

# A Process to Apply Hardwood Pallets as Viable Raw Material for Furniture Making

**Patrick A. Blake**

Masters Thesis Project in Industrial Design

Georgia Institute of Technology

Advisor: Abir Mullick

Spring of 2012

# A Process to Apply Hardwood Pallets as Viable Raw Material for Furniture Making

**Abstract:** *Considering the abundance of wood pallets in today's manufacturing and distribution system, the reckless disposal of pallets calls for a sustainable disposal solution to better utilize the pallets and conserve resources. For example, only 10 percent of wood pallets are recycled and one quarter of all wood in landfills is from pallets. This project examines the use of wooden pallets in furniture making since the furniture industry has seen an increase in hardwood prices and a decrease in the quality due to hardwood shortage. The outcome of this project is a process book that documents collection, transformation and use of pallet wood to construct furniture and offer a sustainable solution for pallet disposal. The book serves as a guide in utilizing processes and using the tools needed to obtain furniture grade wood from pallets for furniture making. While there may be other ways to address pallet disposal or furniture wood scarcity, this process book provides a sustainable solution making good use of discarded pallets.*

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## WOOD SCARCITY

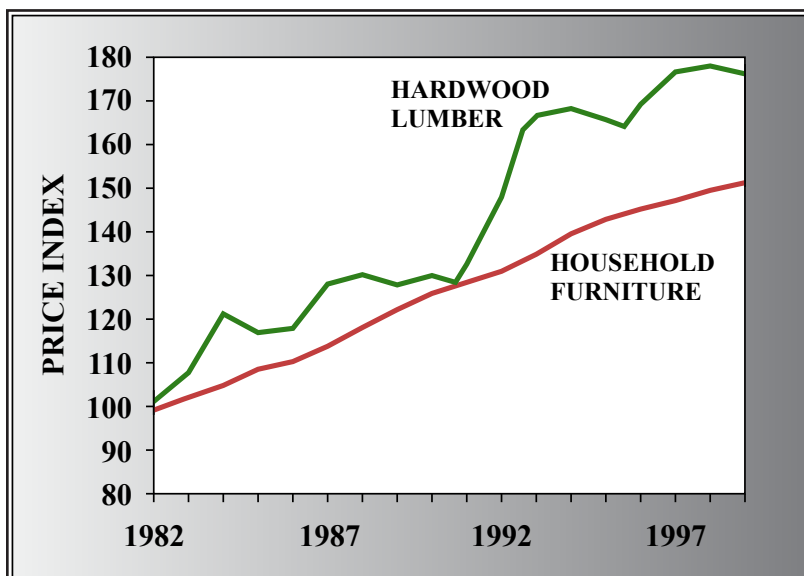
The hardwood shortage is first driven by deforestation. According to a UNEP report “the net loss of the world’s forests is estimated at 18 million acres per year (Achard, 2009).” Leading causes for deforestation range from production of paper products, fuel, lumber and land use. There are movements and grass roots organizations charged to reduce illegal deforestation and poor management of the logging industry such as the Forest Stewardship Council. The Forest Stewardship Council established in 1993, ensures consumers that the wood they are using was not taken illegally and that certain measures were taken to prevent deforestation (The History, 2009). However, the underlying issue remains that no matter how quickly trees are planted to replace the ones cut down, they will not mature fast enough to meet the demand for wood worldwide. The same can be said for better management; no matter how well managed the logging industry is, the demand for lumber remains higher than the rate at which forests are logged. Both factors ultimately drive up the cost of all wood and paper products.



*Deforestation in the Amazon Rainforest (Rise in deforestation, 2010).*

Reclaimed wood or “deconstruction wood” has been emerging since the 1980’s in response to wood scarcity, sustainability and recycling. This resolution has a small impact on the issue of deforestation and the price of goods. There are two primary reasons for “deconstruction wood” popularity. First and foremost is the rising cost of waste disposal; secondly is the consumers’ interest in both the sustainability aspect of reclaimed wood and the patina and aesthetic of the aged lumber. At the moment, the largest market for reclaimed wood is seen in hardwood flooring.

The shortage of wood is evident in the furniture market. Furniture makers have seen the results of hardwood scarcity continue to escalate (Eckelman, 1993). It has become difficult to produce quality solid hardwood furniture at affordable prices. Not only has there been an increase in the price of wood, but there is a drastic decrease in the quality of the wood that is available (Geller, 1998). As a result, many furniture makers and manufacturers are turning to composite or laminated veneer lumber to lower costs. Strength and durability is sacrificed when using non-solid hardwoods in construction of furniture. The hardwood alternatives also often contain formaldehyde and other chemicals. Consumers’ preference and desire for solid hardwood furniture still remains higher than furniture made with the alternatives (Eckelman, 1993).



*“Producer price indices for hardwood lumber and household furniture, adjusted to 1982=100 (from U.S. Department of Labor, 2000)” (Mitchell).*

## PALLET DISPOSAL

Wood pallets were developed around the turn of the 20th century as a means of efficient material transportation and handling. Wood pallets are constructed out of various types of sawn hardwoods and are held together with harden steel nails or staples. A pallet is a structure that stabilizes goods during transportation and storage. They are often used in conjunction with forklifts and pallet jacks (LeBlanc, 2002). The most common hardwood pallets are 3 feet by 4 feet Stringer or Block design pallets; however, pallets come in many shapes and sizes and there are no industry standards regarding size or dimension governing their construction. Some pallets may also be referred to as skids.



The pallet industry has been booming since World War II (LeBlanc, 2002). Most of the items purchased at any grocery, hardware, or department store have arrived on pallets. In the U.S. alone, close to 40% of all hardwoods harvested are used to make wood pallets (Makower, 2005). Once the pallets have transported goods, hundreds of millions of them are discarded in landfills every year by American businesses, costing consumers roughly a billion dollars (Makower, 2005). This allots for one-fourth of all the wood in our landfills belonging to discarded pallets (Makower, 2005), (The [Sustainable], 2009). Pallet recycling does exist, but only 10% of wood pallets are actually recycled. The most common recycling methods involve salvaging usable wood from old pallets to build new ones. Another alternative use for pallets before discarding is fuel. This currently is the leading sustainable method for pallets after use. Still the majority of pallets are seen as expendable, as two-thirds of pallets are used only once before being sent to landfills. This is a concern considering the scarcity of wood worldwide.



*These pallets are waiting to be disposed of in the parking lot of a local Atlanta home building company. Once a month, a pallet grinding company comes to grind the pallets for easier disposal.*



## SIGNIFICANCE

Pallets are made of solid and sometimes expensive hardwoods including Poplar, Mahogany, Oak, Pine, Poplar and more. The sheer abundance of hardwood pallets in our society makes them easily obtainable at a minimal cost. Most businesses even pay to have their pallets hauled away (Garneau, 1997). This, coupled with the lack of quality solid hardwoods in the furniture industry today and higher prices for those that are available, makes reuse of pallets a great option for furniture making. Perhaps consumers could once again purchase solid wood furniture for reasonable prices. If a process was developed for pallet wood to become a viable material for the furniture industry, it could lessen the need to harvest remaining hardwoods and impact deforestation, as well as decrease the amount of landfill space being taken up by discarded pallets.



*"Lounger" by Marc Gervait Stalé made from an assortment of pallet wood (Lounger).*

## PRIOR ART

The search for furniture constructed or designed using pallet wood finds there are only a handful of designers or furniture makers who have used pallet wood as a medium for furniture construction. These designers have identified different reasons for use such as concerns over landfill usage, deforestation, price of wood, scarcity or sustainability. However, the primary stated reason was "because the wood was donated." (Gervait Stalé, 2011). Although few are using pallet wood, their use does prove that pallet wood can be put through a specific process and successfully applied to furniture construction.



*Example of "Pallet Craft" (Pallet Chairs, 2009).*

"Pallet Craft" is another way pallets are currently avoiding landfills and are being turned into furniture, garden planters and other crafts. This is a conscious sustainable movement that mainly takes place on the Internet. Groups and individuals with a passion for recycling pallets post their projects along with "how to" videos and blogs for others to follow. Pallet Craft appears to be a quick and easy arts and craft project rather than a sustainable solution for pallets. The pallet wood is generally left in its raw and rough state to create a more folk art style solution. Although the drive behind Pallet Craft is aimed at sustainability, the longevity and application of the wood does not pose as a valid solution to address wood scarcity in the furniture industry.

Lastly, the application of other reclaimed materials or woods used in furniture production and design were reviewed. Sustainability is a hot topic in our current society. As a result, there are larger numbers of sustainable products or repurposed goods applied to furniture design than ever before. These products range from old signage to repurposed washing machine drums, discarded plastic grocery bags, etc.; the list is endless. However, these applications do not address the desire for solid hardwood furniture by consumers; nor do they contribute to the supply of sustainable or recycled wood materials being applied to furniture design.

## INTRODUCTION

The following contains an overview of the research done to develop a process book for turning discarded pallets into furniture grade wood for the construction of furniture. The steps and processes were developed through many hours of repetitive hands-on work and exposure with pallets, wood, machinery and tools, as well as background research in woodworking, furniture making and lumber processing.



## 1: COLLECTION PROCESS

To begin testing pallet wood for furniture application, pallets first had to be acquired. This made way for the first step in the process, the Collection Process. Finding pallets is not that difficult, however, knowing where to look is key in their attainment. Before applying the wood to physical transforming processes, pallets must be gathered, sorted and dismantled. These steps have been thoroughly investigated and are included in the Collection Process.

### Locating

After initial background research on the magnitude of pallets being discarded in the US alone, the first step was to check dumpsters and landfills in the Atlanta area. This proved to be an effective method, but inconsistent and ultimately a waste of time as compared to going where pallets were readily and knowingly available. Since a large quantity of pallets needed to be acquired, it seemed most effective to set up a direct line of contact with companies that would be discarding pallets. This way, assurance was given that pallets were actually available and also pickup could be arranged. Small individual retail locations as well as construction companies proved to be the leading sources for pallets in the Atlanta area. These pallet providers welcomed the ability to unload their pallets free of charge instead of paying disposal fees. It was also discovered that many larger corporations or franchises were not responsible for their pallets and did not pay disposal fees. Their pallets were normally recouped by their distribution centers. Posting to classified ads such as *Craigslist* also proved to be a decent source for acquiring pallets. Searching for pallets online and posting ads requesting pallets in both yielded pallet acquisition. The main respondents through ads were truck drivers who owned their own personal trucks, or individuals who had received shipments on pallets and were trying to get rid of them. The last avenue for successfully acquiring pallets was identifying individuals who already collected pallets. These individuals generally collect pallets as a source of income. They often create direct contacts with companies and also scavenge for pallets, selling them back to pallet recycling companies for under \$5 a pallet. By simply offering to pay slightly more than what they would receive from the recyclers, they were glad to sell what they had acquired.





## Cataloging

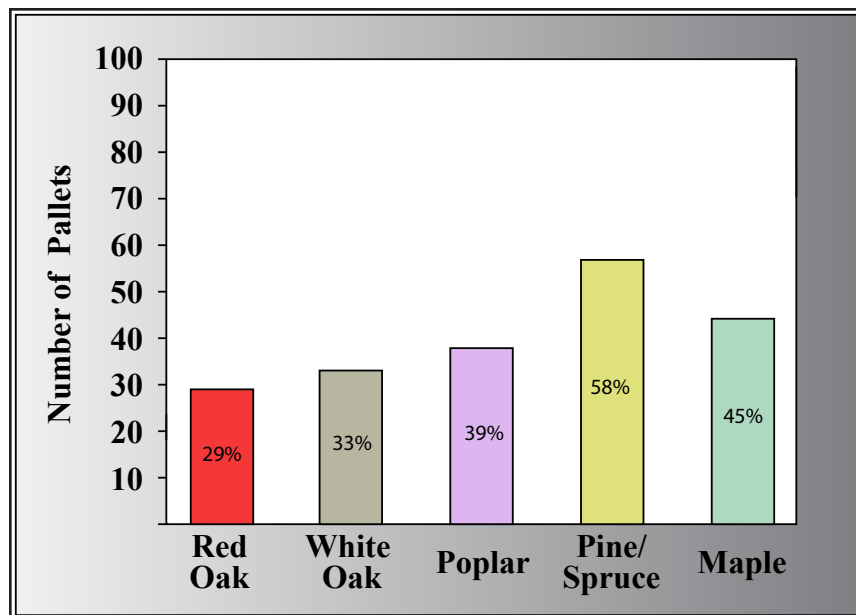
Cataloging the pallets collected was the next step in the research stage. Though cataloging is not part of the process book, it helped determine what woods were most prevalent as well as what types of pallets to expect. A method of cataloging had to first be created. This was done by determining what were the most prevalent pallet configurations and is outlined below.

- A. Two-Way Nonreversible Pallet
- B. Two-Way Reversible Pallet
- C. Four-Way Pallet
- D. "Skid"/Expendable Pallet #

After the most common types of pallet configurations were discovered, 10 pallets were examined to see which types of wood from which they were constructed. One hundred pallets in the Atlanta area were collected and then cataloged by type of wood and configuration. It was discovered that most pallets are constructed with more than one type of wood.

Wood Pallet Classifications		PALLET # <u>47</u>
Done by Patrick A. Blake		
PALLET TYPE	PALLET WOOD	NOTES: <u>EXTENSIVE</u> <u>DAMAGE</u> <u>TO ONE</u> <u>DECK BOARD</u>
<input type="checkbox"/> A	<input checked="" type="checkbox"/> Red Oak	
<input checked="" type="checkbox"/> B	<input type="checkbox"/> White Oak	
<input type="checkbox"/> C	<input checked="" type="checkbox"/> Poplar	
<input type="checkbox"/> D	<input type="checkbox"/> Pine	
<input type="checkbox"/> Other	<input type="checkbox"/> Maple	

Card No. 47 of 100 from the Cataloging Process.



Results of Cataloging Process. Note results are greater than 100%, this is because more than one type of wood was found in most of the pallets.

## Sorting

Sorting evolved after trying to dismantle pallets of different woods, configurations and hardware construction. Having to switch back and forth between tools and methods for dismantling proved to be time consuming. Sorting the pallets prior to dismantling proved to be a more effective method. It also expedite the process of identifying pallets in the best condition, containing the most desirable wood.



The majority of this wood was in no shape to be salvaged.

## Dismantling

In order to effectively dismantle the pallets, it is essential to understand how they are constructed. Prior to dismantling, an investigation of how pallets were held together and what they were held together with was conducted. From researching and physically examining the pallets, it was determined that the pallets were held together by nails and staples along all points of intersect. The nails used most often were helical nails, making them difficult to remove.

The next step was to actually dismantle the pallets, which was done in three research stages. The first stage was attempting to dismantle the pallets with no prior knowledge of any processes or tools used in pallet dismantling. Once this was performed and recorded, further research was done to investigate previous recorded methods for dismantling pallets. Individuals practicing Pallet Craft recorded the most written documentation for pallet dismantling discovered. These methods were then applied in dismantling pallets. Finally, existing methods were combined with personally discovered methods to create a hybrid combination of the two. This was then applied and tested in the dismantling of over 50 pallets. The outcome was to provide an array of methods for a range of skill sets and tools to be used in the dismantling process. The process shows there is no one single way to dismantle a pallet, but a number of ways are proven successful. This allows an individual to decide what method works best for them.



*Using a hand held metal detector to locate hidden nails.*

## 2: SALVAGE PROCESS

### Stripping

Stripping is imperative for two primary reasons. First, the desired outcome is to have furniture quality wood. This wood should be as pure as possible, free of any foreign objects, dirt or imperfections. Secondly, stripping is for protection of the machinery used in future construction. This essential step was confirmed as the result of the dulling of a few machine blades that was experienced.

After stripping over an estimated 700 pallet boards, it was determined that it is first best to remove all visible nails and dirt. After visible detection, if possible, one should then scan the wood with a metal detector to find any nail or nail fragments left behind and remove them as well. If a nail or nail fragment was too difficult to remove, the section of wood containing the nail was cut out. Cutting a piece of the wood off proves less costly than replacing machine blades.

## Utilization

The last step in the Dismantling Process is the Utilization Process. This process basically serves as a Sorting Process post dismantling now that you are working with individual boards as opposed to whole pallets. Not all boards are worth the time and effort it takes to process them. Utilization was developed as a result of running boards repeatedly through future processes, such as planing and edge-jointing, and still ending up with wood that was unable to be used in furniture application. After discovering these issues, research was launched on common wood imperfections that may cause difficulties in woodworking. Once acquiring knowledge of these imperfections and grouping wood by sizes and type, future processes became more efficient.

## 3: IDENTIFICATION PROCESS

Identification is more of a guide for the user than a process. It consists of a list of woods and their properties that were compiled to help identify the more common pallet woods. This list was formed using prior knowledge of wood types, utilization of several wood identification books and grouped with the findings from the cataloging process.



*Heartwood Pine*



#### 4: TRANSFORMATION PROCESS

The Transformation Process is where the wood begins to take on a new form and appearance from its prior state. In Transformation, planing and edge-jointing are introduced. Transformation was derived from close study of how all lumber is processed to become furniture quality wood. Research spans from how mill workers process fresh cut timber to provide to furniture makers, to how furniture makers further process the wood. Over 400 hours were spent observing and studying professional furniture designers on wood processing techniques. Hands-on work alongside these designers was also part of this study. This experience and research helped mold the Transformation Process.

#### 5: APPLICATION PROCESS

The Application Process is the final step to producing furniture grade wood. It involves creating wood forms that are easily applied to furniture design and construction. This again is a result of hands-on experience and observations done with professional furniture designers and makers. This experience and study in addition to outside research, revealed two preferred wood forms for pallet utilization and furniture application, solid and plywood. Throughout the testing of this process, many forms and applications of the wood were achieved while some were unsuccessful. For example, pallet wood proved to be either too dry or aged to steam bend or produce veneers. Thus, the solid and plywood form proved most successful. Solid wood is a versatile application for the wood, which can be lathed, cut into forms and is durable and load bearing. Plywood is an integral part of furniture construction and utilizes all the wood from pallets. Since pallets are made up of many kinds of wood, some of the least desirable woods for a certain design could be used as filler in the inner layers of the ply sheets. Another positive aspect of plywood was that it can be bent in the glue up or plying process and holds its form. This proved to be significant since pallet wood was not able to be steam bent on its own.



*Forming veneers for plywood*

#### PROCESS BOOK

The Process Book is the final compilation of all testing, findings and observations from the research phase. The book is to be picked up and followed by any individual or company in hopes of creating furniture grade wood from discarded pallets, whether that be for sustainability or cost cutting reasons. This book contains numerous methods so that whoever follows the process can utilize proper tools and varied skill sets to successfully execute the process from beginning to end.

# THE PROCESS

## **1 COLLECTION PROCESS**

- **LOCATING**
- **SORTING**
- **DISMANTLING**

## **2 SALVAGE PROCESS**

- **STRIPPING**
- **UTILIZATION**

## **3 IDENTIFICATION PROCESS**

## **4 TRANSFORMATION PROCESS**

- **PLANING**
- **JOINTING**

## **5 APPLICATION PROCESS**

- **SOLIDS**
- **PLYWOODS**



# COLLECTION PROCESS

*The Collection Process is a broad yet very important process. It is a key part in saving the pallets from landfills and getting them prepped for furniture making. In this process you find out how and where to successfully locate pallets that have already or will eventually be discarded. You will begin to see how to sort through pallets efficiently to identify all salvageable parts. The collection process concludes with a variety of ways to dismantle the pallets and begin to identify and sort the types of wood that are contained within the pallets.*

## Locating

Pallets that will be applied to the process first need to be located. Most pallets are free or fairly inexpensive. Finding initial suppliers is key.

## Sorting

Not all pallets are usable; some of them may be rotten or broken. This is where sorting pallets can help make your process more efficient. Some of the pallets may be set aside when in fact the wood is salvageable. Keep these pallets for future consideration.

## Dismantling

Dismantling is a tedious process. It is best to start simple and remove as many of the nails as possible. Depending on the type of wood and nails in the pallet, a saw may be used to finish up this process.

## Identification

The wood will now need to be identified and sorted according to type. Once learning what types of wood are generally in pallets, a simple scratch test can be applied to the wood to remove the weathered outer layer revealing the grain structure.



*Pallets being disposed of (Pallets in Dumpster, 2010)*

# COLLECTION PROCESS

## LOCATING

*It all starts here. The location process is one of the most important processes in intercepting pallets before they wind up in landfills. As plentiful as pallets are, if you don't know how to find them you will only scratch the surface in collecting all usable pallets in your area. Locating pallets is about remaining in contact with your resources. You can drive around and search for discarded pallets in dumpsters, but if you establish resources, the pallets will come to you.*

### Top Observed Resources

- **Small Businesses**
- **Construction Sites**
- **Distribution Centers**
- **Pallet Collectors**

### **Classified Ads**

The most efficient way of locating pallets in your area is via classified ads such as *Craigslist* or your local newspaper. Because pallets are not scarce, individuals and companies constantly post about having pallets removed. Most posters will gladly unload their pallets for free, however pallets being sold generally cost \$2-\$5 a pallet. Another way to use classified ads is to post an ad yourself seeking wooden pallets. Use the system both ways.

<a href="#">atlanta craigslist</a> > <a href="#">otp north</a> > <a href="#">for sale / wanted</a> > <a href="#">materials</a>
<b>Avoid scams and fraud by dealing locally!</b> Beware any deal involving Western Union, Moneygram, wire trans
<b>FREE Scrap Wood &amp; Pallets (Buford, GA)</b>
Date: 2012-02-03, 12:37PM EST Reply to: <a href="mailto:qawjg-2832785124@sale.craigslist.org">qawjg-2832785124@sale.craigslist.org</a> <small>(Errors when replying to ads?)</small>
Free scrap wood and wood pallets available. Must have own pick up truck and must be picked u Pallets are missing slats, etc. and cannot be recycled or sold for reuse. Can be used for wood pro Last chance before taking to the dump. <i>Example pulled from Craigslist listing.</i>

### **Small Businesses**

Maintaining a constant relationship with small businesses is another gateway for pallet collection. These businesses most often pay to have their pallets disposed of, therefore, they will often gladly set aside their pallets for free removal if interest is expressed. The reason for choosing small businesses over large corporations is the reuse of pallets. Large corporations tend to operate through distribution centers where pallets are kept in rotation.

### **Construction Sites**

Construction Sites often operate like small businesses, receiving supplies and materials on pallets and then having to dispose of them afterwards. Contact your local builders and establish a line of communication. Let them know that you are able to remove their pallets free of charge.



*Construction sites send pallets to landfills with the rest of their scrap material.*



# COLLECTION PROCESS

## LOCATING

### **Distribution Centers**

As stated in the Small Business section, distribution centers tend to use their pallets more than once. This is why most larger companies will not give up their pallets knowing they will be returned to the distribution center. If you go straight to the source (the distribution center) there are generally an abundance of pallets. Because pallets have a lifespan, after extensive use distributions centers are willing to part with their pallets. Again it is about contacting them and letting them know you have an interest in unwanted pallets.

### **Pallet Collectors**

You have probably seen them before, driving around in pick-up trucks loaded with pallets. Pallet Collectors are often seen going from business to business collecting discarded pallets. This is often a source of income for these individuals. They have already done all the groundwork; they have all the resources and contacts. Generally they collect pallets to sell them back to pallet recyclers or to sell as firewood. Locating and contacting these individuals could establish a great source for acquiring pallets for your process. Simply offer to pay them for their work in collecting pallets.



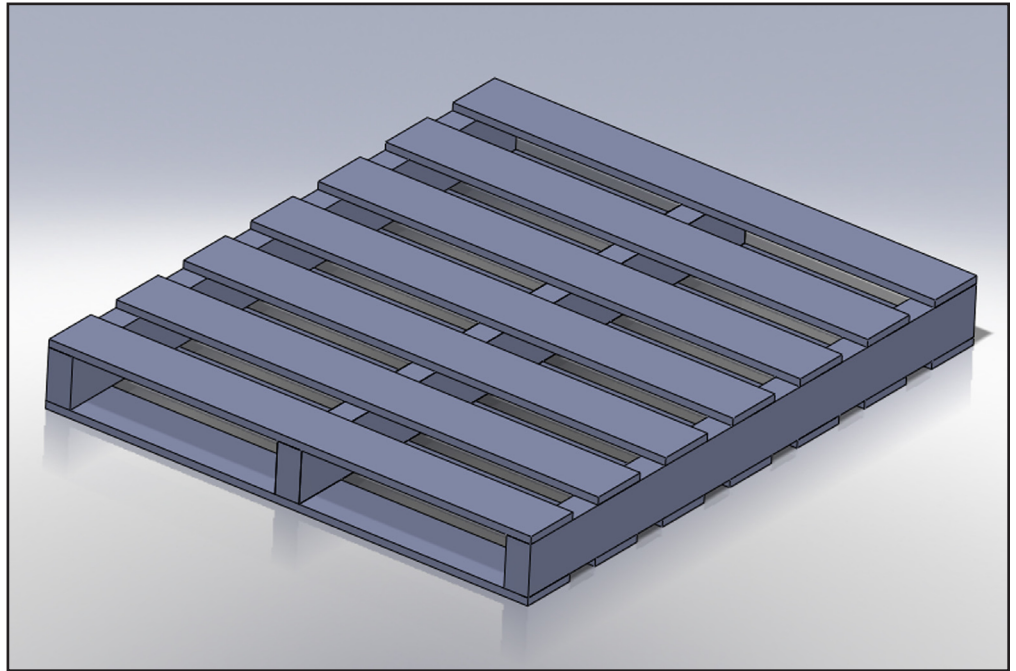
*(Truck O' Pallets, 2010)*

# PALLET OVERVIEW

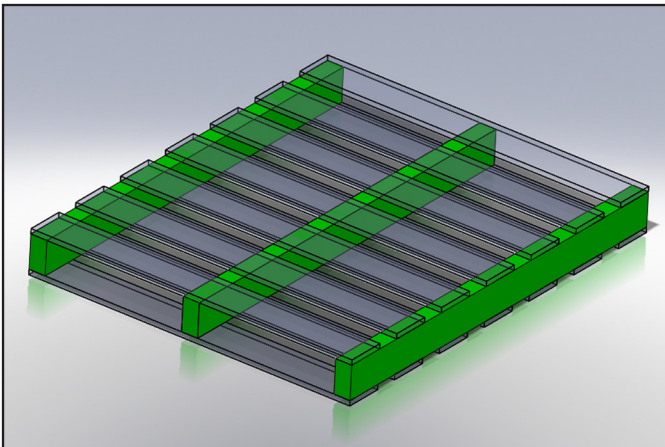
*Before we move further in the collection process, it is best to understand the pallet as a whole. This overview will give you a brief description of the main components of a pallet as well as the many different types of pallets.*

## Basic Components

The stringer pallet is the most commonly used pallet in the United States; the average size being 48" x 40". The Grocery Manufacturer Association (GMA) has created a standard 48" x 40" hardwood stringer pallet specification that is used widely for many consumer products.

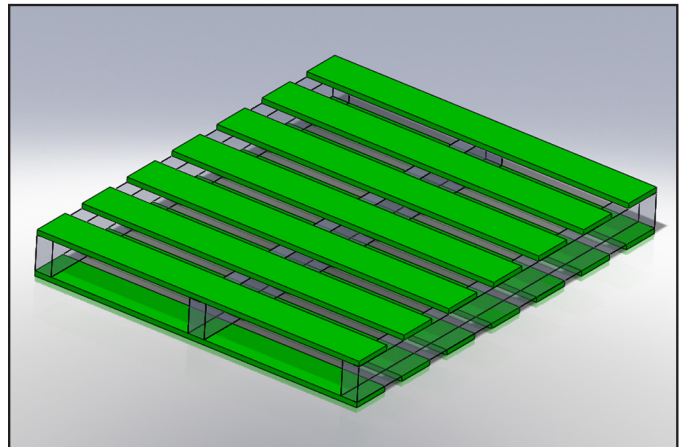


### Stringer



The stringers are the boards that support the unit load, typically 2 x 4's or 3 x 4's, sandwiched between the top and bottom deck boards.

### Deck Board



Deck boards are laid parallel with one another on the top and bottom of the stringers, creating a surface for the unit load to rest. A pallet without a bottom row of deck boards is called a skid.

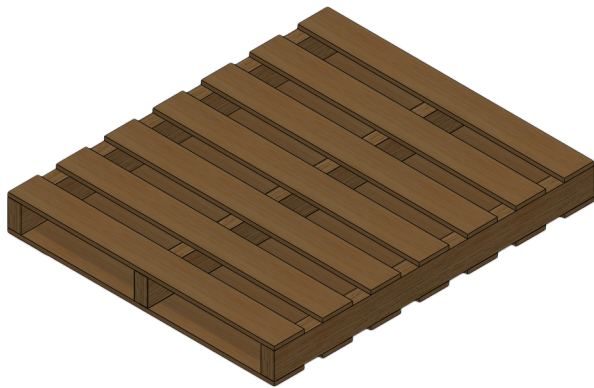


# PALLET OVERVIEW

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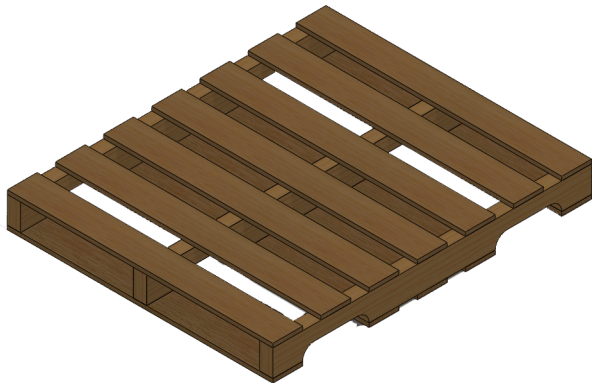
## Basic Pallets

Although pallets may come in any shape, size or configuration there are still some pallets that tend to remain consistent. All kinds of pallets may be applied to the process, however, these three configurations happen to be more common and have been proven to work on a regular basis.



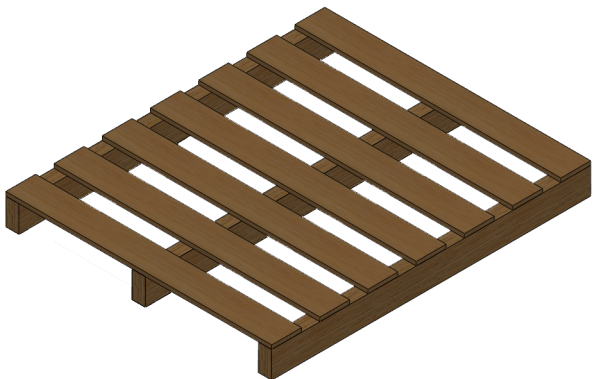
### Two-Way Reversible Pallet

The two-way reversible pallet is often used in warehouses for stacking bag or drum products. Like its name, it can be used on either side. It can also so be accessed by a fork lift or pallet truck from either end (Basic Pallets).



### Four-Way Pallet

The four-way pallet is the standard grocery model pallet. It is also often used in other shipping and storage formats because it can easily be accessed from all four sides by a pallet truck or fork lift (Basic Pallets).



### “Skid”/Expendable Pallet

Coined the “one-way” shipping, these expendable pallets or “skids” are made with low initial cost and are not expected to last past one use due to the lack of deck boards on the bottom. They can also be accessed from two sides with a fork lift or pallet truck (Basic Pallets).

# COLLECTION PROCESS

## SORTING

*Sorting helps with efficiency in the transition from collection to dismantling. Knowing what pallets you have and what can be salvaged can expedite the process. The pallets you have collected have reached the end of their rough load bearing life. Realize that not all pallets or parts of pallets are worth the time it takes to deconstruct them. There are also many types of pallets. Some are fairly complex while others have a rather simplistic construction. This is where knowing what types of pallets you are working with as well as how they are held together will help you with your plan of attack.*



**Damaged**

First take a good look at the amount of salvageable wood in the pallet. If there are only a few pieces worth utilizing, it might be best to put it aside until later. Pallets can be like puzzles--you have to remove several pieces to get to the pieces you want. It is better to pursue pallets where you can use the majority of the pieces.



**Rotted**

Lots of pallets spend time in outdoor elements during their lifespan. This, of course, can mean wood rot in untreated pallet wood. If any part of a pallet seems to be affected by rot, chances are the majority of the wood in the pallet has been affected, too. Trying to remove wood rot can be time consuming.



**Construction**

Certain types of pallets may have little to no decent wood in them such as *block* or *panel pallets*. Block pallets use blocks instead of stringers and panel pallets use sheets of wood instead of deck boards. These types of pallets, as well as ones that have been constructed with more nails than necessary, should be put aside.



# COLLECTION PROCESS

## DISMANTLING

*Dismantling is as basic as doing away with what holds the pallets together.*

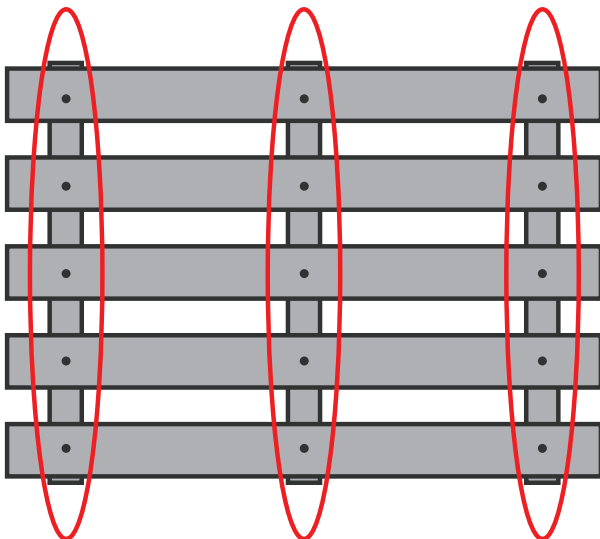


*Rusty with age, these helical nails and staples should be removed from pallets.*

### Nails and Staples

Most pallets are held together with helical nails and occasionally staples. When pallets are initially constructed, these nails and staples are inserted by machines. Due to their helical structure as well as deterioration after use and exposure to harsh elements, these nails and staples can make removal by hand a difficult task. Knowing where they are located and using proper tools can help immensely.

### Where are they?



All nails and staples will be located along any of the cross-sections. Every place a deck board intersects with a stringer you will find a nail or staple. It is not common to find this implemented outside of these cross-sections.



*This is a close up of a helical nail before it has been applied to a pallet. This helical structure helps the nail act like a screw.*

# COLLECTION PROCESS

## DISMANTLING

*Because not all pallets are constructed the same way, not all pallets come apart the same way. There are many different ways to disassemble a pallet, but the best way leaves maximum amount of wood in a usable condition. In the dismantling process, various strategies for dismantling pallets will be uncovered using various tools and methods. There is no one correct way to deconstruct a pallet.*



**The Pry Bar.** The first tool assessed when dismantling pallets should be some fashion of a pry bar. Depending on how secure the pallet is, this is your best option for dismantling the pallet by removing nails and preserving the wood.



Pry bars come in many shapes and sizes, so find what works best for you. The larger the pry bar the more leverage you will possess for those hard to remove boards. Smaller pry bars are better for precision when it comes to removing individual nails.



There are pry bars made especially for pallet dismantling such as the Pallet Buster sold at most freight hardware stores. Its pronged design with long handle provides maximum leverage in deck board removal.



The readily available pry bar is a hammer. The hammer is great for prying and knocking boards loose.



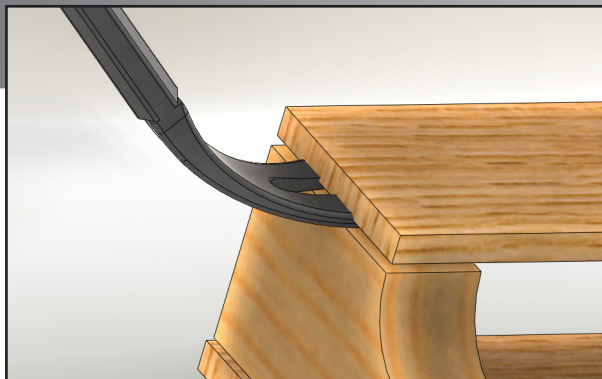
# COLLECTION PROCESS

## DISMANTLING

### Pry Bar Dismantling

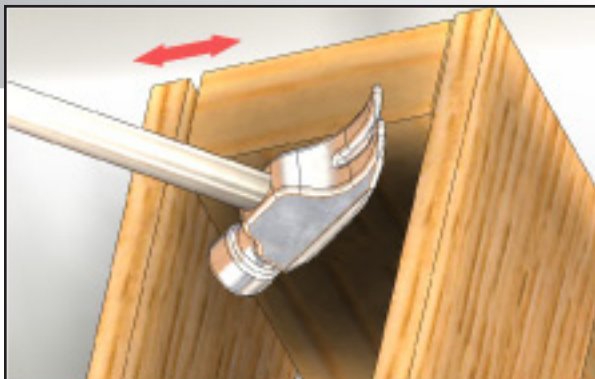


1



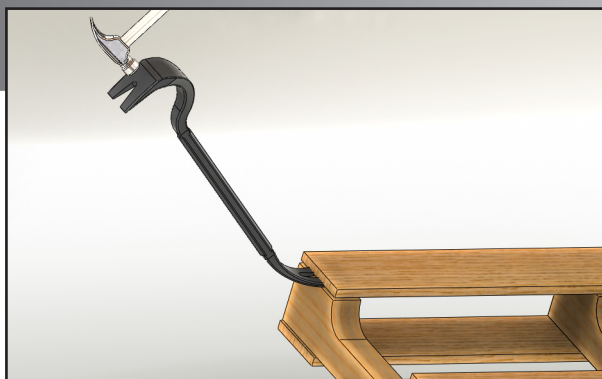
Find separation between the stringer and deck board and begin to work in the pry bar.

2



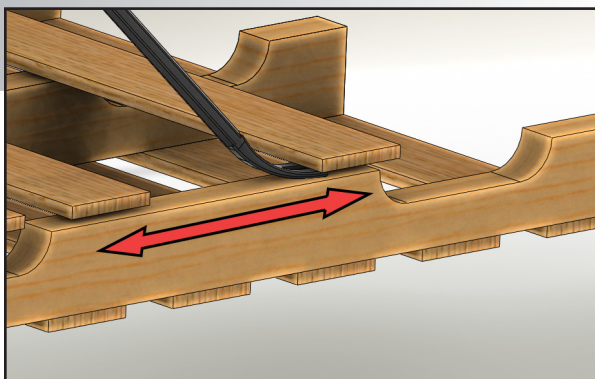
If no separation exists, utilize your hammer to create separation. Sometimes the hammer itself might be sufficient enough for knocking the deck boards loose.

3



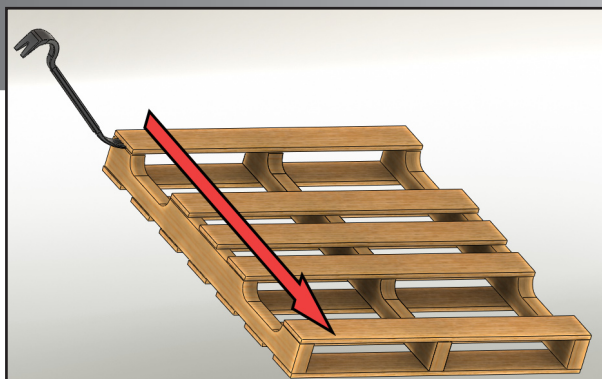
The hammer can also be used to drive the pry bar in deeper to create maximum leverage when prying.

4



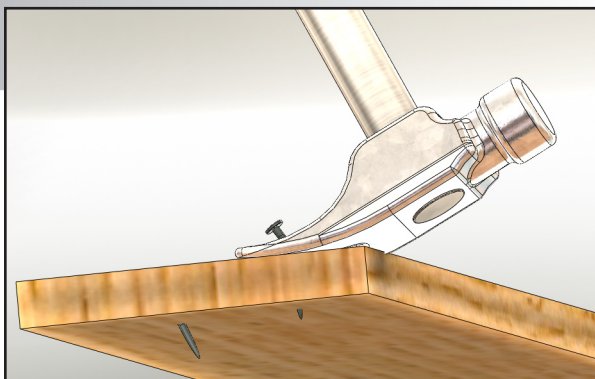
When applying force to the pry bar, it is best to use the stringer as a pivot point for the pry bar to create maximum leverage.

5



Start at one end and work laterally down the deck board. Remove one deck board at a time. This allows easier access to the next deck board.

6

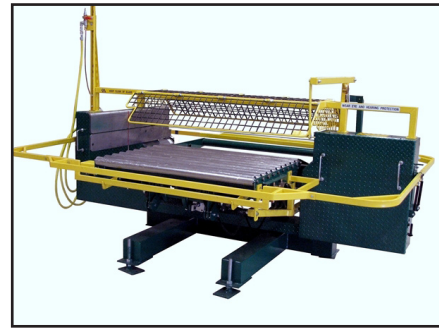


When the deck board is removed from the stringers, continue to use the pry bar and hammer to remove the nails from the deck board itself.

# COLLECTION PROCESS

## DISMANTLING

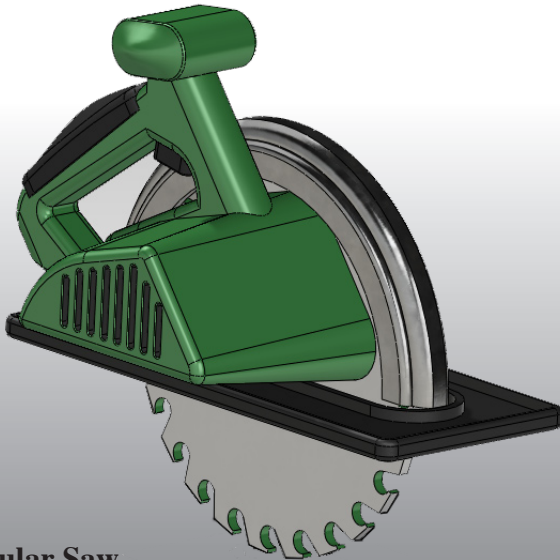
*The other option for dismantling pallets is a saw. Large pallet recycling companies use a custom pallet saw. For our purposes, almost any saw will do. The next section will examine how to use different types of saws to dismantle pallets and how to handle the different scenarios sawing can present.*



*DMA Saw used by large pallet recycling companies for dismantling.*

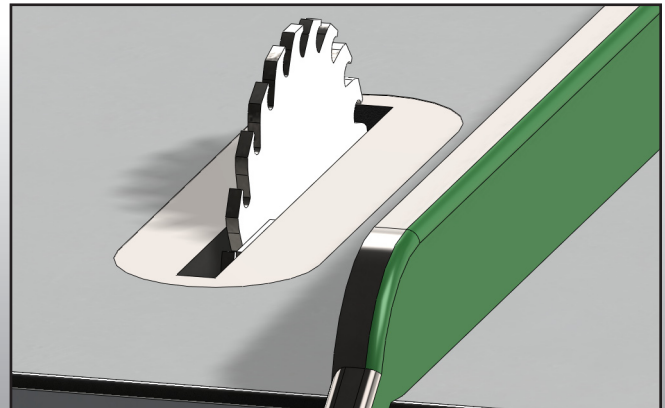
### Saws

There are many different types of saws, most of which are capable enough to assist in pallet deconstruction. These are just a few options to help.



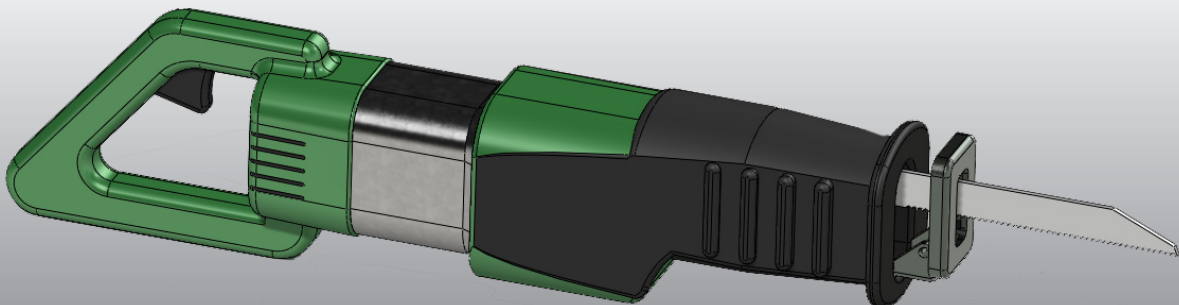
#### Circular Saw

Convenient portable saw that cuts with a toothed metal cutting disc or blade.



#### Table Saw

Basically a circular saw mounted to a table; a table saw tends to be the center of any shop.



#### Reciprocating Saw

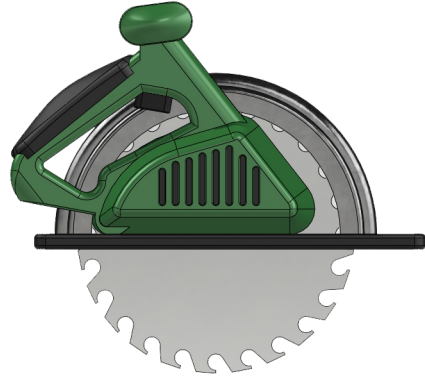
Generally used in construction or demolitions the reciprocating saw cuts with a push and pull reciprocating motion of the blade.



# COLLECTION PROCESS

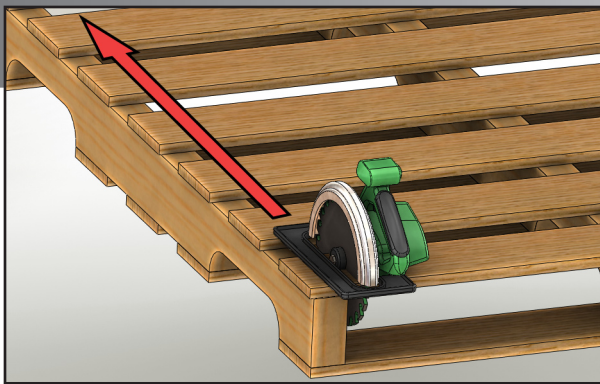
## DISMANTLING

*The Circular Saw can help speed up the process, however, there is a trade off for using it. You will sacrifice more wood than you would by using the pry bar method. If you are aware that the dimensions of your design will not be affected by shorter cuts of wood, this will prove to be a much speedier process.*



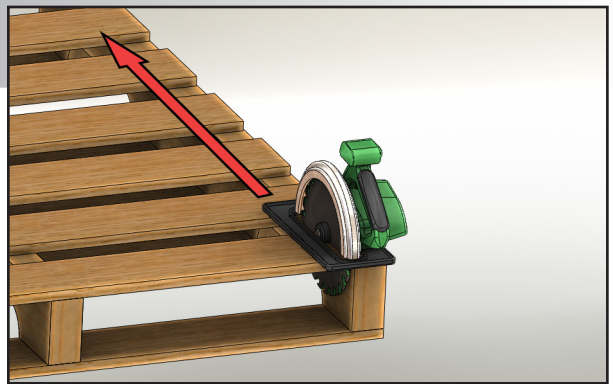
### Part 1 Circular Saw Dismantling

1



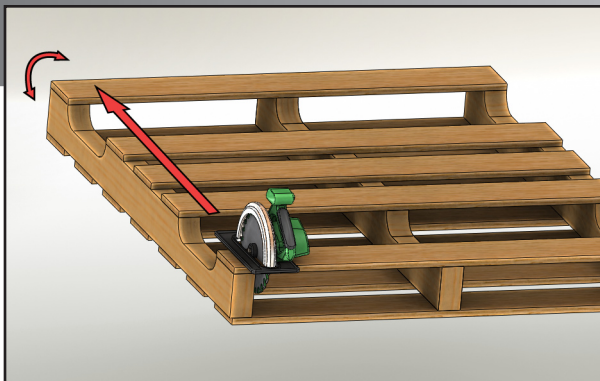
First make a cut just inside the outside stringer across the tops of the deckboards. This will free the ends of the deckboards from the stringer.

2



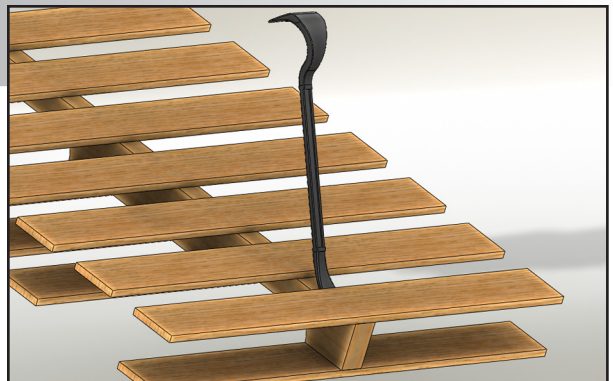
Repeat this procedure on the opposite end of the deckboards.

3



Then flip the pallet and repeat steps 1 and 2 on the back side.

4



You can now remove the deck boards from the middle stringer by using the length of the deckboard as leverage or using a pry bar. If you do not need long lengths you can also cut the deckboards just inside the stringers again.

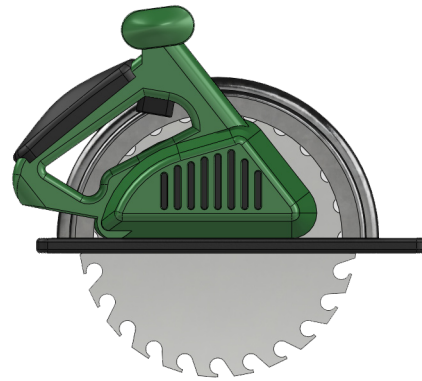


Steps 1-3 can also be accomplished on a table saw if set up properly.

# COLLECTION PROCESS

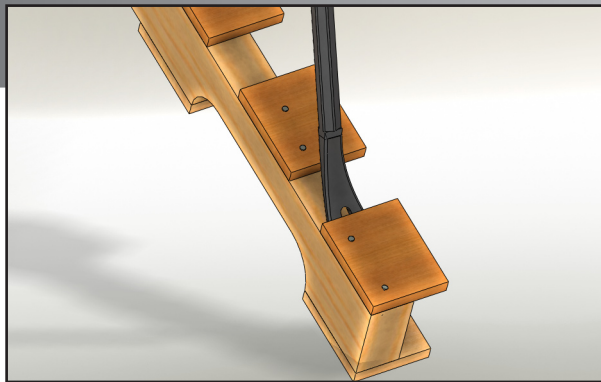
## DISMANTLING

*Part 2 of this process will focus on salvaging the outside stringers. Once the deckboards have been removed from all stringers, the middle stringer should be clear of deckboards and nails and is ready for further processing.*



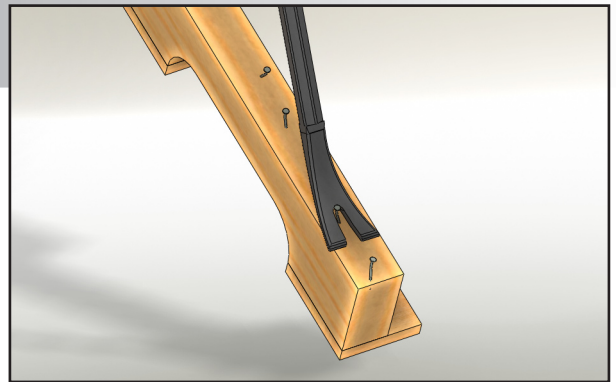
### Part 2 Circular Saw Dismantling

5

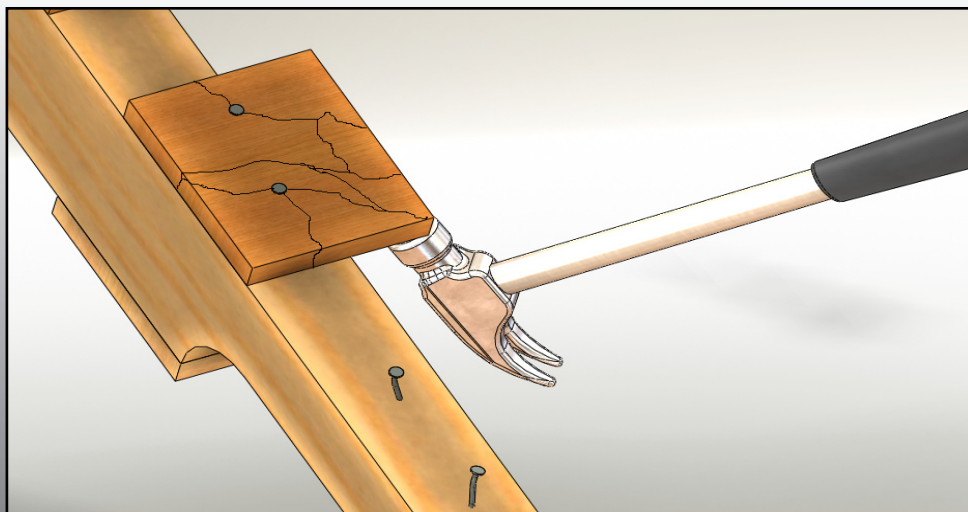


The small end pieces of deckboards that remain attached to the stringers should be able to be removed with little effort from a hammer or pry bar.

6



Once these deckboard pieces are gone, the remaining nails will be exposed making them easy to remove with a hammer claw or pry bar.



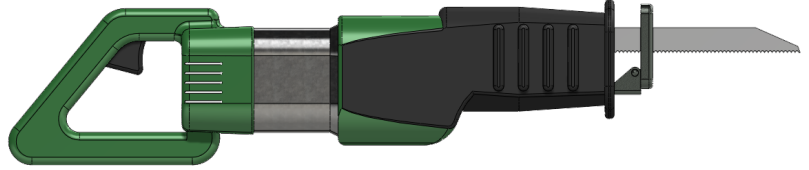
Since the deck board end pieces are too small to be used, it may be easiest to simply break them off with a hammer as an alternative to step 5. Leaving the nails exposed for step 6.



# COLLECTION PROCESS

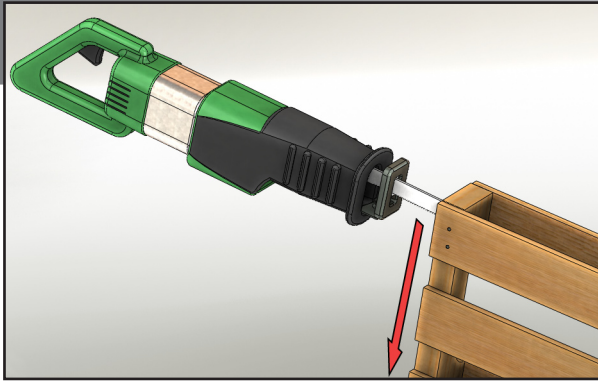
## DISMANTLING

*Using the Reciprocating Saw is another method in decreasing the time it takes to deconstruct a pallet. This process approaches cutting the nail as opposed to the wood. With this in mind, it is best to use a metal cutting blade.*



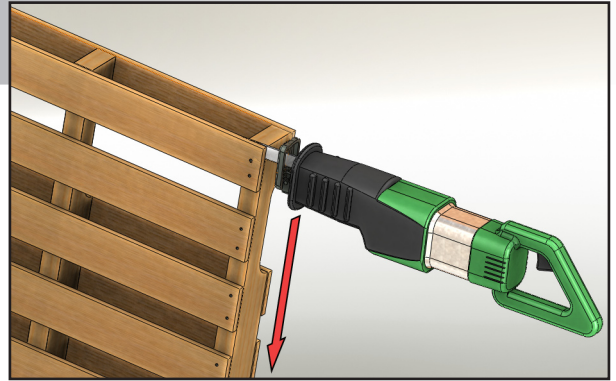
### Part 2 Reciprocating Saw Dismantling

1



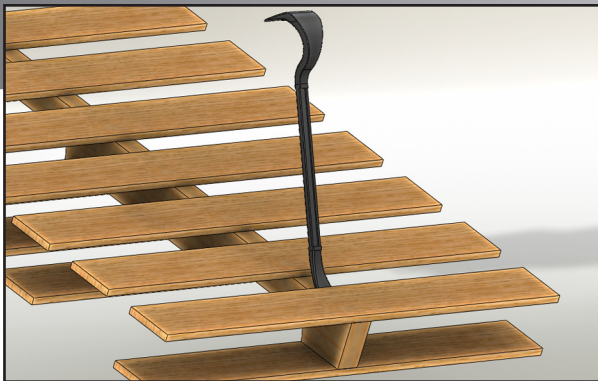
Start on one end. Insert the saw blade between the deckboards and the end stringer. Begin to cut the nails all the way along the stringer on both sides.

2



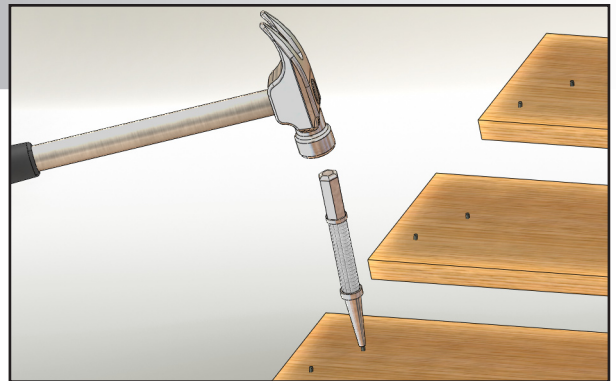
Repeat Step 1 on the opposite end of the pallet, removing the other end's stringer from the deckboards.

3



You are now at the same point in the process as Step 4 in the Circular Saw Process. Repeat this process.

4



Lastly, use a nail punch to remove the remaining upper half of nails from the freed deckboards.

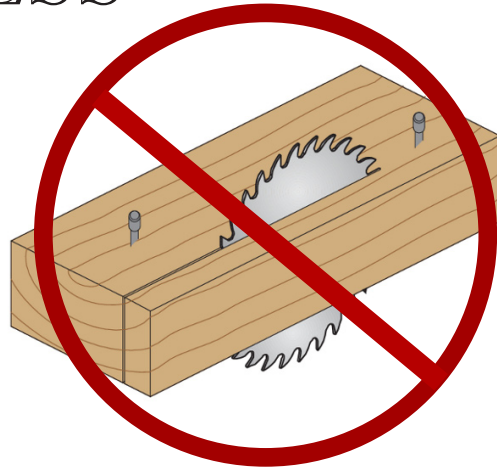


The downfall to cutting the nails with the reciprocating saw is that it is nearly impossible to remove the lower half of the nails from the stringers, rendering them useless unless you can cut around them and can use the smaller stringer pieces.

# SALVAGE PROCESS

## STRIPPING

*To begin salvaging the wood you must make sure the pallet pieces are clear of all foreign objects that might be detrimental to machines used in the current or later processes. This includes any nails or nail fragments that have been left behind or may be dirty.*



1

### Locating

Look over your pieces of pallet wood extremely carefully to find any nails you may have overlooked. Chances are if you have overlooked them the first time, they still may not be noticeable. A handheld metal detector is very helpful in finding nails or nail fragments left behind.



2

### Removal

Once the nails have been located in the wood they must be extracted to ensure they do not damage machinery for future processes. A nail punch can be manipulated to remove buried nails. If the nail is buried too deep, cutting it out right may be the only option.



3

### Dirt

Nails are not the only thing that can cause harm to the machinery used to process the wood. Dirt can also dull blades and gunk up the workings of the machines. Be sure your wood is free of excessive dirt particulates.





# SALVAGE PROCESS

## UTILIZATION

*Pallet wood is rough wood. This means it is not going to be 100% perfect. Take a good look at what you are working with and plan for the transformation process. Not all pieces are going to be worth the time it would take to process them, depending on size and condition. The Utilization process will help you evaluate your pallet wood.*



### Imperfections

Take a good look at each board; the wood can be plagued with many types of defects. Knowing what potential defects are within the wood and how they could affect the quality of the wood as well as the process will help you make more efficient choices.

#### Checks

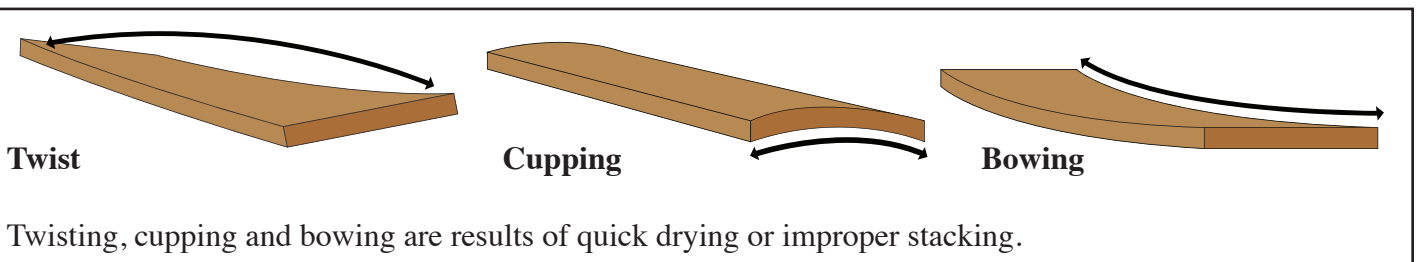
Most often happen along the grain and are a result of rapid drying.

#### Shakes

Are splits that happen due to growth defects or shrinkage stress in the wood, generally happening between the annual growth rings.

#### Knots

The remains of dead branches that are overgrown with new grain making them hard to work with.



#### Twist

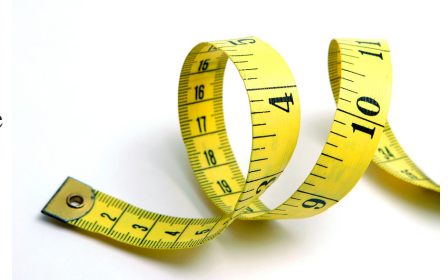
#### Cupping

#### Bowing

Twisting, cupping and bowing are results of quick drying or improper stacking.

### Size

Depending on the needs of your project, some of the wood may be too short or thin. Check the size before moving forward. It will also help to keep same lengths and thicknesses together.



# IDENTIFICATION

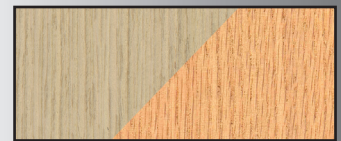
*Not all woods are good for the same application. Knowing what kind of wood you are working with will help you decide how you can apply it in further processes.*

*Some of the more common woods can be identified by their grain, color, texture and smell. However, many woods leave experts resorting to a microscope to determine their type. Below is a list of the most common woods found in pallets and their best uses in the application process.*

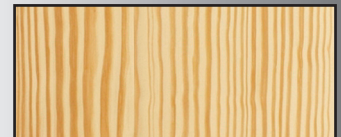


## Most common woods retrieved from pallets:

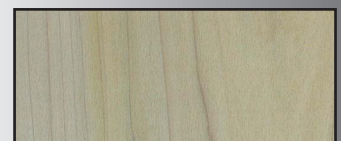
Characteristics	Workability	Furnishing	Weight
Straight-grained with coarse texture. Red Oak is pinkish in color; White Oak is impervious to water.	Good	Good	49 lb/ft <sup>3</sup>
Sapwood is yellow in color and non-resinous. Heartwood is deep yellow to reddish brown and resinous.	Good	Good/Fair	28 lb/ft <sup>3</sup>
Soft and light weight with straight grain and fine texture, heartwood can have green or brown streaks.	Good	Good	31 lb/ft <sup>3</sup>
Hard heavy, straight-grained wood with fine texture.	Difficult	Fair	46 lb/ft <sup>3</sup>
Non-resinous wood, creamy white with pinkish heartwood. Straight-grained with even texture.	Good	Good	28 lb/ft <sup>3</sup>



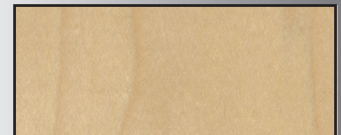
**White Oak/Red Oak**



**Pine**



**Poplar**



**Maple**



**Spruce**



# TRANSFORMATION PROCESS

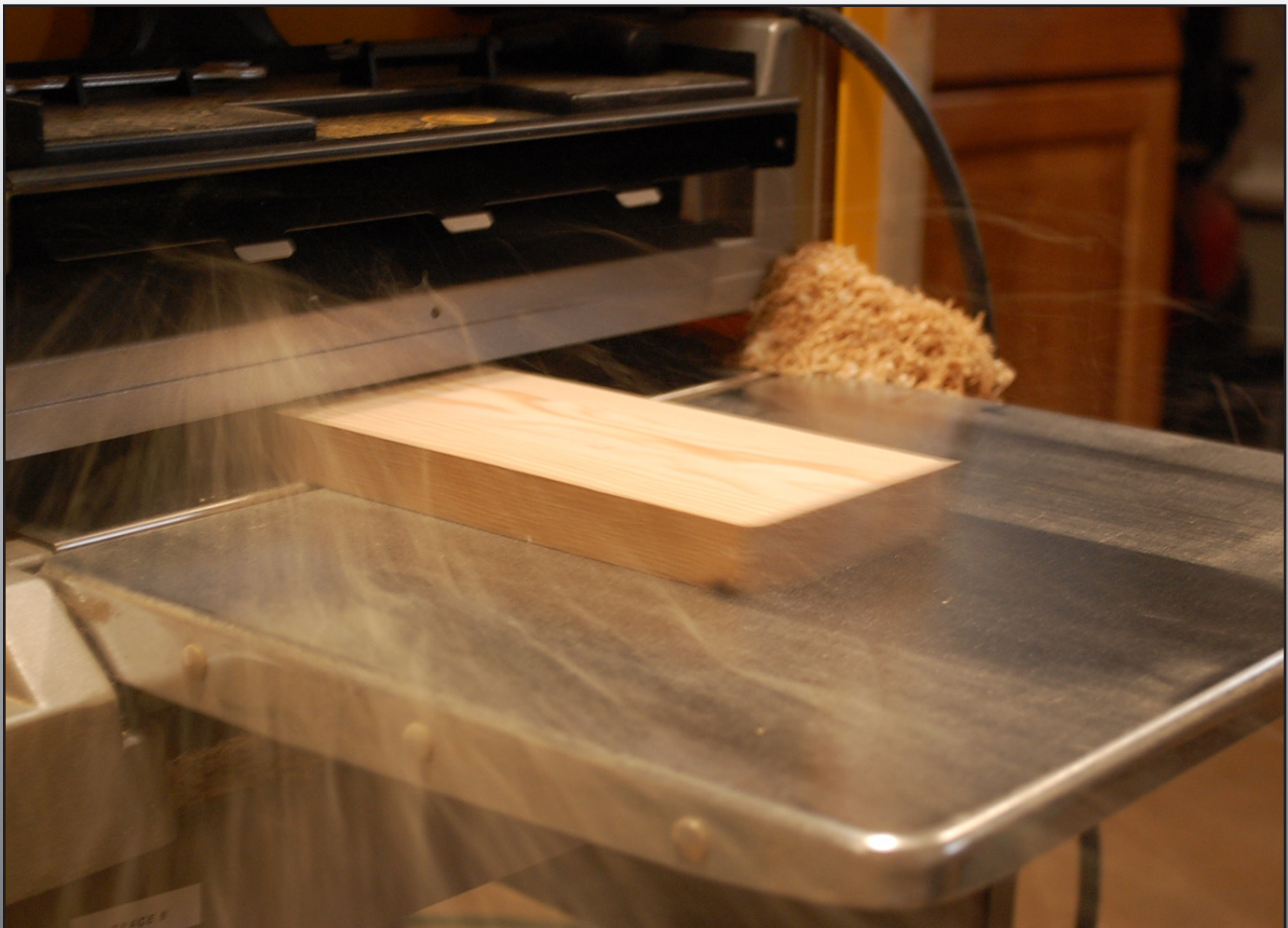
*The Transformation Process is the final process in bringing old pallet wood up to furniture making standards. This is where you begin to reveal how beautiful the old pallet wood is. You will begin this process with the end product from the Salvaging Process. These boards will then be Edge-Jointed and Planed. This leads to the final phase which is the Application Phase.*

## Edge-Jointing

Edge-Jointing is the process of flattening and squaring up the edges of the pallet boards. This can be done before or after the Planing Process. Jointing the edges allows them to meet flush with other pieces of pallet wood in the gluing process.

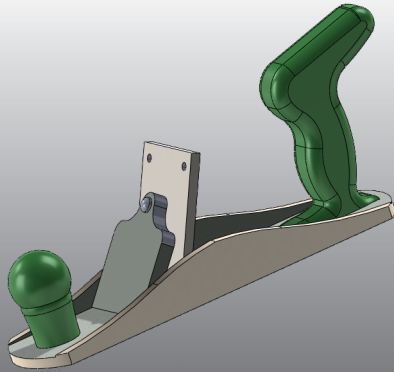
## Planing

Planing is basically the same thing as Edge-Jointing but focusing on the broad side of the boards. The thickness of the wood can also be altered in the planing process. Keep in mind that while gluing the boards in future processes, it is best that they are all the same thickness.

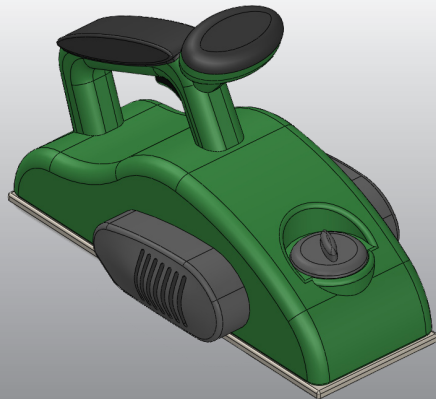


# TRANSFORMATION PROCESS

## PLANING

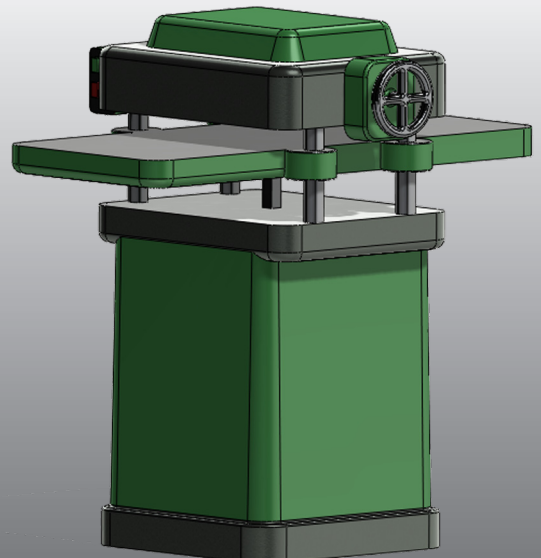


The Bench Plane or Hand Plane is used to smooth wood as well as work it down to desired thickness. They can be made of wood or metal but all have an angular blade that skins smoothly across the wood removing layers as it goes.



Handheld Electric Planer serves the same process and the Bench Planer can speed up the process. It is less precise and cuts with a cylindrical cutterhead as opposed to a single blade.

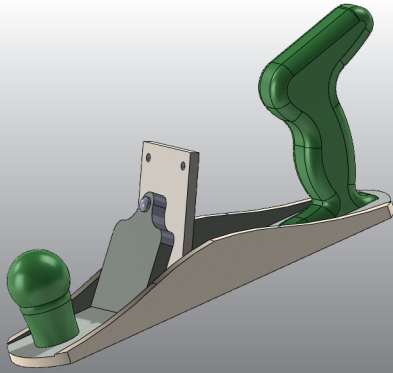
For more efficient planing, it best to turn to a portable or stationary electric planer. These machines take the hand and muscle work out of the equation. They generally take boards with a width of 12-18 inches, much greater than any pallet deckboard or Stringer. They also cut with knives as opposed to a cutterhead or single blade. If these are not accessible, the handheld versions will still produce the same result.





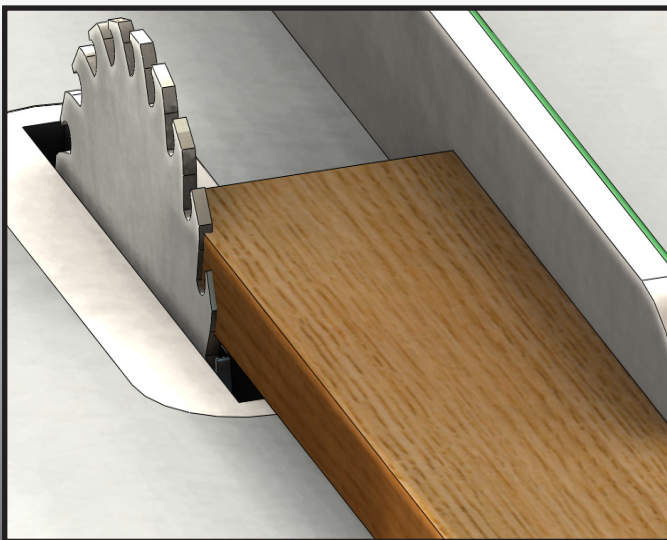
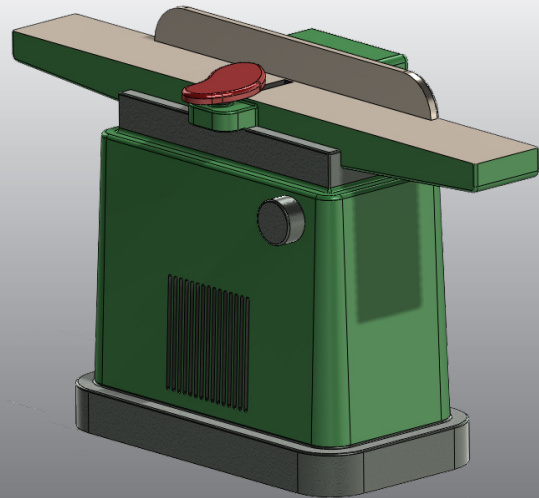
# TRANSFORMATION PROCESS

## JOINTING



Squaring the edges of the boards or jointing can be done using Hand Plane/Bench Plane or a Handheld Electric Planer.

For better and more consistent results, it is best to use a free standing shop Jointer built specifically for squaring and flattening the edges of a board. The free standing jointer cuts with a cutterhead similar to the Handheld Electric Planer.



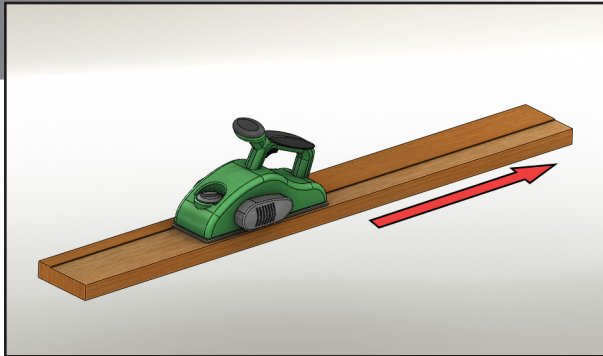
No matter what jointing process is used, it is more difficult to square both edges with themselves. Using a table saw to square the second edge can help immensely. Simply square one edge on the Jointer or Hand Planer, then put that squared edge against the fence on the table saw. Adjust the width so you are removing as little wood as possible on the opposite edge. After one pass, your edges should be squared.

# TRANSFORMATION PROCESS

## PLANING

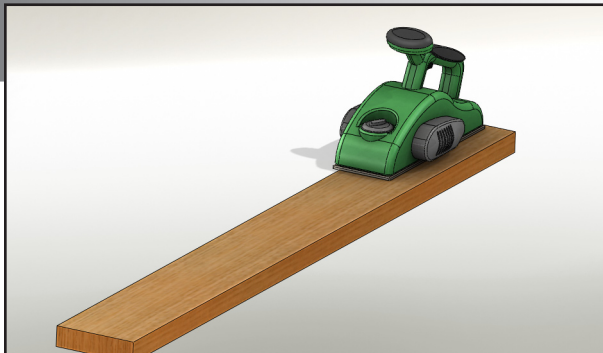
A

1



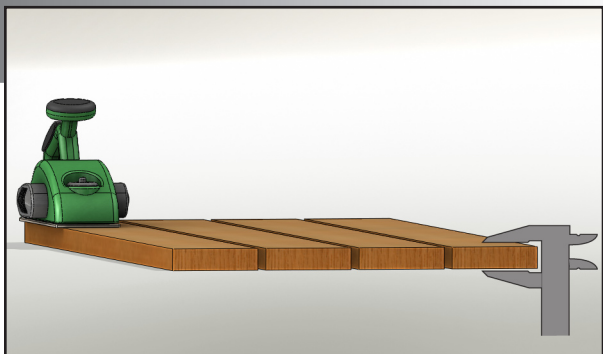
Start by moving the planer down the length of the board. Then repeat, moving slowly further in width each time.

2



Continue until most of the imperfections are removed and wood is flat. Then repeat the process on the side.

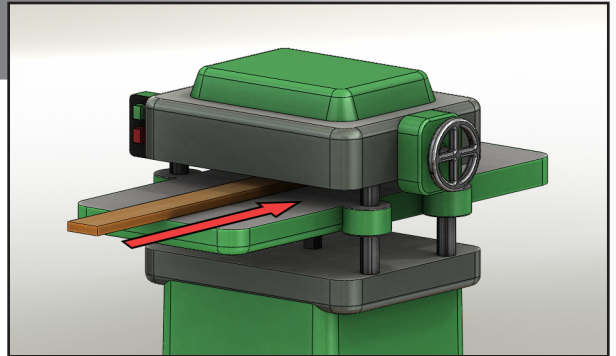
3



Try to reach a desired depth on all your boards.

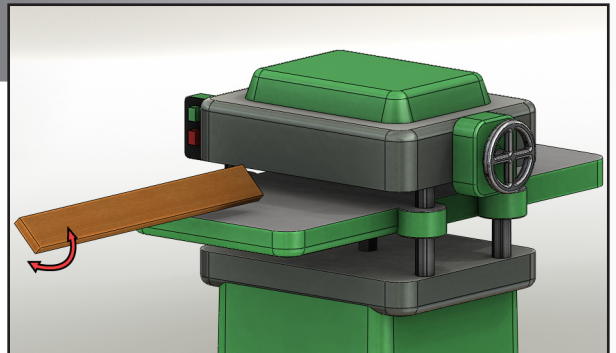
B

1



Set a rabbeting depth a little thicker than desired thickness and send boards through. Repeat until most imperfections are gone and top sides are smooth.

2



Lower the rabbeting depth to desired thickness. Then flip the boards so the unplanned side is facing up and send them through the planer again.

3



Repeat until desired thickness is reached and boards are flat.

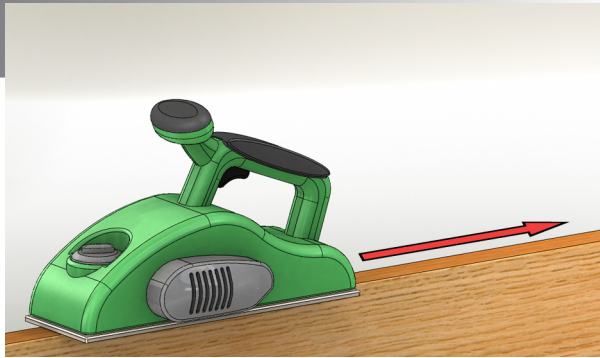


# TRANSFORMATION PROCESS

## JOINTING

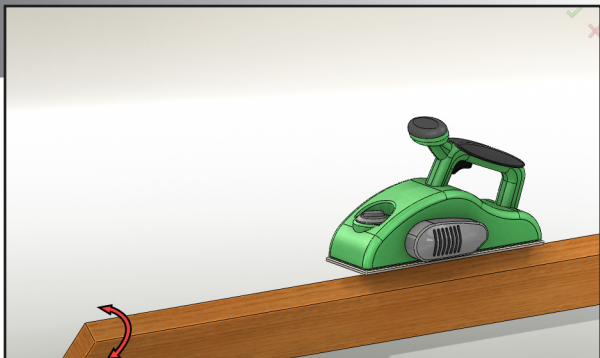
A

1



Clamp the board in place and work the planer down the edge of the board. Continue until the edge is as straight and smooth as possible.

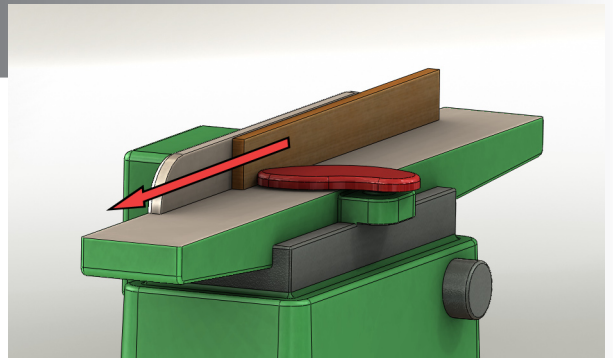
2



After one edge is straight, flip and repeat on other edge trying best to leave the edges square with one another, or as another option, use the table saw on the opposite edge.

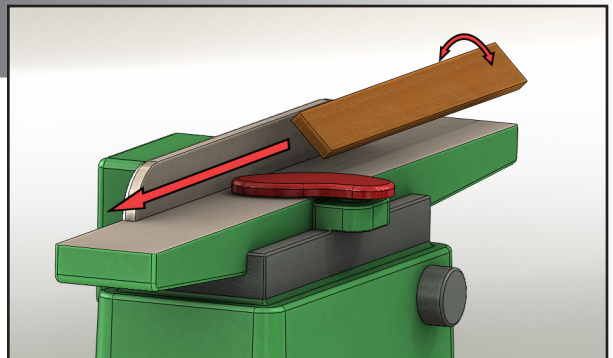
B

1



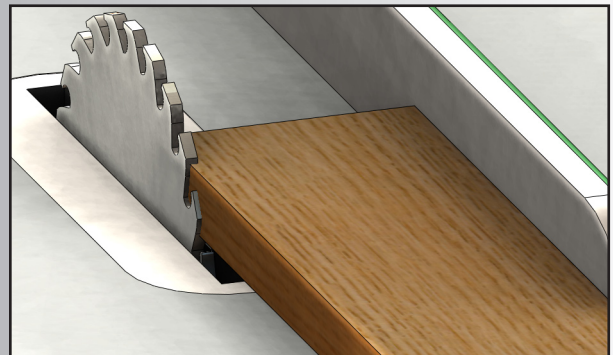
Place the edge side down with the planed side flush against the fence. Run the edge lengthwise over the cutterhead while keeping the board flush to the fence. Repeat until squared.

2



Again repeat this action with the second edge or option to the table saw to be more precise.

Measure the width of your board with one jointed edge, then set the fence width on the tables saw to 1/8" smaller. Run the board through the saw with the jointed edge flush to the fence.



# APPLICATION PROCESS

*The Application Process involves compiling the newly finished furniture grade wood into form that can be applied to furniture design. Up until this point, the finished wood is limited to certain furniture designs due to size and thickness of the wood. The application process will expand the applications of wood.*

## Solids

Creating solid thick blocks or slabs of wood will lend itself to many applications in furniture design. The solids can be used for many load bearing aspects in design. Solids can also be lathed or cut to create unique forms.

## Plywood

Plywood yields another wide variety of options in furniture design. Creating plywood can also utilize all types of pallet wood in one sheet. Bending can also be applied to the wood as it is plied together to create curves.

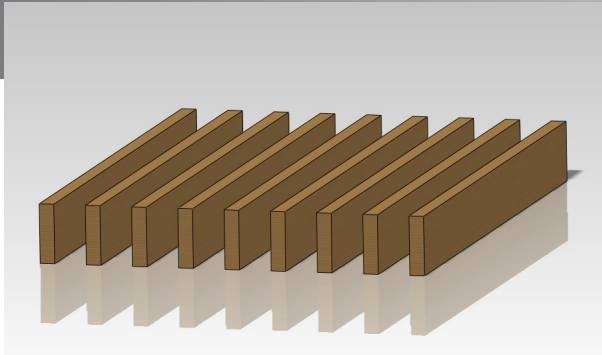




# APPLICATION PROCESS

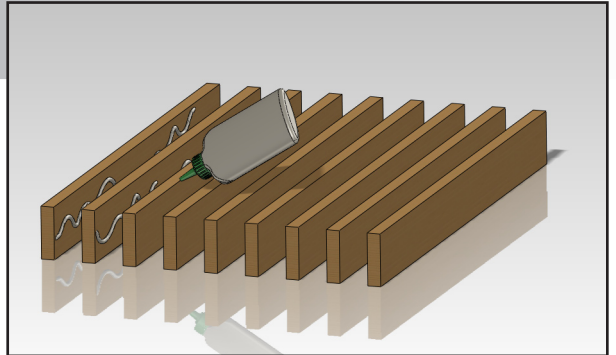
## SOLIDS

1



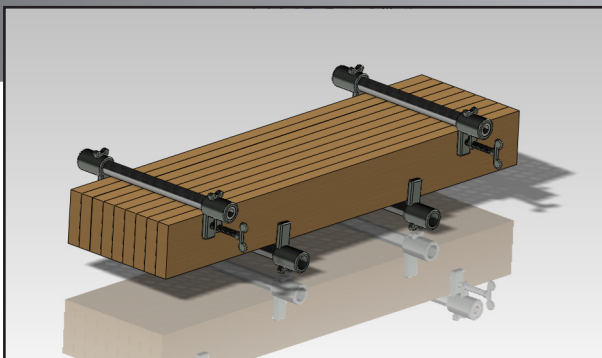
To begin making solid blocks it is best to sort through the planed boards. Piece them together, keeping in mind where the imperfections are and how they will play into the final design.

2



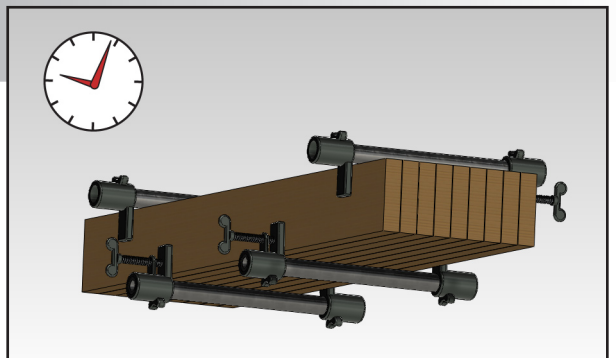
Once you select your order, generously apply wood glue to the back of every board minus the last one.

3



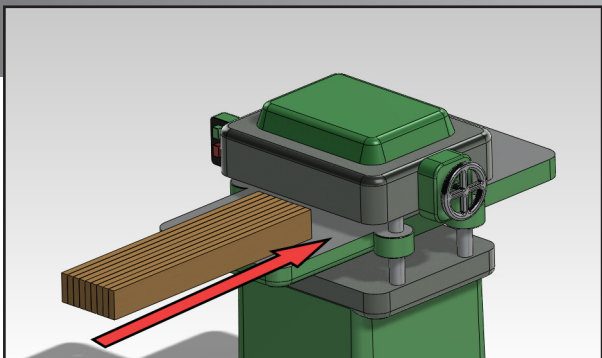
Place all boards together and apply clamps to pull them together. The amount of clamps needed depends on length of the boards, the more clamps the better.

4

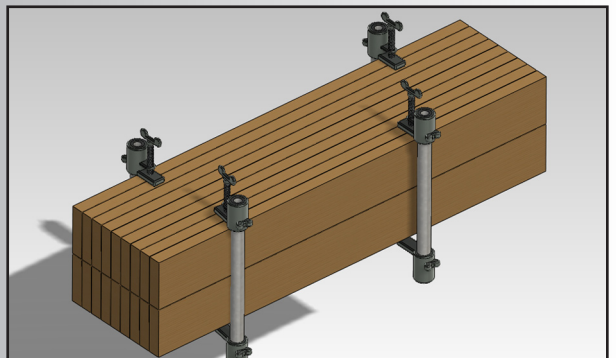


Allow the wood glue to dry for as long as the instructions recommend.

5



Once the glue is dry, run the new solid block through the planer to remove excess glue and to flatten the over all surface.

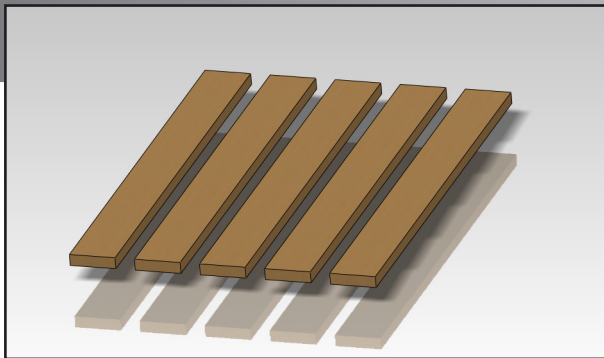


If you desire thicker solids, repeat the gluing and clamping process using the solid blocks.

# APPLICATION PROCESS

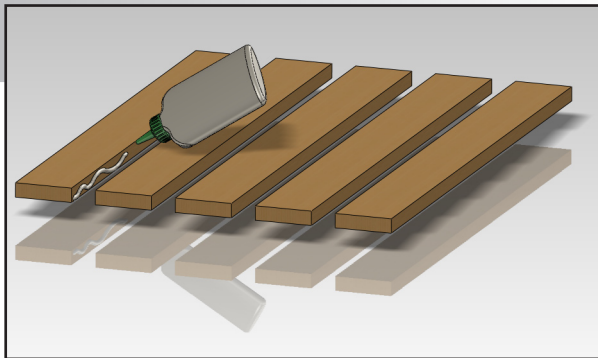
## PLYS

1



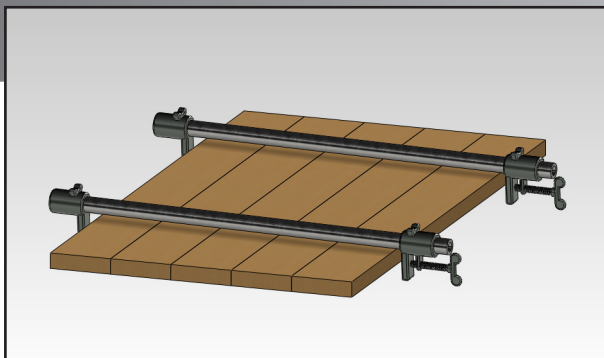
To begin making solid blocks it is best to sort through the planed boards. Piece them together keeping in mind where the imperfections are and how they will play into the final design.

2



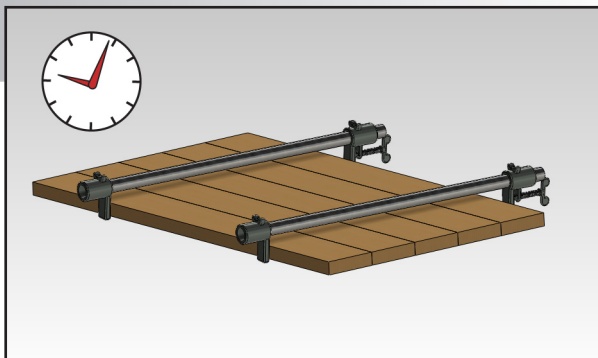
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3



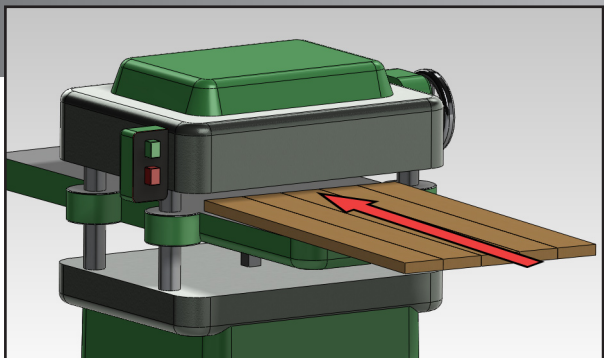
Place all boards together and apply clamps to pull them together. The amount of clamps depends on length of the boards, the more clamps the better.

4

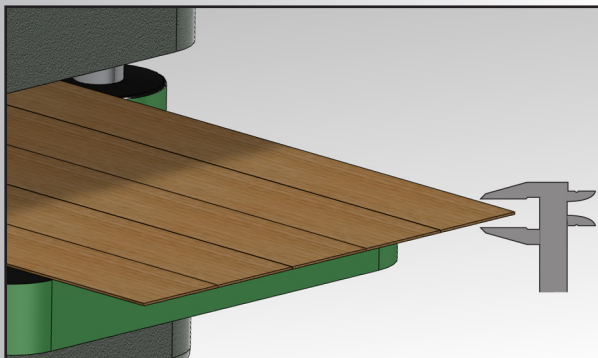


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Once the glue is dry run the new solid block through the planer to remove excess glue and to flatten the over all surface.



If you desire thicker solids, repeat the gluing and clamping process using the solid blocks.

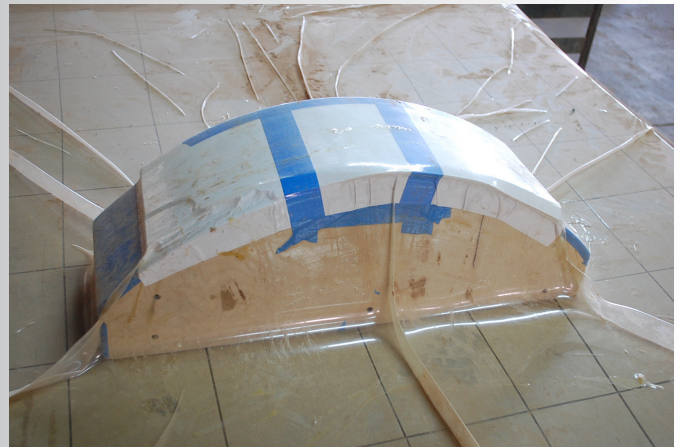


## TESTING

Testing of furniture production was not a part of the process nor was it deliverable for this project. It was an added step to further show how the process proves successful in creating wood that can be applied to furniture construction. Since this was a process to produce furniture quality wood, a piece of quality designer furniture was duplicated to show how the newly processed pallet wood fared in comparison to past proven processes. The chosen furniture example was a Hans Wegner style dining chair produced in Denmark in the 1960's. It was chosen because of its recognition and proven design while utilizing both solid and plywood applications of woods. The duplicate was created using the step-by-step methods from the process book.



The maple pallet wood was edge-jointed, planed and then glued up into sheets. Those sheets were then planed further and turned into plys.



The glue was then applied to four plys. Those plys were then placed in a vacuum bag with a mold and pressure was applied to create a bent ply form.



Solid pieces of maple were picked to match the example chair, then planed to correct thickness. The pieces were then glued up to form solids and cut to form.



The maple pallet pieces were then assembled to mirror the example chair.



“Pallet Dining Chair,” Patrick A. Blake. Spring 2012.

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