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For Fruit and Vegetable Storage . . .

# Selection and Care of Wood Pallet Boxes and Bins

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The increasing cost and difficulty of obtaining new wood pallet boxes and bins makes it very important that proper care is exercised in purchasing and maintaining them. Boxes become a large portion of the capital investment for many storage firms and growers, and their actual life and usage can be greatly extended through proper selection and care.

This bulletin recommends practices that will increase the expected life of boxes and reduce the annual cost of using bulk, wood fruit and vegetable boxes.

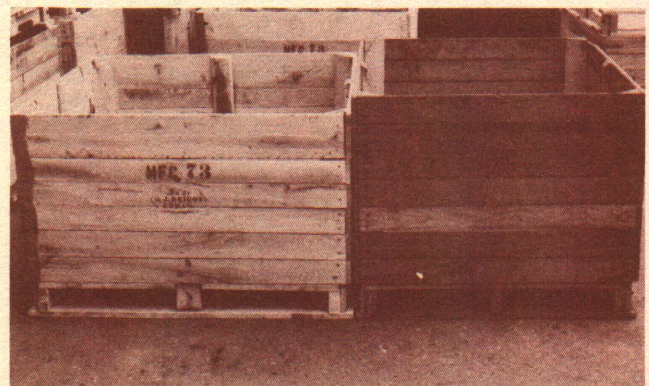
## Box Design

Various designs of boxes are available in limited sizes ranging from 15 to 20 bushels. The actual box design and size may be limited by special requirements of the user, such as size of lift trucks available, size of storage space to fit box size, and suppliers that can manufacture boxes. However, the design is critical to the life expectancy of the boxes and the ease of future repair. Important elements of design are (1) arrangement of the structural parts, either vertical or horizontal, (2) species or kind of wood used, (3) size of box including thickness of wood parts, (4) fasteners used or the type of nails, bolts, clips, strappings, etc., (5) inclusion of rounded edges and chamfers to protect the fruit from cutting and bruising inside the box.

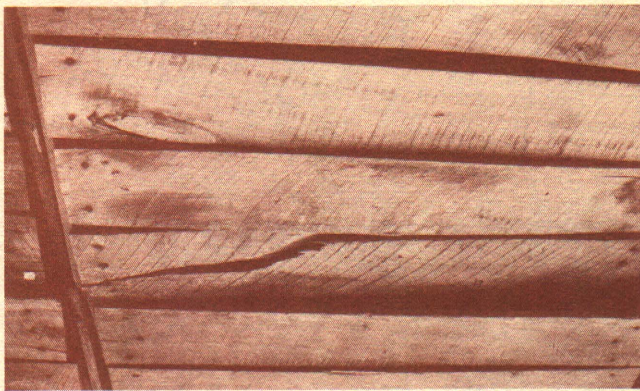


## Construction

There are many different methods of construction and orientation of the structural members of the box. The type of box that has offered good service in Michigan has been the "four-way entry" (referring to entry of the fork truck from four sides versus only two sides) with horizontal boards and vertical posts bolted to the pallet base. The corner posts are usually "nominal"



Two common size pallet boxes—left: 20 bu. box (47" x 47" x 29½"); right 18 bu. 47½" x 40" x 32"). Note: box owner, date of manufacture and the manufacturer of the box is stenciled on box. The corner of the box (left) is color painted for quick identification of box owner.



**Structural failure in box caused by crossgrain.**

4 x 4 inch squares sawn diagonally to form a smooth surface inside the box that will not cut or bruise the contents. Individual boards on the inside of the box should have a rounded or bullnosed edge with a 1/16 to 3/8 inch radius and a smooth surface to prevent damage to fruit used for fresh market. The use of thick and thin boards throughout the box can result in damage to the contents, so the sizes should be consistent. In specifying sizes, the lumber industry commonly uses "nominal" sizes that make an allowance for sawkerf or planing. If a specific thickness board is required, the words "actual thickness" should be used in the specification.

The most common mechanical damage to boxes results from racking and twisting of the box during handling. Apparently, boxes are often dropped from trucks and bumped and smashed with forks from the lift truck. This operator negligence results in reduced life and constant repair.

Keeping boxes in good repair is important in minimizing spoilage. Some types of construction are easier to repair and this should be considered at the time of purchase. If random width boards are used in the original construction of the box, it is more difficult to size and fit the repair boards. It is recommended that "spare" parts be purchased and kept for future use. Boxes should be considered as any other piece of equipment and they will ultimately need repair. If a good maintenance program is used, many additional years of service can be expected from the wood boxes.

### Wood Species Used

The dense woods such as oak, hard maple, birch and white ash have superior strength and nail holding ability. However, the workmanship in constructing the boxes is probably more important than the wood species used. The greatest strength reduction in wood

comes from material having large knots or cross-grain that will result in failures. The use of elm trees which have been left standing for over a year after being killed by Dutch Elm Disease is not recommended because decay is usually present. Elm and most other woods are subject to decay caused by wood destroying fungi under the proper conditions of moisture and temperature. Wood decay greatly reduces the strength and nail-holding properties of any species. Any wood containing decay should not be used in boxes that are expected to have many years service. Preservatives can be used to prevent further decay in wood, but the preservative will not heal wood that is already decayed.

#### DENSE WOODS

Beech  
Birch  
Hard Maple  
Oak  
Rock Elm  
White Ash

#### MEDIUM DENSITY

Ash (not white)  
Soft Elm  
Tamarack  
Gum

#### LOW DENSITY

Aspen  
Basswood  
Cedar  
Cottonwood  
Hemlock  
Pine  
Spruce  
Willow

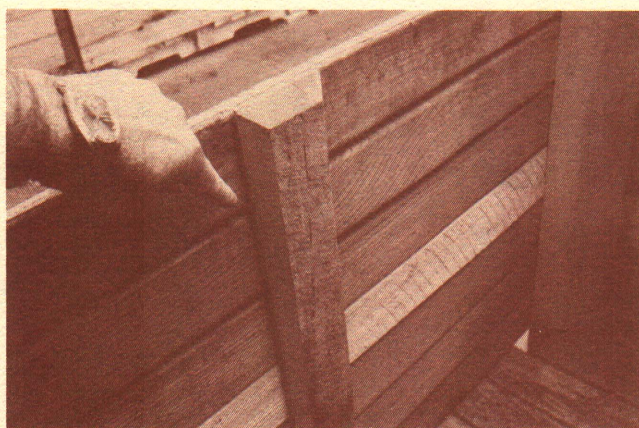
### Size of Box

Many different sizes of bulk boxes are used and sold without standards being developed. Box size is usually dictated by availability and the physical requirements of the storage plant and associated handling facilities. The type of fruit or vegetables to be stored should also be a consideration when determining the size of the box. The capacity and measurements of the fork lift to be used may limit box size.

The actual size of the storage facility—location of



**Repair parts available for reconditioning used boxes. Interchangeability of parts is important for repair and reconditioning.**



**Note chamfered corner and inside rounded edges to protect fruit for fresh market.**

doors, handling and sorting equipment—may also determine box size. It is usually desirable to maximize the use of any space, and a particular size box may result in a greater volume capacity. Considering repair and replacement of boxes, it is usually desirable to use a standard size. The strength of the box is affected by the relation of size and thickness of parts used in construction.

### **Fasteners Used in Box Construction**

The type of fastener and its correct application is critical in box construction. Early failure of many boxes and difficulty in repairing them is a direct result of the fasteners used. The original purchase specification for the boxes should state the number and type of fasteners used.

Most fruit and vegetable boxes are periodically subjected to wet and dry conditions that are very demanding. Corrosion of fasteners has been observed in a number of box failures and the use of corrosion-resistant fasteners may be well worth their additional cost.

**NAILS**—Nails are the most common fastener used in box construction. Many improvements have been made in the common nail that greatly increase its holding power, especially since the boxes are subjected to recurring cycles of wetting and drying. The use of spiral- or annual-grooved nails is definitely suggested and has proved effective in bin construction. Good quality nails of proper gauge, length and hardness are important in the construction of quality boxes.

**BOLTS**—Bolts can be used to fasten the heavy structural member and the pallet frame together. Usually carriage-type bolts are used.

**STRAPS**—Steel straps, preferably high strength and

corrosion resistant, are used in some types of pallets. Some users have indicated that steel straps tend to catch and snag during handling and moving of the boxes, and this may be a disadvantage of that type of construction.

**OTHERS**—Special metal clips and corners as well as hollow rivets are sometimes used in box construction.

### **Surfacing of Wood Construction Members**

A smooth surface inside the fruit box or bin is most desirable for protection of the fruit from damage due to cutting or bruising. It has already been noted that variations in wood thickness should be avoided for the same reason. Wide gaps between wood members will result in exposed edges and damaged contents. The use of curved or eased edges on the wood parts will greatly reduce damage to the contents. Many manufacturers surface the lumber to provide a constant, smooth contact surface with the contents.

### **Preservative Treatment of Wood Boxes**

Examination of a number of fruit boxes in use has shown evidence of decay. The conditions of use for wood boxes, which include ample water, warm temperature and air, permit wood-destroying fungi to grow. When the boxes are under refrigeration the decay fungus will remain dormant and then continue growth when the temperature is elevated.

To reduce wood-destroying fungus growth, a preservative dip treatment of all boxes is suggested. Care must be taken to use an FDA (Food and Drug Administration) approved preservative since the treated wood comes in contact with food products and many wood preservatives are toxic to humans when ingested.

The only wood preservative currently approved in



**Damage caused by failure due to wood decay.**

contact with food products is Copper-8-Quinolinolate. This is sold under various trade names, such as "Box life"<sup>1</sup> or "Bin Seal,"<sup>2</sup> and comes in a ready to use form or a 1 to 5 concentrate. The 1 to 5 concentrate can be mixed by the user with a volatile mineral spirits solvent prior to dipping.

The best results in preservative treating the wood bulk boxes and bins are obtained by immersing the boxes in the preservative solution from 3 to 5 minutes. Following the preservative dip, the boxes should be

servative will penetrate between boards and offers a greater degree of protection to this area.

The cost of dipping the box in a solution of Copper-8-Quinolinolate is approximately \$2.00 but will vary according to size of box and local costs. The increased expected life from treatment is difficult to predict, but at least 2 to 5 years increased life can be expected, depending on conditions. If an operator has experienced failures due to decay, a preservative treatment is strongly suggested.



**Pole type building for storage of boxes when they are not in use. This building protects the boxes and allows them to dry, reducing decay hazard.**

allowed to dry for a minimum of 35 days in a well ventilated area before use. This drying is necessary to allow volatilization of the preservative carrier solvent which may cause odor contamination of fruit products. Laboratory tests<sup>3</sup> at Michigan State University showed there was no odor contamination of Golden Delicious and Jonathan apples after being brought in contact with various wood treatments of both the ready-to-use and concentrate solutions. The conclusion was that Copper-8-Quinolinolate is a safe material for apple containers, provided it is used with an acceptable solvent and the wood allowed to dry for a period of at least 5 weeks, before being used to store apples.

The most likely decay areas of the box appear to be in the joints and around the nails and metal fastenings. This is a critical strength area for the box and difficult to repair. The joint in the box is slow to dry and collects moisture, hence greater decay. The wood pre-

## Handling and Storage of Wood Boxes

Proper storage of the bulk wood boxes or bins when not in use, will increase their useful life considerably. While the wood preservative acts as a poison to the decay fungi, insufficient moisture (below 25%) permits the decay organism to lie dormant until it does have enough moisture to continue growing. The decay organism will also remain dormant in the cold storage room, as long as the temperature is below 50°F. Therefore, the decay hazard can be reduced by both treating the wood and allowing the boxes to dry as quickly as possible after use. Both methods should be used. Also, wood that is drier is stronger in most strength properties and less subject to mechanical failure.

To dry the boxes as soon as possible, store them outside above the ground level, if possible, in an area with good drainage. The nesting of boxes reduces their drying rate. A covered shed or pole building with open sides for good ventilation makes an excellent storage area and provides protection from rain which would increase the drying time. The boxes should be stacked with alleys or tunnels left open to allow the wind to carry the moist air away from the boxes.

A number of possibilities exist for increasing the life

<sup>1</sup> Product of Champion International Company, Kalamazoo, Michigan.

<sup>2</sup> Product of Chapman Chemical Company, Memphis, Tennessee.

<sup>3</sup> K. Prugsakit and Dr. D. H. Dewey, Department of Horticulture, MSU, June 1971. (Mimeo)

of a wood pallet bin in use. Unnecessary roughness and mishandling, such as dropping boxes from trucks or fork damage from lift trucks should obviously be avoided. In addition, the preservative treatment and quick drying of the wood boxes will reduce the possibility of strength loss caused by wood decay and the associated possibility of damage due to strength loss.

### Cost of Wood Pallet Boxes

Initial costs of wood pallet bins have continued to rise. Often, boxes are not available when needed, due to seasonal demands. If the life expectancy of boxes can be increased by both proper selection and care in use, the annual cost of this large investment can be kept to a minimum. It is not so much the initial investment that concerns most managers, but the annual cost.

If the original, delivered cost of a bulk pallet box is \$20.00 and it lasts 10 years, the cost per year would be \$2.00, or  $\$20 \div 10 \text{ yrs.} = \$2.00/\text{yr.}$  However, if the life expectancy could be increased by 5 years by dipping the box in a wood preservative at an additional \$2.00 and using corrosion resistant nails at \$0.50, the annual cost would be less.

Original cost of box:	\$20.00
Additional cost of treating:	\$ 2.00
Additional cost of corrosion resistant nails:	\$ .50
	<u>\$22.50</u>

With life expectancy now increased to 15 years,  $\$22.50 \div 15 \text{ yrs.} = \$1.50/\text{yr.}$  Thus, by getting a better quality box which is more costly initially but has an extended life expectancy, the actual cost per year could be reduced by 25%.

To be complete, the costs should include interest, taxes, repair and insurance. Also, often overlooked is the cost of damaged or bruised and lost fruit and yard clean-up when boxes break open during use.

The least expensive box may not be the best buy; indeed it may be a very poor choice for many reasons. First, the life expectancy may be low which increases its annual cost. Second, there is a need for frequent repair at times when labor is required elsewhere. Other reasons are spilled, damaged fruit and yard clean-up.

### Summary

**SELECTION OF NEW BOXES**—The use of wood pallet bins or boxes for fruit and vegetable handling and storage has proven to be a useful, efficient and economical method. As with other equipment, the initial cost of boxes continues to rise. Experience over the last 20 years since their commercial introduction, has made possible recommendation for their selection and care, and both the wise selection and care of the box will provide additional useful service life and a lower annual cost.

The actual box design should be selected based on past good service records under use conditions. The size of the box should be standardized to fit a required system and dimensions of material used in construction sufficient to assure proper strength and ease of repair. The species of wood used will influence the quality, but of greater importance is the workmanship in building the box. Fastenings used are vital to the continued performance of the box and protection of the contents.

**CARE OF WOOD BOXES**—One must remember that the service life of any pallet wood box can be extended considerably if it is properly cared for. One of the biggest sources of loss is due to unnecessary roughness and mechanical damage caused by fork lift trucks. Treating wood boxes with an approved preservative will reduce the hazard of decay which will cause a subsequent loss of strength. The use of a protected storage area to increase the drying rate of the boxes when not in use is also suggested to reduce the decay hazard.

The wood pallet box or bin has proved a very serviceable and useful tool. It constitutes a large capital investment, and as with any large capital investment, care should be taken in its purchase and use. The annual cost (cost  $\div$  service life years) can be minimized, even if the initial cost increases, by exercising care in the selection and use of the boxes. In addition to the annual cost of the boxes, the protection of the contents and loss of time in cleaning the yard and plant should be considered. It is strongly suggested that a planned program for selection and care of the wood pallet boxes be instituted by all firms using them.

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