td>12 Ea.</td>
</tr>
<tr>
<td>K</td>
<td>'StepBoards' 2&quot;x8&quot;</td>
<td>2&quot;x8&quot;</td>
<td>12'</td>
</tr>
<tr>
<td>L</td>
<td>Angle Supports 1/4&quot;x2&quot;x2&quot; angle or equal welded to tongue, boards bolted w/3/8&quot; bolts 52&quot;</td>
<td>1/4&quot;x2&quot;x2&quot; angle or equal welded to tongue, boards bolted w/3/8&quot; bolts</td>
<td>52&quot;</td>
</tr>
</tbody>
</table>
INSTRUCTIONS AND PRECAUTIONS
ON USING THE
CABLE-HOIST TOBACCO HOUSING SYSTEM

A. BARN DETAILS:

1. Be sure you have acquired and installed:
   a. Full strength two-inch steel pipe across three rafters at two-foot spacing.
   b. Galvanized strap hangers for pipe with two hangers per rafter and six 10-gauge steel pallet nails or equal per hanger.
   c. Wooden brace to middle rafter at each pipe from adjacent post or top beam-support member, adequately nailed and/or blocked into position.
   d. Beam-support members of size, strength and sound lumber quality for post span used, adequately nailed and/or bolted to posts, spaced at least five-foot apart vertically for no-lap tobacco spacing.
   e. Two-inch blocks added to beam-supports, with plywood or board spacers for uniform beam-span length, nailed with seven to eight 4-inch pole barn nails or equal bolt-nail combination.
   f. 5/8" plywood safety-gussets or steel angle strip added to blocks, nailed with five to six 8d common nails for plywood or three nails/screws for the angle.
   g. The specified size, type and strength galvanized cable, two-wraps around pipe, but not crossed on top of pipe, 2 u-bolts with "bar" piece against tension cable, top-most u-bolt approximately 1-inch below pipe, second u-bolt approximately 1-inch below top-most u-bolt, 1 to 2 inches of pig-tail end of cable extending beyond second u-bolt, cable spaced on pipe to hang 7"-8" out from block.

B. BEAM DETAILS:

1. Be sure Beams conform to the following:
   a. Sound quality full dimension yellow pine lumber of sizes and lengths required for your beams, with no serious knots or defects in center one-half of beam or at end sections where stresses and strength requirements are greatest, bolted with blocks and steel pieces as shown on plans.
   b. Chain-saw slit in end extending to end of spacer block (12-inch long slit) so hoist fits behind metal cleats without cable binding.

C. TRANSPORT TRAILERS:

1. The two-wheel trailers to transport the beams should be of the general construction shown with axle and frame strength to support a full load of tobacco, uprights positioned to match the two spacer blocks of the beam (6'-6" apart), vertical length to hold the beam at least 5'-6" above the ground, and cradle supports to allow loose fitting of the beam but prevent rotation under unbalanced loading.
2. Fenders should be added over wheels to protect the leaves of tobacco that would be bruised by the wheels.

D. HYDRAULIC POWER UNIT:
1. The hydraulic power unit must be maintained in a serviceable condition comparable to that of its initial fabrication by checking and doing the following:

   a. Observe and check continuously during use for any leaks, vibrations, noises, etc. that indicate loose fittings, slippages, or other malfunctions that could cause serious breakages and/or failures. Especially check allen set screws on couplings and sprockets for tightness once or twice per harvest season.

   b. DO NOT CHANGE OR REPLACE THE PRESSURE RELIEF VALVE SETTING FROM THE "AS DELIVERED" CONDITION WITHOUT CHECKING WITH THE FABRICATOR OR UK AGRICULTURAL ENGINEER AS TO THE PERFORMANCE OR SAFETY CONSEQUENCES OF SUCH CHANGES.

   c. Use and operate the hoists so as to apply load uniformly on the top surface plate. DO NOT apply load to any other portion of the hoist frame.

   d. Avoid operational procedures where hoses and fittings are put under excessive physical forces that could rupture, break or scuff the components, primarily by letting the hoists come unhooked on unwinding and fall onto the hoses thereby nicking or cutting the hoses, breaking the motor fittings, or other damages.

   e. Maintaining hydraulic oil level approximately two inches below the top of the tank using high quality 10W hydraulic system oil.

   f. Change the hydraulic oil filter after the first season’s use and every 1-2 years thereafter.

   g. Change engine oil before each fall’s harvest season.

   h. Lubricate the roller chains on the hoists with a light weight oil such as WD-40 before and after each fall’s use to prevent excessive wear and rust. DO NOT USE GREASE ON THE CHAINS AS IT CATCHES DIRT AND CAUSES GREATER WEAR ULTIMATELY! KEEP CHAINS TO LESS THAN 1/2" SLACK.

   i. Use and protect the hand-held switches and connecting cable to prevent breakage or other damage. The toggle switches seem subject to over-pressure by strong fingers that want to help "push" the system, or droppage, dragging, stepping on or running-over that bend, distort or actually break the switches. A replacement switch should always be kept on hand.

E. OPERATOR:

1. The key to successful and safe operation of the cable-hoist tobacco housing system is an operator who has received and understood the personal explanations and demonstrations given by University of Kentucky personnel and read these instructions, has built or converted a barn to comply with the structural specifications, built beams and transport trailers likewise to loading and handling specifications, and operates the system in a responsible and attentive manner to achieve the full potential of labor-saving and handling performance characteristic of the fundamental design and development of the system.
2. Just anyone who wants to grab and use the "controls" should **NOT** be allowed to do so unless given adequate preliminary instructions, and training or carefully tutored to hoist a beam to only the first or second tier above the ground. Especially do not let anyone attempt to remove a beam from the barn support position until a full understanding of the methodology of the system and the **DO'S/DON'TS** of this set of instructions are fully comprehended.

3. And, finally, above all, **DO NOT STAND OR WORK UNDER A BEAM OF TOBACCO DURING ANY PROCESS OF HOISTING UP OR DOWN OR MANEUVERING INTO OR OUT OF ANY POSITION. BE SURE A BEAM IS FULLY AND SECURELY POSITIONED ONTO THE SUPPORT BLOCKS OR STRUCTURAL MEMBER BEFORE REMOVING THE HOISTS FROM UNDERNEATH THE BEAM ENDS.** For personal safety, a hard hat could be worn.

4. **REMEMBER:** At some time in the future:

   a. **STICKS OF TOBACCO CAN AND WILL BREAK AND FALL FROM A BEAM OVERHEAD.**

   b. A **BEAM OR STRUCTURAL BARN MEMBER(S) CAN BREAK AND A WHOLE BEAM OF TOBACCO CAN FALL.**

   c. A **CABLE CAN BE PINCHED, FRAYED OR LEVERAGED SUCH THAT IT CAN BREAK AND THE HOIST AND A BEAM OF TOBACCO CAN FALL.**

5. While adequate strengths, safety factors and operational procedures have been designed into the systems as developed, demonstrated and recommended, we have no control over local conditions and day-to-day operations that could compromise the design and operational features and cause abnormal, precarious and/or unsafe operation thereby possibly resulting in damage to property or injury to workers or other persons in the vicinity.

**F. PLAN HOW TO FILL THE BARN:**

1. The cable-hoist system works best when you have an open area beside the beam being lifted to observe the hoisting procedure. A lower height area should be the last area to be filled for best visibility. Thus, start at one side-wall and fill toward the opposite side-wall, saving either the outside or next-to-outside space until last, depending on driveway width.

**G. HOIST-CABLE HOOK-UP:**

1. When preparing to hoist beams in a certain area, locate the hoist power unit in the adjacent driveway with the rear end facing the area of operation. As you face the work area, the left-side hoist will correspond to the left toggle switch. When holding the switch box with the cable toward you, pushing the left toggle will cause the left hoist to wind up the cable thereby raising the load, pulling will wind down lowering the load, and likewise for the right-side hoist and toggle switch.

2. Before or after hooking a cable to a hoist, make a practice of leaving the hook on the drum facing toward the handle to make it easy to hook or unhook the cable. The hoists are made to be lifted and held with the left hand with the top end to the right so the cable can be inserted through the top hole and hooked to the drum with the right hand. See Figure 1 for an illustration of the drum and hook. The switch box can be held by either hand or against the body while hooking the cable.
When hooking the hoist to the cable, be sure the cable loop is still strong and is fully seated behind the hook on the hoist drum. A loop caught partially on the point or edges of the hook can slip off under load or be cut and frayed to cause later failure. The cable should wrap around the drum evenly and not build up on the hook to similarly slip-off, cut, or fray the cable. Be sure the cable does not get outside the side flanges and get entangled in the chains or shaft.

3. When unhooking the hoist from the cable:
   
   a. DO NOT unwind the cable so far as to let the hoist fall onto the ground thereby possibly damaging the hoist or hoses.

   b. DO NOT unwind the cable so far as to begin rewinding in the opposite direction and severely kinking the cable or causing other damage.

4. We feel it best for one person alone to handle the control switches and hoist hook-up to ensure safe and careful hand and eye coordination as past experiences have shown a two-person procedure is subject to dangers to a person or the hoist when someone pushes a control button while another person has hands and/or fingers in a precarious position when hooking or un-hooking the cable!

H. POSITIONING A HOIST UNDER A BEAM:

1. A hoist already hooked to a cable must be guided under the beam end such that the cable freely slides into the sawed slot and the hoist fits snugly up under the wooden beam, behind the metal cleats, and with the handle (and short leg) side of the hoist facing outward, away from the tobacco. If the slot has not been cut far enough, there will be
problems guiding the hoist into position behind the cleats when taking down the beams. The short legs help the hoist frame clear the barn cross supports when the beam is angled for raising or lowering in the barn. Center the hoist under the beam for balanced loading, to ensure the cable has space to roll-up, and to keep the cable from rolling up on the point of the hook which can cut or fray the cable or cause slip-off and a drop-impact action that can SNAP cables under a heavy tobacco load (see Figure 2).

![Diagram of hoist positioning]

**FIGURE 2:** Positioning of hoist under beam.

---

2. When a hoist has been placed under one end of the beam, raise the beam 3-4 inches and then proceed to position the other hoist. Again, we recommend only one person position the hoist and operate the controls to ensure coordinated action of hand, eye and hoist for this important step.

3. Be sure both hoists are snugly into position before beginning the lift into the barn.

---

I. LIFTING A LOADED BEAM INTO THE BARN:

1. Now is the time for "LIFT-OFF!" The time when the power is applied and action takes place! Remember that you are manipulating 1500-1800 pounds (or more) of tobacco with the ease of pressing two small control switches but mis-judgments or careless procedures can break a cable, a beam, or barn member and *dump* the load!

2. Raise one end of the beam approximately 24" to 30" above the other to establish an angle that lets the beam move freely upward between the supports and blocks. Watch and proceed carefully as the beam clears the transport trailer or other supporting stand (Figure 3).
a. AT THE END OF THE BARN:

Raise the end toward the middle of the barn first and keep it above the other end at the end-wall for best procedures in positioning the beam up in the barn.

![Diagram of a beam being lifted into a barn]

FIGURE 3: Manipulating the beam to an angle for lifting into the barn.

3. Upon establishing a suitable angle, press both switches for a steady lifting up into the barn, or move one end at a time as you gain familiarity with the method. NOTE: FOR HEAVY LOADS, THE POWER UNIT AND HOISTS MAY NOT LIFT BOTH ENDS AT THE SAME TIME. IF SO, WORK ONE END AT A TIME.

a. Move back and forth into a position to observe each end of the beam as it approaches and passes a block or support. **STOP** the movement if necessary if a beam end appears to be in danger of catching under a plywood scab, block, brace or support and carefully operate one end of the beam at a time until the end is clear of the obstructions (Figure 4). If one end of the beam is obviously catching under an obstacle often, then the cables may **not be centered** on the pipes thus causing mis-alignment. Correct the cable positions at the next opportunity.

b. As a last resort to clearing an obstacle with a beam end, grab the set of hoses of the hoist at the end in trouble and while standing toward the middle of the beam **BUT OUT TO THE SIDE AND NOT UNDER THE LOAD**, pull on the hoses until the beam clears the obstacle, or swings back and forth, and press the switch to move the end past the obstacle.

c. When one end of the beam is lowered to help clear an obstruction BE SURE THE OTHER END HAS 4-6 INCHES OF FREEDOM TO MOVE SUFFICIENTLY, THAT IT IS NOT LOCKED UNDER OR AGAINST AN OBSTRUCTION AND PUTS THE FULL BEAM LEVERAGE AGAINST A TIGHT CABLE AND INSTANTLY **SNAPS** THE CABLE (Figure 5a).
d. The sloped ends of the beam help it to slide past an obstacle during lifting but be sure the other end is free to move and does not get wedged under or against a block brace or support member.

**FIGURE 4:** Keep one end of the beam 4-6 inches above or below an obstruction when maneuvering the other end past a similar block or support.

**FIGURE 5a:** DO NOT (a) JAM BEAM AGAINST CABLE CLAMPS AND PIPE OR (b) LOWER ONE END WHILE THE OTHER END IS LIKELY TO WEDGE OR LEVERAGE UNDER OR AGAINST A BLOCKAGE!
4. When putting a beam into position at the top of the barn, position the higher end of the beam about 6-12 inches above the top block and support, BUT NOT JAMMED UP AGAINST THE CABLE U-BOLTS AND PIPE (Figure 6), and carefully elevate the other end up past the blocks. Once both ends are freely above the block supports, carefully level and lower the beam into position onto the blocks and supports. If the cables are properly positioned, the beam will naturally center when leveled and positioning will be easy. See Figure 6.

FIGURE 6: Properly spaced cables will automatically center a beam onto the support blocks.

(If any mis-alignment exists, raising the "SHORT" end (only when the other end is free swinging) is supposed to "pull" the beam to that direction an inch or two and allow the other end to be lowered into contact with the block such that the other end will then rest properly on the block when lowered.

When lowering this second end, be sure the other hoist is a couple of inches below the beam so "pivoting action" will not lift the end up off the block and re-swing the beam out of position. If the hoist that is not in contact with the beam has to be used to re-lift the beam, use the hoses to guide it properly back under the beam squarely and fully behind the cleats. Stand out from under the beam as far as possible and ready to move further if any breakage or failure should occur and items fall.

5. Once a beam is leveled and firmly positioned onto the blocks with the metal cleats obviously behind the plywood safety scab, the hoists can be lowered for engaging another beam. Pull the hoses away from the trailer frame as necessary to allow pull-up and positioning another trailer.
If you are operating alone and need to pull another trailer into position, leave the hoists above the lower tier (if the lower tier has not been filled), pull the hoses over to a nail on a nearby post or hooks on the hoist unit so as to hang them up out of the way for the pull-up. Move the next trailer into position, then lower the hoists for engaging the beam.

When the lowest beam has been positioned, the hoists can be lowered completely and unhooked for moving to another cable location.

6. Lay the hoists on the ground toward the next location or onto the power unit and move the power unit to the next location, positioning it again with the rear of the unit facing the area of operation so the left hoist and switch correspond, and likewise for the right hoist and switch.

7. As suggested earlier, the highest tiers in the barn should NOT be the last to be filled due to restricted visibility. Save one of the lower runs for the final fill-out.

J. SWINGING EXTRA BEAMS UNDERNEATH THE LOWER TIER:

1. To gain maximum efficiency of a barn and the cable-hoist system, a layer of beams can be hung from the lower support member and gain 25-30% more barn capacity, provided:

   a. There is sufficient height to hang this extra beam.

   b. The barn floor stays dry and has good ventilation under the tobacco tips to ensure good curing. Leaves closer than 12-15 inches to the ground in moist and poorly ventilated driveways seem prone to be darker, may have houseburn, and may have more occurrence of mold toward the end of the cure. If you use this method, any smaller size tobacco ought to be saved for this swinging tier.

   c. A trailer needs hinged uprights that allow fold-down to pull out from under the low tobacco. Trailers are normally backed into the driveway, unloaded, and pulled out. This process is slower than the higher beams but is a trade-off for the extra barn capacity. OR, HOOK ALL AVAILABLE TRAILERS TOGETHER FOR MAXIMUM NUMBER OF BEAMS AT ONE TIME, THEN BACK IN OTHERS IF NEEDED.

2. The hanging beams must be supported by cable or rope of adequate strength. Figure 7 illustrates some possible ways to hang the beam. Cable or rope rated 1000 pounds or more of safe load capacity in single strand or 500 pounds-plus when looped with double-strand. Avoid sharp edges or abrasions that can cut or fray and weaken the cable or rope. The rope or cable needs to be moved or somehow pulled out of the way when not in use so that hoisting and lowering of higher beams and the hoist will not get entangled in these pieces. The double-strand loop is preferred so it can easily be moved over to a post and out of the way when not in use.

Notice that two sets of these hanging cables or ropes will be needed at the interior barn supports so one can be used for the end of each beam butting together at that point. The ropes or cables at the ends of the barn will have to go through a crack between boards or a hole in the siding (or equal attachment). This may prevent sliding a loop over out of the way. Thus, an extra hook for the loose ends may be necessary.
K. REMOVAL OF BEAMS WITH CURED TOBACCO FROM THE BARN:

1. What goes up must come down! And the cured tobacco must come down at bulking and stripping time. Removing the beams from the barn is essentially the reverse process of hoisting them into the barn, except this process can be a little more tedious and requires more attention when moving the beams past blocks, supports, braces, etc. More attention is required because the metal cleat ends can catch on wooden members coming down rather than sliding by as when hoisting upward.

2. To remove a beam, connect the hoists to the cables and wind them up the cable to the beam. Use the hoses to guide one hoist at a time into position: handle toward the end of the beam, the hoist frame fully behind the metal cleats and solidly against the wood (same as Fig. 2). Guide the hoists so the cable does not wrap over the point of the hook on the drum which can cut, fray or "pop" the cable when unwrapping with a loaded beam! Lift the first end of the beam three to four inches, then guide the other hoist into position behind the cleats and lift the beam a few inches.

3. Decide which end of the beam will be the easiest to bring down first as follows:

   a. At the end of the barn, the beam end toward the siding should come down first. This lets the other end swing freely in the open space.

   b. At other interior locations, either end can come down first unless one end hangs with less overlap of the blocks which generally should come down first, especially at the very top level in the barn.

   The end of the beam to come down first will be called the "lower" end of the beam and the other end the "higher" end in the following steps.

Rev. 9/23/91
GAD
4. To proceed with lowering of a beam, raise the "higher" end of the beam approximately 12 inches above the blocks, if space permits. Be sure the "lower" end is high enough above its blocks to remain swinging freely and not let the end pivot down onto the blocks and loosen the hoist from its secure position.

5. As the "high" end goes up, the "lower" end should begin to swing away from the block and the safety catch (plywood or metal) for clearance to pass by.

If so, begin to lower this "lower" end until the metal cleats move past the blocks and safety plates. Then lower the "higher" end in sequence, or both ends together, until the "higher" end nears the blocks and safety-catch. Carefully observe the movement and operate the controls to ensure safe passage of the metal cleats past the obstructions.

If the cleats of either end will not freely clear the obstructions, grasp the hoses and swing the beam away from the obstructions while standing to the side of the beam, observing the end movement, and operating the controls carefully to lower the beam past the obstruction.

6. Continue the sequence of lowering each end past the obstructions until past the lowest tier, then position the beam onto a trailer or support for further movement and stick removal, or leave hanging just above the ground for stick removal and bulking. OR, ABOVE A WAGON FOR DIRECT BULKING ONTO THE WAGON.

7. CORRECTIVE ACTION: If a beam end catches on an obstruction while being lowered and the hoist swings freely (Figure 8), STOP LOWERING IMMEDIATELY AND GET THE HOIST BACK UNDER THE BEAM END AS FULLY AS POSSIBLE. If the hoist will not go to the proper position behind the cleats, let it "catch" under the rear cleat and safely behind the front cleats for temporary lifting of the beam and SETTING INTO A SAFE POSITION ON THE BLOCKS OR SUPPORTS. Lower the other end, if necessary, to permit positioning the "loose" hoist into proper position for further lowering with better attention to the cleats catching on an obstruction.
FIGURE 8: When lowering beams, be careful to NOT catch metal cleats on plywood, wood or metal pieces thus letting the hoist become loose and likely causing a beam to fall.

8. The lowering of a beam can result in the critical action illustrated by Figure 5b if you become careless with the "lower" end of the beam while letting the "higher" end down. BE ALERT TO THE CLEARANCES NEEDED FOR SAFE LOWERING OF A LOADED BEAM.

9. Notice any cables that are frayed, kinked or otherwise damaged such that replacement should be done as soon as possible.

10. Also, notice any cables that are not properly spaced on the pipe and cause undue difficulty in maneuvering the beams into and out of position.

L. STORAGE OF BEAMS:

1. The wooden beams should not be left on the ground of the barn for more than a few days as the moisture of the soil will begin a slow deterioration and weakening of the wooden members.

2. Stack the beams up on concrete or wooden blocks to allow air movement underneath. Or, load the beams onto an available wagon or other special carrier for storage until the next season. The two-wheel trailers can be used to hold approximately 20 beams each as illustrated by Fig. 9. Thus, each three trailers will hold beams for two acres of tobacco capacity.

M. STORAGE OF HYDRAULIC HOIST EQUIPMENT:

1. At the end of use, look over the hoists and hydraulic power unit to be sure no leaks or other problems exist that need attention before the hurry of next season.

2. Gas should be drained from the tank and the engine run until the carburetor is dry so sludge and gum will not form due to gas evaporation during the spring and summer.

3. Removing the plug, putting some lightweight oil in the cylinder and rotating the crankshaft a few times could help lubricate the surfaces and reduce corrosion as moisture penetrates the components during the off season.
4. Hoses should be wiped clean of any oil residues to help preserve the quality of the rubber.

5. The battery should be removed and placed in a non-freezing location to prevent unnecessary winter damage, then recharged prior to next season's use.

6. The hydraulic oil filter should be changed after the first season of use and every year or two thereafter.

7. For longest life of the engine, 20W oil should be used in the late fall or winter during take-down if weather gets below 50 degrees. Replace with 30W for the next fall's housing operations.

8. Store the power unit in a suitable dry and protected area (stripping room, garage, shop, etc.) such that moisture or dirt contamination, animal or equipment damage, or pilferage (maybe theft?) will be less likely to occur during the off-season. The operational quality of your hoist unit is essential to dependable housing and take-down of tobacco for many years to come. Treat it with care and respect so it will last the 200 acres or more it is expected to last, or maybe much more!

---

TRAILER MODIFICATIONS TO STORE BEAMS

---

George A. Duncan
U. KY Ag. Engr. Dept.
October, 1989
Rev. 9-91
Bill of Materials Estimates for Cable Hoist Beams and Barn  
(Estimates for one acre of capacity @ 7200 plants, 6 plants/stick, 50 sticks/14 ft beam, thus 24 beams/acre)  
(40 sticks/12 ft beam, 30 beams/acre)

<table>
<thead>
<tr>
<th>Description</th>
<th>Size</th>
<th>Qty. Req./Ac</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Wood, Yellow Pine, full dimension, Beam members</td>
<td>2” x 8” x 14 ft</td>
<td>48 ea</td>
</tr>
<tr>
<td>Spacer blocks, one end cut at 15°</td>
<td>1.25” x 8” x 11”</td>
<td>48 ea</td>
</tr>
<tr>
<td>“ “, square cut ends</td>
<td>1.25” x 4” x 8”</td>
<td>72 ea</td>
</tr>
<tr>
<td>Option: 2” x 6” x 12 ft for shorter beams and corresponding 6” blocks</td>
<td></td>
<td>60 ea</td>
</tr>
<tr>
<td>Spacer blocks, etc as required.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Metal end pieces for beams:</td>
<td>0.25” x 1” x 9”</td>
<td>96 ea</td>
</tr>
<tr>
<td>3. Bolts, 3/8” black, hex or machine head, grade 2</td>
<td>3/8” x 6” typically</td>
<td>264 ea</td>
</tr>
<tr>
<td>Nuts, hex</td>
<td>3/8”</td>
<td>264 ea</td>
</tr>
<tr>
<td>Flat washers</td>
<td>3/8”</td>
<td>264 ea</td>
</tr>
<tr>
<td>40d ring shank nail</td>
<td>40d (5”)</td>
<td>48 ea</td>
</tr>
<tr>
<td>4. Pipe, 2 inch steel, schedule 40, black or equal</td>
<td>2” x 60”</td>
<td>as req. for barn</td>
</tr>
<tr>
<td>(typically 30-35 ft/ac)</td>
<td>2” x 30”</td>
<td>as req. for barn</td>
</tr>
<tr>
<td>5. Metal strap for pipe hangers, 16 gauge Galv.</td>
<td>7/8” x 15”</td>
<td>as req. for pipes</td>
</tr>
<tr>
<td>(typically 36-42/ac)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Nails, 1.5” or 1.63”, 11 gauge, spiral shank pallet type for metal straps</td>
<td>1.5” x 11 ga.</td>
<td>5-7 lbs</td>
</tr>
<tr>
<td>6. Cable, 5/32”, 7x19 strands, galv., aircraft type</td>
<td>2800 lb tensile</td>
<td>as req. for barn</td>
</tr>
<tr>
<td>(typically 250-300 ft/ac)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Aluminum sleeves for cable ends &amp; clamp tool</td>
<td>5/32”</td>
<td>as req. for cable ends</td>
</tr>
<tr>
<td>(typically 12-18 ea/ac)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Cable clips, U-bolt clamps, 3/16”</td>
<td>3/16”</td>
<td>as req. for cable ends</td>
</tr>
<tr>
<td>(typically 24-36 ea/ac)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*aNote:* Southern Yellow Pine is recommended for beams for strength and least weight when seasoned. Oak or other heavy hardwoods are rather heavy for manual handling when stacking or placing onto trailer-carrier. Poplar or similar lighter hardwoods are lower in strength and very marginal for supporting the loads without danger of breakage or serious bending.

GAD,  
BAE Dept.,  
UKy., 4/05
September 23, 1991

MEMORANDUM:

TO: Builders and Converters of Barns for Cable Hoist System and County Extension Agents Involved

FROM: George A. Duncan

RE: Some Guidelines on Materials, Specifications, Substitutions, Construction, and Operation

Good News: A good number of tobacco producers throughout KY. and from MD to MO are adopting the cable hoist system for tobacco housing. Most are building new barns but several are converting, either at first or after building a barn and wanting to include more of the total operation.

Bad News: I cannot visit all of the producers early-on and go over some important features and DO's and DON'Ts. Instructions and construction details contained in the 50-plus pages of handouts and blueprints are not fully read and understood as to material sizes, requirements, strengths, and construction procedures. Consequently, I am seeing and hearing more cases of selecting or substituting materials and using construction practices that do not meet the standards needed to ensure strong and safe operation. Briefly, some areas of borderline problems are:

1. Use of Poplar or dressed lumber for critical barn rafters, beam support members and beams without having a special re-design for such substitution of 'weaker' lumber. (See Guidelines on Selection of Lumber.)

2. Using lumber for beams and barn support members having excessive size and number of knots or defects in critical areas resulting in breakage under heavy tobacco loads.

3. Being skimpy on blocks for spacers in beams. (1-5/16" thick by 3" wide or wider recommended.)
4. Reducing size, number or type of bolts securing the beams. (Hex heads with flat washers are recommended for full tightening.)

5. Wanting to omit the steel pieces at the ends of the beams. (The steel pieces anchor the hoist during lifting and secure the beam on the support blocks.)

6. Important size or number of nails and straps securing the steel pipe to the barn rafters. (Refer to diagrams.)

7. Omitting the top brace to the middle rafter and other barn bracing and post anchoring. (Refer to diagrams.)

8. Wrong size and number of U-bolt clips to secure cable to pipe at top of barn. (Use 3/16 inch as shown in diagrams.)

9. Oversize aluminum sleeves on cable to form loop at end and 'wire' end sticking out of sleeve to poke fingers during use! (See diagram.)

10. Changing several material and construction details of the trailer-carriers that result in weaknesses, less than desirable convenience in operation and, sometimes, jeopardizing structural strength, safety, and function during operation. (Refer to diagrams.)

11. Improper cable loop over bottom beam to hang swinging beam which doubles load on support member and side block causing twists and failures! (Loop cable over cross member per diagram!)

Some enclosed information on wood strength addresses the problem of #1.

Additional drawings and photocopied illustrations address problems #2 through #11 as to requirements but not all 'WHYS' and 'WHY NOTS' which are partially covered in some of the other handouts. If you don’t understand, it may be best to ask now rather than to find out in the heat and hurray of August or September.

Trailers need to be 'sleek' and free of odd braces and members to enable easy HANDLING, PASSING-THROUGH AND HANGING of tobacco, MINIMUM OF BRACES AT AXLE to INJURE SHINS when handing from the ground or WALK BOARDS to enable riding and handing, FOLDING UPRIGHTS that fold TOWARD THE REAR to enable pulling from under 'swinging' beams (if you plan to do this), an easy to engage SLIDE CATCH and easy to INSERT AND PULL PIN used for anchoring/releasing the braces, and ADEQUATE SIZE STEEL for 'tongue' and 'uprights' to support 1400-1800 pounds of tobacco over ditches, chug-
holes, etc. from field to barn. If you or your 'trailer builder' want to 'go native' and innovate with new ideas, it might be best to give me a call before many hours and $$ are invested in some off-beat ideas that could become a serious deficiency. Otherwise, go ahead and build as common, crude, and cheap as you wish.

If you want to check YOUR beam and/or trailer 'design' before repeating the mistakes many times (and before harvest), then load the beam with one 8-inch concrete block for every stick of tobacco you plan to hang on the beam (35 to 40 for 12-foot beams and 40-45 for 14-foot beams) and give it the 'lift test' in the barn or put on a trailer for a 'road test' to the field and back a few times with the most apt 'hot-rod driver.'

NOTE: For each pair of concrete blocks, put two tobacco sticks half-way through the beam and hang a block on each side snug against the beam. Add the extra blocks evenly from one end to the other of the beam to distribute the weight. Use baler twine, small rope or wire to secure the blocks from slipping off the sticks during these test operations.

CAUTION: No empty beam should be lifted more than the bottom tier level in a barn as a 'trial' or 'demo' without at least 4 to 6 concrete blocks of dummy load to help secure the beam on the hoists during the higher-up lifting and maneuvering.

PLEASE, PLEASE read the OPERATORS INSTRUCTIONS included previously in this package before using the hoist or letting anyone else 'grab the controls and start playing.' There are some important DO's and DON'Ts for proper and safe operation. A video is available to give detailed instructions for those who might watch rather than read such advice. Send $10.00 for a copy.

I am glad to help in any way if you will just call or contact me.

Good luck and keep the hammers swinging!

GAD:ljp

Enclosures
### TABLE 2: RELATIVE STRENGTH OF SOME WOOD SPECIES COMPARED TO WHITE OAK AS BASE OF 100.

<table>
<thead>
<tr>
<th>Species</th>
<th>Relative Strength</th>
<th>Relative Stiffness</th>
<th>Density, Lbs/CuFt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ash, White</td>
<td>73</td>
<td>94</td>
<td>36</td>
</tr>
<tr>
<td>Black</td>
<td>102</td>
<td>69</td>
<td>31</td>
</tr>
<tr>
<td>Beech</td>
<td>109</td>
<td>100</td>
<td>40</td>
</tr>
<tr>
<td>Birch</td>
<td>109</td>
<td>100</td>
<td>39</td>
</tr>
<tr>
<td>Hemlock</td>
<td>80</td>
<td>69</td>
<td>25</td>
</tr>
<tr>
<td>Hickory</td>
<td>138</td>
<td>113</td>
<td>46</td>
</tr>
<tr>
<td>Oak, Red</td>
<td>102</td>
<td>94</td>
<td>39</td>
</tr>
<tr>
<td>White</td>
<td>100</td>
<td>100</td>
<td>42</td>
</tr>
<tr>
<td>Pine, S.Y.</td>
<td>109</td>
<td>100</td>
<td>32</td>
</tr>
<tr>
<td>Poplar, Y.</td>
<td>73</td>
<td>69</td>
<td>25</td>
</tr>
<tr>
<td>Sycamore</td>
<td>80</td>
<td>75</td>
<td>31</td>
</tr>
</tbody>
</table>

Ref.: USDA Forest Products Lab.

### TABLE 3: LOAD BEARING COMPARISONS OF FULL DIMENSION AND DRESSED LUMBER, ASSUMING SAME QUALITY WOOD WITH FULL DIMENSION AS BASE OF 100.

<table>
<thead>
<tr>
<th>Nominal Size</th>
<th>Actual Size</th>
<th>Position</th>
<th>Relative Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x12x16' Full Dim.</td>
<td>2 x12</td>
<td>Edge</td>
<td>100</td>
</tr>
<tr>
<td>&quot; Dressed</td>
<td>1.5x11.5</td>
<td>Edge</td>
<td>69</td>
</tr>
<tr>
<td>2x10x16' Full Dim.</td>
<td>2 x10</td>
<td>Edge</td>
<td>100</td>
</tr>
<tr>
<td>&quot; Dressed</td>
<td>1.5x9.5</td>
<td>Edge</td>
<td>68</td>
</tr>
<tr>
<td>2x12x16' Dressed</td>
<td>1.5x11.5</td>
<td>Edge</td>
<td>99</td>
</tr>
<tr>
<td>2x8x16' Full Dim.</td>
<td>2 x8</td>
<td>Edge</td>
<td>100</td>
</tr>
<tr>
<td>&quot; Dressed</td>
<td>1.5x7.5</td>
<td>Edge</td>
<td>66</td>
</tr>
<tr>
<td>2x10x16' Dressed</td>
<td>1.5x9.5</td>
<td>Edge</td>
<td>106</td>
</tr>
<tr>
<td>2x6x16' Full Dim.</td>
<td>2 x6</td>
<td>Edge</td>
<td>100</td>
</tr>
<tr>
<td>&quot; Dressed</td>
<td>1.5x5.5</td>
<td>Edge</td>
<td>63</td>
</tr>
<tr>
<td>2x8x16' Dressed</td>
<td>1.5x7.5</td>
<td>Edge</td>
<td>186</td>
</tr>
<tr>
<td>3x4x14' Full Dim.</td>
<td>3 x4</td>
<td>Edge</td>
<td>100</td>
</tr>
<tr>
<td>3x4x14' Dressed</td>
<td>2.5x3.5</td>
<td>Edge</td>
<td>64</td>
</tr>
<tr>
<td>8x2x14' Full Dim.</td>
<td>8 x2</td>
<td>Flat</td>
<td>100</td>
</tr>
<tr>
<td>8x2x14' Dressed</td>
<td>7.5x1.5</td>
<td>Flat</td>
<td>53</td>
</tr>
<tr>
<td>6x2x14' Full Dim.</td>
<td>6 x2</td>
<td>Flat</td>
<td>100</td>
</tr>
<tr>
<td>6x2x14' Dressed</td>
<td>5.5x1.5</td>
<td>Flat</td>
<td>52</td>
</tr>
<tr>
<td>4x3x14' Full Dim.</td>
<td>4 x3</td>
<td>Flat</td>
<td>100</td>
</tr>
<tr>
<td>4x3x14' Dressed</td>
<td>3.5x2.5</td>
<td>Flat</td>
<td>61</td>
</tr>
<tr>
<td>4x4x14' Full Dim.</td>
<td>4 x4</td>
<td>Flat</td>
<td>100</td>
</tr>
<tr>
<td>4x4x14' Dressed</td>
<td>3.5x3.5</td>
<td>67</td>
<td></td>
</tr>
</tbody>
</table>