

## **Agricultural Technology and Mechanical Systems Career Development Event 2013**

### **Team Activity: Roof Layout (KEY)**

#### Event Format

##### A. Equipment Provided:

1. One sharpened No. 2 pencil.
2. Calculator – participants will be allowed to provide their own.
3. Scratch paper for problem solving.

##### B. Team Activity

The team activity evaluates the ability of team members to work together to use decision-making and problem analysis skills while applying and concepts taught in construction (specifically roofing).

1. Members of a team work together cooperatively to complete this section.
2. Sixty (60) minutes are allowed for completion of the team activity. At the end of the activity, each team submits the completed document to be scored.
3. The team activity involves the use of construction skills and the resource information.
4. The team activity has a maximum value of 200 points per team and is only included in the team score. Points are divided as follows:
5. All team members must be involved in the team activity to receive credit. If a team has two or less participants no credit will be allowed in the team portion of the event.

#### **Directions:**

Work as a group to complete parts A, B, and C. Organize yourselves in order to properly address all sections. While you are working you will be evaluated by an observer on your ability to work as a team. You have 1 hour to compile your answers in either a Microsoft Word or Excel Document. Your document must include a cover page, description of activity, description of roles, tables (Part C), and correct formatting.

#### **Scenario:**

You have decided to quit working for your egotistical boss and start your own dairy operation! Luckily your grandfather is senile and has agreed to sign over his lease to you in return for a weekly sponge bath.

Congratulations, you have just inherited 2,000 acres! Sadly, your grandpa destroyed all of the storage barns and you are left with nothing. You decide to start off with a small storage shed to get your feet wet.

The storage shed will be used to support the processing of dairy products. The foundation and frame work is finished. Now what remains is the roof layout.

First you must convert pitch to slope: Roof slopes are expressed in 2 ways, (a) pitch and (b) slope (rise per foot of run). Rise per foot of run is what is needed to lay out a rafter and figure its length. When pitch is given, you first need to convert to rise per foot of run. An easy formula to follow is:

$$\text{Rise} = \text{Pitch} \times 2 \times 12$$

Examples: 1/2 pitch, rise =  $1/2 \times 24 = 12$  inches

and 1/4 pitch, rise =  $1/4 \times 24 = 6$  inches

Slope then would be 12/12 (rise/run)

and 6/12

### Part A (50 points)

**\*Note (Bolded words are not provided for those in competition)**

You wish to order roofing material for a small storage barn with a 1/4 pitch that is 10 feet wide. You want to allow for an overhang of 1 foot on each side. What is the slope? (10 points)

**Rise =  $1/4 \times 2 \times 12 = 6/12$  slope (6 inches of rise per 1 foot of run)**

What length is the rafter including overhang? (Hint: the rise number determines the length of rafter from rafter table on the square) (25 points)

**The if the sloped length of the truss rafter is L, the roof span R, P is pitch, and The equivalent formula using the pitch, P, is**

$$L = 1 + (R/2)\text{sqrt}(1+P^2)$$

**A roof's span is 10 feet, with 12 inches of overhang, and pitch of 1/4. Here we have R = 10, V = 1 (since 12 inches is 1 foot) and P = 1/4**

$$\begin{aligned} L &= 1 + (10/2) \text{sqrt}(1 + (1/4)^2) \\ &= 1 + (5)\text{sqrt}(1.0625) \\ &= 1 + 5.3125 \\ &= \underline{6.3125 \text{ feet}} \end{aligned}$$

What board length should be ordered, based in standard lumber sizes? (10 points)

**Need an 8 foot 2x10 or stud**

Another term for rafter is Truss. (5 points)

**Part B (50 points)**

Your shed is finished and now you wish to build a barn with a 26 foot span with a 1/3 pitch and an 18 inch overhang on each side.

What length rafter will you need? (15 points) Will a 16 foot 2 x 10 be long enough? (5 points)

**A roof's span is 26 feet, with 18 inches of overhang, and pitch of 1/3. Here we have R = 26, V = 1.5 (since 18 inches is 1.5 feet) and P = 1/3**

$$\begin{aligned} L &= 1.5 + (26/2) \text{ sqrt}(1 + (1/3)^2) \\ &= 1.5 + (13)\text{sqrt}(1.111) \\ &= 1.5 + 14.44 \\ &= 15.94 \text{ feet..... so yes a 16 foot 2x10 will work} \end{aligned}$$

You want to attach a lean-to shed roof to the previous barn. The span is 12 feet, the slope is 4/12 and the overhang is 18 inches.

What length of rafter do you need? (20 points)

**A roof's span is 12 feet, with 18 inches of overhang, and pitch of 1/4. Here we have R = 12, V = 1.5 (since 18 inches is 1.5 feet) and P = 4/12**

$$\begin{aligned} L &= 1.5 + (12/2) \text{ sqrt}(1 + (4/12)^2) \\ &= 1.5 + (6)\text{sqrt}(2.111) \\ &= 1.5 + 12.67 \\ &= 14.167 \text{ so a } \underline{15 \text{ foot } 2x10} \end{aligned}$$

What is the rise/run for each of the following pitches? (2 points for each correct answer)

$$1/8 = (x24=3/12)$$

$$1/6 = (x24=4/12)$$

$$1/4 = (x24=6/12)$$

$$1/3 = (x24=8/12)$$

$$1/2 = (x24=12/12)$$

**Part C (40 points)**

Before purchasing your trusses, you must decide if it would be more beneficial to purchase steel or wooden trusses. Create a table comparing the advantages and disadvantages of steel and wood trusses.

Lastly, as a team, in a word document present your reasoning by explaining which type of truss you would use. (Hint: Factors may include climate, cost, and efficiency).

1) Advantages/Disadvantages- Steel-For commercial buildings, steel trusses are a good option because they combine **functionality with safety**. Wood Trusses however, are often used in residential construction because it is less expensive and requires less labor to assemble or install.

2) Cost/Installation-Metal Trusses (Light Gauge Steel Trusses) have become more popular in that last few years. However, what many do not understand is that **Metal Trusses cost 5X as much as standard Pre-Fabricated Wood Trusses. Installation will also cost you more for metal trusses,** due to everything having to be screwed instead of nailed.

3) Stability- **Metal Trusses are worse for fire,** because metal will give and start to collapse faster in heat than Pine

4) Environment- The **Wood Truss Industry is Green and better for the environment** than Metal Trusses. All Yellow Pine used in Wood Trusses is Harvested “Grown” no old growth Timber is used.