What Type of Farm Shop Do I Really Need?

by
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for
Building It from the Ground Up Program
Lebanon, MO
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A Well-Planned Farm Shop....

- is energy-efficient
- is a place to assemble, service, repair, adjust & modify machinery and equipment
- is a place to work on farm, family and recreational vehicles and hobby projects
- encourages preventative maintenance of equipment
- is a headquarters for farm management, employees and daily callers

What’s the price of a day lost to a breakdown during planting or harvest that could have been fixed in a good shop?
Top 10 List of Shop “Musts”
by a poll of farmers

- Size
- Ventilation
- Lighting
- Heating
- Wall covering
- Drainage
- Water
- Office space
- Electrical outlets
- Pneumatic lines
- Extinguishers
- Tools and accessories
What We’ll Cover

- Initial Planning
- Concrete
- Lighting
- Electrical
- Insulation
- Ventilation
- Heating
- Tools & parts storage
- Safety

Photo credit: http://www.agriculture.com
Initial Planning

- Warm-weather or year-round shop?
  - How handy are you?
- Make it big enough for equipment 5-10 years from now
  - Build length with expansion in mind
  - Research how to hold costs down
- Locate shop within 150 feet of house
- Storage for service manuals & records
- Energy-efficiency
  - Lighting, heating, insulation
  - Insulate shop like you would your house
Initial Planning

- Think about grade before construction
  - Will you have floor heat, water drains?
  - Floors at least 12” above existing grade; slope 5% away

- Shop size
  - Size door with at least 2 ft. of side clearance and 1 ft. of head clearance for largest equipment
  - Install 36” service door to save energy
  - Add room for work benches, welders, tool caddies and walking room around machinery

- Utilities
  - Telephone, running water, rest room, future office?
  - Run electrical conduit for future needs
Warm-Weather Shop Layout
Basic Farm Shop Floor Plan
40’ x 48” Farm Shop Floor Plan
Concrete Floor

- A necessity
  - Durable and easier to clean
  - Easier to find dropped parts
  - Easy to roll shop tools around
  - Reduces dust problems

- Subgrade preparation
  - Remove all sod, vegetation, manure, etc.
  - Compact fill soil in moist 4”-6” lifts, or allow soil to settle 6-12 months before building
<table>
<thead>
<tr>
<th></th>
<th>Effort</th>
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<tbody>
<tr>
<td>Man</td>
<td>8-12 psi</td>
</tr>
<tr>
<td>Bulldozer - D5 Cat.</td>
<td>7- 9 psi</td>
</tr>
<tr>
<td>- D7 Cat.</td>
<td>8-10 psi</td>
</tr>
<tr>
<td>- D8 Cat.</td>
<td>10-13 psi</td>
</tr>
<tr>
<td>Ag. Tractor - Rear</td>
<td>15-20 psi</td>
</tr>
<tr>
<td>- Front</td>
<td>35-45 psi</td>
</tr>
<tr>
<td>Rubber-tire Scraper</td>
<td>40-60 psi</td>
</tr>
<tr>
<td>Sheepsfoot Roller</td>
<td>&gt; 300 psi</td>
</tr>
<tr>
<td>Woman in high heels</td>
<td>&gt; 860 psi</td>
</tr>
</tbody>
</table>
Concrete Floor

- Use 6-mil plastic over soil to stop moisture migration
  - Add 2” rigid foam over plastic if heating floor
  - Install electrical conduit for future needs
- Add a 4” thick compacted gravel or sand base
- Slope the concrete floor 1” per 10 ft. toward a drain or the entry door
- Use 3,500 psi concrete, add 6% air-entrainment in outdoor slabs
- Thicken outer 16” of slab to reinforce edges
## Slab Thickness (Unreinforced)

<table>
<thead>
<tr>
<th>Use</th>
<th>Thickness</th>
<th>Relative Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2-ton pickup or less</td>
<td>4&quot;</td>
<td>100%</td>
</tr>
<tr>
<td>Small trucks, farm machinery, few larger trucks,</td>
<td>5&quot;</td>
<td>145%</td>
</tr>
<tr>
<td>loaders, manure tankwagons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequent large trucks, grain wagons or manure</td>
<td>8&quot;</td>
<td>400%</td>
</tr>
<tr>
<td>tankwagons</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Ordering Ready-Mix Concrete

- What you want concrete for
- How much you need (in cubic yards)
- Strength of concrete you need (in psi)
  - Price is based on compressive strength
- Durability:
  - Water:cement ratio, OR
  - Gallons of water per bag of cement
- Air entrainment (in percent)
- Slump (in inches)
- Other needed properties
Lighting

- General indoor lighting (20 foot-candles at floor level)
  - ½ watt fluorescent per sq.ft. floor area, or 2 watts incandescent per sq.ft. floor area
  - Equals 1 double-tube, T-5 or T-8 4-ft. fluorescent fixture at 8 ft. height per 80-100 square feet of floor area
  - Light-colored ceilings and upper walls help

- Indoor task lighting
  - Use double-tube, 4-ft. fluorescent fixtures mounted 4 ft. above the work bench and positioned toward the front half
  - Use incandescent or LED lamps over rotating tools like grinding wheels to avoid the strobe effect
Lighting

General outdoor lighting

- Use 200-400 watt high-pressure sodium or metal halide lamps, mounted at a 15-25 foot height, with photocell control
- Space up to 125 feet apart for best lighting conditions
- Place a 150-watt spotlight, with motion sensor activation, on one or both sides of the entrance door instead of over the door, to keep out flying insects.
Electrical

- Minimum 200-amp, 240-volt service
  - Locate near service door for emergency shut-off
- Outlets
  - Locate max. 10 ft. apart around walls at 4 ft. height
  - One 20-amp duplex outlet for each 4 ft. of work bench; put under front edge to keep cords off the bench
  - One for each permanent motor-driven tool that is ½ HP or less
- Use GFCI/AFCI outlets in damp & outdoor locations
Individual branch circuits must be used for outlets serving motors larger than 1/2 HP
- Plan for one circuit to serve no more than three 1/3 HP motors, two 1/2 HP motors, or one 1 HP motor or larger

Use at least a 50-amp, 240-volt, 2-wire with ground circuit and outlet for a welder
- Locate it just inside the door, OR
- Add a second weatherproof outlet on an outdoor yard pole, so larger machinery can be repaired outside
Insulation

- **Warm-weather shop**
  - R-5 in ceiling or roof to relieve summer heat, condensation

- **Year-round shop**
  - R-18 sidewalls
  - R-30 to R-49 ceiling
  - R-10 doors
  - R-10 under heated concrete floors, R-5 if unheated
Ventilation

- Wall-mounted exhaust fan
  - Allow 1,000-2,000 CFM airflow per welder
- Vent engine exhaust outdoors with rubber hose or metal ducting
  - Provide 100 CFM airflow per vehicle in shop

Photo credit: http://www.sentryair.com
Wall Covering

- Fire-resistant wall board for insulated shops
- Durability
  - 5/8” plywood or 3/4” particleboard around welding area and workbenches
- Build firewall between shop and machinery storage if both are under same roof
- Perforated metal on upper walls good for sound control
Heating Options

- **Temperature**
  - Occupied = 45-60°F
  - Not in use = 40-45°F

- **Radiant (infrared) heaters**
  - Ceiling-mounted or portable floor-type
  - Provide the most instant heat
  - Are easily changed and relatively safe
  - Makes a room at 60°F feel almost as comfortable as one at 70°F degrees with forced air heat
  - Raising heater height increases area heated
  - Size at 40 BTUs (British Thermal Units) per hour, per square foot of floor area.
Heating Options

- Gas-fired or waste-oil forced-air furnaces
  - Good for heating large areas
  - Ceiling-mounted units help keep hot air from stagnating near the ceiling
  - Waste oil units are economical to operate
    - Provide a quick heat source
    - Most will burn No. 1 or No. 2 fuel oil as well as waste oil
  - Size at 50 BTUs per hour, per square foot of floor area.
  - Use a minimum of 70,000 BTUs per hour if the shop is fan-vented at 1,000 CFM to remove welding fumes, engine exhaust or dust.
Heating Options

- In-floor heaters
  - The most expensive to install
  - Electric resistance cable or hot water pipes buried in concrete over rigid foam insulation
  - Make the floor warm to work on, are quiet, and reduce dust circulation
  - Takes the system several hours to warm the shop to a comfortable temperature
  - Work best in conjunction with a ceiling-mounted forced-air furnace near the door
  - Size electric heat cables at 15 watts per square foot
  - Size water pipes at 50 BTUs per square foot in the bench area and 4 feet out into the service area
  - Keep max. floor temperature < 80°F for foot comfort
Heating Options

- Unvented fuel-fired space heater
  - Offers relatively inexpensive supplemental heat
  - Must have outside ventilation of 4 CFM per 1000 BTUs per hour of heater capacity to prevent CO buildup

- Electric resistance heaters
  - 100% efficient
  - Use several smaller units instead of one large unit, due to their high operating expense

- Solar
  - At the mercy of Mother Nature
  - Warm air can be directed at ceiling or floor
Top 12 List of Shop Tools
from Terry Halleran

1. Welder – MIG (under 3/16”); stick (3/16” & larger)
2. Oxy/acetylene or oxy/propane torch
3. Right-angle grinder
4. Metal-cutting bandsaw
5. Drill press (½” chuck)
6. Pedestal grinder (for sharpening tools)
7. Wrench set/socket set – up to 1” (quality)
8. Wrench set/socket set – 1”-2” (cheap)
9. Air compressor / ½” air ratchet / driver
10. Sliding miter saw or table saw (woodworking) / chop saw
11. Shop safety – fire extinguisher / clean water / safety glasses / dust masks
12. Misc. hand tools – hammers / ½” drill / circ. & hand saws / clamps / grease gun / 50’ x 110v and 25’ x 220v ext. cords / wiring tools
Pneumatics

- Makes repair jobs easier
- Air compressor
  - Minimum of two-stage, 2-5 HP, 60-gallon unit, 150-200 PSIG
  - ½” air hoses (25 ft. and 50 ft. lengths)
- Air ratchet (½”)
- ½” and ¾” black (gas) pipe with quick-couplers around shop walls
Tools & Parts Storage

- Reclaim your floor space
  - Any flat spot will collect stuff
  - Throw away stuff not needed
- Put everything on wheels
  - Portable worktables
  - Welders (stacked)
  - Tool caddies
- Floor hooks
- Hoist
- Oil barrel rack & lubrication cabinet on wall
- Water heater overhead on wall
Tools & Parts Storage

- Loft storage
- Plastic crates to store equipment
Tools & Parts Storage

- Shipping containers - $3200 each
Safety

- Fire extinguishers
  - At least two ABC dry chemical units in welding & lube areas
- Water for fire protection
- Electrical shut-off near service door
- Vent hoods and hoses
- Personal protection
  - Safety glasses, leather gloves
  - Face shields & goggles for grinding, sanding
  - Dust masks & respirators for sanding, painting
  - Vent hood and helmet for cutting, welding
  - Respirators for painting, pesticides
For More Information

- MWPS-26 Farm Shop Plans Book
  extension.missouri.edu/p/MWPS26

- Planning Farm Shops for Work and Energy Efficiency (Purdue University)
  https://www.extension.purdue.edu/extmedia/ae/ae-104.html

- Top Shops Design Showcase
  www.agriculture.com/machinery/farm-shop/plans/top-shops-design-showcase_241-sl28748

- Designing a Dream Shop
  farmindustrynews.com/designing-dream-shop

- Farm Shop Energy Efficiency Checklist and Tips
  www.extension.org/pages/30409/farm-shop-energy-efficiency-checklist-and-tips

- Make Your Shop a Power Shop
  www.agriculture.com/machinery/farm-shop/top-shops/make-your-shop-a-power-shop_243-sl6928
Questions??

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