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Designing Novel Grooved Pallets for Industrial Application

Mirza Mohammed Abdullah Baig
Cleveland State University

DESIGNING NOVEL GROOVED PALLETS FOR INDUSTRIAL APPLICATION

MIRZA MOHAMMED ABDULLAH BAIG

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We hereby approve thesis

For

MIRZA MOHAMMED ABDULLAH BAIG

Candidate for the Masters of Civil Engineering degree

For the Department of

Civil and Environmental Engineering

And

CLEVELAND STATE UNIVERSITY'S

College of Graduate Studies by

____
Dr. Lutful I. Khan
Advisor, Chair

____
Department & Date

____
Dr. Tushar M. Borkar

____
Department & Date

____
Dr. Stephen F. Duffy

____
Department & Date

May 7, 2018
Student's Date of Defense

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DEDICATION

To my family, Mr and Mrs. Mirza Riaz Baig

and Aaminah Najmus Sahar

DESIGNING NOVEL GROOVED PALLETS FOR INDUSTRIAL APPLICATION

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ABSTRACT

The purpose of this study was to model an improved pallet design which could overcome the drawbacks and failures of the pallets available in the market today. The new modeled pallets were designed to improve the capacity of the individual pallets and thereby increase the efficiency of the material handling process. The new modeled pallets were also designed with the aim to replace the racking system used for storage in the warehouse industry. The study was performed using two finite element analysis software, SOLIDWORKS and ANSYS, as analysis tools to study the behavior of the design under various real world conditions. The results obtained from numerous simulations using these software were compared with the market conditions to evaluate the degree of success of the study. A new design was proposed from the evolution of a primary design by optimizing with respect to capacity and functionality simultaneously. From the data obtained, it was concluded that the proposed new pallet design could significantly increase the capacity and safety compared to the existing ones, and serve as a benchmark for the material handling industry.

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CHAPTER I

INTRODUCTION

Pallets are mainly used as loading platforms for the material handling industry which operates all over the world. Pallets are generally divided into two categories, (i) two way entry pallets and (ii) four way entry pallets. The distinction between these two types of pallets can be made by the number of openings in the pallet as entry options for the forklift. The genesis of pallets and their history is discussed in chapter 2. The aim of this study was to model an improved pallet design which could overcome the drawbacks and failures of the standard pallets available in the market today and replace the existing racking system used for storage of these pallets in the warehouse industry.

The motivation behind this study was to increase the operation efficiency of the material handling industry which is an important element in global economy. The existing pallets have a limited capacity due to their simple design and are prone to accidents which can have catastrophic consequences.

A new pallet design was developed and analyzed with finite element analysis (FEA) tools to simulate real world conditions. One of the primary design considerations was to curb the disastrous accidents which occur due to the fragility of the standard pallets available in the market today. Thus the main design issues faced during this study was to coalesce the different goals of the design criteria into one single final model which would be an improvement with respect to all the aforementioned aspects. This problem was approached with the help of a framework setup as seen in Figure 2.1 which achieved increased efficiency through iterations. The step-by-step evolution of the design is described in chapters 2 and 3 along with the complications faced at each level. The two finite element analysis (FEA) tools SOLIDWORKS 2017 and ANSYS 16.0 were used to analyze the design and determine the results which are discussed in the chapters 3 and 4 respectively. In this study, the framework does not account for business analysis to determine the precise monetary benefits of the new design, due to various impediments ranging from the trade secrets about manufacturing costs to the selling costs.

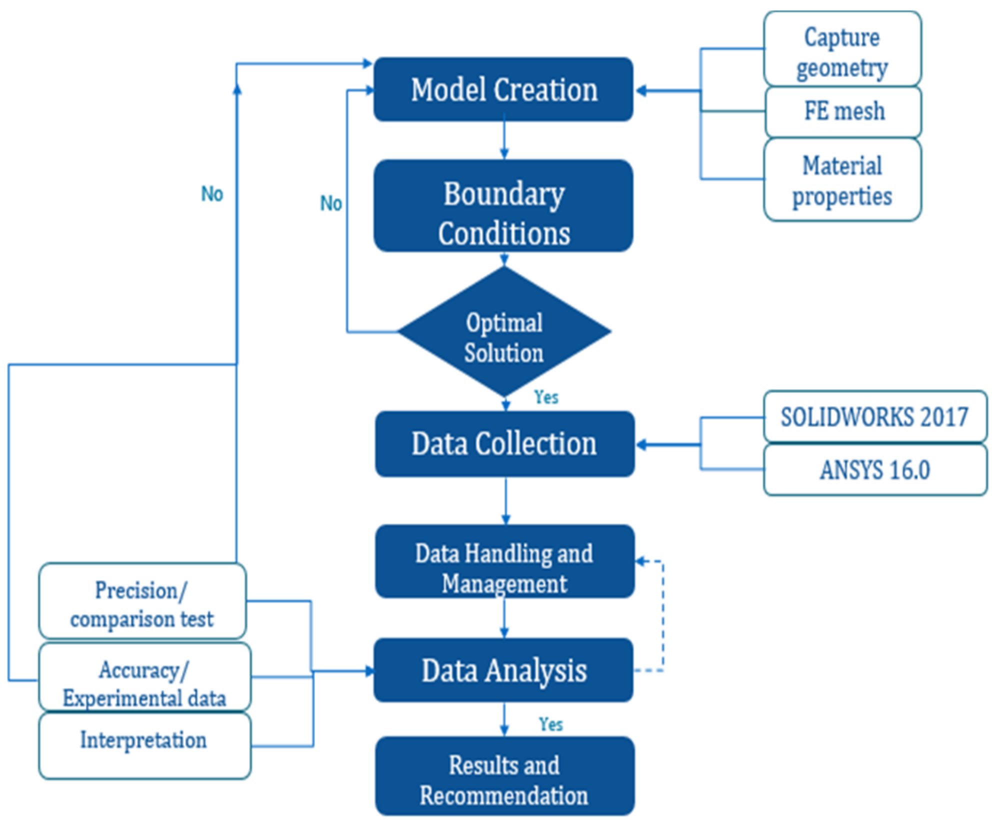


Figure 1.1: Framework implemented in this study.

In chapter 4, the benefits and improvements of the new design over the most widely used market pallets is discussed along with the procedure for data collection and data analysis. The pallets were compared with respect to their apparent strength (load bearing capacity) and their self-weight (weight of the individual pallet) to determine the superiority of the design. Thus the new design and its advantages are presented in chapter 5, this chapter reflects light on the conclusion and discussion of the results and future work respectively.

CHAPTER II

BACKGROUND

2.1 Basics of Pallets

Pallets are an essential part of the goods trade throughout the world and plays an important role in shipping and storage industry. They are used to transport, store and display items but their importance is often overlooked. The most basic definition of pallet is “a small, low, portable platform on which goods are placed for storage or moving, as in a warehouse or a vehicle [25].”

Initially pallets were designed to facilitate in the shipping of cargo, and store goods at the docks before transporting. The pallets were an essential part during the World Wars, as the armaments and the food supplies were moved on these pallets via ships, trains and trucks. During those times, chaos and delays were common due to lack of a standard pallet size. This led to the birth of a “standard size” for the pallets called the Euro Pallet with 48″ x 48″ dimension. With the advent of time, material handling and the cargo industry has adopted a new size, of 48″ x 40″ four-way entry wood pallet, also called as the GPMC (Grocery Products Manufacturers of Canada) pallet that became the current standard. This is the most common pallet size in today’s material handling industries. The GPMC wooden pallets are generally designed in two categories:

a. **Stringer pallets**: These pallets are designed with long strips of wood as a support to the deck which carries the load. These were initially designed as two-way pallet, with only two ways for the forklift to lift them. Recently, these pallets are designed as four-way pallet as per the industry demand, as this design provides easy access to the forklift from four sides (Figure 2.1).

b. **Block pallets:** These pallets are similarly designed to the stringer pallet with the addition of blocks to support additional deck bearing load. These are also designed as four-way pallets, and capable of carrying heavier loads than stringer pallets (Figure 2.1).

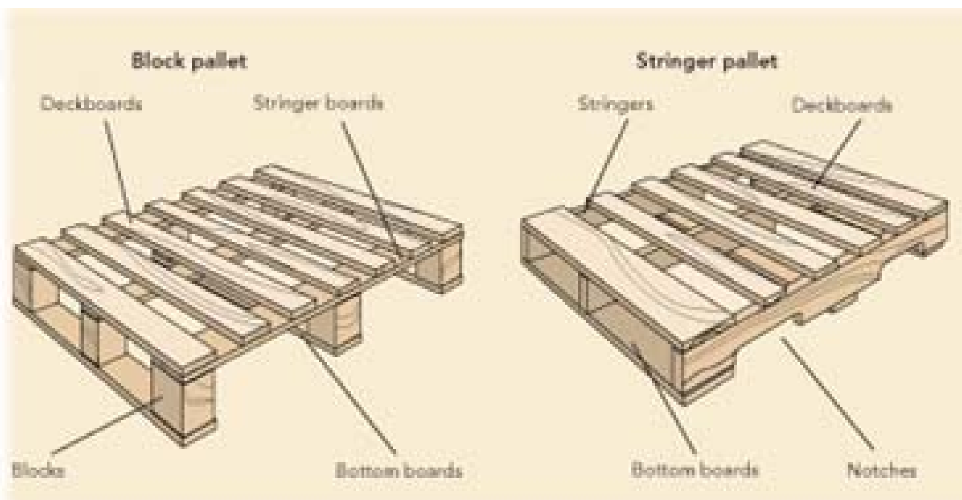


Figure 2.1: Classical block pallet and stringer pallet respectively [8].

Currently, nearly a billion pallets are manufactured in the world on a yearly basis, and about two billion pallets are in use in the United States alone [25]. From these pallets, almost ninety percent are manufactured using wood as their primary raw material.

2.2 Market Pallets

A comparative study of the existing market pallets is provided in this section. The primary materials used for pallet construction are wood, plastic, aluminum and steel. The different types of pallets are discussed in the following sections.

2.2.1 Wooden Pallets

Wooden pallets are found in every industry and warehouse. These are the most common pallets in use today seen in Figure 2.2 and have the following advantages.

- Strong and reliable for transportation and storage of goods.
- Least expensive of the different types of pallets available in the industry.
- With the environmental awareness in mind these pallets are recyclable and can be reused for different purposes as they can be disassembled easily [6].
- Easy to manufacture and can be maintained regularly without extensive repair.
- High friction which leads to reduced risk of accidents due to skidding.

However, the wooden pallets have the following disadvantages.

- The wooden pallets are designed for single trip trade.
- The pallets can be used for stacking to a very limited extent.
- Heavier when compared to plastic pallets and therefore more costly for transportation.
- Difficult to clean and have to be regularly checked for bacteria and fungi.
- Because of the simple design, they break down easily and regularly, resulting in increased maintenance costs.

- Susceptible to damage due to water and the environment conditions, if they are not properly stored.

With the demand for cheaper and more stable pallets, slightly different designs of wood pallets are currently available in the market [3]. These includes Press-wood Pallet and the Lightweight Plywood Pallet which have very low load bearing capacity and are mostly used as view pallets (pallets used to display cargo for advertisement purposes). The wood pallets which are readily available and most widely used in the industry currently are the wood block pallets shown in Figure 2.2, because of their higher apparent strength when compared to wood stringer pallets. These pallet weigh about 60 lbs. and can support a load of 5,500 lbs. when resting on ground. The other specifications of this particular pallet are given in Table 2.1.

Table 2.1: Wood block pallet specification [26].

BLOCK PALLET							
MODEL NO.	**WOOD TYPE**	**SIZE L x W**	**WEIGHT CAPACITY**	**SHPG. WEIGHT**	**PRICE EACH (MIN. 5)**		
					5	**10**	**20+**
H-4793	**Heat-Treated**	**48 x 40"**	**5,500 lbs.**	**59 lbs.**	**$61**	**$58**	**$55**

Figure 2.2: Most commonly used block pallet in the industry [8] [26].

The evolution of pallets continues, as the demand increases constantly with trades taking place all across the globe. Nowadays pallets are also manufactured using plastic and corrugated cardboard. The demand for such pallets are increasing with increased environmental awareness [5].

2.2.2 Plastic Pallets

Plastic pallets were developed to overcome the drawbacks of the wood pallets and increase efficiency (Figure 2.3). The advantages of the plastic pallets are as follows [11].

- Lightweight with high loading bearing capacity.
- Resistant to water damage and exposure to harsh environment.
- Recyclable and have a greater life span compared to wood pallets.
- Easy to maintain and do not have nails and screws protruding unlike wooden pallets, which could cause chipping and damage to the products [20].

However the plastic pallets have the following disadvantages.

- Repair is not simple, as the pallet is melted down and recycled into the new pallets when damaged.
- More expensive when compared to wooden pallets.

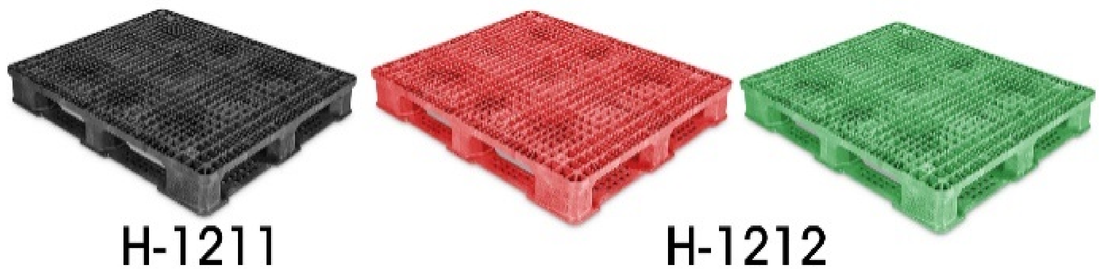


Figure 2.3: Most commonly used plastic pallet in the industry [16] [26].

The plastic pallets which are readily available and most used in the industry are the heavy duty plastic pallets (Figure 2.3). As their name suggests, they have higher load bearing capacity than standard pallets and are also integrated for racking. These pallets weigh about 50 lbs. and can carry a load of 30,000 lbs. when resting on ground. This capacity decreases drastically when these pallets are resting on the forks of forklift trucks and the racks in warehouse operations. Additional specifications of this particular pallet are given in the Table 2.2.

Table 2.2: Market plastic pallet specification [26].

RACKABLE HEAVY DUTY PLASTIC PALLET:									
MODEL NO.	**SIZE L x W**	**WEIGHT CAPACITY (LB.)**			**SHPG. WEIGHT**	**PRICE EACH**			
		FLOOR	**FORK**	**RACK**		**1**	**5**	**10+**	
H-1211	48 x 40"	30,000	5,000	2,000	50 lb.	$109	$109	$109	
H-1212*	48 x 40"			2,200	50 lb.	125	125	125	
H-4059	48 x 48"	20,000	3,200	1,600	50 lb.	119	115	109	
MODEL NO.	**SIZE L x W**	**WEIGHT CAPACITY**			**SHPG. WEIGHT**	**PRICE EACH**			
		FLOOR	**FORK**			**1**	**5**	**10+**	
H-6096	48 x 40"	30,000 lb.	4,000 lb.		34 lb.	$69	$67	$65	

2.2.3 Corrugated Cardboard Pallets

With the industrial need for a lightweight pallets the cardboard pallets [21] were introduced as shown in Figure 2.4. The following are the advantages of this type of pallets.

- Very lightweight pallets [15] leading to reduced transportation costs.
- Easy to handle.
- Easy to manufacture and are flexible in design [2].
- Completely recyclable.

Figure 2.4: Corrugated Cardboard pallet [26].

The disadvantages of the corrugated cardboard pallets are as follows.

- Low load bearing capacity. They can carry a load of 1500 lbs. to 2000 lbs.
- Easily damaged when exposed to harsh environment.

With the lightweight low load bearing pallets demand being satisfied with cardboard pallets, there was an equally strong demand for the opposite end of the spectrum for a high load bearing pallet [14] to improve the cost/benefit ratio of the entire operation. The demand for this particular pallet primarily exists in military operations, heavy cargo shipments and air freight. To meet this demand the following kinds of pallets were introduced in the market.

2.2.4 Metal/ Aluminum Pallets

These metal pallets are made of steel and aluminum which increases the weight of the pallet but also increases the strength of the pallet significantly. The following are the advantages of these pallets.

- Stronger than plastic, paper and wood pallets.
- Can be used for long term storage.
- Easy to maintain and clean.
- Recyclable and durable.
- Not affected by harsh environment.
- Longer life of the pallet.

The metal/aluminum pallets have the following disadvantages.

- Heavy weight causes increase in the weight of the freight leading to increase in transportation costs.
- Costly when compared to wood and plastic pallets.

The Metal/Aluminum pallets shown in Figure 2.5, are readily available and their use is gradually increasing in the industry. These pallets weigh about 60 lbs. and can carry a load of 30,000 lbs. when resting on ground.

This capacity decreases drastically when these pallets are resting on the forks of the forklift or on the racks in warehouses. The other specifications of this particular kind of pallets are mentioned in Table 2.3.

Table 2.3: Market Steel and Aluminum pallet specification [26].

<table>
<tr><th rowspan="2">MODEL NO. (Steel)</th><th rowspan="2">SIZE L x W</th><th colspan="3">WEIGHT CAPACITY (LB.)</th><th rowspan="2">SHPG. WEIGHT</th><th colspan="3">PRICE EACH</th></tr>
<tr><th>FLOOR</th><th>FORK</th><th>RACK</th><th>1</th><th>3</th><th>5+</th></tr>
<tr><td>H-7124</td><td>48 x 48"</td><td>8,000</td><td>4,000</td><td>2,200</td><td>73</td><td>$200</td><td>$190</td><td>$180</td></tr>
<tr><th rowspan="2">MODEL NO. (Aluminum)</th><th rowspan="2">SIZE L x W</th><th colspan="3">WEIGHT CAPACITY (LB.)</th><th rowspan="2">SHPG. WEIGHT</th><th colspan="3">PRICE EACH</th></tr>
<tr><th>FLOOR</th><th>FORK</th><th>RACK</th><th>1</th><th>3</th><th>5+</th></tr>
<tr><td>H-4062</td><td>48 x 40"</td><td rowspan="2">30,000</td><td rowspan="2">5,000</td><td rowspan="2">5,000</td><td>48</td><td>$329</td><td>$319</td><td>$309</td></tr>
<tr><td>H-4063</td><td>48 x 48"</td><td>54</td><td>375</td><td>365</td><td>355</td></tr>
</table>

Figure 2.5: Most commonly used aluminum pallet in the industry [26].

2.2.5 Military/ Air cargo Pallets

These pallets are specifically designed, as the containers in the aircrafts are not compatible with conventional pallets and it is difficult to maneuver a forklift in the confined space of an aircraft. Therefore military pallets and aircraft containers are designed specifically to meet these challenges.

The two main systems in use are the 463L pallet and Unit Load Device or ULD. In case of the 463L pallet, as seen in Figure 2.6, both the top and bottom surfaces of the pallet are flat in order to facilitate the rolling of the pallet into the cargo holds and cargo nets and slings are used to secure the products to the pallet.

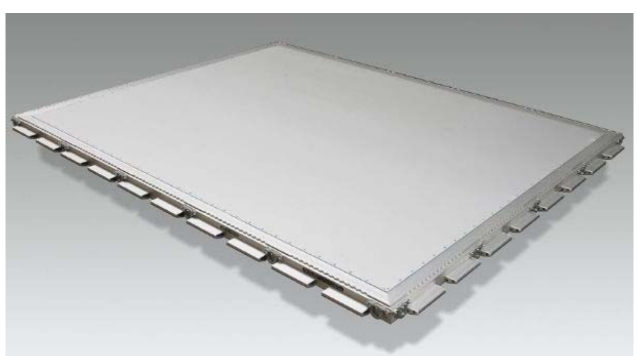


Figure 2.6: Most commonly used 463L cargo pallet in the industry [26].

These pallets have a significantly higher load bearing capacity when compared to the other pallets available in the market today. These are designed for specific military use like parachute drops from the aircrafts, loaded with military equipment and vehicles. Thus these pallets are designed with high strength metal composites to withstand the impact of such operations and hence their weight and cost are significantly higher than other pallets.

2.3 Proposed Design

2.3.1 Preliminary Design

The initial pallet model designed was 51″ x 51″ x 6.5″, made from aluminum and plastic to achieve higher load bearing capacity. This design was modeled in SOLIDWORKS for certain specific uses in the material handling industry and for a self-sustaining racking system. This design tackled numerous disadvantages of the existing pallets described in chapter 3 which influenced the evolution of the design significantly.

The model was then imported to ANSYS for further analysis. The primary aim of increasing the capacity was achieved but the self-weight of the pallet was also higher when compared to existing pallets, thus the design failed the "Optimal solution" parameters of the framework (Figure 2.7). Therefore, the design of the model was modified with each iteration of the framework eventually obtaining the final design proposed in this study. This preliminary design is discussed in detail in chapter 3.

2.3.2 Modified Design

The final design of the pallet proposed in this study was modified from the preliminary design to retain its high load bearing capacity characteristic. The modified design model was 48″ x 40″ x 5.5″, made from wood and plastic to decrease the self-weight of the preliminary design. This design was modeled to retain the key features of the preliminary design such as the self-sustaining racking system. The details of this design is discussed in chapter 3.

This final model was also designed and analyzed in SOLIDWORKS, and imported to ANSYS for further investigation. With the modifications to the preliminary design and adaptation of different materials for the construction of the pallet the self-weight was reduced well below the standard specifications, thus the final design was obtained as the model passed all the parameter of the framework (Figure 2.7).

2.4 Implemented Framework

The framework shown in Figure 2.7 is a system observed for the design of the model pallet in this study which concludes in the event a superior design for the pallet was secured.

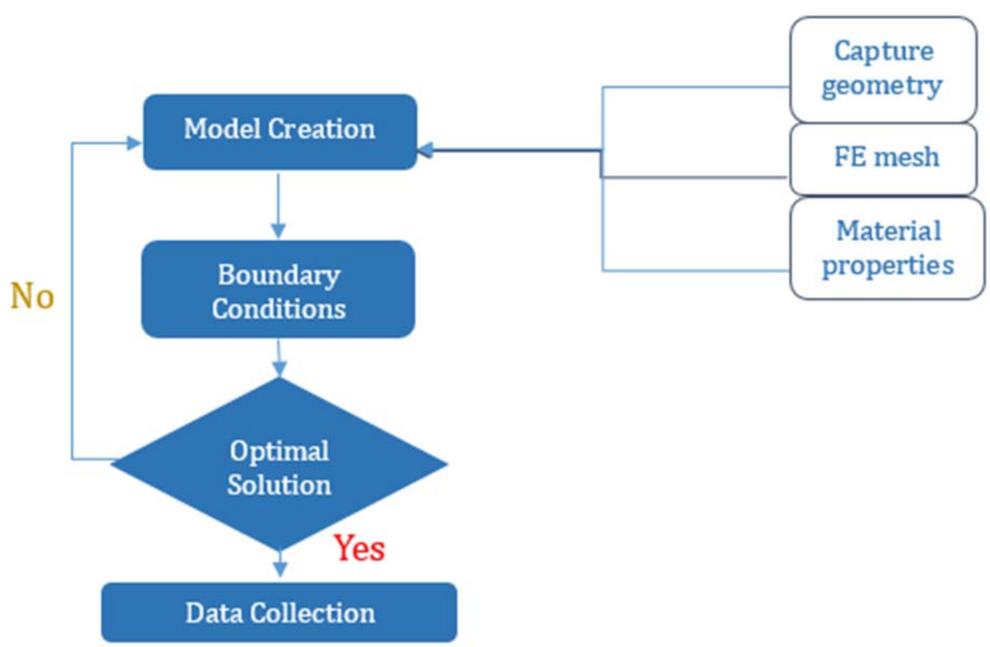


Figure 2.7: The framework implemented for the design of the pallet model.

As the preliminary design of the modeled pallet was excess in weight which lead to, the failure of the “Optimal solution” parameter of the framework as seen in the Figure 2.7. Thus according to the framework to proceed, a new design should be modeled and tested with the respective boundary conditions. As the setup of the framework was defined to achieve the goal of an efficient and superior pallet model these steps were repeated until this objective was complete.

CHAPTER III

METHODOLOGY & DESIGN DEVELOPMENT

3.1 Evolution of the pallet design

In this study, the final pallet designed has been chosen to be 48″ x 40″ x 5.5″, because the industry has adopted this size as a standard. The new designed is a four way pallet to provide easy access for forklifts and pallet jacks. The industry has adopted the 48″ x 40″ pallet size because this dimension perfectly aligns with the size of the standard cargo containers and most trucks which are used to transport pallet mounted goods as seen in Figure 3.1.

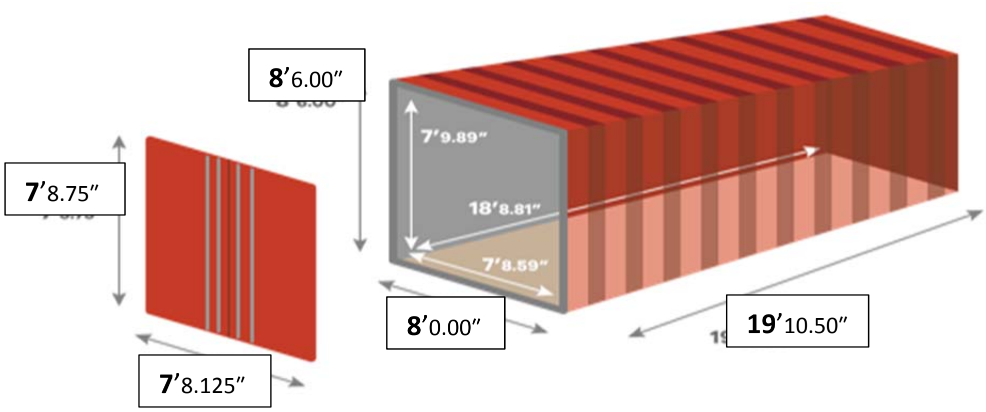


Figure 3.1:Dimensions of the cargo container used in shipping and transporting pallets all over the globe [28].

The common dimension of trucks and containers are 8′ x 20′. Thus, we can see that the dimensions of the container are precisely suited for the 48″ x 40″ pallet. The container can hold as many as two pallets along the width and six pallets along the length. This leads to optimization of the transportation and fuel costs and results in an efficient goods transportation system. This is not just important from the economic aspect but also equally important for logistics purposes. The absence of extra room inside the containers, eliminates the risk of sliding and skidding of pallets across the surface of the container which could damage the goods and the pallets themselves.

3.1.1 Rationale for changes to preliminary design

The 48″ x 40″ is also the standard size of racks at warehouses for storage and warehouses, example Walmart, home depot etc., for display purposes. The new model conforms to the same dimensions of the entire pallet using industry.

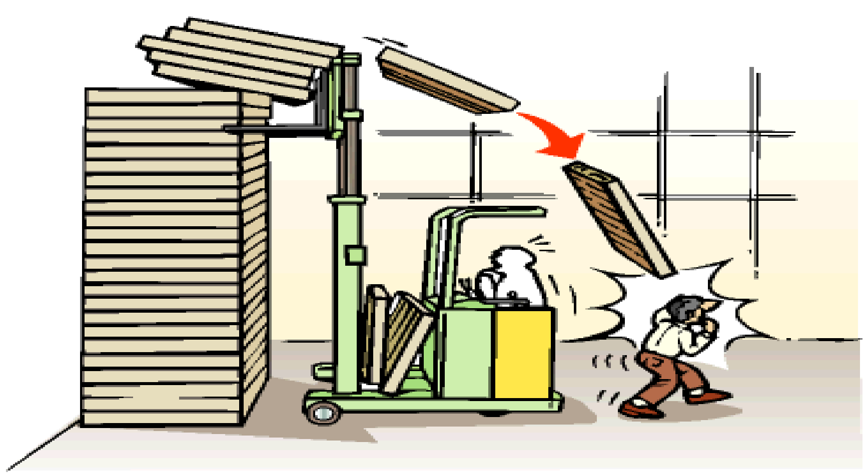


Figure 3.2: Accidents in workplace due to slipping and skidding of pallets [30].

The proposed design addresses the shortcomings of the current pallets by increasing the bearing capacity of the individual pallet. The existing standard pallets are also difficult to stack when they are empty as the deck boards could slide against each other, shown in Figure 3.2 and cause accidents which may lead to serious injuries to workers and cause loss of human life. It should be noted that stacked loaded pallets are extremely susceptible to fall due to a minor bump or mishap and cause damages. There have been many reported cases of warehouse accidents [12] and mishaps which have unfortunately led to loss human life.

Typically loaded pallets used for long term storage in warehouses are stacked on racks. These racks are an additional cost in the warehouse industry as they are usually built using metal frames (Figure 3.3).

Figure 3.3: Failure of racking systems due to load and deformation built up [29].

To avoid the restriction of maneuverability of the forklift and to decrease the cost of construction, the rack systems are usually designed undersized and frail. This has led to many catastrophic warehouse incidents leading to loss of products and human life. In some truly devastating incidents, the failure of one rack triggered a system failure leading to the breakdown of an entire racking system or an entire row of the racks as shown in Figure 3.4.

When it comes to pallet jack failure, the primary causes are: damage from the forklift, racks overloaded, racks with altered configurations, a change in operation (such as rearrangement), not using the equipment correctly, buying a smaller rack capacity in order to save money, and faulty equipment(i.e.., pallet). According to 2011 statistics, many as 20,000 workers are injured in forklift and racking accidents alone each year and 25 percent of those accidents happen when a forklift overturns [27]. Most of these accidents are fatal or at the least crippling, the U.S. Department of labor holds all the records of such accidents under the Occupational Safety and Health Administration (OSHA) [27].

Figure 3.4: Series failure of racking systems in warehouses [29].

The leading cause of racking failure is the excess loading and prolonged deflection of the beams resulting in failure (Figure 3.3). The other most common type of accident in warehouses are the sliding of the product or the goods atop the pallet, whilst being moved with the forklift from one destination to another as shown in Figure 3.6. These accidents occur in scenarios for example, when the forklift suddenly brakes or turns. The associated incidents are usually minor and mostly the damage is limited to the goods. But in some cases the sliding of pallets becomes very dangerous, for example when relocating the pallets high on the racking system or moving the pallet with delicate or hazardous goods. This could lead to serious injuries to the people around the working station.

3.2 Pallet Design Development

3.2.1 Preliminary Design

The initial aim of this study was to design a model pallet with increased efficiency and safety which can replace the standard pallets used in the industry today. The preliminary pallet was designed with the aim to overcome the aforementioned drawbacks in the standard pallets [8] and to eliminate the shortcomings of the racking system used for pallet storage.

3.2.1.1 Different types of pallets depending on their use

To accomplish this goal, two types of new pallets were initially designed based on their function:

a. The Box pallet

b. The Drum pallet

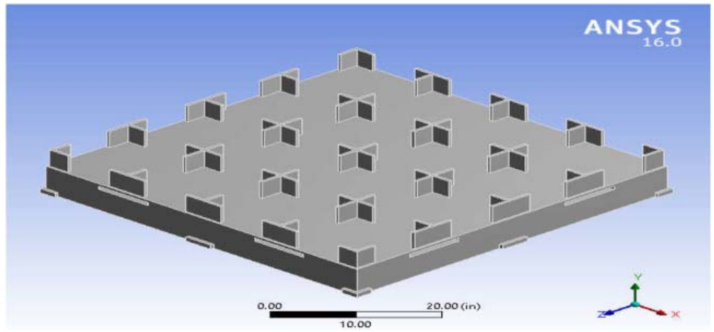


Figure 3.5: Initial box base pallet model in ANSYS.

Just as the name suggests, the drum pallets were designed to transport or handle drums which are an essential form of cargo transported throughout the world. These drum pallets were further distinguished in two types to establish a new form of stacking system for the pallets:

- The Top Drum pallet
- The Base Drum pallet

As evident from the name the base drum pallets (Figure 3.6) were designed to act as the base of the stacking system which is shown in Figure 2.9. Thus as the acting base of the stacking system, this pallet was designed to withstand significantly higher loads when compared to top drum pallets. With environmental sustainability in mind, these pallets were designed using two materials, plastic and aluminum.

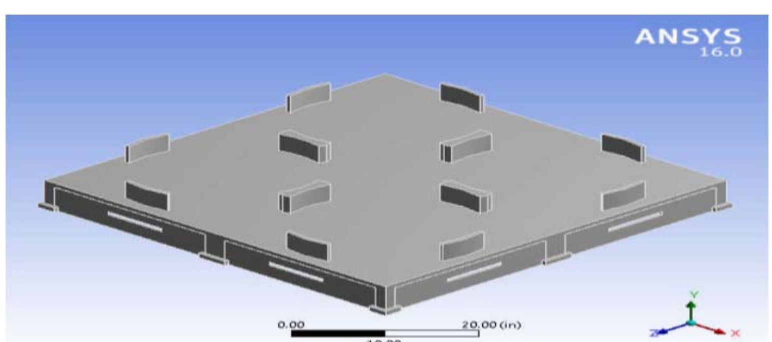


Figure 3.6: Initial drum base pallet model in ANSYS.

The box pallets were modeled to handle all other cargo forms other than drums, with specific grooves designed on the top surface of this pallet to hold cargo in box form seen in Figure 3.5. These pallets were further distinguished in two types to establish a new form of stacking system for the pallets see in Figure 3.7 and 3.8.

- The Top Box pallet
- The Base Box pallet

Similar to the drum pallets, the aforementioned pair of box pallets were designed with the same specific purpose of stacking in mind and with the same two materials plastic and aluminum. Besides sustainability, the other intention behind the use of two materials was to compensate for the demands most prevalent in the industry, namely the demand for the lightweight and heavyweight load capacity pallets for the material handling industry.

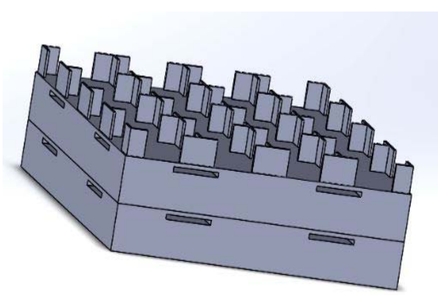


Figure 3.7: Empty box pallet stacked

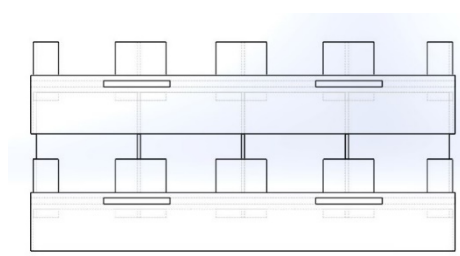


Figure 3.8: Loaded box pallets stacked.

3.2.1.2 Data Analysis

The pallets were dimensioned 51″ x 51″ x 6.5″ which corresponds to median dimension pallets in the industry. The top box pallet and the top drum pallets were designed for everyday use with their respective counterpart, the base drum and the base box pallets which were mostly designed for stacking purposes.

These pallets were analyzed in ANSYS workbench and SOLIDWORKS simulation, to determine the apparent strength shown in Table 3.1. The analysis of the models via the two F.E.A. software [4] are explained in depth in the SOLIDWORKS report in the section 3.3.1. The results derived through numerous simulations attached in Appendix B clearly indicated the apparent strength and the self-weight of these particular pallet for both materials plastic and aluminum.

Table 3.1: Maximum capacity of individual pallets calculated using SOLIDWORKS simulation with the factor of safety close to 1.00.

Type	Material	Dimension (inch x inch)	Static (ground) Apparent strength (lbf)	Static (forklift) Apparent strength (lbf)
Base Box pallet	Plastic	51 x 51	150,000	16,000
Base Box pallet	Aluminum	51 x 51	180,000	22,000
Base Drum pallet	Plastic	51 x 51	65,000	65,000
Base Drum pallet	Aluminum	51 x 51	75,000	75,000
Top Box pallet	Plastic	51 x 51	45,000	15,000
Top Box pallet	Aluminum	51 x 51	55,000	17,000
Top Drum pallet	Plastic	51 x 51	12,000	12,000
Top Drum pallet	Aluminum	51 x 51	15,000	15,000

As evident from Table 3.1, the preliminary design modeled pallets are high functioning, heavy duty pallets. Although the capacity of these pallets is very high, the increase in weight of the individual pallets poses a significant problem. These pallets well exceed the required daily use capacity of 5000 lbf to 8000 lbf in the material handling industry and their high self-weight increases the transportation costs. These drawbacks limits this design to specific uses only. This lead to the study to move in a direction where the core pallet design was retained but the pallet was optimized both in the weight and dimensional aspects. Thus the initial steps taken to rectify the problem concerning the self-weight of the preliminary design was to reduce the dimensions of the pallet. The design was further improved as numerous simulations were run according to the framework, until the model was optimized with the blend of capacity versus self-weight.

This final modified pallet design is defined in detail in the section 3.2.2 with the specifications and the respective changes in the design. Even though the preliminary pallet design is useful for a very limited market, they still can have an impact in the market as a possible option for military pallets. Further the aluminum base pallets of both drum and box types have the maximum apparent strength of 75000 lbf as shown in the Table 3.1 which can prove to be useful.

It should be noted that the simulations run using the F.E.A. software were time consuming as there were quite a large number of degree of freedom and nodes assigned to the model for the analysis to depict the behavior as close to reality as possible. The framework gave clear reasons for the evolution of the design and distinguished the changes made from the aforementioned preliminary design to the modified final model.

3.2.2 Modified Design

Accidents associated with the pallet handling operations may lead to casualties and loss of goods which leads to an economic liability for the company. These incidents usually cause delay in warehouse operations which is one of the main impediments to the efficiency of the entire material handling and storage industry. The proposed modified model of the pallet will be efficient for racking with the products and equally suited for racking empty just like the pallets shown in Figure 3.7 and 3.8. The new design would eliminate the need for a warehouse racking system and also solve the problem of sliding and slipping of existing pallets during forklift operations (Figure 3.10). The elimination of the racking system is beneficial in both the safety as well as the financial aspects as the cost reduction would be quite significant. The modified pallet design shown in Figure 3.9 is not only capable of handling additional design load than the existing standard pallets present in the market today, but is also lighter in weight. These advantages of this modified pallet model are discussed in detail in the results and conclusion chapters.

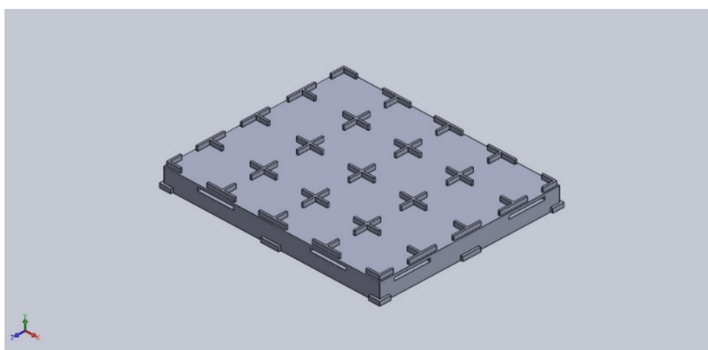


Figure 3.9: Improved and optimized design of pallet, base pallet modeled in SOLIDWORKS.

This new pallet model was primarily designed in SOLIDWORKS 2017 and analyzed using SOLIDWORKS simulation. This SOLIDWORKS design was imported into ANSYS workbench and analyzed to provide a better understanding of the behavior of the new model. It also validated the data obtained from the SOLIDWORKS simulation. ANSYS workbench and SOLIDWORK simulation are efficient tools for simulating the behavior of the model, under various applied loads, situations and circumstances.

3.2.2.1 Specifications of the final modified design

The proposed pallet is 48″ x 40″ x 5.5″ in size and designed in two parts, a) base pallet, as shown Figure 3.9, and b) top pallet, as shown in Figure 3.11. The reason for proposing two different modeled pallets was to eliminate the need for a racking system.

The pallets were designed in SOLIDWORKS in layers which could be simulated in the real world exercise of manufacturing these pallets. The pallets shown in the Figure 3.9 was specifically modified with grooves at the top surface to accommodate boxes of goods. These grooves were provided to encase the boxes and prevent them from sliding or slipping. The proposed pallet was designed with the ease of manufacturing in mind. The main reason for designing the pallets in the steps which closely match with the actual manufacturing process was to maintain the simplicity of the design of the wood pallets. This assembly process is expected to be executed by the same efficiency as the standard traditional wooden pallet in the market today with the same machinery. The grooves designed on the top surface of the new model is flexible, to accommodate other shapes and sizes of goods. The base pallet and the top pallet resting on the base pallet form an instant racking system. The grooves also have a secondary role where they would prevent the pallet stack from sliding across (Figure 3.10) and lead to increased safety.

Figure 3.10: Failure of loaded pallet on the forklift [31].

The racking system inherent in the design is an important feature as it eliminates the need for additional racking frames currently used. This type of racking system will significantly reduce the height of the stacked pallets due to the fact that the top pallet caps on the pallet below to an extent. Also, this will lead to an increase in the number of pallets and goods inside the cargo container, which in turn would increases the shipping and transportation output per trip [10] and contribute to cost benefit. As per the requirement for the stacking system, the base pallet was designed to withstand significantly more load than the top pallet, making it marginally heavier.

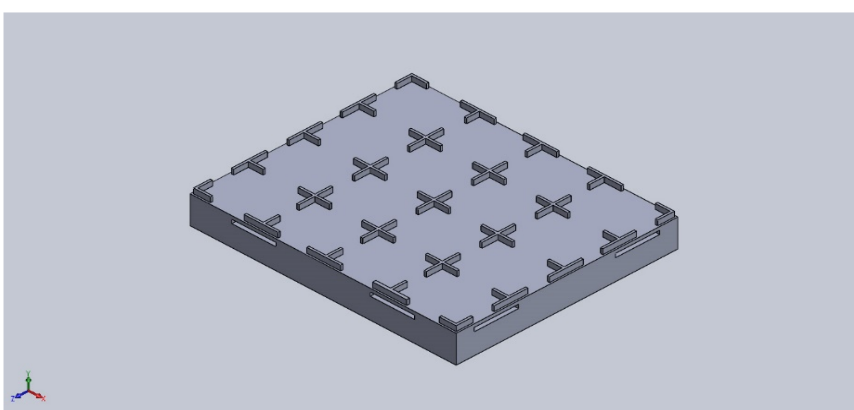


Figure 3.11: Improved and optimized design of pallet, top pallet modeled in SOLIDWORKS.

Hence the designs of the base pallet and the top pallets are slightly different. The Figure 3.11 shows the top pallet with same dimensions as the base pallet. These pallets can be stacked just like the preliminary design, shown in Figures 3.7 and 3.8. The grooves present on the face of the pallet are design options which can be changed according to the cargo handling requirements. With the pallets design yielding good results, the need to design a separate pallet for drums was deemed unnecessary as the new pallet design could accommodate drums in their design by just changing the grooves at the top surface.

3.2.2.2 Analysis of the modified design

After the design of the model in SOLIDWORKS, the next step was to analyze the model with the help of the SOLIDWORK simulation tool. The simulation tool was used to analyze the pallet in static condition or rest condition and ANSYS was used to analyze for the dynamic condition or the condition in which the pallet was moving. The first step of the simulation was to assign the specific material to the model. This steps rendered the model similar to the one which can be manufactured. The material properties were the most significant because they provided the simulation with data to calculate the mass of the model and also to simulate the behavior of the model under all different conditions. As discussed earlier, the wood pallets are still the most prominent pallets in the industry. Thus the modified pallets were first assigned "Balsa wood" as the material in this step shown in the Figure 3.12. The choice of balsa wood was mainly due to the limitations of the wood material choices available within the SOLIDWORKS simulation library. The wood pallets in the industry are currently built with a blend of different kinds of woods specifically suitable for pallets and thus is functionally and economically efficient as pallet raw material. These wood mixtures have better strength to weight ratio [7] when compared to the balsa wood material available in SOLIDWORKS library.

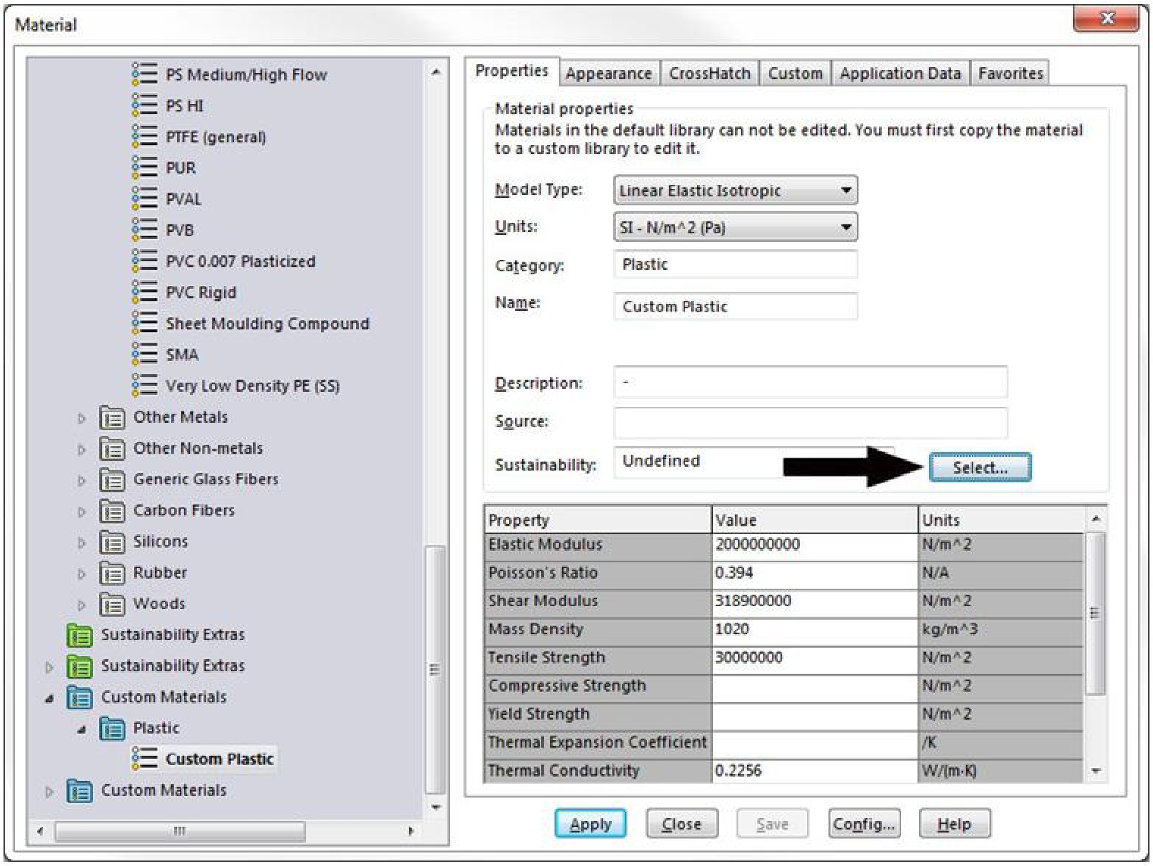


Figure 3.12: Assigning material properties to the model in SOLIDWORKS.

3.2.2.3 Material specifications

In this study, the model was assigned three materials and analyzed in both static and dynamic conditions. The material choices are mentioned below.

i. Balsa Wood

ii. Low density PE (polyethylene)

iii. Acrylic medium high impact (plastic)

The reason for the use of these three materials for the pallet is that the balsa wood pallet was designed to meet the market expectation of a low to medium end capacity pallet demand and the other two materials were used to meet as the steadily rising demand for high load capacity pallets [1]. The adoption of the two plastic materials here was also due to limitations of choices in SOLIDWORKS library. These material properties were also imported along with the model design to ANSYS 16.0 for analysis, so that the boundary conditions were identical in the simulation and analysis by both finite element software. The next step of the simulation was to assign the precise conditions of the pallets for the simulation tool for analysis. This step involved providing precise points where the parts of the pallet model rested on the ground or the forks of the forklift seen in the report attached in section 3.3.1. The pallet was analyzed in the static condition, as for resting on the ground and dynamic condition, on the forks of the forklift which move from one height to other at a specific rate.

The specific rate is the speed with which the forklift motor lifts the pallets and similarly the speed at which the pallets are brought back down. Generally the forklifts function at a speed of $0.58m/sec$ whilst moving in the upward direction and $0.42m/sec$ moving in the downward direction. The pallets are simulated while they rest on the forklift because the load bearing capacity of the pallet is different depending upon the condition of the pallet. Generally, the capacity decreases drastically from the resting on the ground condition to resting on the forks of the forklift condition due to significant increase in pallet deformation. The pallet were precisely simulated with the uniform base excitation tool for both the speed rates.

In the next step the pallet was subjected to loads on the top surface and the behavior was simulated in both static and dynamic conditions. In case of the dynamic conditions the pallets was also subjected to a specific speed consistent with the speed of the forklift to lift the pallet to a certain height. This application of the loads and the excitation of the pallet during the simulation was carefully chosen to duplicate the real world function as close as possible.

The next step involved the meshing the model for finite element analysis in both ANSYS 16.0 and SOLIDWORKS 2017. The mesh setting was set as fine as possible so that the F.E.A. software could evaluate and provide a rendering of reasonable precision. The meshing was refined repeatedly for accuracy during the sketch of the stress and strain plot and deformation rendering, so that we could interpret the behavior of the model. Finally the last step involved the plotting of the factor of safety and its rendering, which denoted the parts of the model with the factor of safety value less than 1.00 as red. With this factor of safety plot, the pallets were subjected to increasing loads until the factor of safety (F.O.S.) approached 1.00. All the steps can be seen in the SOLIDWORKS report in section 3.3.1.

3.3 Data Analysis

By following the above steps and running the simulation for increasing values of load, the analysis was stopped once the factor of safety reached close to 1.00. The static analysis provided three deformation plots with respect to von Mises stress, strain and deflection. The plot and the corresponding image provided a clear picture of the model behavior. It should be noted that these images were magnified by a substantial magnitude to get a better perspective. The factor of safety image was setup in such a way that, if the load values caused the factor of safety value to fall below 1.00 the plot showed red color on the model rendering at the specific location where the value went below the threshold. In the case where the value of the F.O.S. remained greater than 1.00, the model rendering was depicted in blue color.

As the analysis was completed to satisfaction, the next step was to generate reports for the all necessary analysis conducted. The reports generated were extensive and expansive, exactly like the report shown in section 3.3.1. The report shown is a SOLIDWORKS simulation of a base wood pallet resting on the ground, represented as the static condition in the report. It shows all the aforementioned steps in the order which is similar in all simulations subject to minute changes. The changes mostly occur during setting up the conditions for the simulations either static or dynamic state. In case of the dynamic simulation, significantly more amount of time was required to obtain results and the factor of safety plot. On an average the dynamic analysis required one to two hours in case of a coarse mesh, and increased exponentially with refining of the mesh.

The results which are depicted in the next chapter are from the reports generated in both SOLIDWORKS Simulation and ANSYS workbench which are attached in the Appendix A.

3.3.1 SOLIDWORKS simulation report

The following report (Section 3.3.1.1) shows the simulation for a base pallet of the proposed modified design. This model was analyzed in SOLIDWORKS 2018 for static conditions as represented in the Tables 3.2 and 3.6. The dimensions of the pallet were 48″ x 40″ x 5.5″ and the mass of the pallet about 20 lb. as shown in Table 3.2. In this simulation the pallet was assigned the material properties of balsa wood (Table 3.5).

The various other software settings such as units and model properties are given in Tables 3.3 and 3.4 respectively.

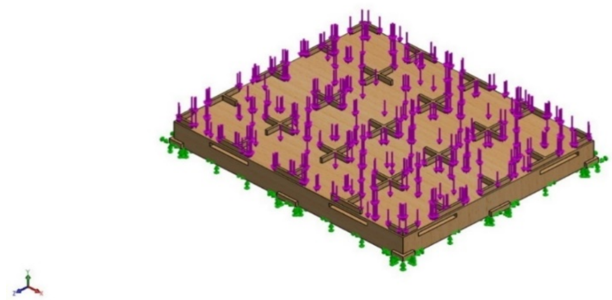
The top surface of the pallet was then subjected to a distributed load of 50,000 lbf whilst the surface of the pallet in contact with the ground was fixed to the ground, thus the static condition (Section 3.3.1.5). Furthermore, the model of the pallet was assigned a mesh for finite element analysis (Section 3.3.1.6) which was refined continuously as per the framework to obtain an optimal solution. The workings of the mesh tool are given in the Tables 3.7 and 3.8. This solution (Table 3.9) was checked with the results from the ANSYS 16.0 for the same boundary conditions.

The SOLIDWORKS tool was used to plot the von Mises stress (Table 3.10), displacements (Table 3.11), strains (Table 3.12) and factor of safety plots (Table 3.13) to accurately describe the behavior of the model.

3.3.1.1 Model Information

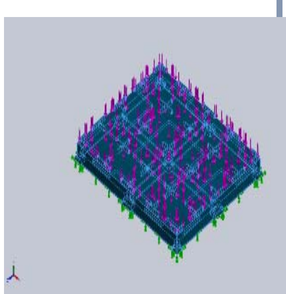
This section of the SOLIDWORK report gives information regarding the proposed modeled design of the pallet from its dimension to the mass properties.

Table 3.2: Proposed new design model information.



Model name: Base Pallet 48x40

Current Configuration: Default

Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Solid Bodies			
Boss-Extrude5 	Solid Body	Mass:8.84909 kg Volume:0.0553103 m^3 Density:159.99 kg/m^3 Weight:86.721 N	C:\Users\Public\Documents\Base Pallet 48x40.SLDPRT Mar 26 15:44:18 2018

3.3.1.2 Study Properties

This section of the SOLIDWORK report gives information regarding the properties which were adopted during the generation of the report.

Table 3.3: Properties of the new model.

Study name	Static 3
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	FFE Plus
In-plane Effect:	**Off**
Soft Spring:	**Off**
Inertial Relief:	**Off**
Incompatible bonding options	**Automatic**
Large displacement	**Off**
Compute free body forces	**On**
Friction	**Off**
Use Adaptive Method:	**Off**

3.3.1.3 Units

This section of the SOLIDWORK report gives information regarding the units adopted during the design of the pallet model.

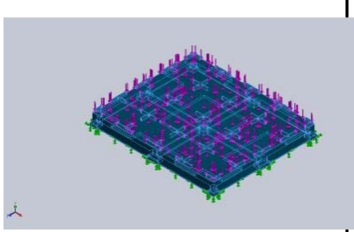
Table 3.4: Units used in the simulation.

Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m^2

3.3.1.4 Material Properties

This section of the SOLIDWORK report gives information regarding the properties of the material assigned to the modeled design.

Table 3.5: Material assigned to the new model.

Model Reference	Properties		Components
	Name: Model type: Default failure criterion:	**Balsa** **Linear Elastic Isotropic** **Unknown**	**Solid Body 1(Boss-Extrude5)(Base Pallet 48x40)**

	Yield strength: **2e+007 N/m^2** Elastic modulus: **3e+009 N/m^2** Poisson's ratio: **0.29** Mass density: **159.99 kg/m^3** Shear modulus: **3e+008 N/m^2**	
Curve Data: N/A		

3.3.1.5 Loads and Fixtures

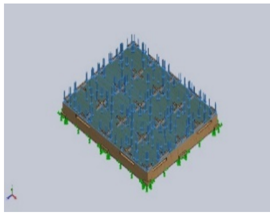
This section of the SOLIDWORK report gives information regarding the boundary conditions observed during the simulation and analysis.

Table 3.6: Boundary conditions on the model.

Fixture name	Fixture Image	Fixture Details
Fixed-1		**Entities:** **1 face(s)** **Type:** **Fixed Geometry**

Resultant Forces

Components	X	Y	Z	Resultant
Reaction force(N)	**0.0630116**	**133447**	**0.0876665**	**133447**
Reaction Moment(N.m)	**0**	**0**	**0**	**0**

Load name	Load Image	Load Details
Force-1		**Entities:** **1 face(s)** **Type:** **Apply normal force** **Value:** **50000 lbf**

3.3.1.6 Mesh information

This section of the SOLIDWORK report gives information regarding the standard specifications of the mesh assigned to the model.

Table 3.7: Assigning mesh conditions to the model.

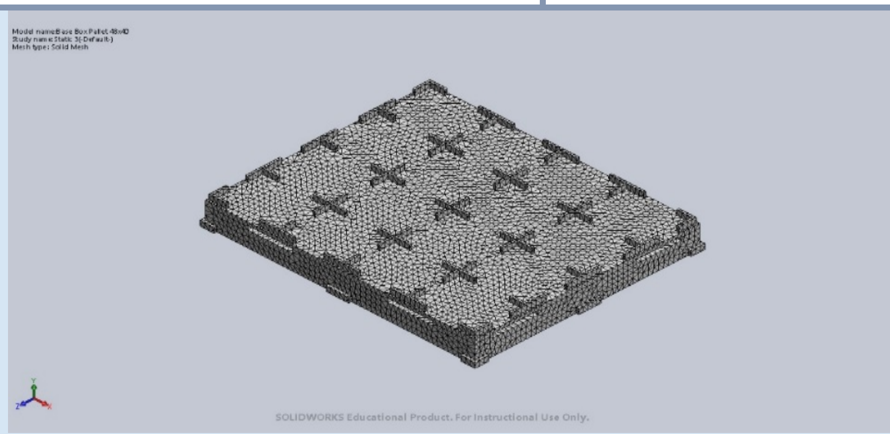
Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off
Jacobian points	4 Points
Element Size	0.920847 in
Tolerance	0.0460424 in
Mesh Quality Plot	High

3.3.1.7 Additional mesh information

This section of the SOLIDWORK report gives information regarding the specific mesh assigned to the modeled design.

Table 3.8: Additional mesh information.

Total Nodes	79335
Total Elements	42659
Maximum Aspect Ratio	7.6609
% of elements with Aspect Ratio < 3	91.5
% of elements with Aspect Ratio > 10	0
% of distorted elements(Jacobian)	0
Time to complete mesh(hh;mm;ss):	00:00:09
Computer name:	MSL-REF-70



3.3.1.8 Resultant Forces

This section of the SOLIDWORK report gives information after the analysis occurs to with respect to the conditions set for the simulation.

Table 3.9: Reaction forces on the model.

Reaction forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	0.0630116	133447	0.0876665	133447

Reaction Moments

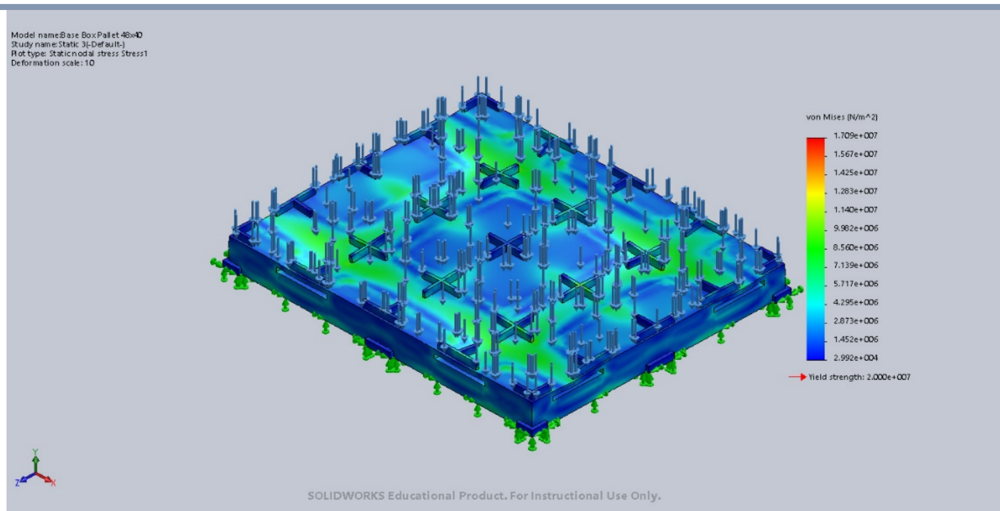
Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

3.3.1.9 Study Results

This section of the SOLIDWORK report gives the result from the simulation which is interpreted to determine the validity of the analysis as the framework suggests.

Table 3.10: Von Mises stress plot.

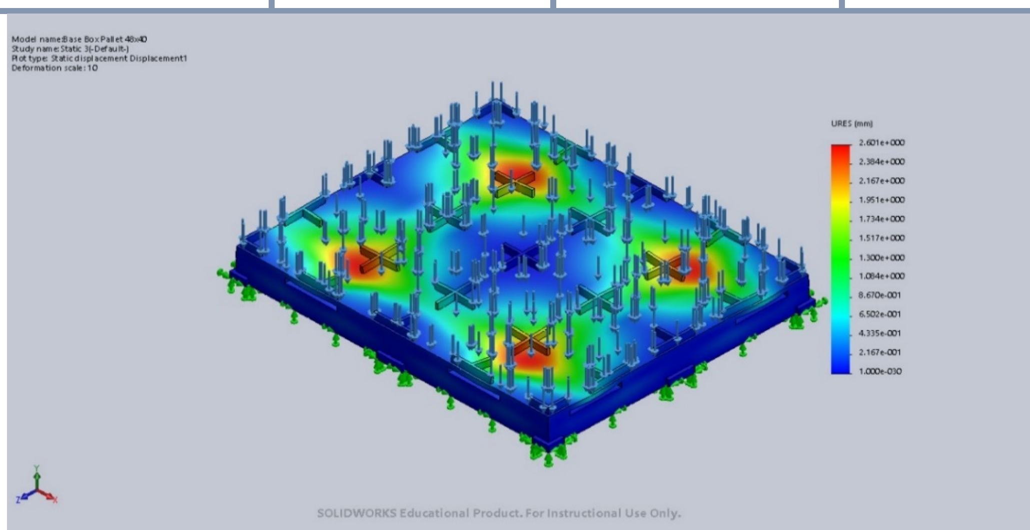
Name	Type	Min	Max
Stress1	VON: von Mises Stress	2.992e+004N/m^2 Node: 7171	1.709e+007N/m^2 Node: 58702



Base Pallet 48x40-Static-Stress-Stress1

Table 3.11: Displacement plot.

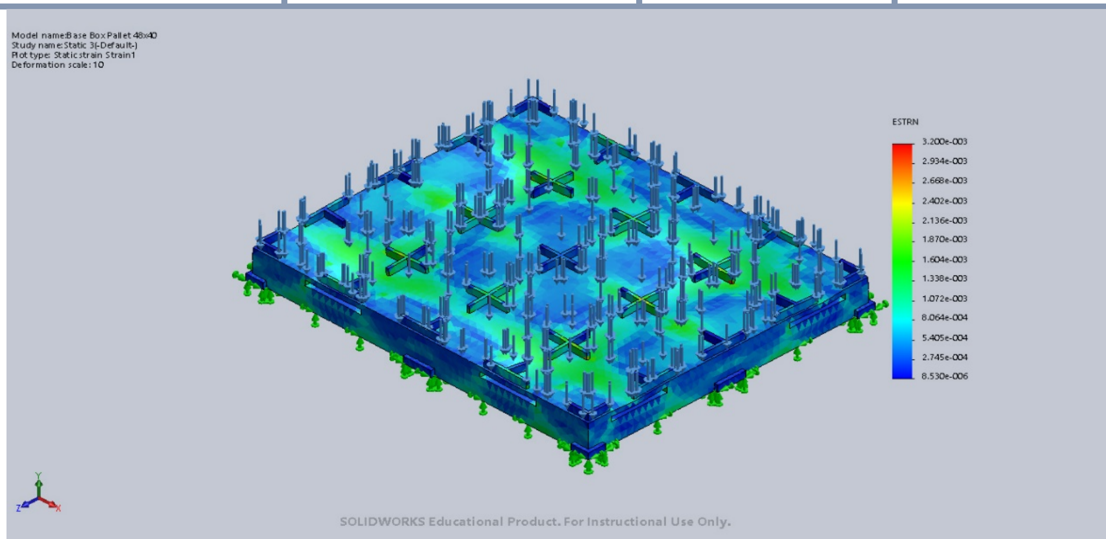
Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+000mm Node: 1834	2.601e+000mm Node: 41263



Base Pallet 48x40-Static-Displacement-Displacement1

Table 3.12: Strain plot.

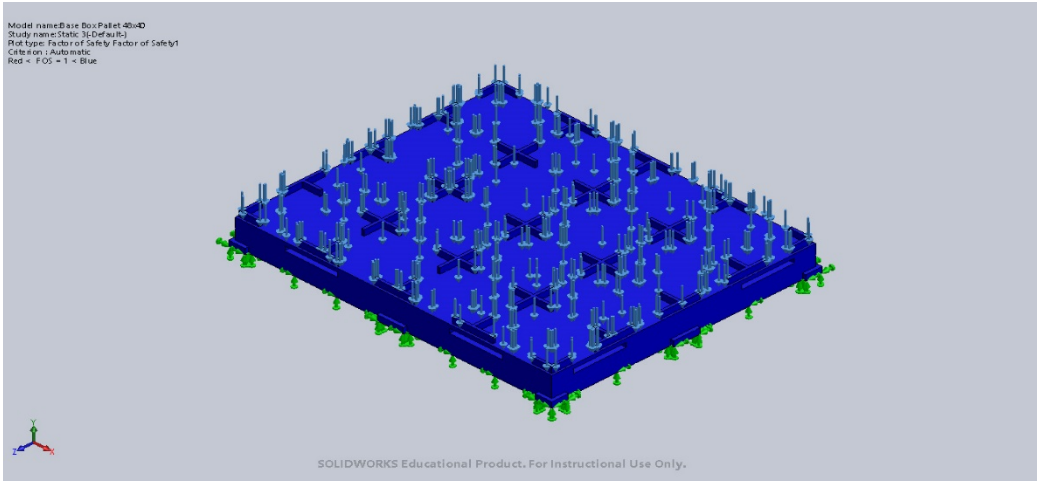
Name	**Type**	**Min**	**Max**
Strain1	ESTRN: Equivalent Strain	8.530e-006 Element: 24956	3.200e-003 Element: 32249



Base Box Pallet 48x40-Static-Strain-Strain1

Table 3.13: Factor of Safety plot.

Name	**Type**	**Min**	**Max**
Factor of Safety1	Automatic	1.170e+000 Node: 58702	6.685e+002 Node: 7171



Base Box Pallet 48x40-Static 3-Factor of Safety-Factor of Safety1

3.4 Interpretation of the implemented framework

A simulation example of a Base pallet resting on the ground shown in the section 3.3.1. This pallet was loaded with increasing load until the factor of safety reached a value of 1.00. Thus the conditions of each phase of the framework for this particular design was satisfied and this design was considered as the final optimized design. The data obtained from these simulations before being finalized was checked with respect to three criteria, a) Comparison test, b) Accuracy test, c) Interpretation as shown in the framework in Figure 3.13. The model analysis first checked for deformations and stress/strain behavior across the design as shown in Tables 3.10 and 3.11 respectively.

The next check was for the maximum von Mises stress against the yield strength of the material to evaluate for failure. The final test was to compare the results with the specifications of the standard market pallets to determine the degree of success. Ideally, experimental tests would have been performed to confirm the findings of the F.E.A. tools to provide confidence in the results. However, such tests were outside the scope of this study. To overcome the limitations the analysis was conducted in two different F.E.A. tools.

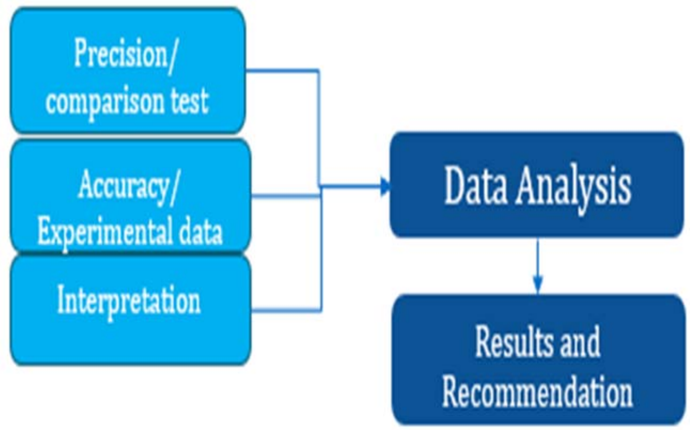


Figure 3.13: Securing the final model design from the framework after the evaluation of the data generated.

The next chapter shows all the results obtained from both SOLIDWOKS 2017 and ANSYS 16.0 through the framework, for different simulations of the final design under different conditions. All the results obtained from SOLIDWOKS simulation were for static condition. The dynamic analysis was performed in ANSYS 16.0 only because the SOLIDWOKS simulation tools had limitations for carrying out dynamic analysis.

CHAPTER IV

RESULTS

4.1 Individual analysis

The modified design models were analyzed and optimized in ANSYS 16.0 and SOLIDWORKS 2017 and the corresponding reports are attached in the Appendix A. The results obtained from these reports are shown in tables. In Table 4.1, all the results obtained from SOLIDWORKS simulation in static condition is shown. The dynamic analysis was performed in ANSYS specifically because the SOLIDWORKS dynamic analysis was unreliable.

4.1.1 SOLIDWORKS simulation results

The SOLIDWORKS finite element analysis provided us the results presented in Table 4.1. The weights of the modified final design pallets for wood and both types of plastics were about 20 lb. and 110 lbs.-150 lb. respectively. These results obtained were significant as the weight of the proposed pallets was lighter and the capacity was higher compared to the existing pallets. Therefore with the combination of lower self-weight and higher apparent strength, the study was deemed to be yielding good results.

Table 4.1: Maximum capacity of individual pallets calculated using SOLIDWORKS simulation with the factor of safety close to 1.00.

Pallet Type	Condition	Material	Weight (lb.)	Load Capacity (lbf)
BASE PALLET	Resting on ground	BALSA	19.5	50,000
BASE PALLET	Resting on ground	LOW DENSITY PE	110.23	13,000
BASE PALLET	Resting on ground	ACRYLIC MEDIUM HIGH IMPACT	146.34	75,000
TOP PALLET	Resting on ground	BALSA	19.3	8,000
TOP PALLET	Resting on ground	LOW DENSITY PE	109.37	3,000
TOP PALLET	Resting on ground	ACRYLIC MEDIUM HIGH IMPACT	145	22,000

4.1.2 ANSYS 16.0 results:

In Table 4.2, the data obtained from ANSYS workbench for both conditions while resting on the ground and resting on the forklift are shown. Here we can compare the data obtained from the two different FEA software and arrive at the conclusion that the values coalesce around the same numbers. This increases the confidence of the analysis and the data obtained.

Table 4.2: Maximum capacity of individual pallets calculated using ANSYS with the factor of safety close to 1.00.

Pallet Type	Condition	Material	Weight (lb.)	Load Capacity (lbf)
BASE PALLET	Resting on ground	BALSA	19.5	56,202
BASE PALLET	Resting on forklift	BALSA	19.5	12,765
BASE PALLET	Dynamic(moving forklift)	BALSA	19.5	12,765
BASE PALLET	Resting on ground	LOW DENSITY PE	110.35	67,442
BASE PALLET	Resting on forklift	LOW DENSITY PE	110.35	14,614
BASE PALLET	Dynamic	LOW DENSITY PE	110.35	14,614
BASE PALLET	Resting on ground	ACRYLIC MEDIUM HIGH IMPACT	146.32	76,831
BASE PALLET	Resting on forklift	ACRYLIC MEDIUM HIGH IMPACT	146.32	24,235
BASE PALLET	Dynamic	ACRYLIC MEDIUM HIGH IMPACT	146.32	24,235
TOP PALLET	Resting on ground	BALSA	19	7,744
TOP PALLET	Resting on forklift	BALSA	19	4,756
TOP PALLET	Resting on ground	LOW DENSITY PE	107.66	8,992
TOP PALLET	Resting on forklift	LOW DENSITY PE	107.66	4,158
TOP PALLET	Resting on ground	ACRYLIC MEDIUM HIGH IMPACT	142.76	15,736
TOP PALLET	Resting on forklift	ACRYLIC MEDIUM HIGH IMPACT	142.76	9,779

Considering the similarity of the values obtained from both the F.E.A. tools in Table 4.1 and Table 4.2, we can stipulate that the self-weight of the modified final designed wood pallet is about 20 lb. with a capacity of around 50,000 lbf, conservatively. For the plastic pallets, the self-weight was around 145lb. and capacity ranged between 13,000 lbf and 75,000 lbf.

It was also evident from the data obtained that the capacity of the pallets decreased significantly for dynamic condition. This was consistent with the data shown in chapter 2 for the different existing pallets.

4.2 Individual pallet comparison with market pallets

These results were compared to the specifications of the market pallets shown in the Table 2.1, for assessing the success of the study in Table 4.3. The capacity/weight ratio of the new designed pallet was 2500 while that of the existing pallets was 140. The higher capacity/weight ratio of the modified final pallets evidently established the advantage of the proposed design.

Table 4.3: Market wood pallet comparison with the base wood pallet of the modified design.

Model	Market pallet	New Model SOLIDWORKS analyzed	New Model ANSYS analyzed
	Series 1	Series 2	Series 3
Dimension (in x in)	48″ x 40″	48″ x 40″	48″ x 40″
Material	Wood	Wood	Wood
Shipping Weight lbs.	59	20	20
Weight Capacity(floor) lb.	8,250	50,000	56,202
Weight Capacity(fork) lb.	5,500	13,000	12,765

A comparison of the most common pallet used in the world with modified final pallet design proposed is shown in Figure 4.1. It is evident that the modified final pallet design could reduce the costs of the material handling and the transportation industry to a great extent. The graph in Figure 4.1 depicts a comparative analysis of weight versus the apparent strength of the pallets which yields the clear advantage of the modified final designed pallet. This can be achieved as the capacity of individual modified final pallets is more than five times when compared to the standard market pallet. It should be kept in mind that a very conservative value of the modified final pallet was taken into account for this estimate.

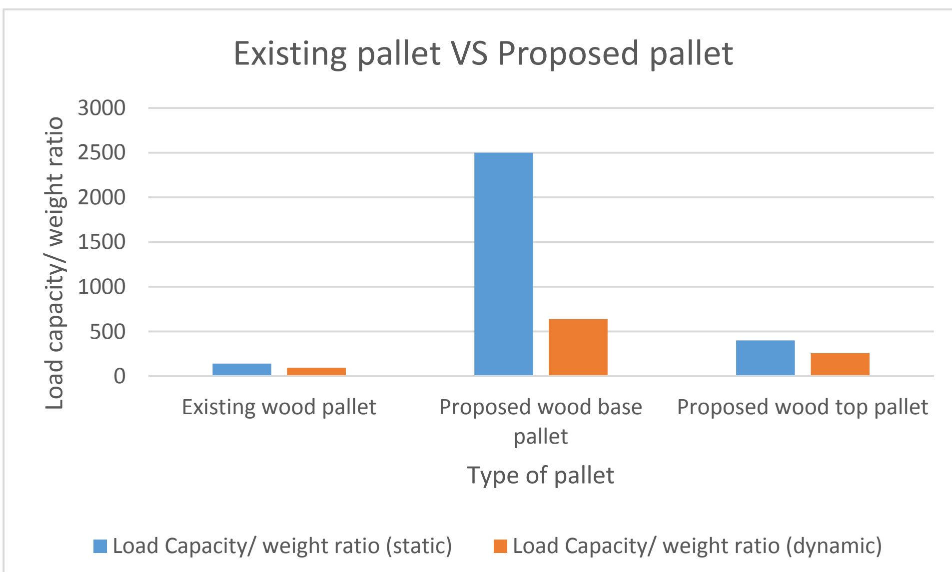


Figure 4.1: Graphical representation of comparison between existing wood pallet and proposed wood pallet simulated in SOLIDWORKS and ANSYS.

One of the objectives for this study was to replace the racking system in warehouse and thereby decrease storage costs and increase benefits. The proposed pallets are self-racking. However, the top pallet was designed, with daily work in mind and hence it was not designed to withstand massive loads like the base pallet. Despite that constraint, Table 4.4 shows that the top pallets also have similar load bearing capacity as the market pallets but are much lighter. The capacity/weight ratio of the new designed top pallet is 421.00 and the existing pallets have 140.00 which evidently established the advantage of the new design.

Table 4.4: Market wood pallet comparison with the top wood pallet of the modified design.

Model	Market pallet	New Model SOLIDWORKS analyzed	New Model ANSYS analyzed
Dimension (in x in)	48″ x 40″	48″ x 40″	48″ x 40″
Material	Wood	Wood	Wood
Shipping Weight lbs.	59	19	19
Weight Capacity(floor) lb.	8,250	8,000	7,744
Weight Capacity(fork) lb.	5,500	5,120	4,756

Now, when we compare the modified final pallet design with the existing heavy duty plastic pallet (Table 4.5), we can see that the modified final pallet design values are similar at rest conditions but their capacity while resting on the forklift is significantly higher. Again the extremely low self-weight of the modified final design gives it a big advantage over the competition.

Table 4.5: Market plastic pallet comparison with the proposed wood pallet design.

Model	Market pallet	New Model SOLIDWORKS analyzed	New Model ANSYS analyzed
	Series 1	Series 2	Series 3
Dimension (in x in)	48″ x 40″	48″ x 40″	48″ x 40″
Material	Plastic	Wood	Wood
Shipping Weight lbs.	50	20	20
Weight Capacity(floor) lb.	30,000	50,000	56,202
Weight Capacity(fork) lb.	5,000	13,000	12,765

Thus we can draw reasonable conclusions from these comparisons, which all the data in table relay one clear message about the modified final pallet design would outperform the market pallet [17]. As the industry evolves, with the growth of environment awareness the plastic pallets is expected to slowly but surely replace the wood pallets.

The graph in Figure 4.2 depicts a comparative analysis of weight versus the apparent strength of the pallets which yields the clear advantage of the modified final designed pallet. The capacity/weight ratio of the new designed pallet is 2500.00 and the existing pallets have 600.00 which evidently established the advantage of the modified final design.

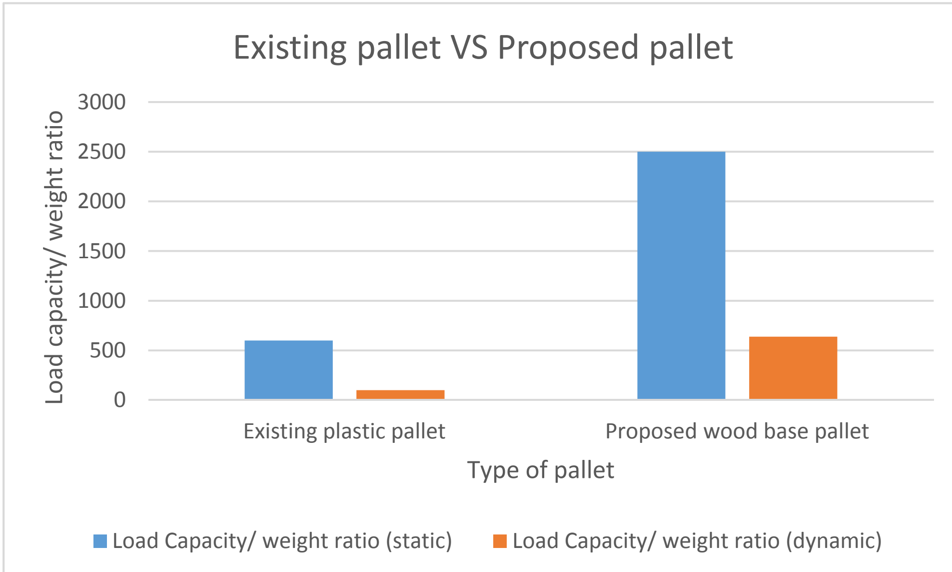


Figure 4.2: Graphical representation of comparison between existing plastic pallet and proposed wood pallet simulated in SOLIDWORKS and ANSYS.

The plastic pallets of the modified final design are modeled to function as heavy duty pallets for the military and air freight industry. These new plastic pallets are exactly same in the design criteria when compared to the wood pallets but these are heavier and more durable. These pallets can also be instantaneously racked which saves time, money and space, the three major factors in play in the material handling industry. The proposed plastic pallets have twice the bearing capacity as seen in Figure 4.2 but are heavier for the medium end market of the industry.

CHAPTER V

DISCUSSION, CONCLUSION & FUTURE WORK

5.1 Discussion

The warehouse storage/ racking system can be enhanced by swapping the base wood pallet with the proposed base plastic pallet which has a higher apparent strength. The proposed racking system embedded with the pallets would improve the storage process leading to substantial cost benefits and lead to an incentive for adoption of this pallet system. It should be noted that, the weight of the model of the final modified design in both the F.E.A. software does not take into account the weight of the bolts and fasteners required in manufacturing the wooden pallet. Therefore a conservative value is adopted in the Table 4.1 and 4.2 to account for this discrepancy. The plastic pallets are manufactured as molds, hence they do not require any kind of bolts or nails in their respective manufacturing processes. The numerous advantages stated at the end of this chapter highlights the efficiency and practicality of the final design.

It should be noted that the results obtained in this study was primarily based on design, as the material choice in the software was limited. The market pallets are manufactured from better material with better yield strength and better weight to strength ratio [7], [9]. The new design of the pallets will therefore is projected to yield better results with the access to these materials. The final pallet design was guided by the market demand to overcome the limitations of the existing pallet.

5.2 Conclusions

The following are conclusions of the final modified design which are backed by the data and simulations from two different F.E.A. software (SOLIDWORKS and ANSYS 16.0).

i. The lightweight of the design helps in saving transportation and shipping costs.

    - The costs could be reduced by increasing the number of pallets which can be transported in one shipment or by reducing the total weight of the shipment significantly.
    - The costs could also be scaled back by the instant racking system aspect of the design, which allows more pallets to be stacked during transportation and reduce the probability of accidents.

ii. The design helps to minimize the accidents caused due to slipping and sliding of pallet and the goods respectively.

    - One of the important feature of this design is the grooves on the top surface of the pallet, which increases the safety during material handling operations.

iii. The other inherent design feature of the self-sustaining racking system most notably saves time and space in the material handling operations which in today's world is a significant benefit

- This feature can replace the existing racking system used at warehouses [13] for long term storage due to the durability of design, which leads to significant cost reduction.
- This also eliminates huge cost of autonomous racking system used in the warehouse industry.

iv. The compatibility of the final design, for example between the base wood and base plastic pallet could be interchanged to increase the capacity of the racking feature.

It should be remembered that the apparent strength values obtained for the pallets are only theoretical and requires physical testing for verification of the strengths. However, the strength values reported for each individual pallet are very conservative and represent the lower limits. The behavior of the model under applied loads in both the software was reasonable enough to give confidence in the final proposed design in this study.

5.3 Future Work

The following works could be pursued in the future, to improve the design and also to establish economic advantage of the new pallet design.

- The pallets can be designed with better materials like Mg-Cu/CNT's [24], other super alloys or materials [18].
- The cost benefit analysis could be conducted on the pallets to clearly determine the economic advantage.
- Modification for airline industry as a substitute for ULD's could be explored.

- These pallet deign should be verified experimentally to determine the validity of the F.E.A. analysis.
- The pallets should also be analyzed under impact load conditions and checked for structural failure due to prolonged fatigue, excess deformations [19].

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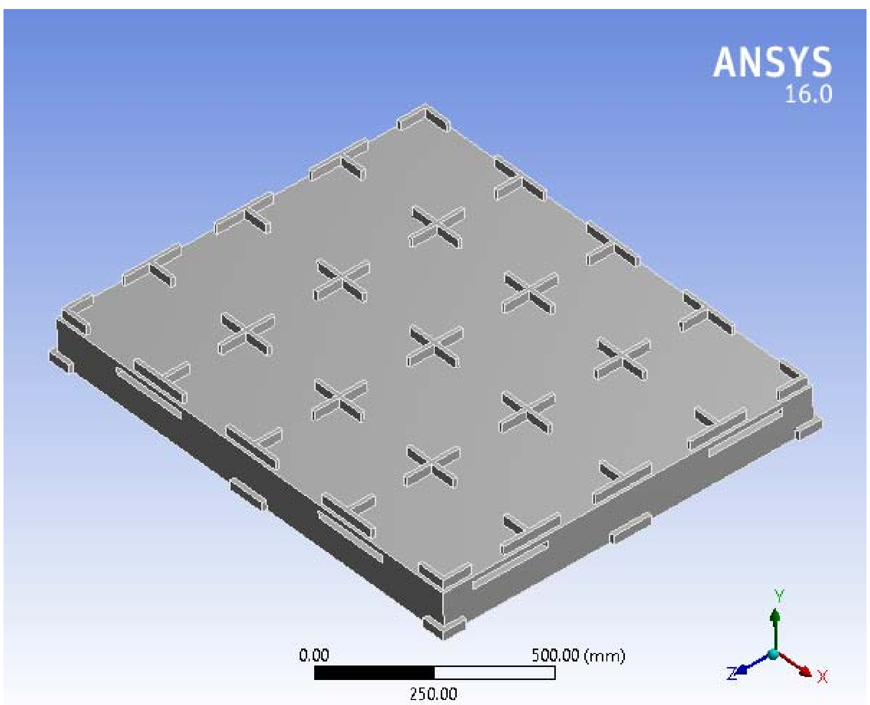
APPENDIX A

FINAL DESIGN SIMULATIONS

Project

First Saved	Saturday, March 24, 2018
Last Saved	Saturday, March 24, 2018
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	1244.6 mm
Length Y	139.7 mm
Length Z	1041.4 mm

Properties	
Volume	5.531e+007 mm³
Mass	8.8491 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	12291
Elements	42354
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\jagad\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	*Base Box Pallet 48x40.SLDPRT new for ansys*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Reference Frame	Lagrangian
Material	
Assignment	Balsa
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	1244.6 mm
Length Y	139.7 mm

Length Z	1041.4 mm
Properties	
Volume	5.531e+007 mm³
Mass	8.8491 kg
Centroid X	-1.0897e-002 mm
Centroid Y	20.981 mm
Centroid Z	6.0372e-003 mm
Moment of Inertia Ip1	7.8358e+005 kg·mm²
Moment of Inertia Ip2	1.9408e+006 kg·mm²
Moment of Inertia Ip3	1.1681e+006 kg·mm²
Statistics	
Nodes	12291
Elements	42354
Mesh Metric	None

Coordinate Systems

TABLE 4
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

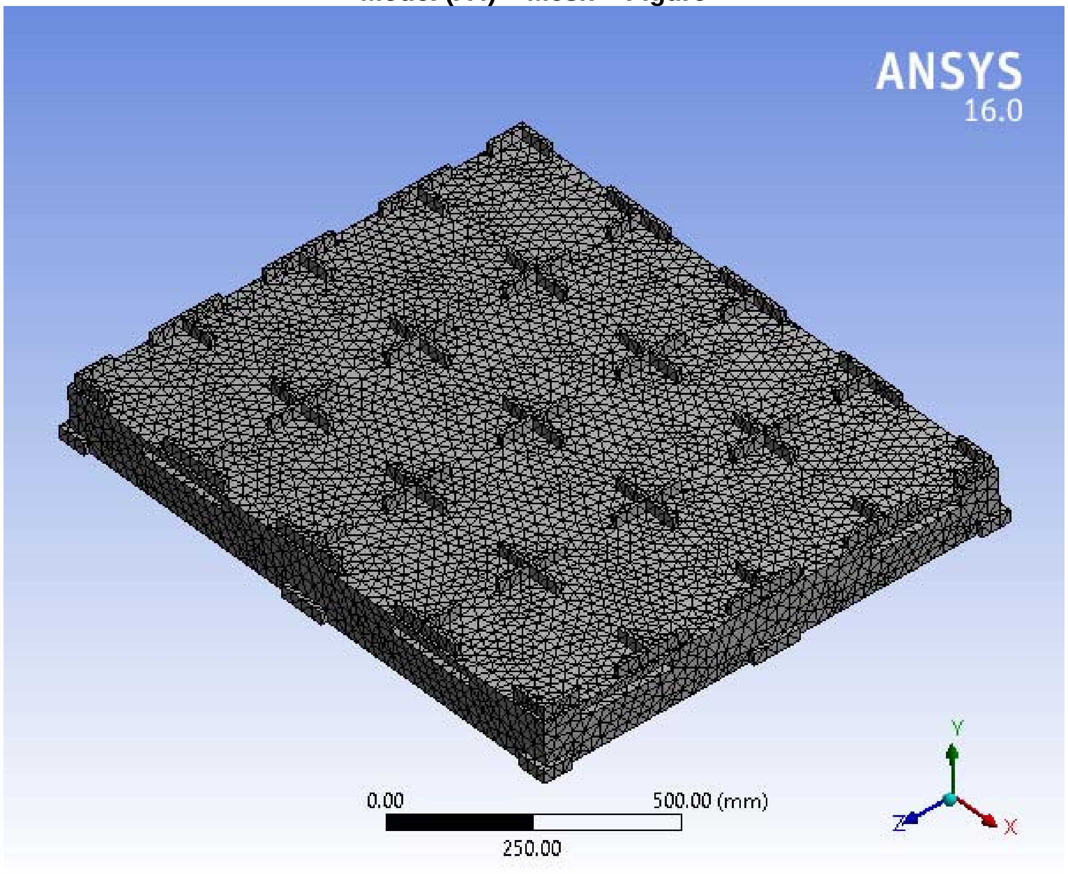
Mesh

TABLE 5
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Explicit
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Medium
Element Size	Default

Initial Size Seed	Active Assembly
Smoothing	High
Transition	Slow
Span Angle Center	Coarse
Minimum Edge Length	10.160 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Explicit
Element Midside Nodes	Dropped
Straight Sided Elements	
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Full Mesh
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	12291
Elements	42354
Mesh Metric	None

FIGURE 1
Model (A4) > Mesh > Figure



Explicit Dynamics (A5)

TABLE 6
Model (A4) > Analysis

Object Name	*Explicit Dynamics (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Explicit Dynamics
Solver Target	AUTODYN
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 7
Model (A4) > Explicit Dynamics (A5) > Initial Conditions

Object Name	*Initial Conditions*
State	Fully Defined

TABLE 8
Model (A4) > Explicit Dynamics (A5) > Initial Conditions > Initial Condition

Object Name	*Pre-Stress (None)*	*Velocity*
State	Fully Defined	
Definition		
Pre-Stress Environment	None	
Pressure Initialization	From Deformed State	
Input Type		Velocity
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. mm/s
Y Component		580. mm/s
Z Component		0. mm/s
Suppressed		No
Scope		
Scoping Method		Geometry Selection
Geometry		1 Body

FIGURE 2
Model (A4) > Explicit Dynamics (A5) > Initial Conditions > Velocity > Figure

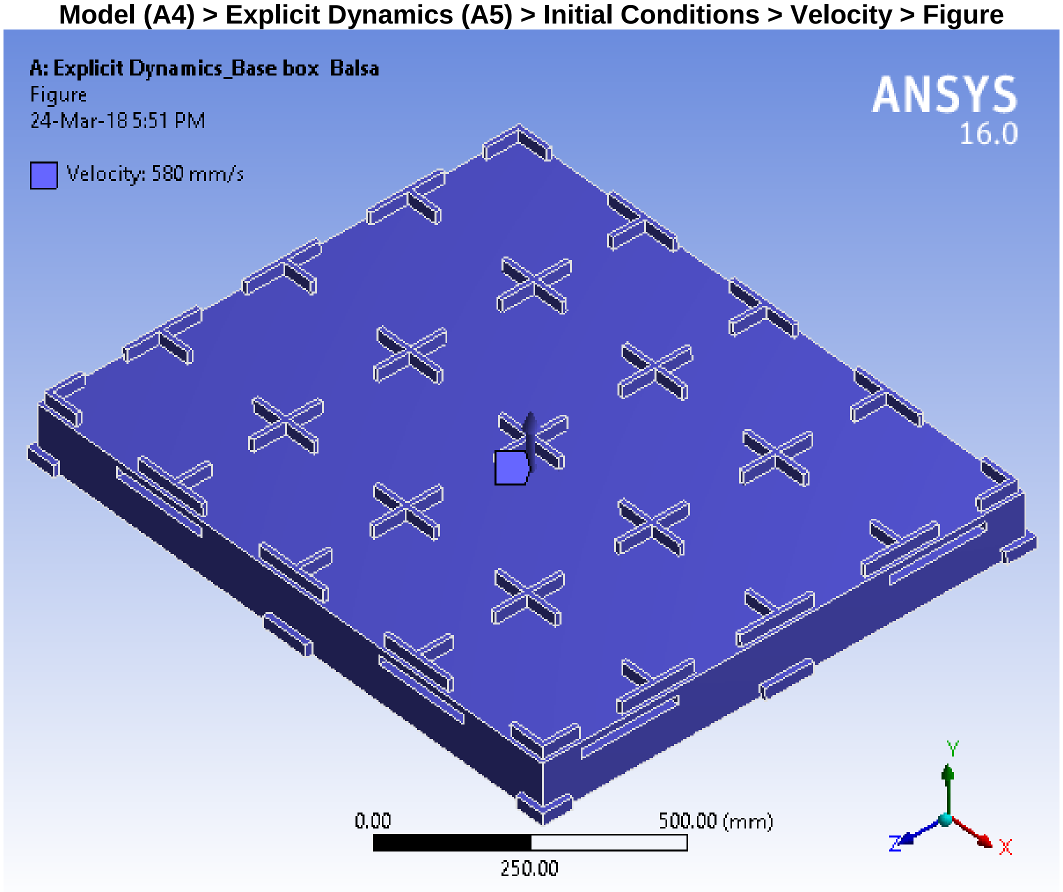


TABLE 9
Model (A4) > Explicit Dynamics (A5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Analysis Settings Preference	
Type	Program Controlled
Step Controls	
Resume From Cycle	0
Maximum Number of Cycles	1e+07
End Time	2.e-004 s
Maximum Energy Error	0.1
Reference Energy Cycle	0
Initial Time Step	Program Controlled
Minimum Time Step	Program Controlled
Maximum Time Step	Program Controlled
Time Step Safety Factor	0.9
Characteristic Dimension	Diagonals
Automatic Mass Scaling	No
Solver Controls	
Solve Units	mm, mg, ms
Beam Solution Type	Bending
Beam Time Step Safety Factor	0.5
Hex Integration Type	Exact
Shell Sublayers	3
Shell Shear Correction Factor	0.8333
Shell BWC Warp Correction	Yes

Shell Thickness Update	Nodal
Tet Integration	Average Nodal Pressure
Shell Inertia Update	Recompute
Density Update	Program Controlled
Minimum Velocity	1.e-003 mm s^-1
Maximum Velocity	1.e+013 mm s^-1
Radius Cutoff	1.e-003
Minimum Strain Rate Cutoff	1.e-010
Euler Domain Controls	
Domain Size Definition	Program Controlled
Display Euler Domain	Yes
Scope	All Bodies
X Scale factor	1.2
Y Scale factor	1.2
Z Scale factor	1.2
Domain Resolution Definition	Total Cells
Total Cells	2.5e+05
Lower X Face	Flow Out
Lower Y Face	Flow Out
Lower Z Face	Flow Out
Upper X Face	Flow Out
Upper Y Face	Flow Out
Upper Z Face	Flow Out
Euler Tracking	By Body
Damping Controls	
Linear Artificial	0.2

Viscosity	
Quadratic Artificial Viscosity	1.
Linear Viscosity in Expansion	No
Artificial Viscosity For Shells	Yes
Hourglass Damping	AUTODYN Standard
Viscous Coefficient	0.1
Static Damping	0.
Erosion Controls	
On Geometric Strain Limit	Yes
Geometric Strain Limit	1.5
On Material Failure	No
On Minimum Element Time Step	No
Retain Inertia of Eroded Material	Yes
Output Controls	
Save Results on	Equally Spaced Points
Result Number Of Points	20
Save Restart Files on	Equally Spaced Points
Restart Number Of Points	5
Save Result Tracker Data on	Cycles
Tracker Cycles	1
Output Contact Forces	Off
Analysis Data Management	

Solver Files Directory	C:\Users\jagad\AppData\Local\Temp\WB_3988_2\unsaved_project_files\dp0\SYS\MECH\
Scratch Solver Files Directory	

TABLE 10
Model (A4) > Explicit Dynamics (A5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. N (step applied)
Y Component		-3.e+006 N (step applied)
Z Component		0. N (step applied)

FIGURE 3
Model (A4) > Explicit Dynamics (A5) > Fixed Support > Figure

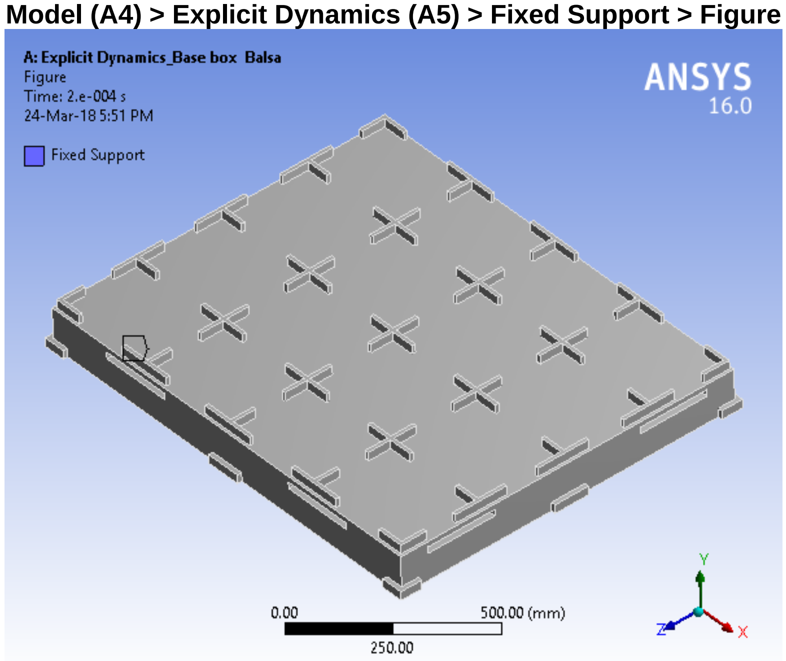


FIGURE 4
Model (A4) > Explicit Dynamics (A5) > Force

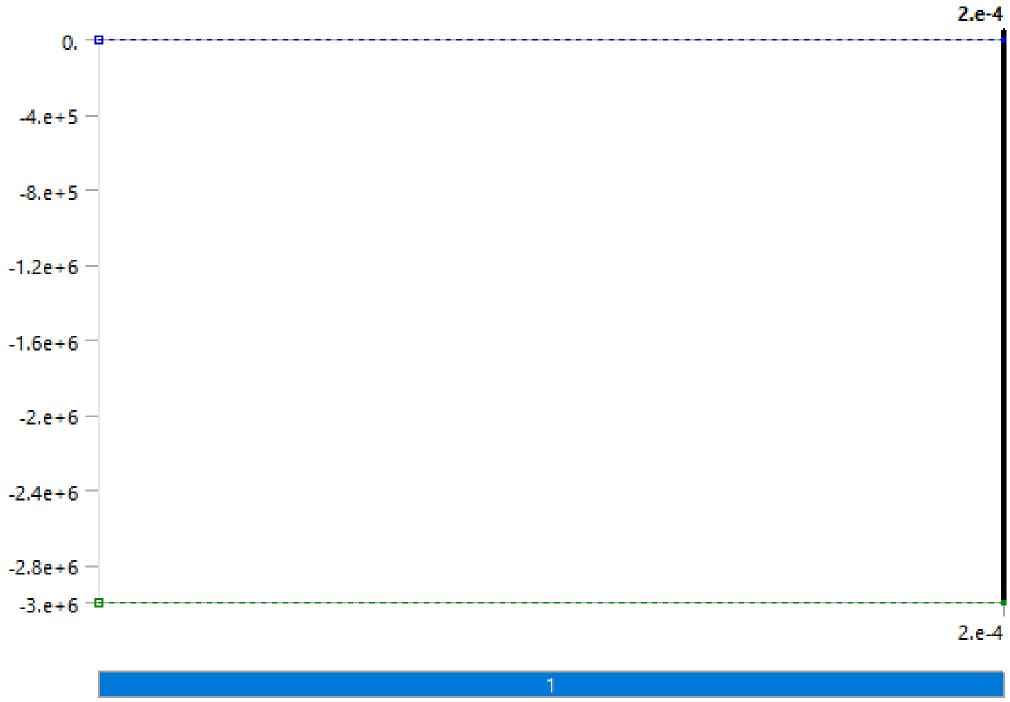
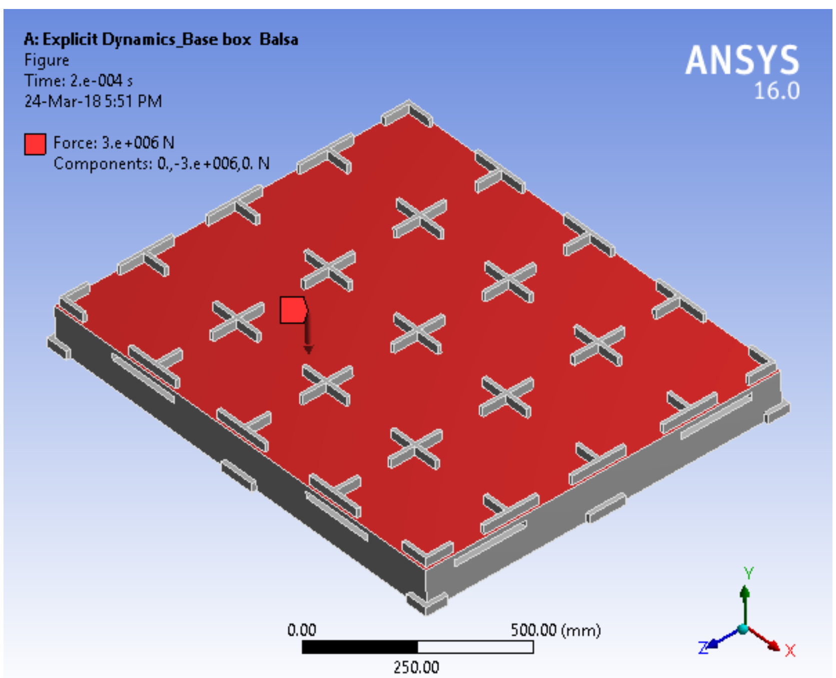


FIGURE 5
Model (A4) > Explicit Dynamics (A5) > Force > Figure



Solution (A6)

TABLE 11
Model (A4) > Explicit Dynamics (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 12
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Update Interval	2.5 s
Display Points	All
Display Filter During Solve	Yes

TABLE 13
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Results

Object Name	*Directional Deformation*	*Equivalent Stress*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Directional Deformation	Equivalent (von-Mises) Stress	Equivalent Elastic Strain
Orientation	Y Axis		
By	Time		
Display Time	Last		
Coordinate System	Global Coordinate System		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	-6.5936 mm	0.22873 MPa	6.0599e-004 mm/mm
Maximum	0.38456 mm	23.368 MPa	3.8021e-002 mm/mm
Minimum Value Over Time			
Minimum	-6.5936 mm	0. MPa	0. mm/mm
Maximum	0. mm	0.27059 MPa	6.6365e-004 mm/mm

Maximum Value Over Time			
Minimum	0. mm	0. MPa	0. mm/mm
Maximum	0.38456 mm	23.368 MPa	3.8021e-002 mm/mm
Information			
Time	2.0007e-004 s		
Set	21		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

FIGURE 6
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Directional Deformation

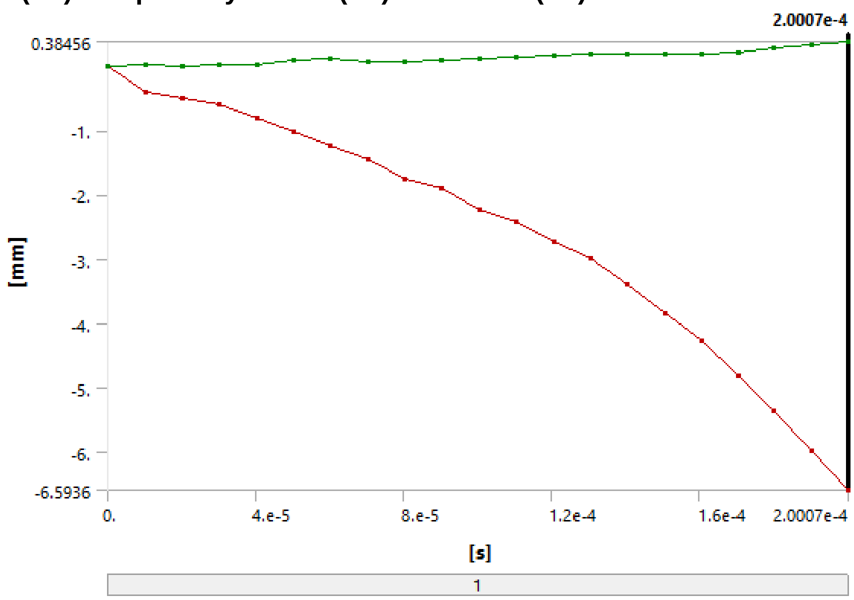


TABLE 14
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Directional Deformation

Time [s]	Minimum [mm]	Maximum [mm]
1.1755e-038	0.	0.
1.0151e-005	-0.40014	2.169e-002
2.0174e-005	-0.48306	1.2903e-002
3.0197e-005	-0.60021	2.7665e-002
4.022e-005	-0.79723	2.7775e-002
5.0244e-005	-1.0107	0.10184
6.027e-005	-1.234	0.13097
7.0299e-005	-1.4448	7.9359e-002
8.0329e-005	-1.7484	7.7967e-002
9.0359e-005	-1.8864	0.10072
1.0039e-004	-2.2196	0.13069
1.1041e-004	-2.4075	0.15803
1.2044e-004	-2.7198	0.18105
1.3046e-004	-2.9838	0.18887

1.4049e-004	-3.3792	0.18972
1.5051e-004	-3.8296	0.19881
1.6054e-004	-4.2745	0.20567
1.7057e-004	-4.8068	0.22791
1.8001e-004	-5.3633	0.27894
1.9004e-004	-5.9859	0.33249
2.0007e-004	-6.5936	0.38456

FIGURE 7
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Directional Deformation > Figure

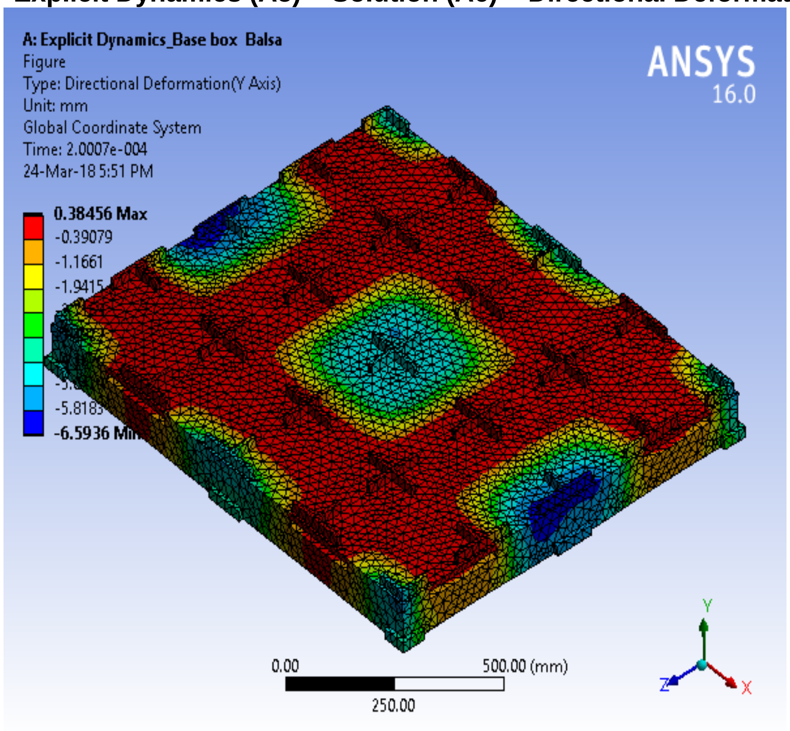


FIGURE 8
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Equivalent Stress

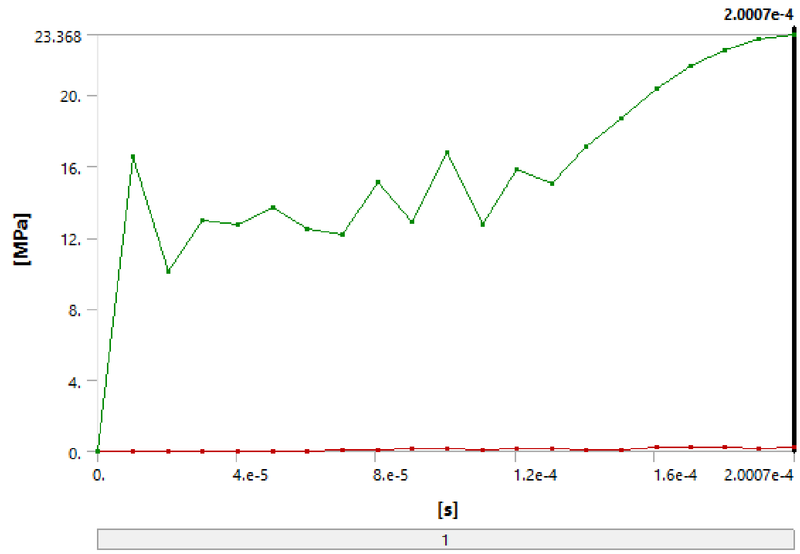


TABLE 15
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]
1.1755e-038	0.	0.
1.0151e-005		16.496
2.0174e-005	5.9823e-007	10.099
3.0197e-005	5.0874e-005	12.963
4.022e-005	8.3957e-004	12.713
5.0244e-005	5.7447e-003	13.665
6.027e-005	2.4108e-002	12.468
7.0299e-005	6.698e-002	12.163
8.0329e-005	4.4046e-002	15.123
9.0359e-005	0.15608	12.881
1.0039e-004	0.15143	16.741
1.1041e-004	5.9742e-002	12.71
1.2044e-004	0.16402	15.814
1.3046e-004	0.18231	15.016
1.4049e-004	7.0273e-002	17.05
1.5051e-004	0.11912	18.659
1.6054e-004	0.2375	20.332
1.7057e-004	0.27059	21.653
1.8001e-004	0.25279	22.498
1.9004e-004	0.15477	23.095
2.0007e-004	0.22873	23.368

FIGURE 9
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Equivalent Stress > Figure

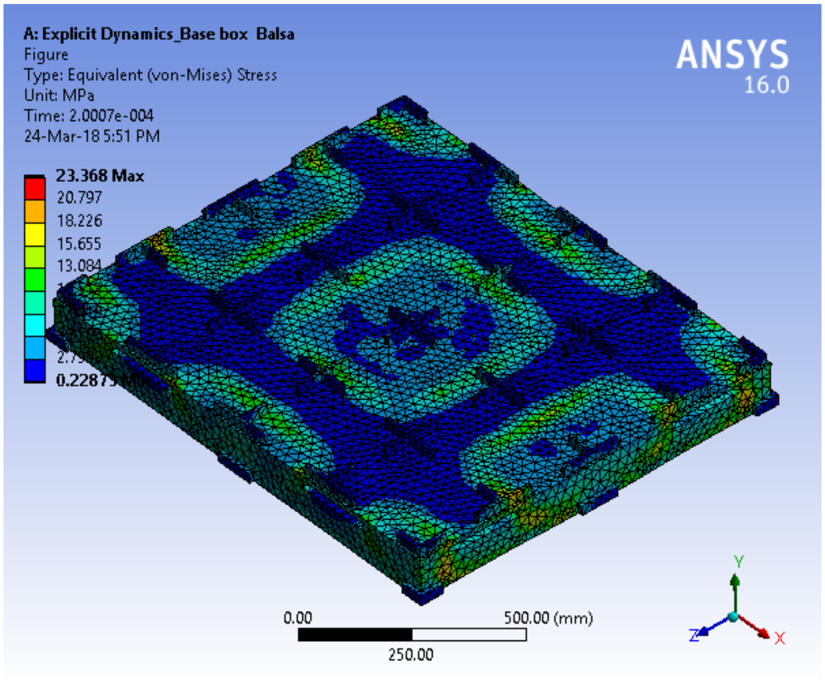


FIGURE 10
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Equivalent Elastic Strain

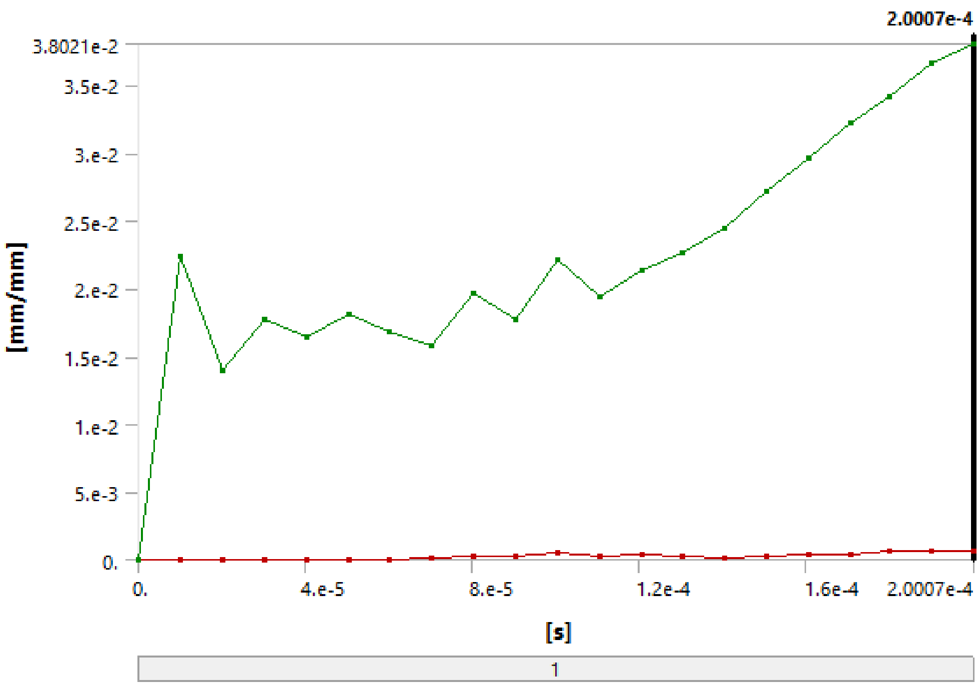


TABLE 16
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]
1.1755e-038	0.	0.
1.0151e-005		2.2323e-002
2.0174e-005	1.329e-009	1.392e-002
3.0197e-005	8.3705e-008	1.7677e-002
4.022e-005	1.1336e-006	1.6469e-002
5.0244e-005	7.6119e-006	1.8065e-002
6.027e-005	3.1548e-005	1.6825e-002
7.0299e-005	9.1904e-005	1.5749e-002
8.0329e-005	1.9975e-004	1.9686e-002
9.0359e-005	3.1011e-004	1.7754e-002
1.0039e-004	4.62e-004	2.208e-002
1.1041e-004	2.6978e-004	1.9447e-002
1.2044e-004	4.2597e-004	2.1369e-002
1.3046e-004	2.6407e-004	2.2688e-002
1.4049e-004	1.9237e-004	2.4452e-002
1.5051e-004	2.351e-004	2.7146e-002
1.6054e-004	4.2328e-004	2.9609e-002
1.7057e-004	4.2777e-004	3.2201e-002
1.8001e-004	6.6365e-004	3.4153e-002
1.9004e-004	6.015e-004	3.6562e-002
2.0007e-004	6.0599e-004	3.8021e-002

FIGURE 11
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Equivalent Elastic Strain > Figure

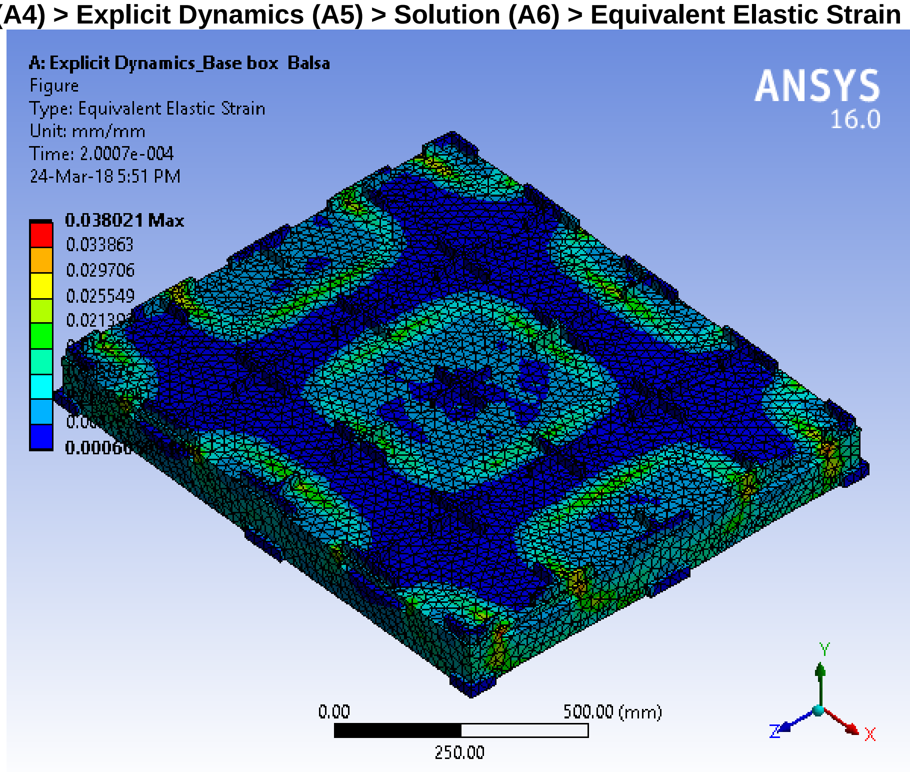


TABLE 17
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Tensile Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 18
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Stress Tool > Results

Object Name	*Safety Factor*	*Stress Ratio*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Safety Factor	Stress Ratio
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Integration Point Results		
Display Option	Averaged	
Average Across Bodies	No	
Results		
Minimum	1.0403	0.
Maximum		0.96126
Minimum Value Over Time		
Minimum	1.0403	0.
Maximum	15.	0.
Maximum Value Over Time		
Minimum	15.	0.
Maximum	15.	0.96126
Information		
Time	2.0007e-004 s	
Set	21	

FIGURE 12
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Stress Tool > Safety Factor

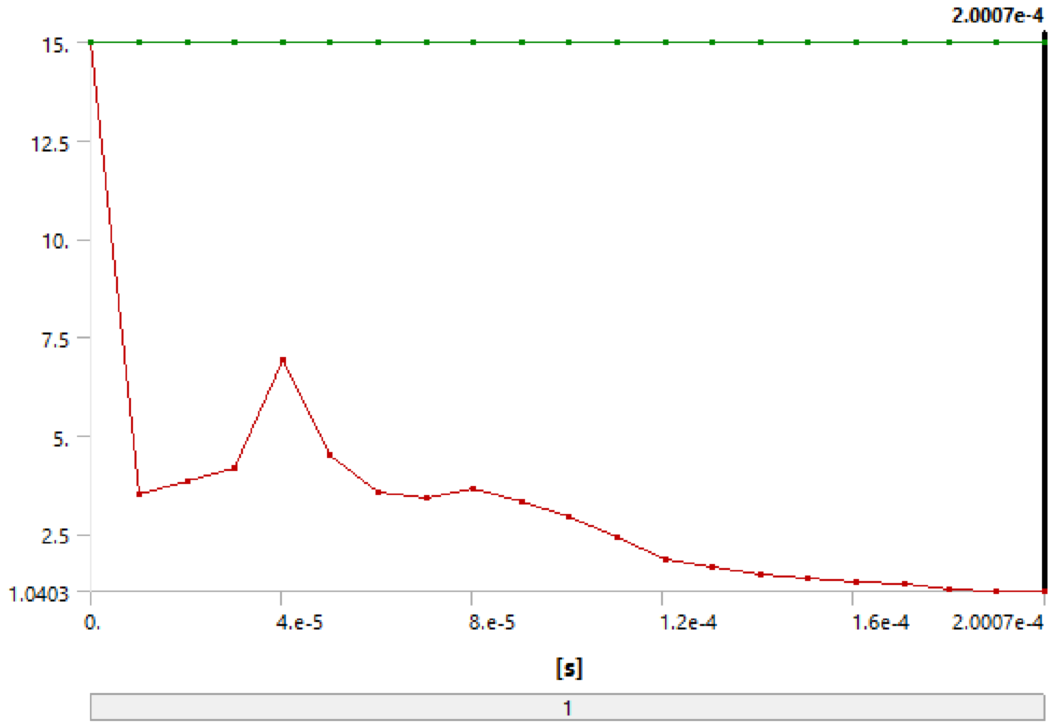


TABLE 19
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.1755e-038	15.	15.
1.0151e-005	3.5067	
2.0174e-005	3.8501	
3.0197e-005	4.1615	
4.022e-005	6.9165	
5.0244e-005	4.5122	
6.027e-005	3.5351	
7.0299e-005	3.4161	
8.0329e-005	3.6506	
9.0359e-005	3.3044	
1.0039e-004	2.9467	
1.1041e-004	2.3956	
1.2044e-004	1.8387	
1.3046e-004	1.6591	
1.4049e-004	1.4879	
1.5051e-004	1.3904	
1.6054e-004	1.3007	
1.7057e-004	1.2356	
1.8001e-004	1.0827	
1.9004e-004	1.06	
2.0007e-004	1.0403	

FIGURE 13
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Stress Tool > Safety Factor > Figure

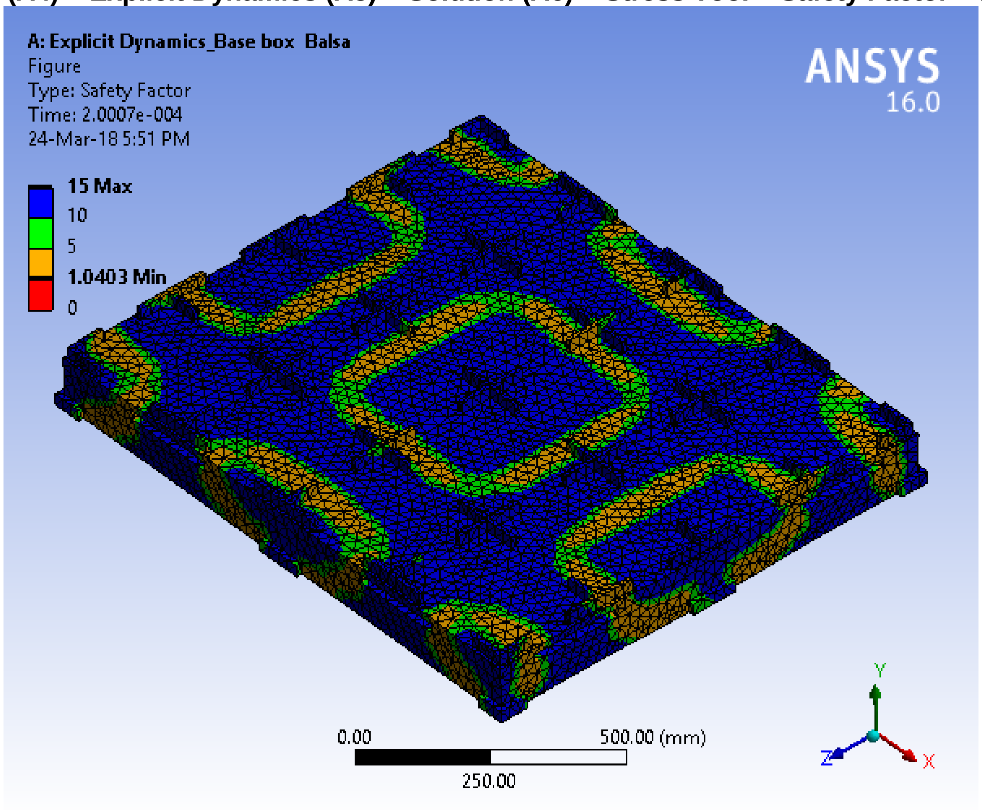


FIGURE 14
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Stress Tool > Stress Ratio

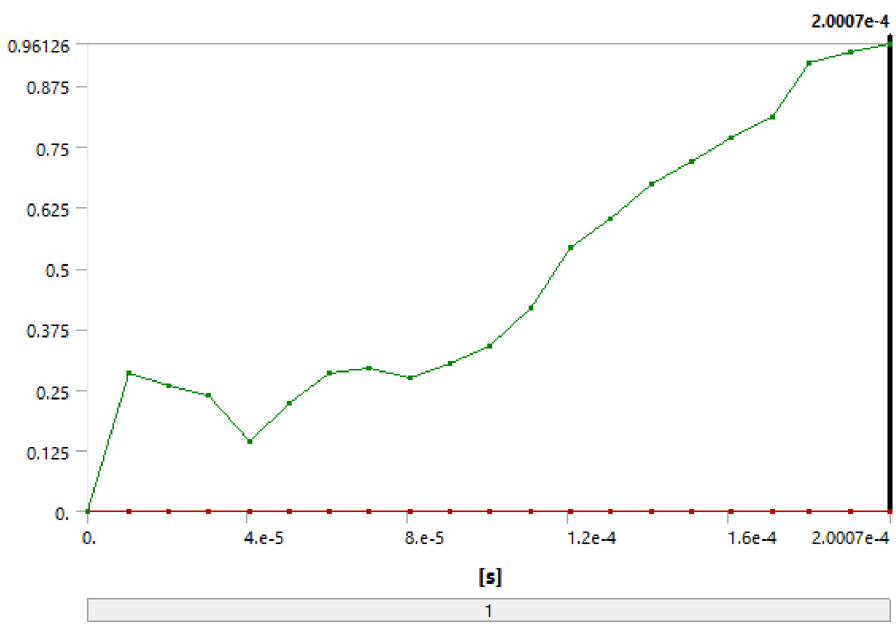
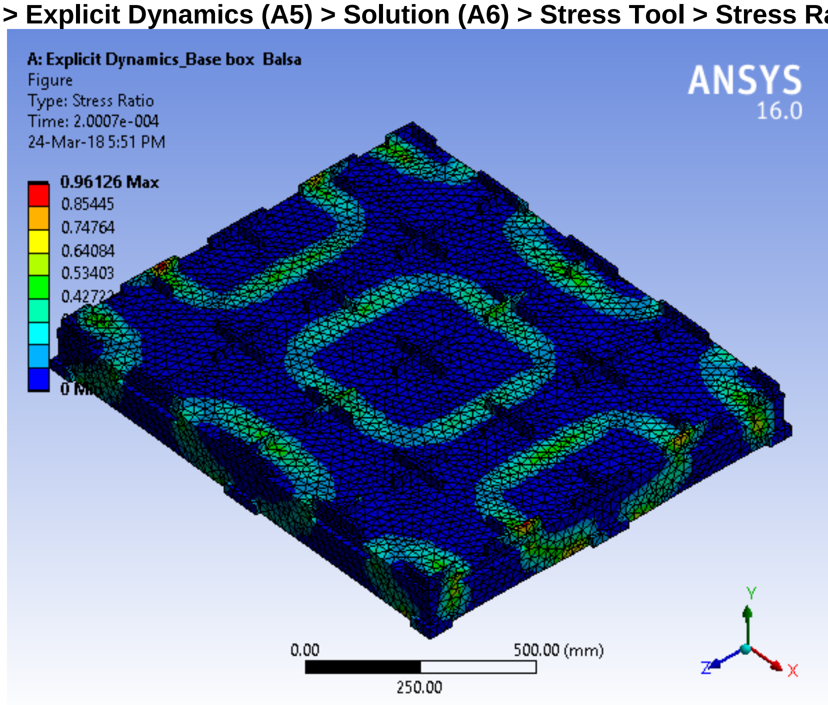


TABLE 20
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Stress Tool > Stress Ratio

Time [s]	Minimum	Maximum
1.1755e-038		0.
1.0151e-005		0.28517
2.0174e-005		0.25973
3.0197e-005		0.2403
4.022e-005		0.14458
5.0244e-005		0.22162
6.027e-005		0.28288
7.0299e-005		0.29273
8.0329e-005		0.27393
9.0359e-005		0.30262
1.0039e-004	0.	0.33937
1.1041e-004		0.41743
1.2044e-004		0.54387
1.3046e-004		0.60273
1.4049e-004		0.67207
1.5051e-004		0.7192
1.6054e-004		0.76882
1.7057e-004		0.8093
1.8001e-004		0.92362
1.9004e-004		0.94342
2.0007e-004		0.96126

FIGURE 15
Model (A4) > Explicit Dynamics (A5) > Solution (A6) > Stress Tool > Stress Ratio > Figure



Material Data

Balsa

TABLE 21
Balsa > Constants

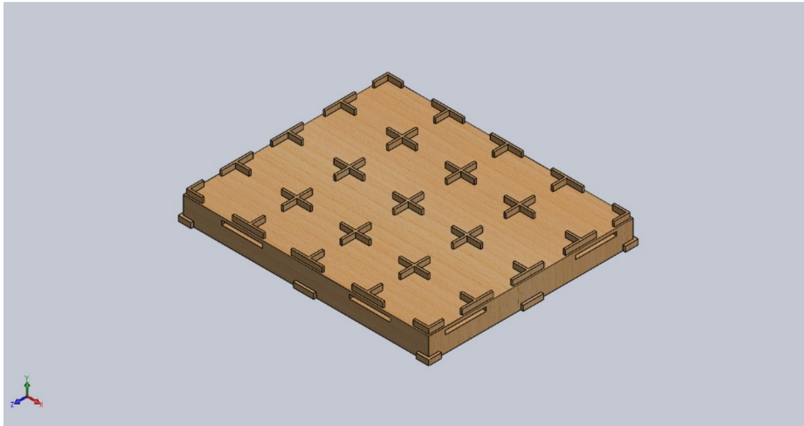
Density	1.5999e-007 kg mm^-3
Thermal Conductivity	5.e-005 W mm^-1 C^-1

TABLE 22
Balsa > Isotropic Elasticity

Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	774	0.29	614.29	300

TABLE 23
Balsa > Tensile Yield Strength

Tensile Yield Strength MPa
20

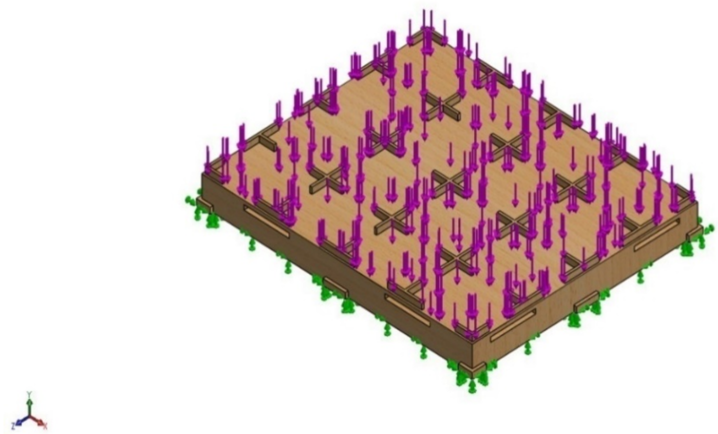


Simulation of Base Box Pallet 48x40

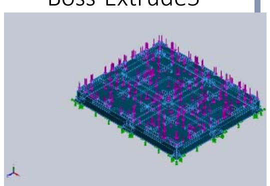
Date: Monday, March 26, 2018
Designer: Solidworks
Study name: Static 3
Analysis type: Static

Table of Contents

Model Information



Model name: Base Box Pallet 48x40
Current Configuration: Default

Solid Bodies			
Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Boss-Extrude5 	Solid Body	Mass:8.84909 kg Volume:0.0553103 m^3 Density:159.99 kg/m^3 Weight:86.721 N	C:\Users\Public\Documents\Base Box Pallet 48x40.SLDPRT Mar 26 15:44:18 2018

Study Properties

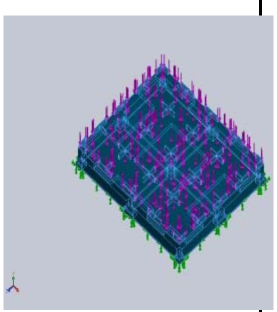
Study name	Static 3
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	FFEPlus

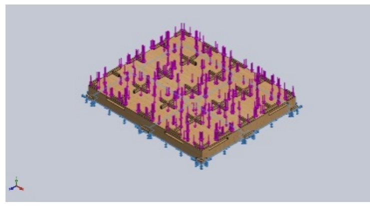
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off
Result folder	SOLIDWORKS document (C:\Users\Public\Documents)

Units

Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m^2

Material Properties

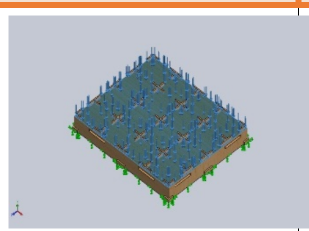
Model Reference	Properties	Components
	Name: **Balsa** Model type: **Linear Elastic Isotropic** Default failure criterion: **Unknown** Yield strength: **2e+007 N/m^2** Elastic modulus: **3e+009 N/m^2** Poisson's ratio: **0.29** Mass density: **159.99 kg/m^3** Shear modulus: **3e+008 N/m^2**	**SolidBody 1(Boss-Extrude5)(Base Box Pallet 48x40)**
Curve Data: N/A		

Fixture name	Fixture Image	Fixture Details
Fixed-1		**Entities:** **1 face(s)** **Type:** **Fixed Geometry**

Resultant Forces

Components	X	Y	Z	Resultant
Reaction force(N)	0.0630116	133447	0.0876665	133447
Reaction Moment(N.m)	0	0	0	0

Loads and Fixtures

Load name	Load Image	Load Details
Force-1		**Entities:** **1 face(s)** **Type:** **Apply normal force** **Value:** **30000 lbf**

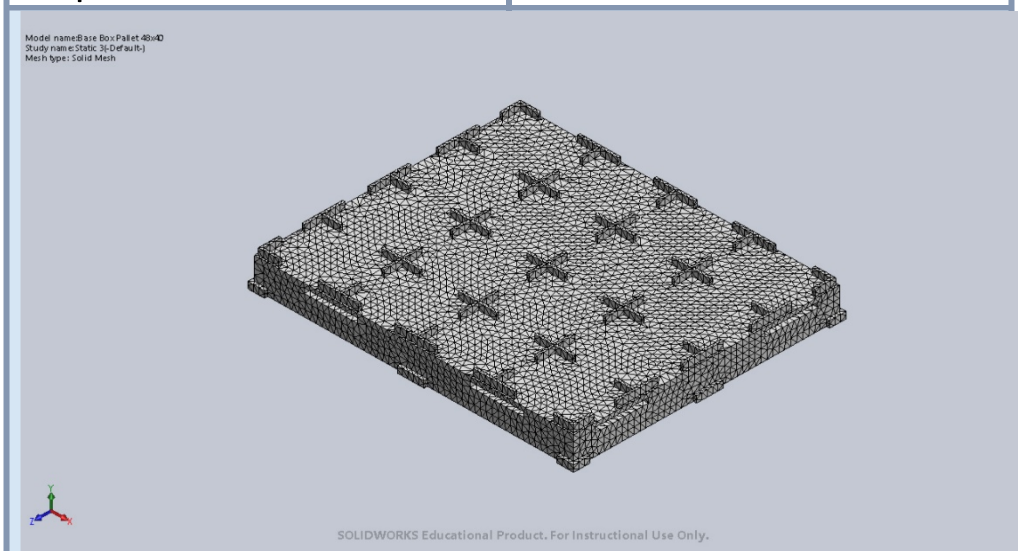
Mesh information

Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off

Jacobian points	4 Points
Element Size	0.920847 in
Tolerance	0.0460424 in
Mesh Quality Plot	High

Mesh information - Details

Total Nodes	79335
Total Elements	42659
Maximum Aspect Ratio	7.6609
% of elements with Aspect Ratio < 3	91.5
% of elements with Aspect Ratio > 10	0
% of distorted elements(Jacobian)	0
Time to complete mesh(hh;mm;ss):	00:00:09
Computer name:	MSL-REF-70



Resultant Forces

Reaction forces

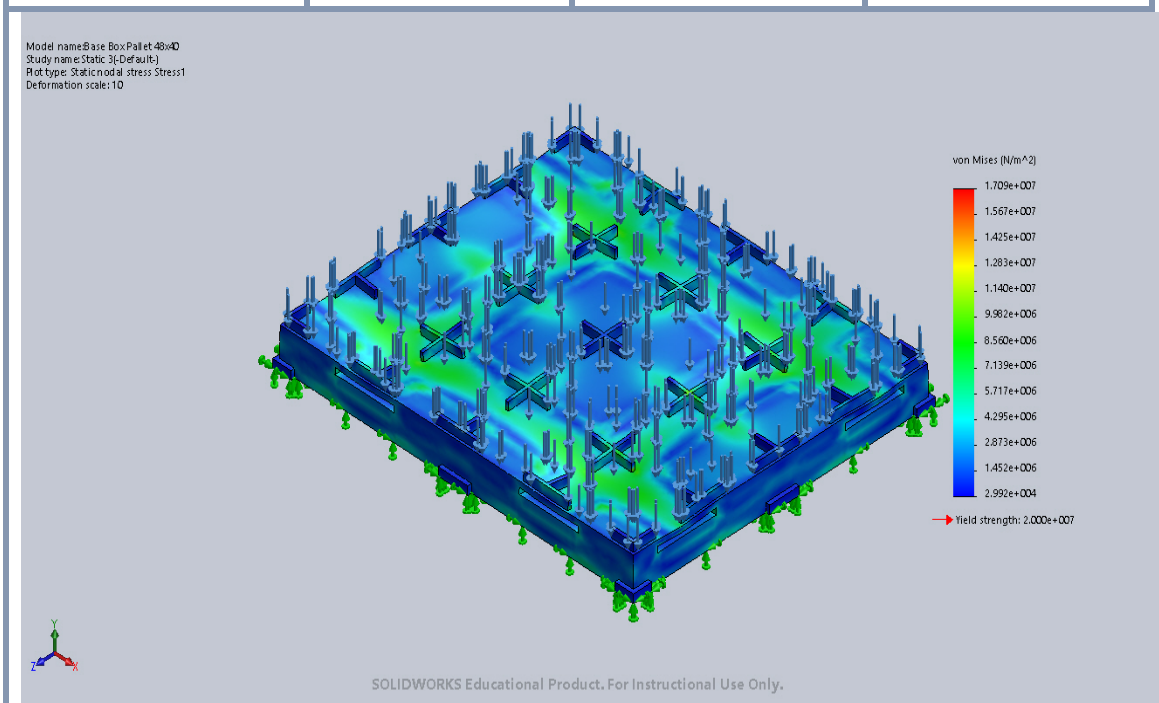
Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	0.0630116	133447	0.0876665	133447

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

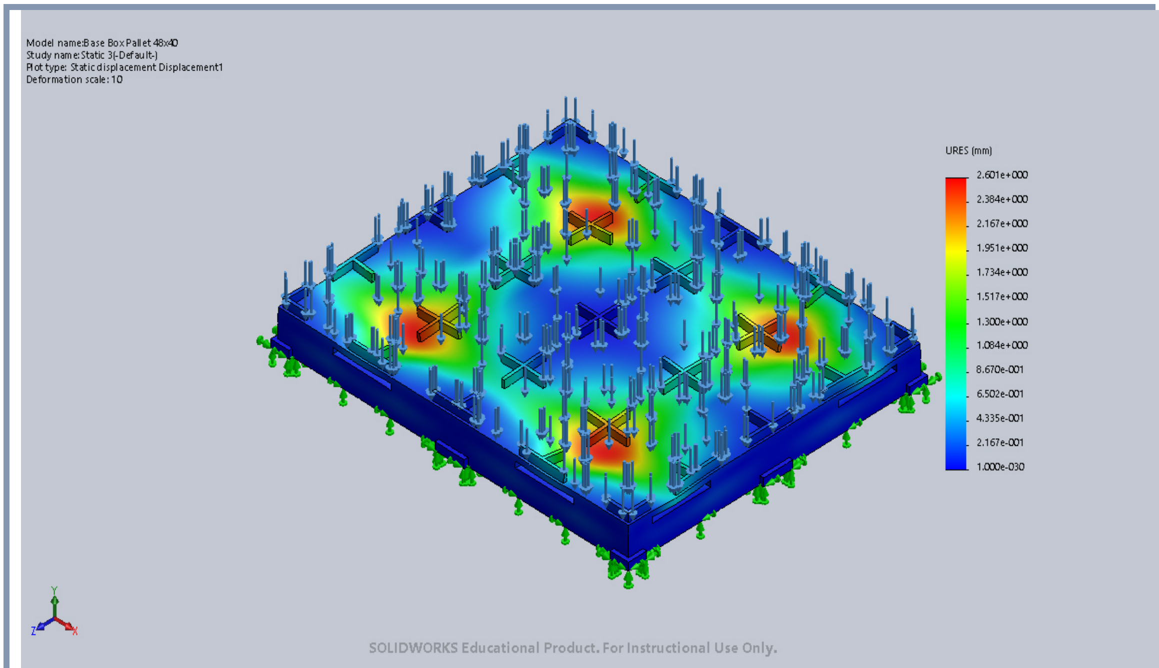
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	2.992e+004N/m^2 Node: 7171	1.709e+007N/m^2 Node: 58702



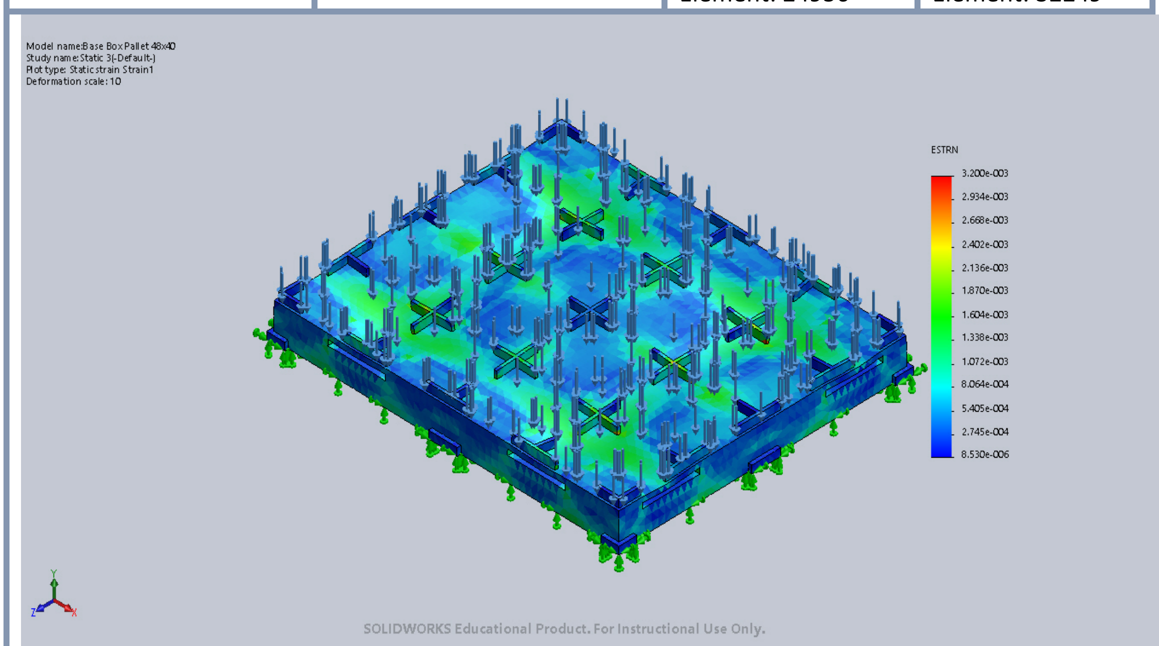
Base Box Pallet 48x40-Static 3-Stress-Stress1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+000mm Node: 1834	2.601e+000mm Node: 41263



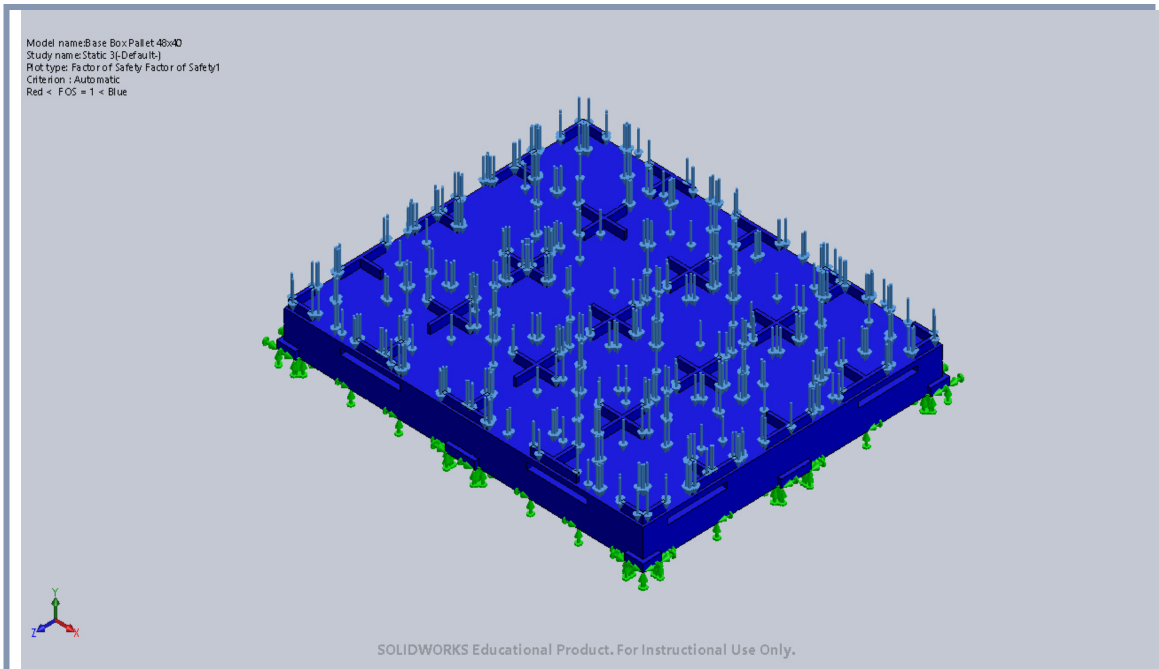
Base Box Pallet 48x40-Static 3-Displacement-Displacement1

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	8.530e-006 Element: 24956	3.200e-003 Element: 32249

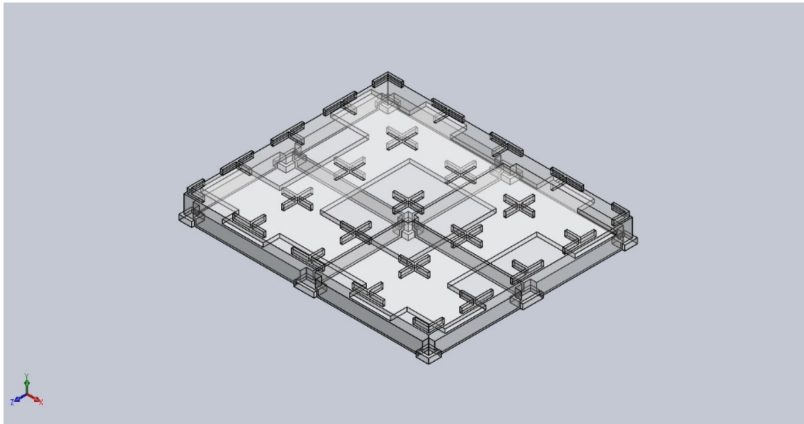


Base Box Pallet 48x40-Static 3-Strain-Strain1

Name	Type	Min	Max
Factor of Safety1	Automatic	1.170e+000 Node: 58702	6.685e+002 Node: 7171



Base Box Pallet 48x40-Static 3-Factor of Safety-Factor of Safety1



Simulation of Base Box Pallet 48x40

Date: Thursday, March 15, 2018
Designer: Solidworks
Study name: Static 1
Analysis type: Static

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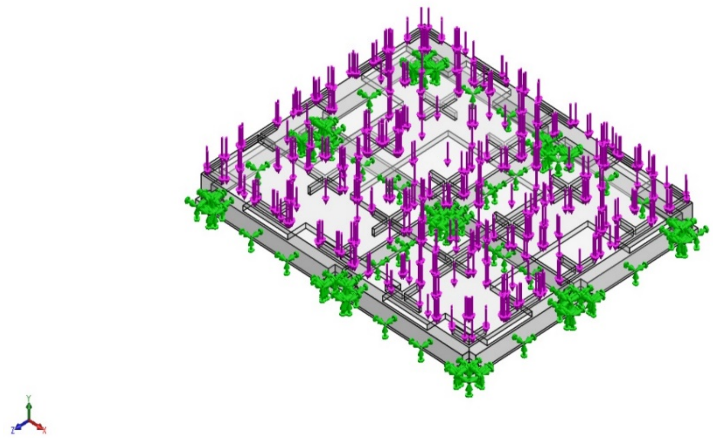
Model Information



Model name: Base Box Pallet 48x40
Current Configuration: Default

Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Boss-Extrude5 	Solid Body	Mass:66.3723 kg Volume:0.0553103 m^3 Density:1200 kg/m^3 Weight:650.449 N	C:\Users\2690526\Documents\Base Box Pallet 48x40.SLDPRT Mar 15 14:42:16 2018

Study Properties

Study name	Static 1
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	FFEPlus
Inplane Effect:	Off

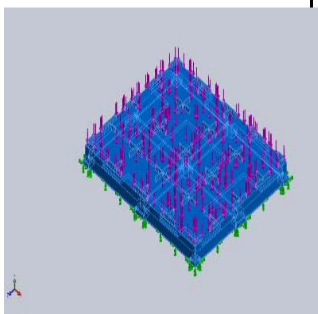
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off
Result folder	SOLIDWORKS document (C:\Users\2690526\Documents)

Units

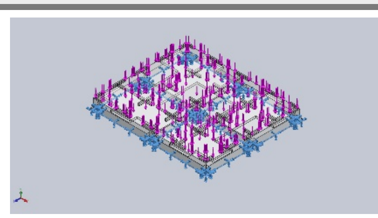
Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m^2

Model Reference	Properties	Components

Material Properties

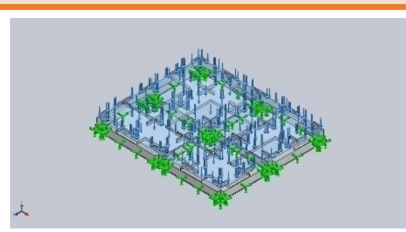
	Name: **Acrylic (Medium-high impact)** Model type: **Linear Elastic Isotropic** Default failure criterion: **Max von Mises Stress** Yield strength: **4.5e+007 N/m^2** Tensile strength: **7.3e+007 N/m^2** Elastic modulus: **3e+009 N/m^2** Poisson's ratio: **0.35** Mass density: **1200 kg/m^3** Shear modulus: **8.9e+008 N/m^2** Thermal expansion coefficient: **5.2e-005 /Kelvin**	**SolidBody 1(Boss-Extrude5)(Base Box Pallet 48x40)**
Curve Data: N/A		

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details
Fixed-1		**Entities:** 1 face(s) **Type:** Fixed Geometry

Resultant Forces

Components	X	Y	Z	Resultant
Reaction force(N)	**0.188259**	**333618**	**0.09412**	**333618**
Reaction Moment(N.m)	**0**	**0**	**0**	**0**

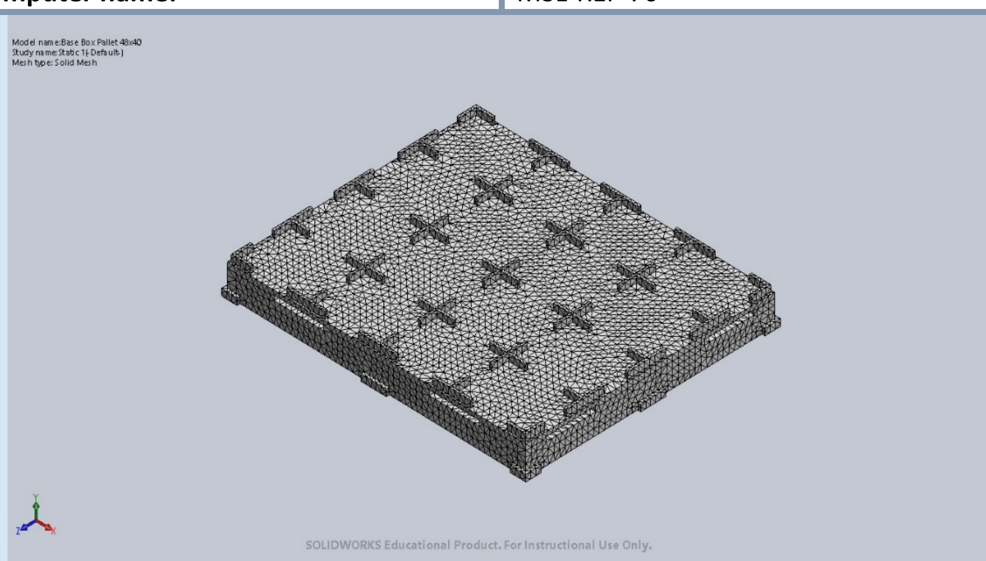
Load name	Load Image	Load Details
Force-1		**Entities:** 1 face(s) **Type:** Apply normal force **Value:** 75000 lbf

Mesh information

Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off
Jacobian points	4 Points
Element Size	0.920847 in
Tolerance	0.0460424 in
Mesh Quality Plot	High

Mesh information - Details

Total Nodes	79335
Total Elements	42659
Maximum Aspect Ratio	7.6609
% of elements with Aspect Ratio < 3	91.5
% of elements with Aspect Ratio > 10	0
% of distorted elements(Jacobian)	0
Time to complete mesh(hh;mm;ss):	00:00:10
Computer name:	MSL-REF-70



Resultant Forces

Reaction forces

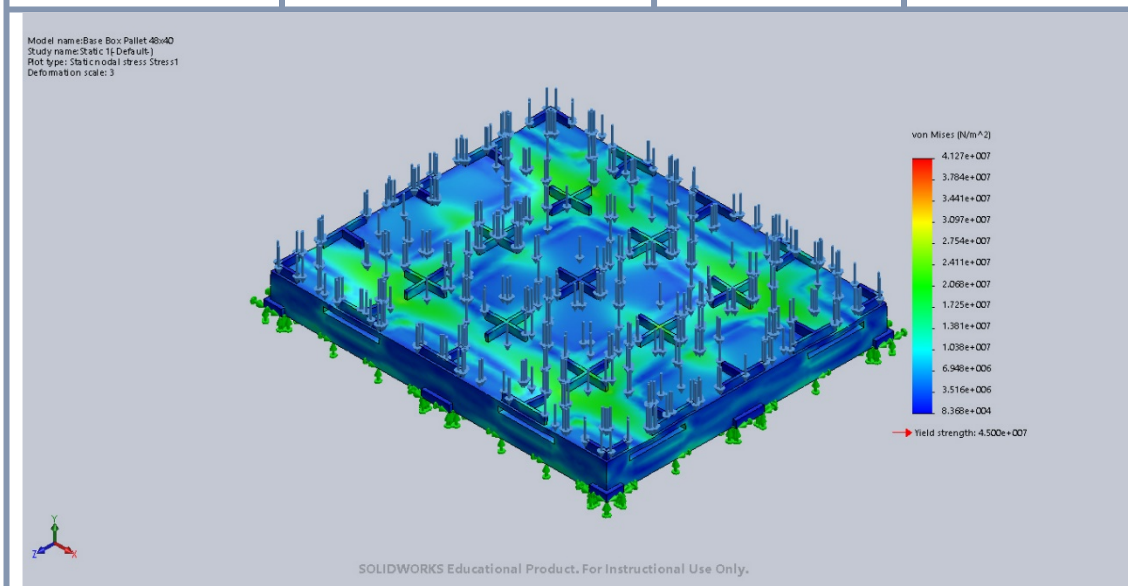
Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	0.188259	333618	0.09412	333618

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

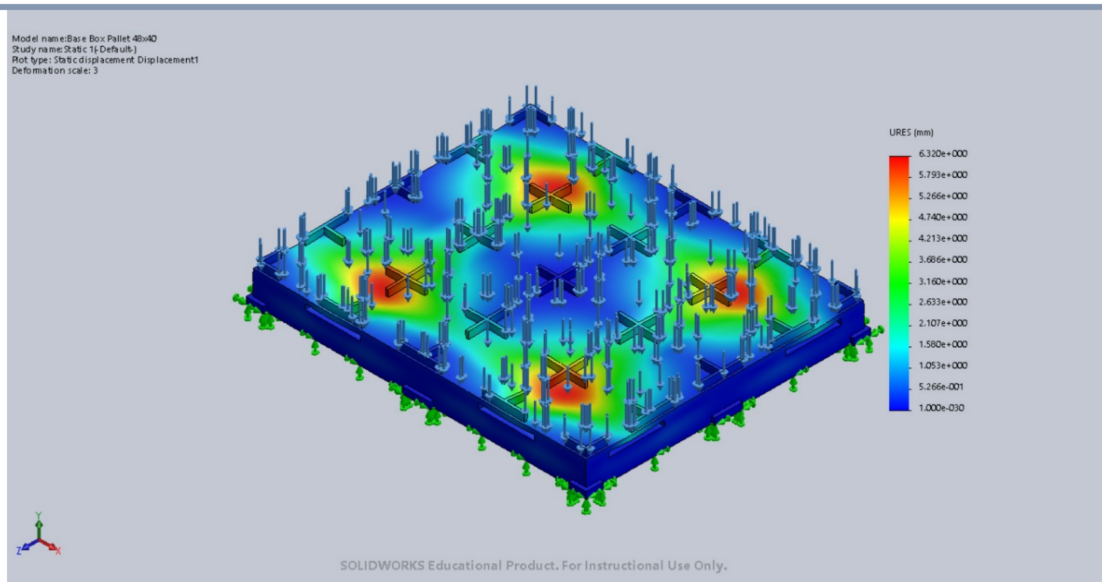
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	8.368e+004N/m^2 Node: 7171	4.127e+007N/m^2 Node: 58702



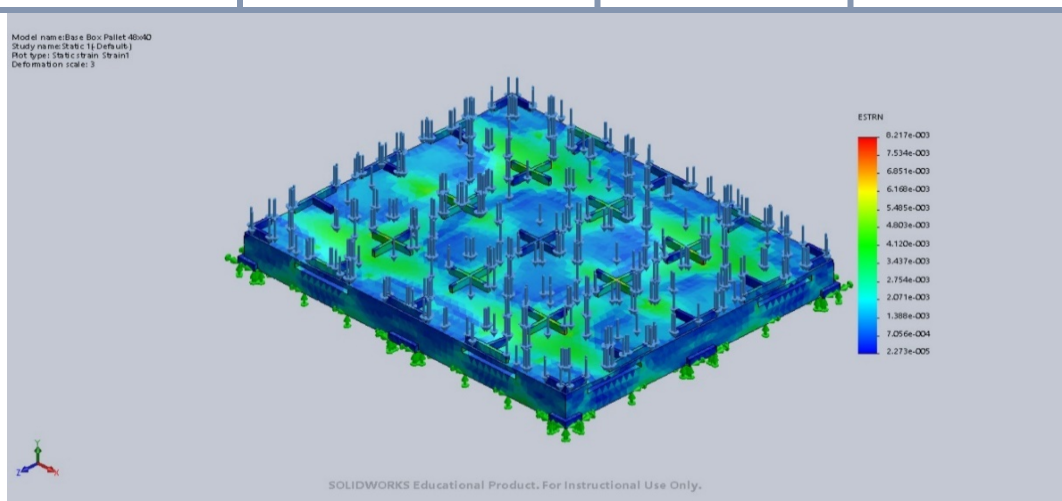
Base Box Pallet 48x40-Static 1-Stress-Stress1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+000mm Node: 1834	6.320e+000mm Node: 47057



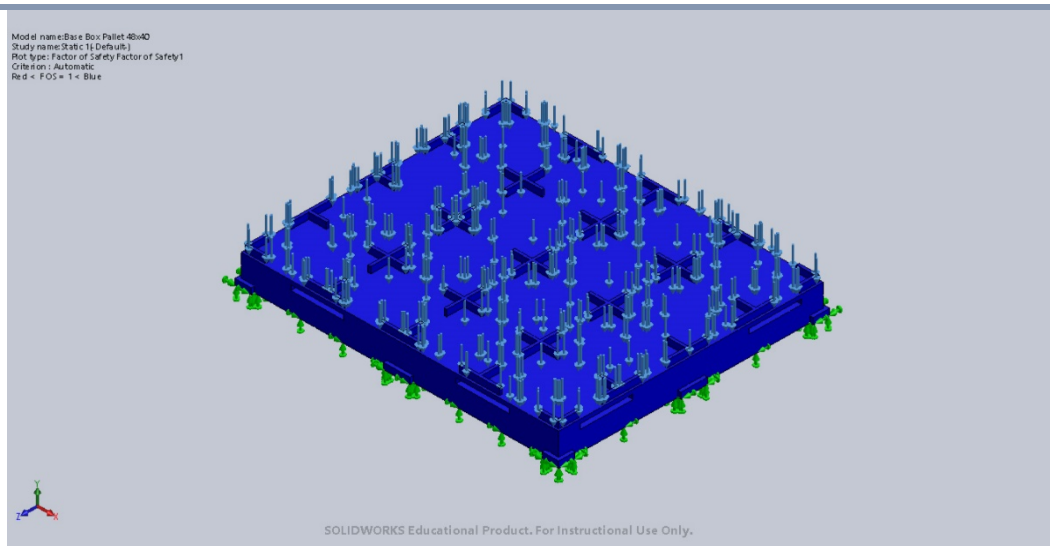
Base Box Pallet 48x40-Static 1-Displacement-Displacement1

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	2.273e-005 Element: 24956	8.217e-003 Element: 32249

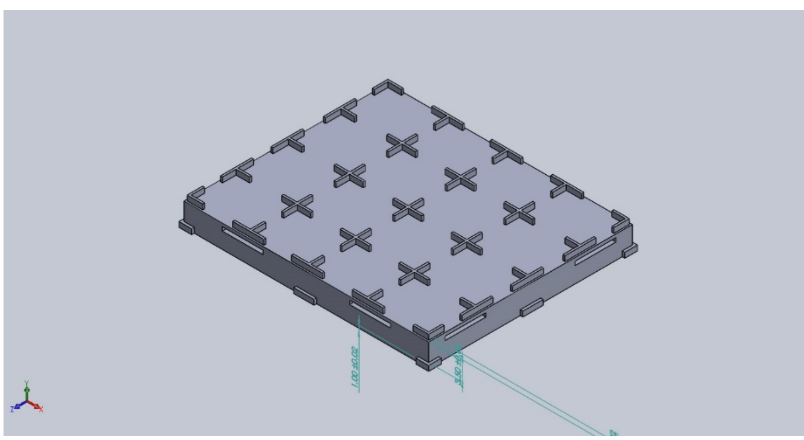


Base Box Pallet 48x40-Static 1-Strain-Strain1

Name	Type	Min	Max
Factor of Safety1	Automatic	1.090e+000 Node: 58702	5.378e+002 Node: 7171



Base Box Pallet 48x40-Static 1-Factor of Safety-Factor of Safety1

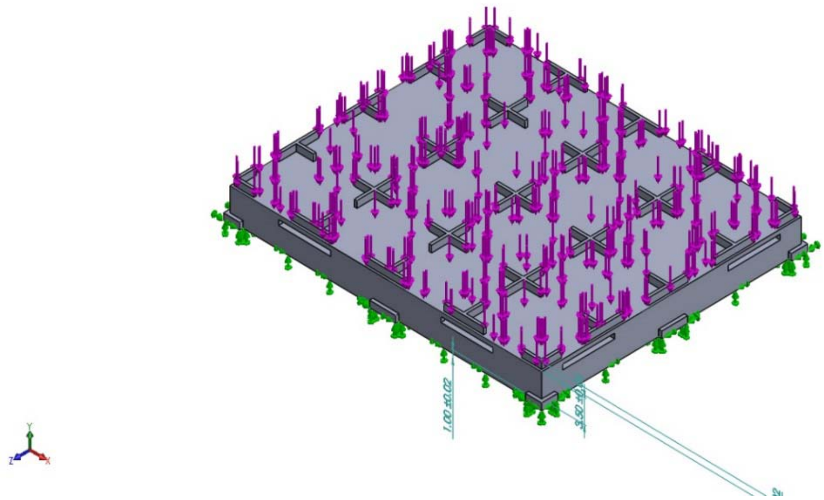


Simulation of Base Box Pallet 48x40

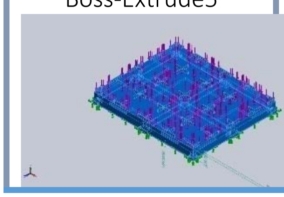
Date: Friday, March 16, 2018
Designer: Solidworks
Study name: Static 2
Analysis type: Static

Table of Contents

Model Information



Model name: Base Box Pallet 48x40
Current Configuration: Default

Solid Bodies			
Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Boss-Extrude5 	Solid Body	Mass:50.0558 kg Volume:0.0553103 m^3 Density:905 kg/m^3 Weight:490.547 N	C:\Users\2690526\Documents\Base Box Pallet 48x40.SLDPRT Mar 16 08:28:14 2018

Study Properties

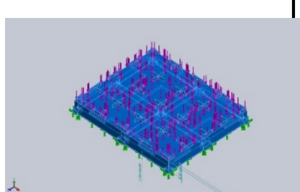
Study name	Static 2
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin

Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	FFEPlus
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off
Result folder	SOLIDWORKS document (C:\Users\2690526\Documents)

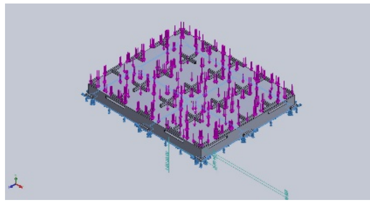
Units

Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m^2

Material Properties

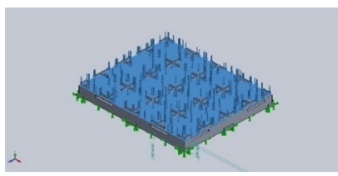
Model Reference	Properties	Components
	Name: **Very Low Density PE (SS)** Model type: **Linear Elastic Isotropic** Default failure criterion: **Max von Mises Stress** Yield strength: **6.89476e+006 N/m^2** Tensile strength: **3.4e+007 N/m^2** Elastic modulus: **1.72369e+008 N/m^2** Poisson's ratio: **0.3** Mass density: **905 kg/m^3**	**SolidBody 1(Boss-Extrude5)(Base Box Pallet 48x40)**
Curve Data:N/A		

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details
Fixed-1		**Entities:** **1 face(s)** **Type:** **Fixed Geometry**

Resultant Forces

Components	X	Y	Z	Resultant
Reaction force(N)	**0.0182878**	**55000.3**	**0.0227728**	**55000.3**
Reaction Moment(N.m)	**0**	**0**	**0**	**0**

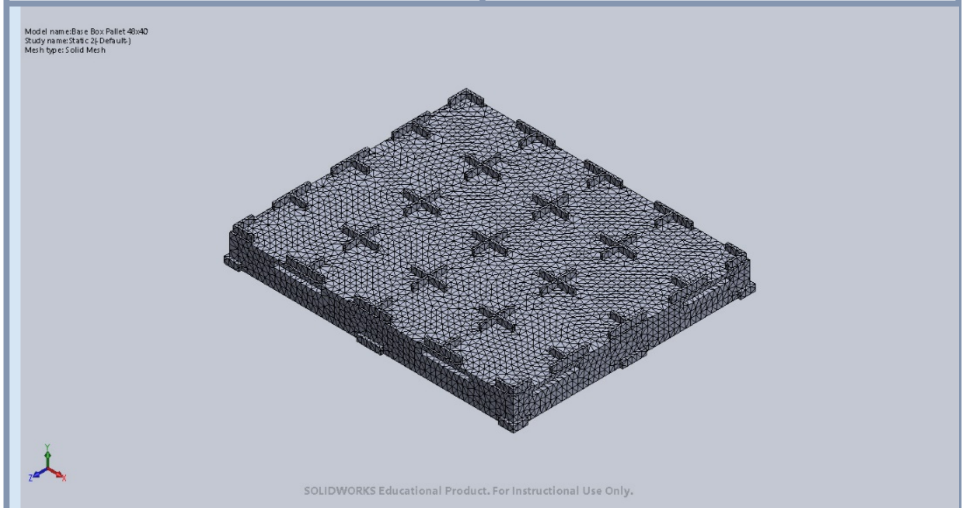
Load name	Load Image	Load Details
Force-1		**Entities:** **1 face(s)** **Type:** **Apply normal force** **Value:** **55000 N**

Mesh information

Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off
Jacobian points	4 Points
Element Size	0.920847 in
Tolerance	0.0460424 in
Mesh Quality Plot	High

Mesh information - Details

Total Nodes	79335
Total Elements	42659
Maximum Aspect Ratio	7.6609
% of elements with Aspect Ratio < 3	91.5
% of elements with Aspect Ratio > 10	0
% of distorted elements(Jacobian)	0
Time to complete mesh(hh;mm;ss):	00:00:09
Computer name:	MSL-REF-70



Resultant Forces

Reaction forces

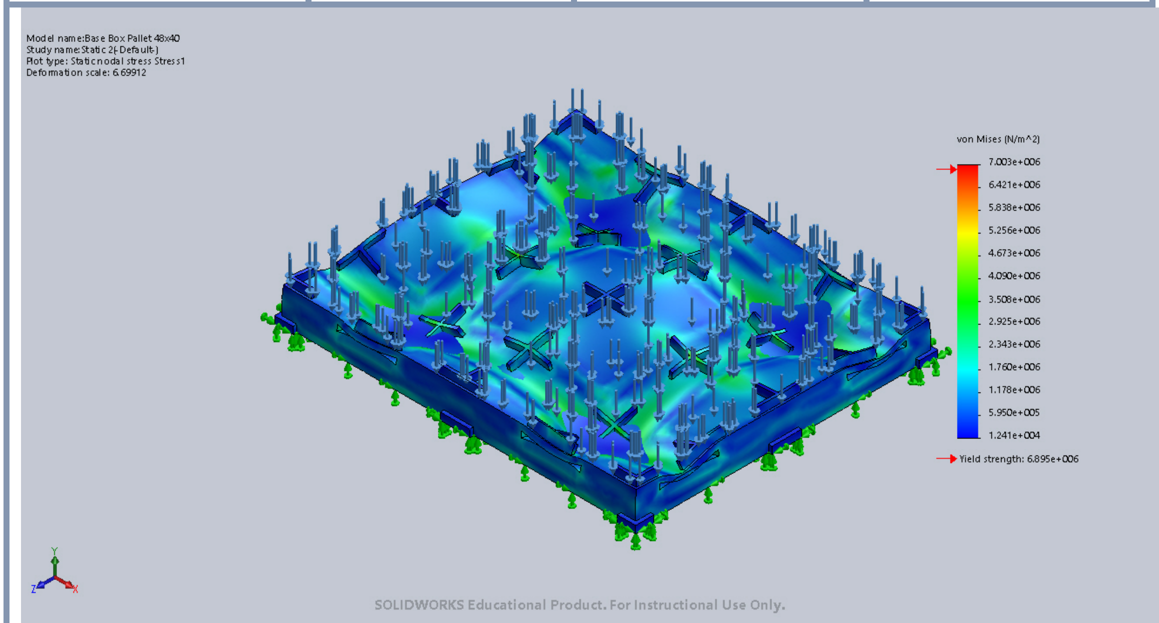
Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	0.0182878	55000.3	0.0227728	55000.3

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

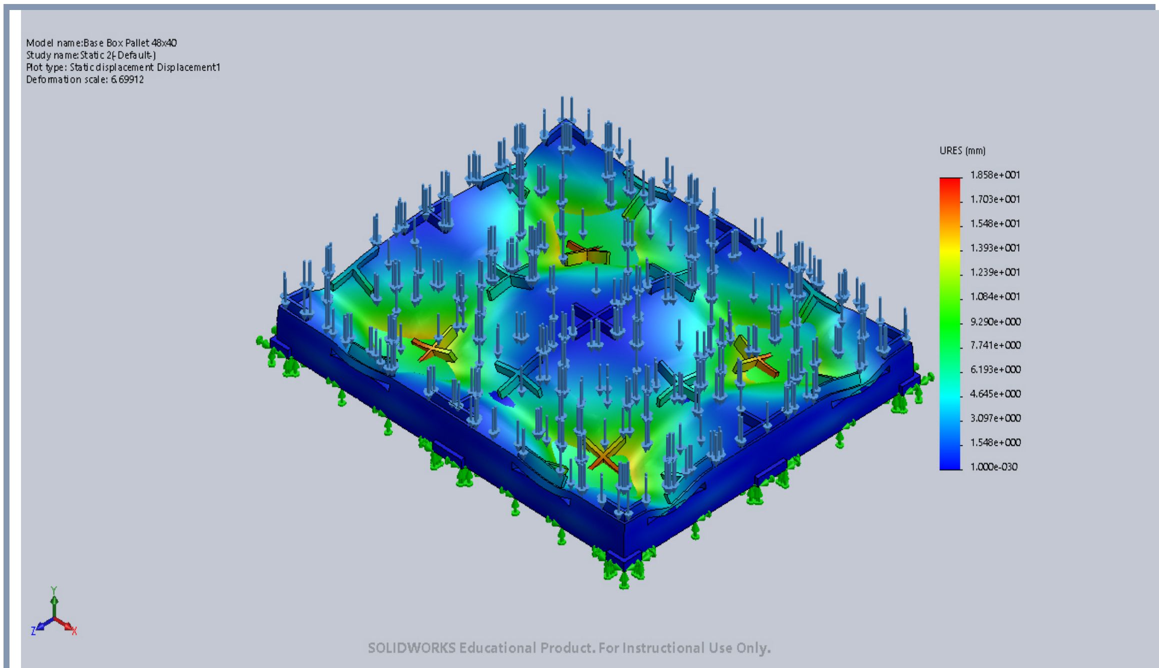
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	1.241e+004N/m^2 Node: 7171	7.003e+006N/m^2 Node: 58702



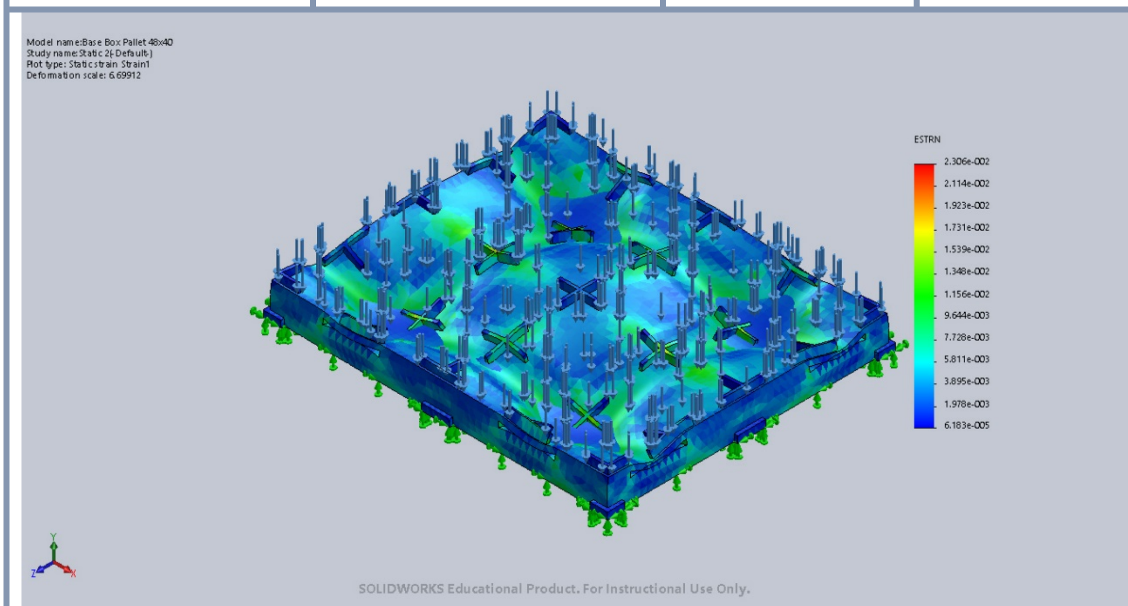
Base Box Pallet 48x40-Static 2-Stress-Stress1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+000mm Node: 1834	1.858e+001mm Node: 47057



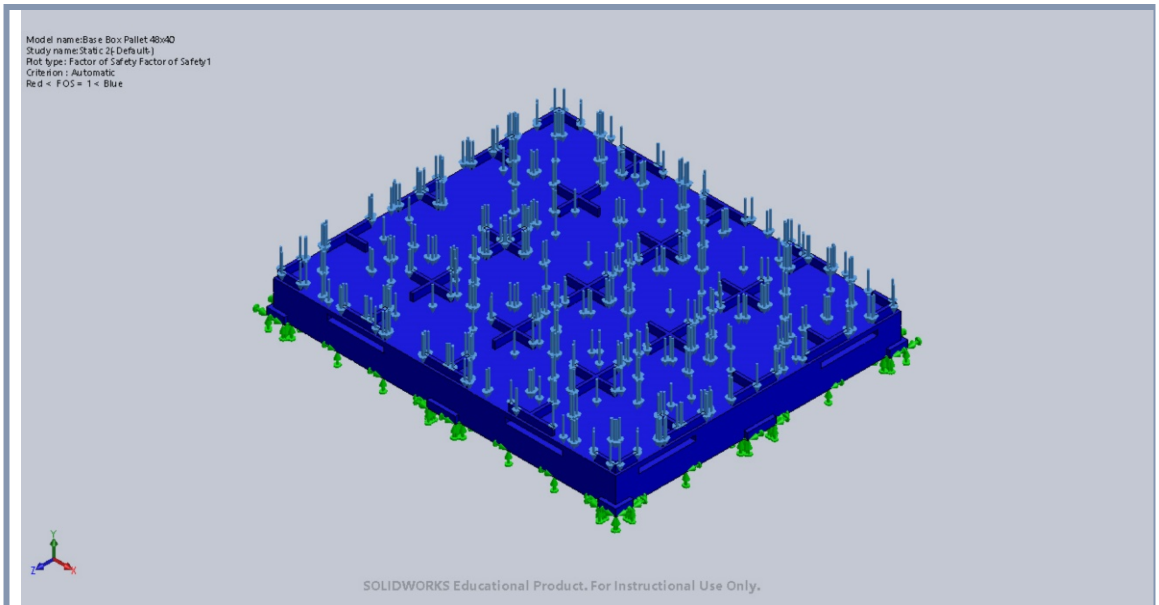
Base Box Pallet 48x40-Static 2-Displacement-Displacement1

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	6.183e-005 Element: 24956	2.306e-002 Element: 32249



Base Box Pallet 48x40-Static 2-Strain-Strain1

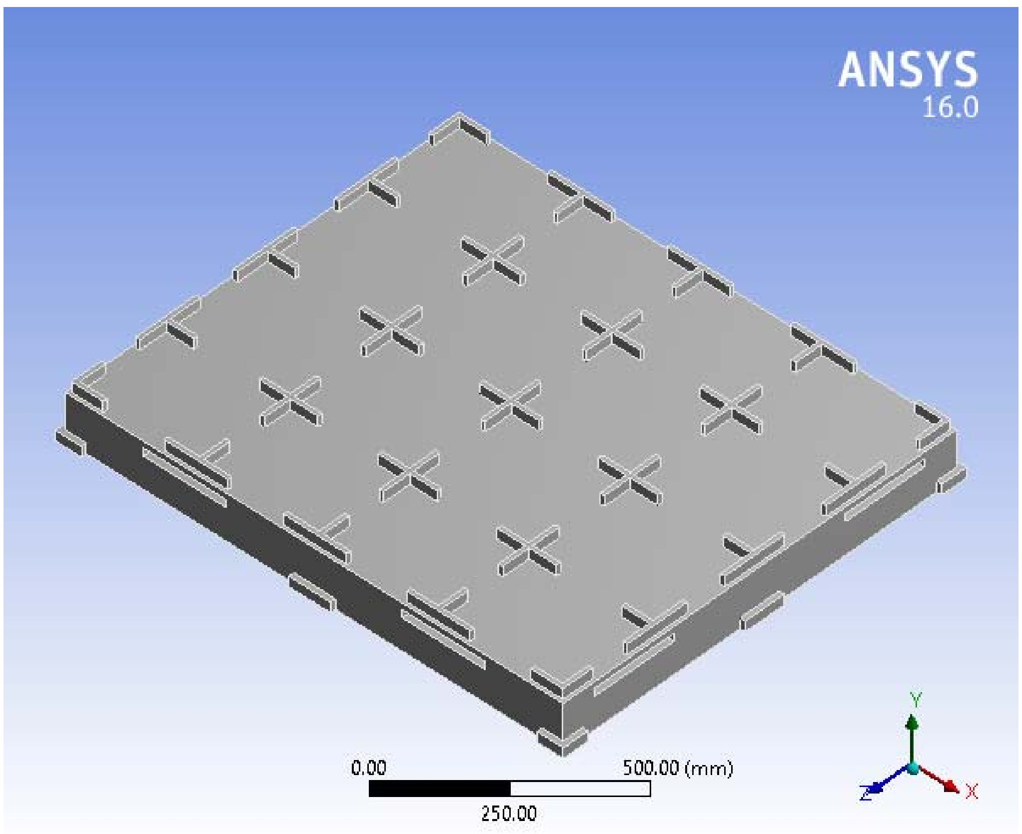
Name	Type	Min	Max
Factor of Safety1	Automatic	9.845e-001 Node: 58702	5.557e+002 Node: 7171



Base Box Pallet 48x40-Static 2-Factor of Safety-Factor of Safety1

Project

First Saved	Saturday, March 24, 2018
Last Saved	Saturday, March 24, 2018
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (B4)

Geometry

TABLE 2
Model (B4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	1244.6 mm
Length Y	139.7 mm
Length Z	1041.4 mm

Properties	
Volume	5.531e+007 mm³
Mass	66.372 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	12291
Elements	42354
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\jagad\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (B4) > Geometry > Parts

Object Name	*Base Box Pallet 48x40.SLDPRT new for ansys*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Reference Frame	Lagrangian
Material	
Assignment	Acryllic Medium High Impact
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	1244.6 mm
Length Y	139.7 mm

Length Z	1041.4 mm
Properties	
Volume	5.531e+007 mm³
Mass	66.372 kg
Centroid X	-1.0897e-002 mm
Centroid Y	20.981 mm
Centroid Z	6.0372e-003 mm
Moment of Inertia Ip1	5.8772e+006 kg·mm²
Moment of Inertia Ip2	1.4557e+007 kg·mm²
Moment of Inertia Ip3	8.7611e+006 kg·mm²
Statistics	
Nodes	12291
Elements	42354
Mesh Metric	None

Coordinate Systems

TABLE 4
Model (B4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

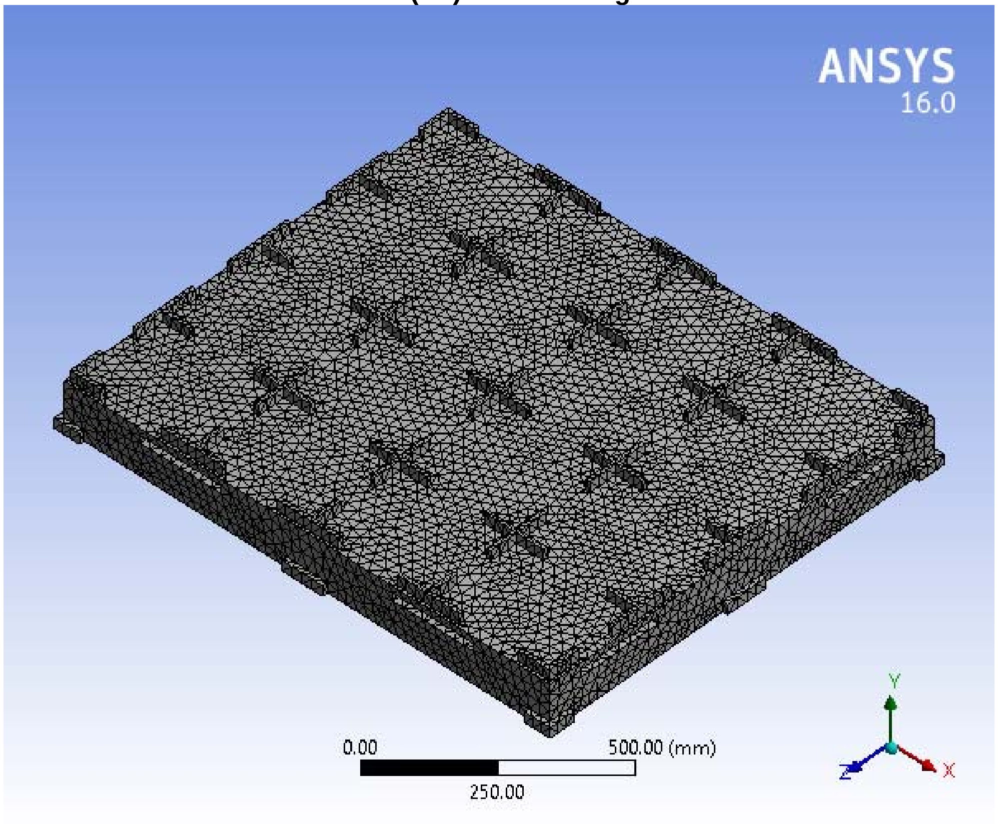
Mesh

TABLE 5
Model (B4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Explicit
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Medium
Element Size	Default

Initial Size Seed	Active Assembly
Smoothing	High
Transition	Slow
Span Angle Center	Coarse
Minimum Edge Length	10.160 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Explicit
Element Midside Nodes	Dropped
Straight Sided Elements	
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Full Mesh
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	12291
Elements	42354
Mesh Metric	None

FIGURE 1
Model (B4) > Mesh > Figure



Explicit Dynamics (B5)

TABLE 6
Model (B4) > Analysis

Object Name	*Explicit Dynamics (B5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Explicit Dynamics
Solver Target	AUTODYN
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 7
Model (B4) > Explicit Dynamics (B5) > Initial Conditions

Object Name	*Initial Conditions*
State	Fully Defined

TABLE 8
Model (B4) > Explicit Dynamics (B5) > Initial Conditions > Initial Condition

Object Name	*Pre-Stress (None)*	*Velocity*
State	Fully Defined	
Definition		
Pre-Stress Environment	None	
Pressure Initialization	From Deformed State	
Input Type		Velocity
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. mm/s
Y Component		580. mm/s
Z Component		0. mm/s
Suppressed		No
Scope		
Scoping Method		Geometry Selection
Geometry		1 Body

FIGURE 2
Model (B4) > Explicit Dynamics (B5) > Initial Conditions > Velocity > Figure

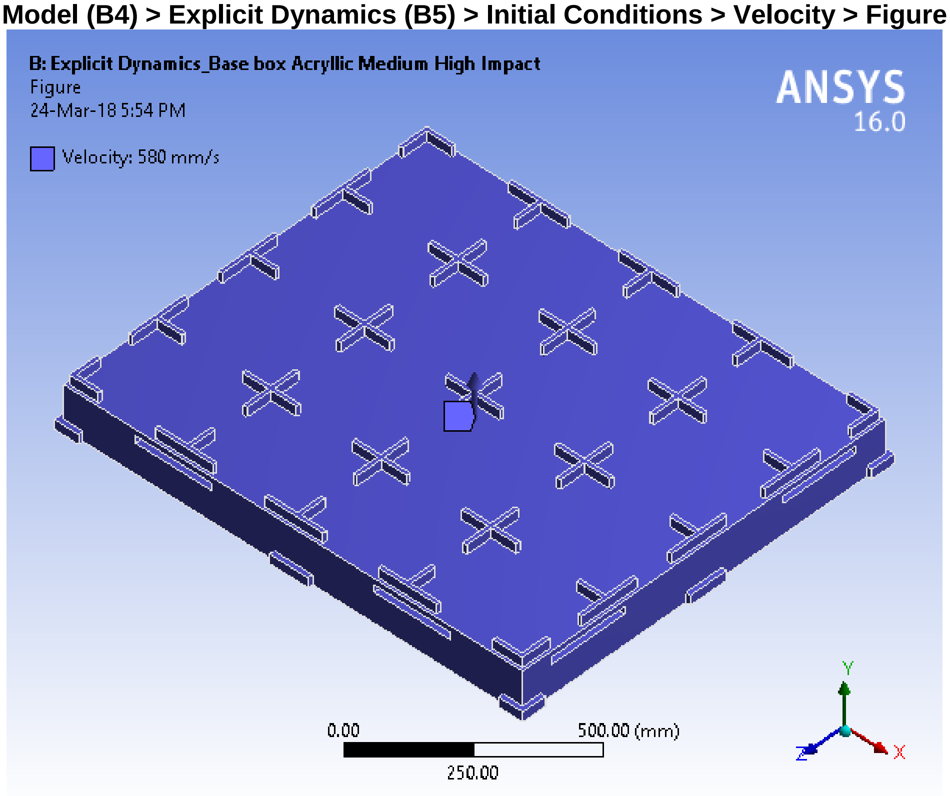


TABLE 9
Model (B4) > Explicit Dynamics (B5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Analysis Settings Preference	
Type	Program Controlled

Step Controls	
Resume From Cycle	0
Maximum Number of Cycles	1e+07
End Time	2.e-004 s
Maximum Energy Error	0.1
Reference Energy Cycle	0
Initial Time Step	Program Controlled
Minimum Time Step	Program Controlled
Maximum Time Step	Program Controlled
Time Step Safety Factor	0.9
Characteristic Dimension	Diagonals
Automatic Mass Scaling	No
Solver Controls	
Solve Units	mm, mg, ms
Beam Solution Type	Bending
Beam Time Step Safety Factor	0.5
Hex Integration Type	Exact
Shell Sublayers	3
Shell Shear Correction Factor	0.8333
Shell BWC Warp Correction	Yes
Shell Thickness Update	Nodal
Tet Integration	Average Nodal Pressure
Shell Inertia Update	Recompute
Density Update	Program Controlled
Minimum Velocity	1.e-003 mm s^-1

Maximum Velocity	1.e+013 mm s^-1
Radius Cutoff	1.e-003
Minimum Strain Rate Cutoff	1.e-010
Euler Domain Controls	
Domain Size Definition	Program Controlled
Display Euler Domain	Yes
Scope	All Bodies
X Scale factor	1.2
Y Scale factor	1.2
Z Scale factor	1.2
Domain Resolution Definition	Total Cells
Total Cells	2.5e+05
Lower X Face	Flow Out
Lower Y Face	Flow Out
Lower Z Face	Flow Out
Upper X Face	Flow Out
Upper Y Face	Flow Out
Upper Z Face	Flow Out
Euler Tracking	By Body
Damping Controls	
Linear Artificial Viscosity	0.2
Quadratic Artificial Viscosity	1.
Linear Viscosity in Expansion	No
Artificial Viscosity For Shells	Yes
Hourglass Damping	AUTODYN Standard
Viscous Coefficient	0.1
Static	0.

Damping	
Erosion Controls	
On Geometric Strain Limit	Yes
Geometric Strain Limit	1.5
On Material Failure	No
On Minimum Element Time Step	No
Retain Inertia of Eroded Material	Yes
Output Controls	
Save Results on	Equally Spaced Points
Result Number Of Points	20
Save Restart Files on	Equally Spaced Points
Restart Number Of Points	5
Save Result Tracker Data on	Cycles
Tracker Cycles	1
Output Contact Forces	Off
Analysis Data Management	
Solver Files Directory	C:\Users\jagad\AppData\Local\Temp\WB_3988_2\unsaved_project_files\dp0\SYS-1\MECH\
Scratch Solver Files Directory	

TABLE 10
Model (B4) > Explicit Dynamics (B5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	

Define By		Components
Coordinate System		Global Coordinate System
X Component		0. N (step applied)
Y Component		-9.85e+006 N (step applied)
Z Component		0. N (step applied)

FIGURE 3
Model (B4) > Explicit Dynamics (B5) > Fixed Support > Figure

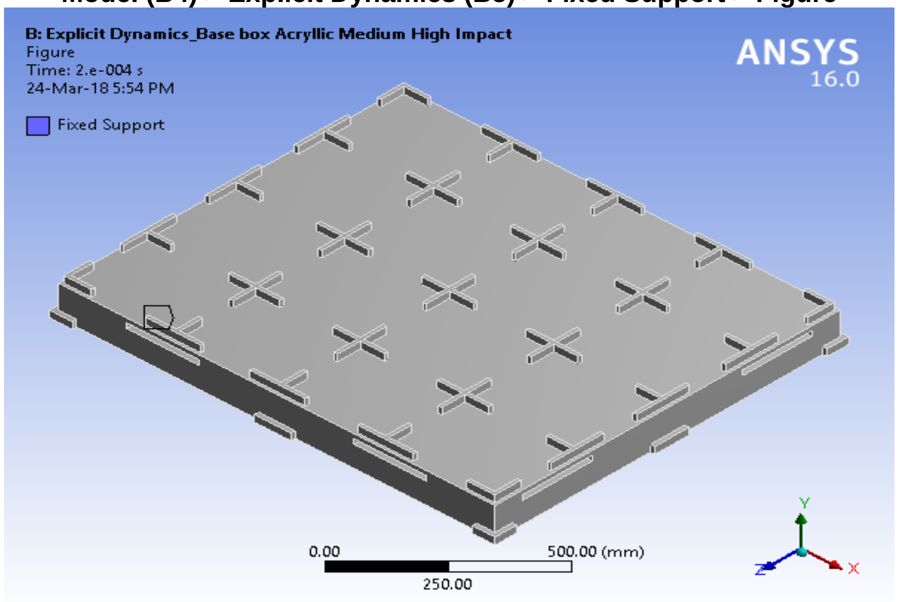


FIGURE 4
Model (B4) > Explicit Dynamics (B5) > Force

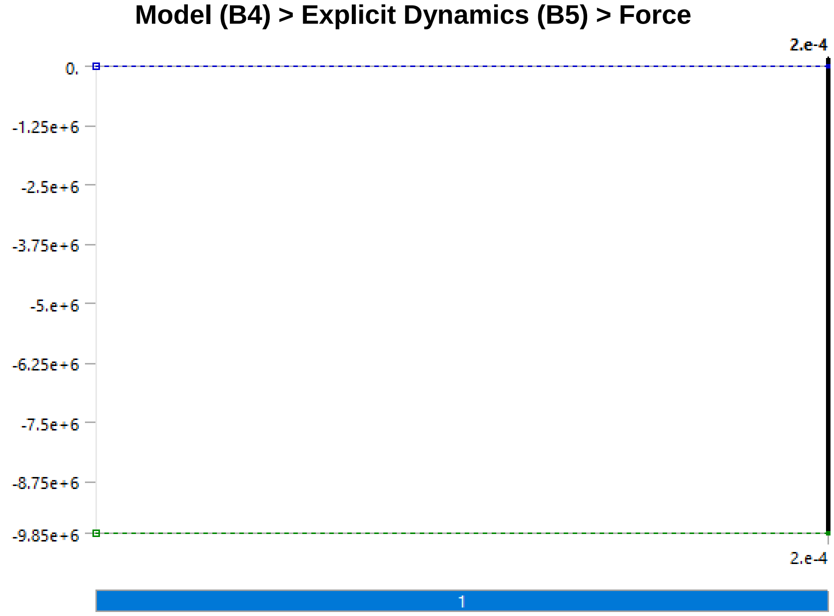
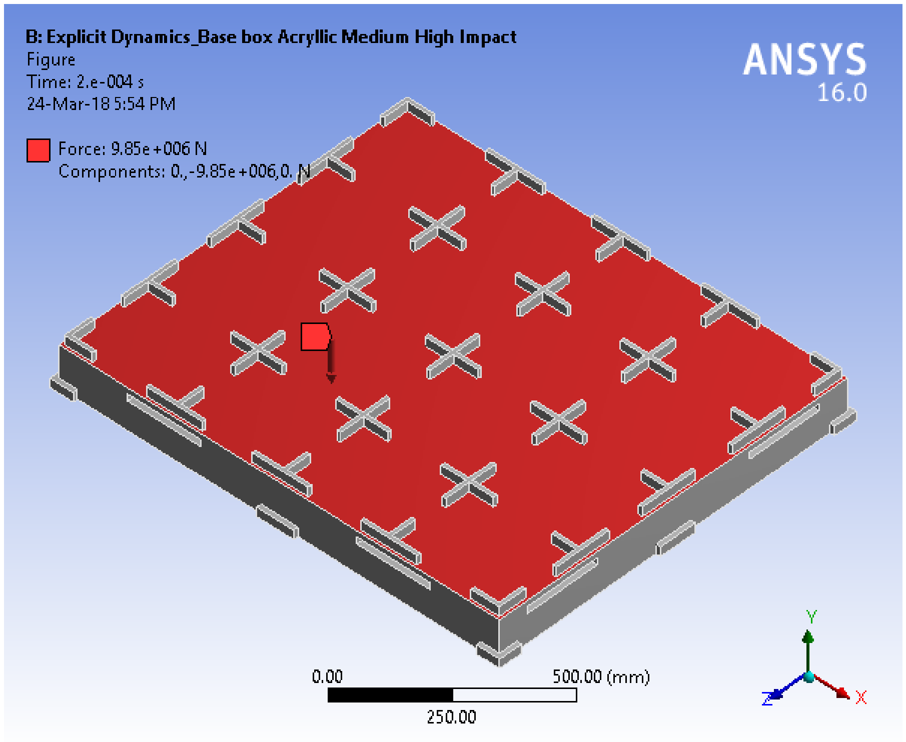


FIGURE 5
Model (B4) > Explicit Dynamics (B5) > Force > Figure



Solution (B6)

TABLE 11
Model (B4) > Explicit Dynamics (B5) > Solution

Object Name	*Solution (B6)*
State	Solved
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 12
Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Update Interval	2.5 s
Display Points	All
Display Filter During Solve	Yes

TABLE 13
Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Results

Object Name	*Directional Deformation*	*Equivalent Stress*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Directional Deformation	Equivalent (von-Mises) Stress	Equivalent Elastic Strain
Orientation	Y Axis		
By	Time		
Display Time	Last		
Coordinate System	Global Coordinate System		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	-3.0995 mm	0.35551 MPa	3.5529e-004 mm/mm
Maximum	0.24271 mm	46.641 MPa	2.3024e-002 mm/mm
Minimum Value Over Time			
Minimum	-3.0995 mm	0. MPa	0. mm/mm
Maximum	0. mm	0.54113 MPa	3.6819e-004 mm/mm
Maximum Value Over Time			
Minimum	0. mm	0. MPa	0. mm/mm
Maximum	0.24271 mm	55.272 MPa	2.3615e-002 mm/mm
Information			
Time	2.0064e-004 s		
Set	21		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

FIGURE 6
Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Directional Deformation

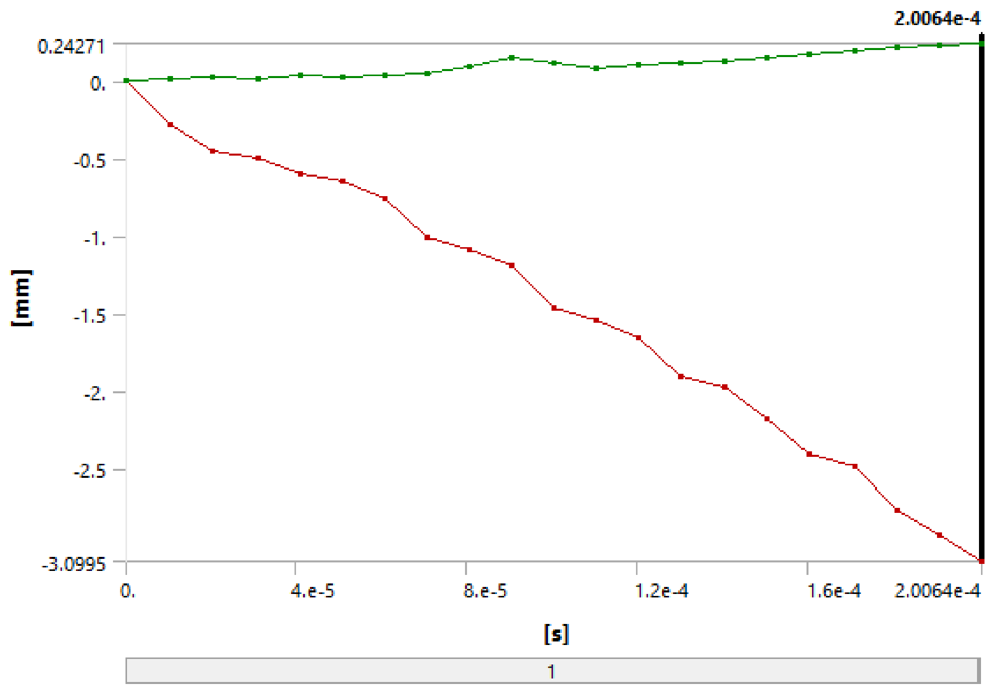


TABLE 14
Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Directional Deformation

Time [s]	Minimum [mm]	Maximum [mm]
1.1755e-038	0.	0.
1.0117e-005	-0.27918	1.1876e-002
2.0054e-005	-0.44964	2.76e-002
3.0819e-005	-0.49838	1.9653e-002
4.0756e-005	-0.59453	4.181e-002
5.0692e-005	-0.64141	3.1741e-002
6.0629e-005	-0.75579	4.0431e-002
7.0567e-005	-1.0069	5.0699e-002
8.0505e-005	-1.0843	9.4034e-002
9.0445e-005	-1.1848	0.15334
1.0039e-004	-1.462	0.11484
1.1033e-004	-1.5477	8.7336e-002
1.2028e-004	-1.6541	0.10077
1.3022e-004	-1.9082	0.11564
1.4017e-004	-1.9778	0.13419
1.5011e-004	-2.1837	0.1569
1.6005e-004	-2.4023	0.17965
1.7082e-004	-2.4912	0.2017
1.8076e-004	-2.7667	0.21956
1.907e-004	-2.9286	0.23438
2.0064e-004	-3.0995	0.24271

FIGURE 7
Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Directional Deformation > Figure

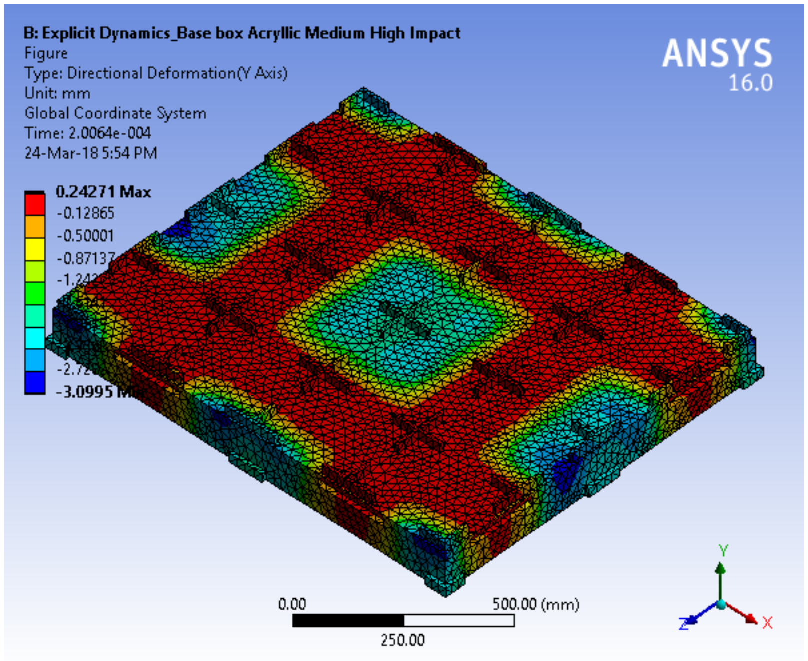


FIGURE 8

Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Equivalent Stress

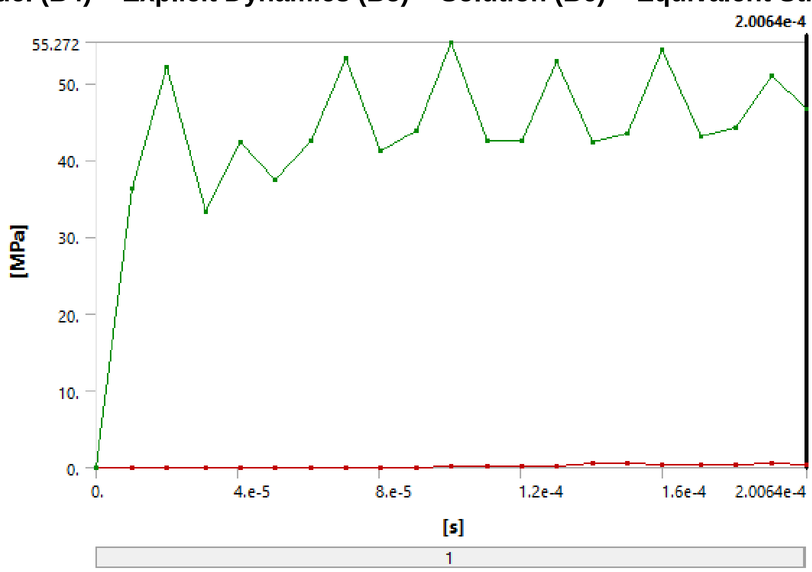


TABLE 15

Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]
1.1755e-038	0.	0.
1.0117e-005		36.212
2.0054e-005		52.159
3.0819e-005	3.0805e-006	33.362
4.0756e-005	4.8466e-005	42.38
5.0692e-005	6.9692e-004	37.413
6.0629e-005	3.3447e-003	42.494

7.0567e-005	1.2727e-002	53.144
8.0505e-005	3.8051e-002	41.124
9.0445e-005	9.1586e-002	43.745
1.0039e-004	0.19018	55.272
1.1033e-004	0.18471	42.448
1.2028e-004	0.14426	42.413
1.3022e-004	0.21731	52.908
1.4017e-004	0.5092	42.247
1.5011e-004	0.49529	43.439
1.6005e-004	0.35584	54.366
1.7082e-004	0.39307	43.109
1.8076e-004	0.44743	44.234
1.907e-004	0.54113	50.908
2.0064e-004	0.35551	46.641

FIGURE 9
Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Equivalent Stress > Figure

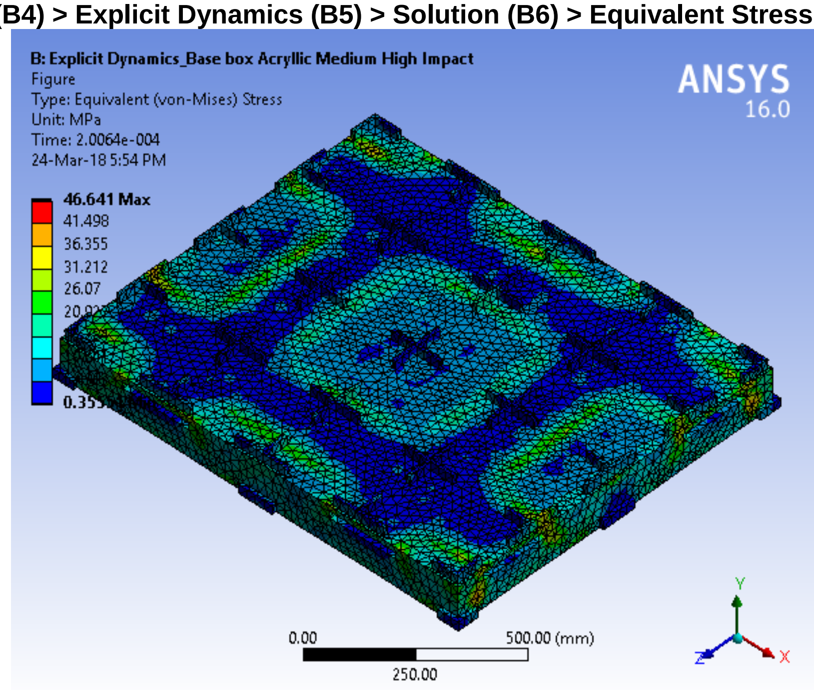


FIGURE 10
Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Equivalent Elastic Strain

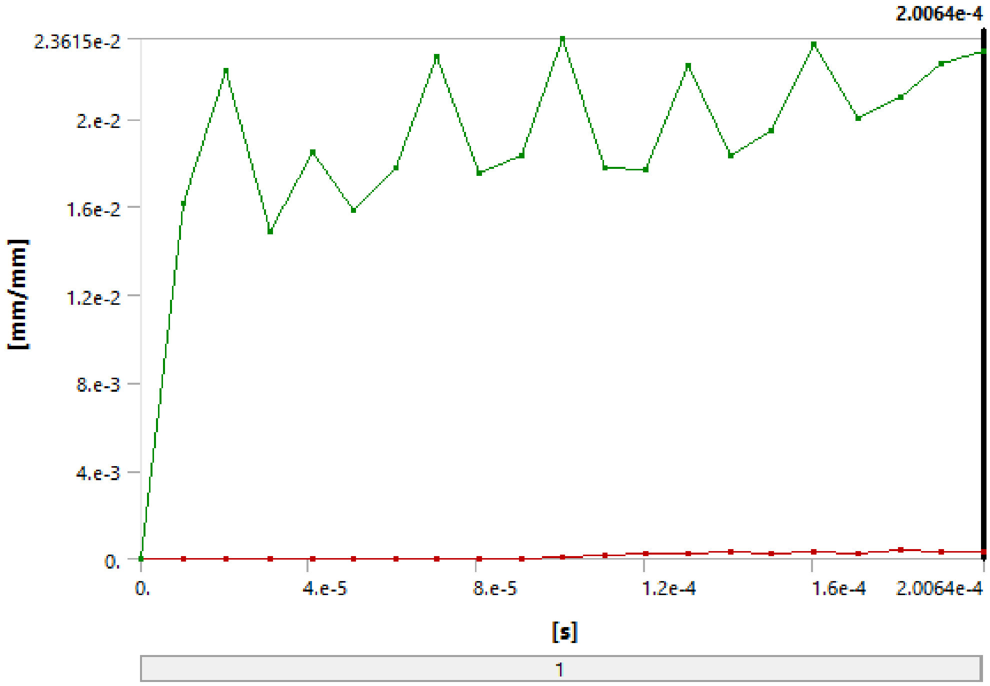


TABLE 16
Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]
1.1755e-038	0.	0.
1.0117e-005		1.6156e-002
2.0054e-005		2.2134e-002
3.0819e-005	2.1674e-009	1.4899e-002
4.0756e-005	4.1408e-008	1.8448e-002
5.0692e-005	3.0394e-007	1.5807e-002
6.0629e-005	1.4482e-006	1.7746e-002
7.0567e-005	5.4333e-006	2.2841e-002
8.0505e-005	1.6103e-005	1.7506e-002
9.0445e-005	3.8525e-005	1.8339e-002
1.0039e-004	7.9955e-005	2.3615e-002
1.1033e-004	1.4616e-004	1.773e-002
1.2028e-004	2.2235e-004	1.7702e-002
1.3022e-004	2.7173e-004	2.2417e-002
1.4017e-004	3.2765e-004	1.8337e-002
1.5011e-004	2.5272e-004	1.9407e-002
1.6005e-004	2.9626e-004	2.3396e-002
1.7082e-004	2.792e-004	1.9997e-002
1.8076e-004	3.6819e-004	2.0973e-002
1.907e-004	2.978e-004	2.2515e-002
2.0064e-004	3.5529e-004	2.3024e-002

FIGURE 11
Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Equivalent Elastic Strain > Figure

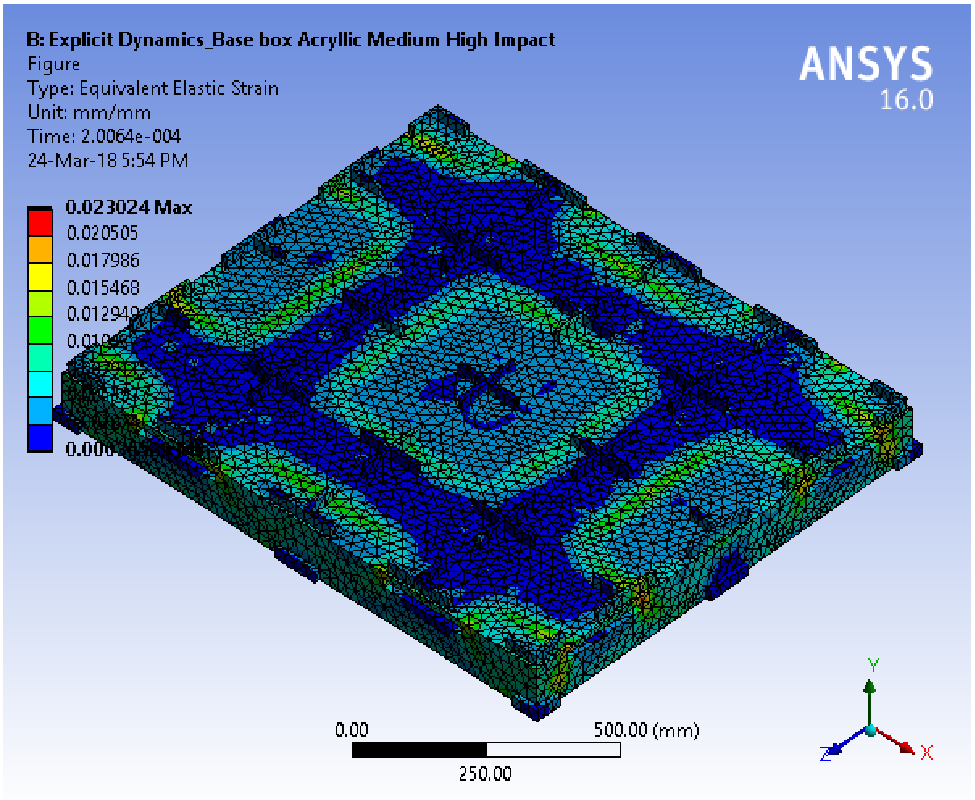


TABLE 17
Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Tensile Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 18
Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Stress Tool > Results

Object Name	*Safety Factor*	*Stress Ratio*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Safety Factor	Stress Ratio
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Integration Point Results		
Display Option	Averaged	
Average Across Bodies	No	

Results		
Minimum	1.9051	0.
Maximum		0.5249
Minimum Value Over Time		
Minimum	1.9051	0.
Maximum	15.	0.
Maximum Value Over Time		
Minimum	15.	0.
Maximum	15.	0.5249
Information		
Time	2.0064e-004 s	
Set	21	

FIGURE 12
Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Stress Tool > Safety Factor

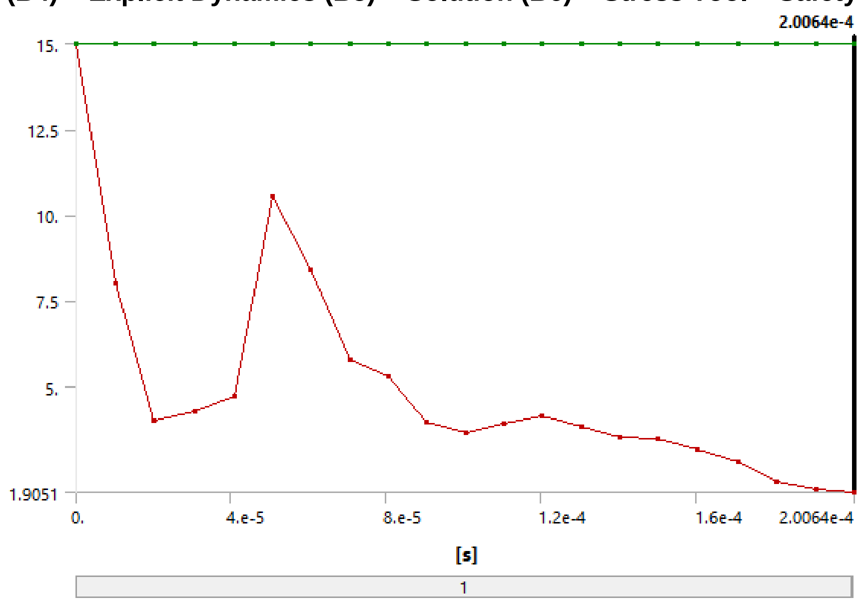


TABLE 19
Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.1755e-038	15.	15.
1.0117e-005	8.0056	
2.0054e-005	3.9983	
3.0819e-005	4.2852	
4.0756e-005	4.7151	
5.0692e-005	10.554	
6.0629e-005	8.4032	
7.0567e-005	5.7997	
8.0505e-005	5.2906	
9.0445e-005	3.9676	

1.0039e-004	3.6444	
1.1033e-004	3.9009	
1.2028e-004	4.1397	
1.3022e-004	3.8424	
1.4017e-004	3.5255	
1.5011e-004	3.4769	
1.6005e-004	3.1734	
1.7082e-004	2.7948	
1.8076e-004	2.2382	
1.907e-004	1.9818	
2.0064e-004	1.9051	

FIGURE 13
Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Stress Tool > Safety Factor > Figure

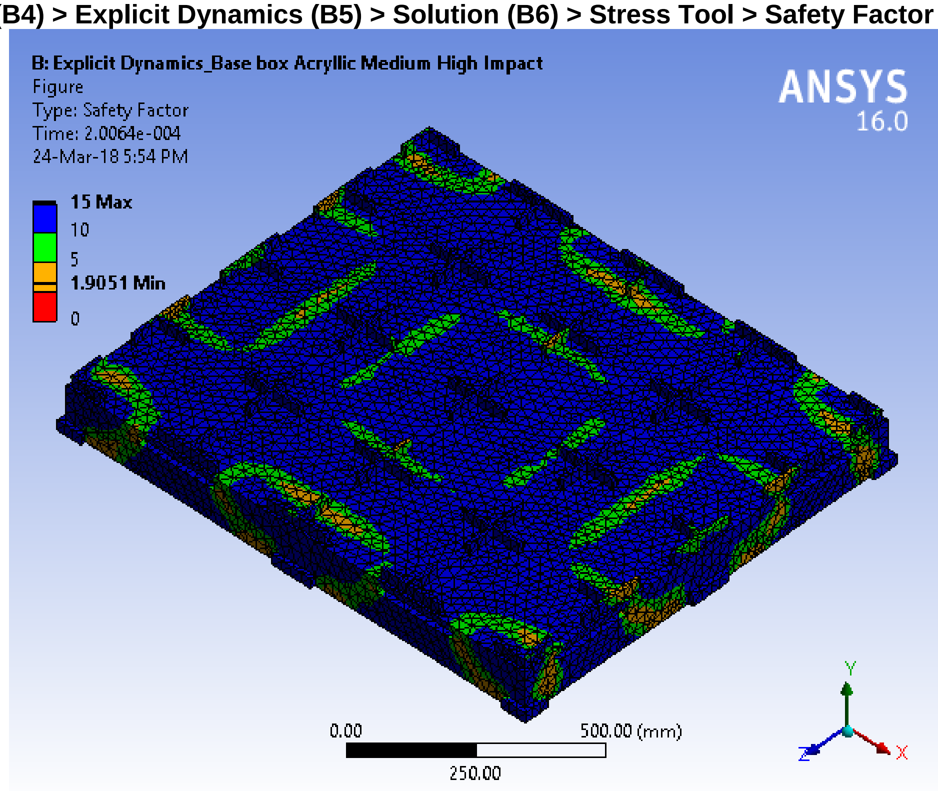


FIGURE 14
Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Stress Tool > Stress Ratio

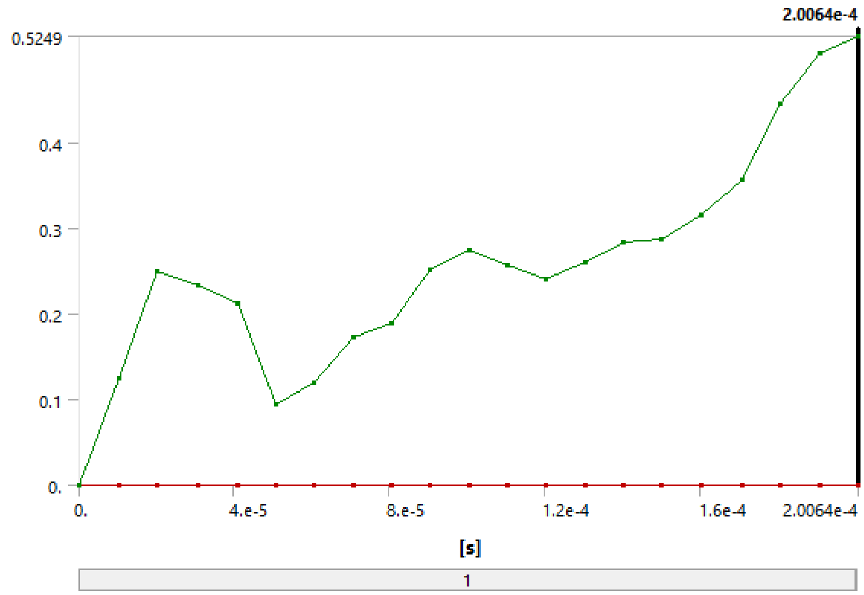
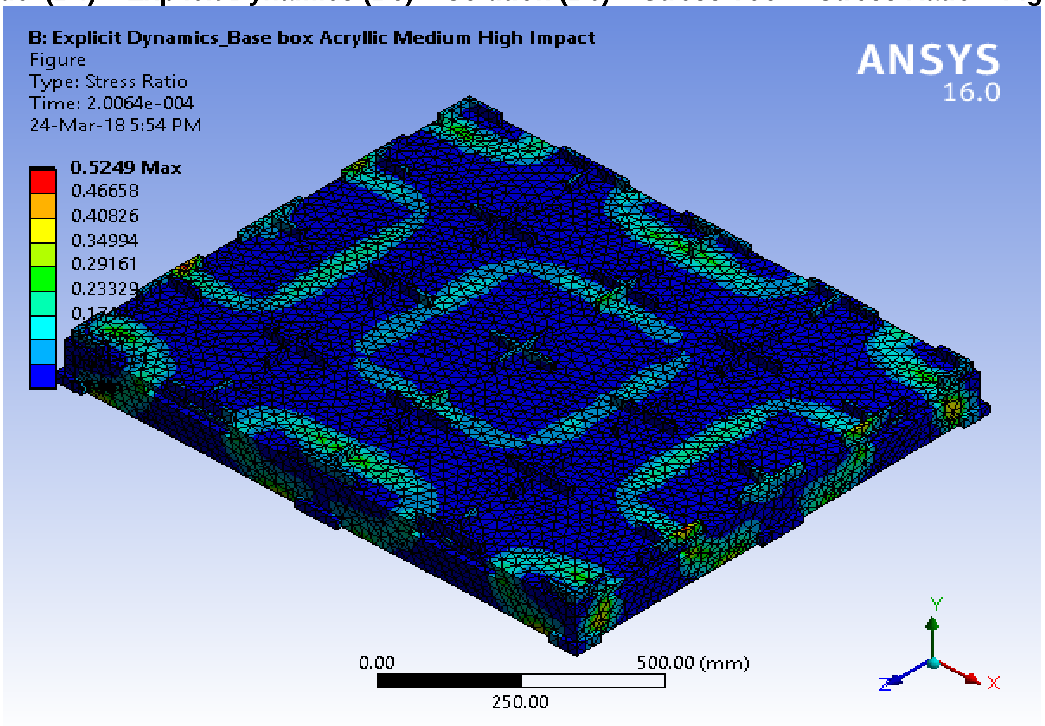


TABLE 20
Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Stress Tool > Stress Ratio

Time [s]	Minimum	Maximum
1.1755e-038	0.	0.
1.0117e-005		0.12491
2.0054e-005		0.25011
3.0819e-005		0.23336
4.0756e-005		0.21208
5.0692e-005		9.4748e-002
6.0629e-005		0.119
7.0567e-005		0.17242
8.0505e-005		0.18902
9.0445e-005		0.25204
1.0039e-004		0.27439
1.1033e-004		0.25635
1.2028e-004		0.24156
1.3022e-004		0.26025
1.4017e-004		0.28365
1.5011e-004		0.28762
1.6005e-004		0.31512
1.7082e-004		0.3578
1.8076e-004		0.44679
1.907e-004		0.5046
2.0064e-004		0.5249

FIGURE 15
Model (B4) > Explicit Dynamics (B5) > Solution (B6) > Stress Tool > Stress Ratio > Figure



Material Data

Acryllic Medium High Impact

TABLE 21
Acryllic Medium High Impact > Constants

Density	1.2e-006 kg mm^-3
Coefficient of Thermal Expansion	5.2e-005 C^-1
Thermal Conductivity	2.1e-004 W mm^-1 C^-1

TABLE 22
Acryllic Medium High Impact > Isotropic Secant Coefficient of Thermal Expansion

Reference Temperature C
-0.15

TABLE 23
Acryllic Medium High Impact > Isotropic Elasticity

Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	2403	0.35	2670	890

TABLE 24
Acryllic Medium High Impact > Tensile Yield Strength

Tensile Yield Strength MPa

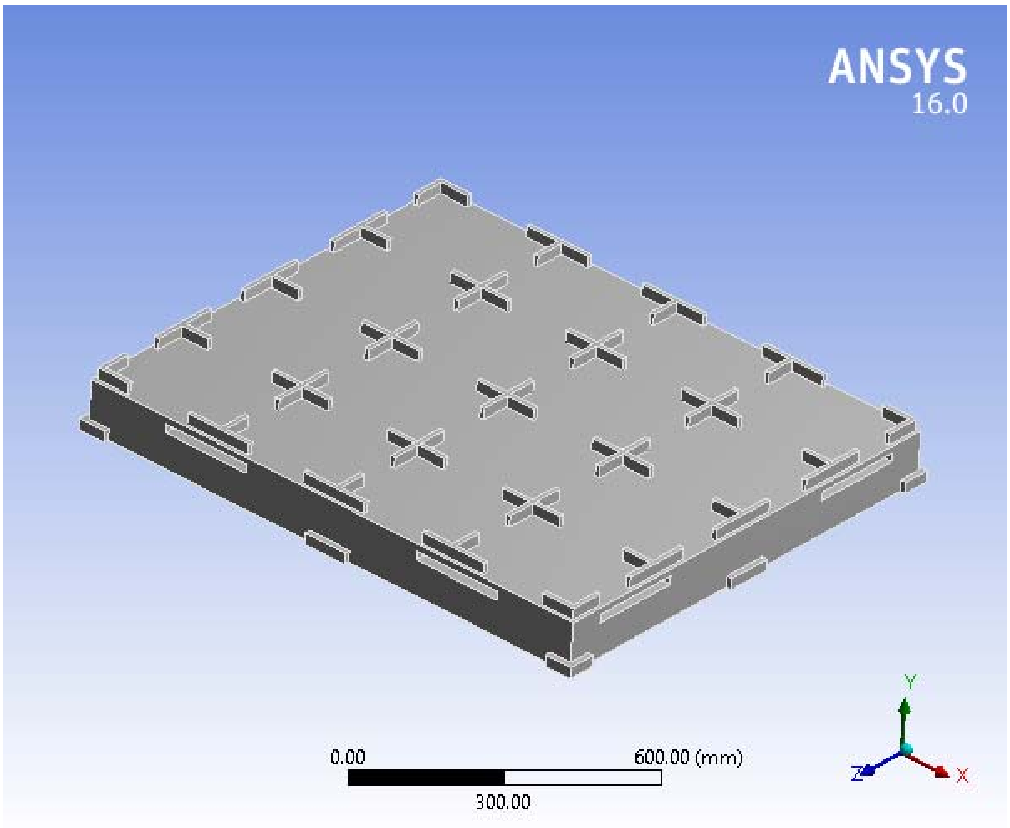
73

TABLE 25
Acryllic Medium High Impact > Compressive Yield Strength

Compressive Yield Strength MPa
45

Project

First Saved	Saturday, March 24, 2018
Last Saved	Saturday, March 24, 2018
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (B4)

Geometry

TABLE 2
Model (B4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	1244.6 mm
Length Y	139.7 mm
Length Z	1041.4 mm
Properties	

Volume	5.531e+007 mm³
Mass	66.372 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	101197
Elements	53631
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\jagad\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (B4) > Geometry > Parts

Object Name	*Base Box Pallet 48x40.SLDPRT new for ansys*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Acryllic Medium High Impact
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	1244.6 mm
Length Y	139.7 mm
Length Z	1041.4 mm
Properties	

Volume	5.531e+007 mm³
Mass	66.372 kg
Centroid X	-1.0897e-002 mm
Centroid Y	20.981 mm
Centroid Z	6.0372e-003 mm
Moment of Inertia Ip1	5.8772e+006 kg·mm²
Moment of Inertia Ip2	1.4557e+007 kg·mm²
Moment of Inertia Ip3	8.7611e+006 kg·mm²
Statistics	
Nodes	101197
Elements	53631
Mesh Metric	None

Coordinate Systems

TABLE 4
Model (B4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

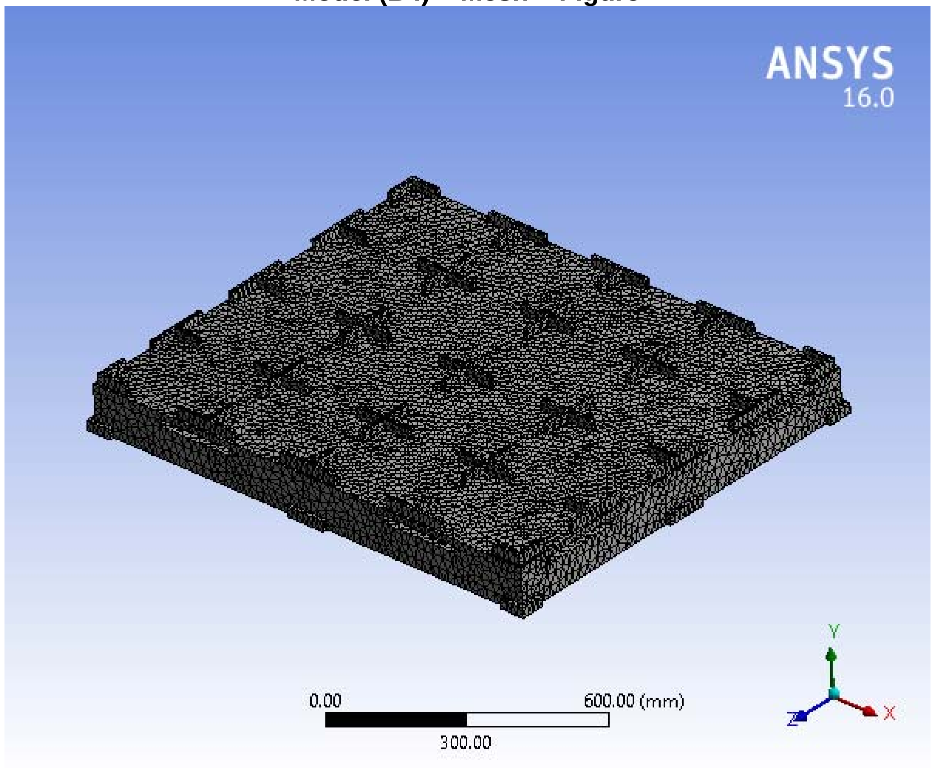
Mesh

TABLE 5
Model (B4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium

Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	10.160 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	101197
Elements	53631
Mesh Metric	None

FIGURE 1
Model (B4) > Mesh > Figure



Static Structural (B5)

TABLE 6
Model (B4) > Analysis

Object Name	*Static Structural (B5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 7
Model (B4) > Static Structural (B5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step	1.

Number	
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellane	No

ous	
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\jagad\AppData\Local\Temp\WB_CHAITRAJAGADISH_jagad_3720_2\unsaved_project_files\dp0\SYS-1\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 8
Model (B4) > Static Structural (B5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. N (ramped)
Y Component		-3.5e+006 N (ramped)
Z Component		0. N (ramped)

FIGURE 2
Model (B4) > Static Structural (B5) > Fixed Support > Figure

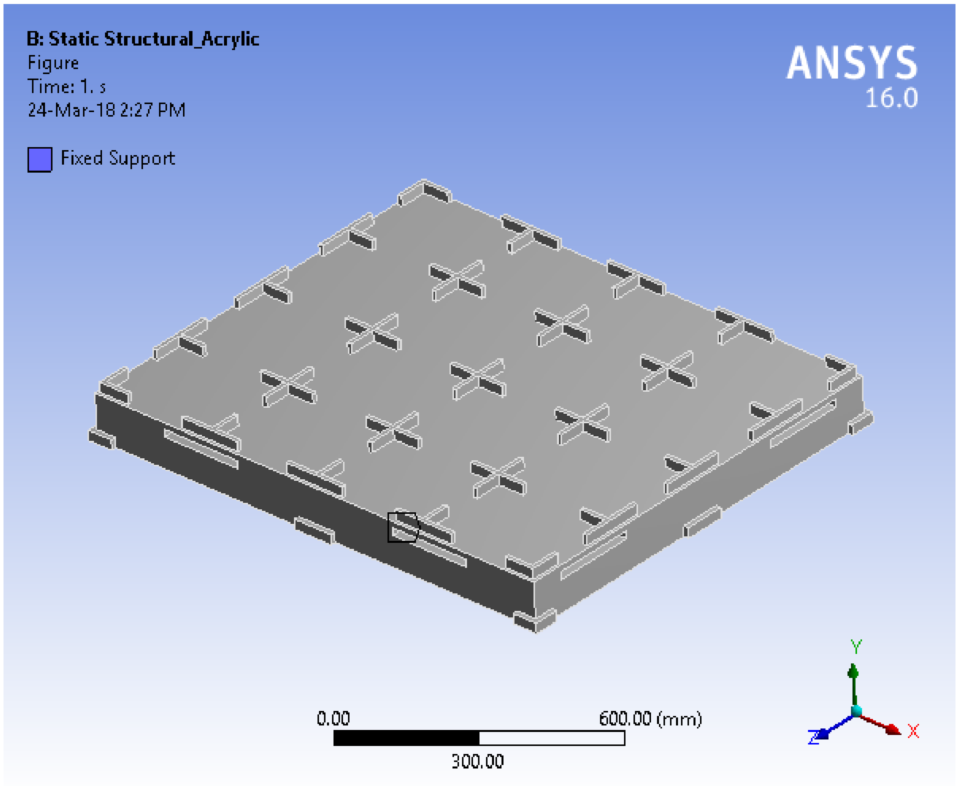


FIGURE 3
Model (B4) > Static Structural (B5) > Force

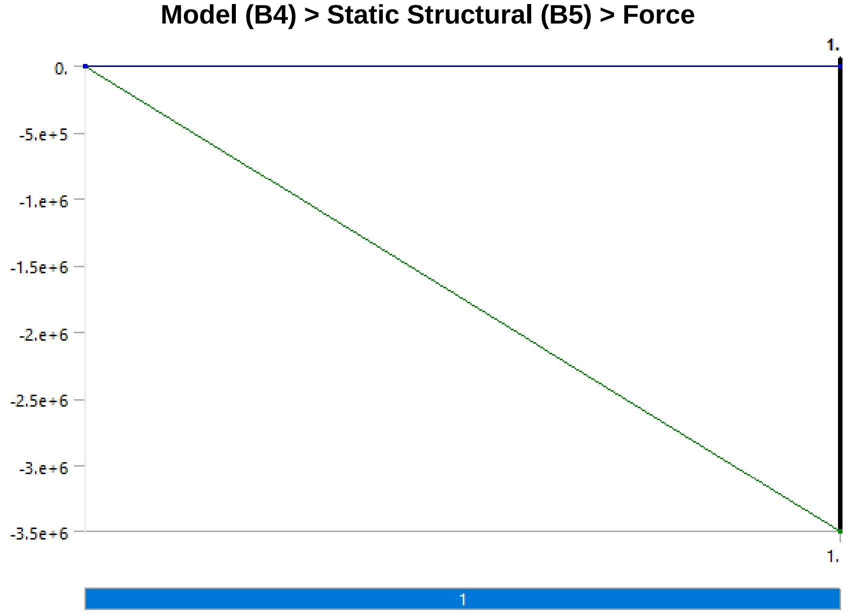
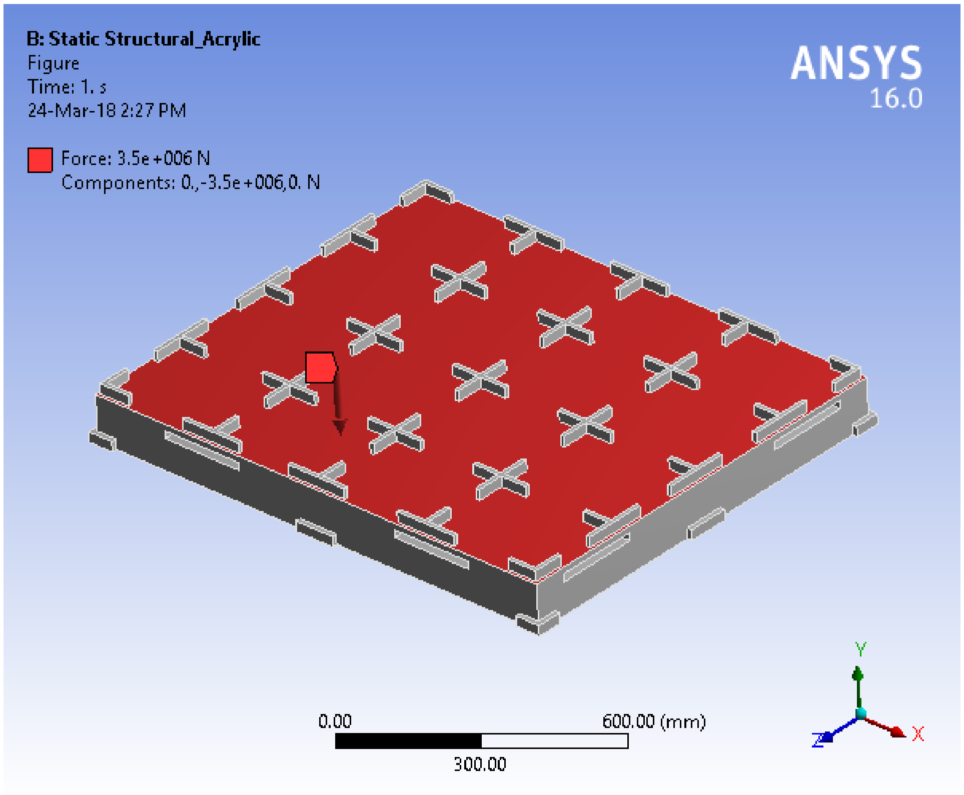


FIGURE 4
Model (B4) > Static Structural (B5) > Force > Figure



Solution (B6)

TABLE 9
Model (B4) > Static Structural (B5) > Solution

Object Name	*Solution (B6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10
Model (B4) > Static Structural (B5) > Solution (B6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes

Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11
Model (B4) > Static Structural (B5) > Solution (B6) > Results

Object Name	*Directional Deformation*	*Equivalent Stress*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Directional Deformation	Equivalent (von-Mises) Stress	Equivalent Elastic Strain
Orientation	Y Axis		
By	Time		
Display Time	Last		
Coordinate System	Global Coordinate System		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	-7.0738 mm	4.0496e-003 MPa	1.6852e-006 mm/mm
Maximum	0.56379 mm	82.598 MPa	4.2365e-002 mm/mm
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

TABLE 12
Model (B4) > Static Structural (B5) > Solution (B6) > Directional Deformation

Time [s]	Minimum [mm]	Maximum [mm]
1.	-7.0738	0.56379

FIGURE 6
Model (B4) > Static Structural (B5) > Solution (B6) > Directional Deformation > Figure

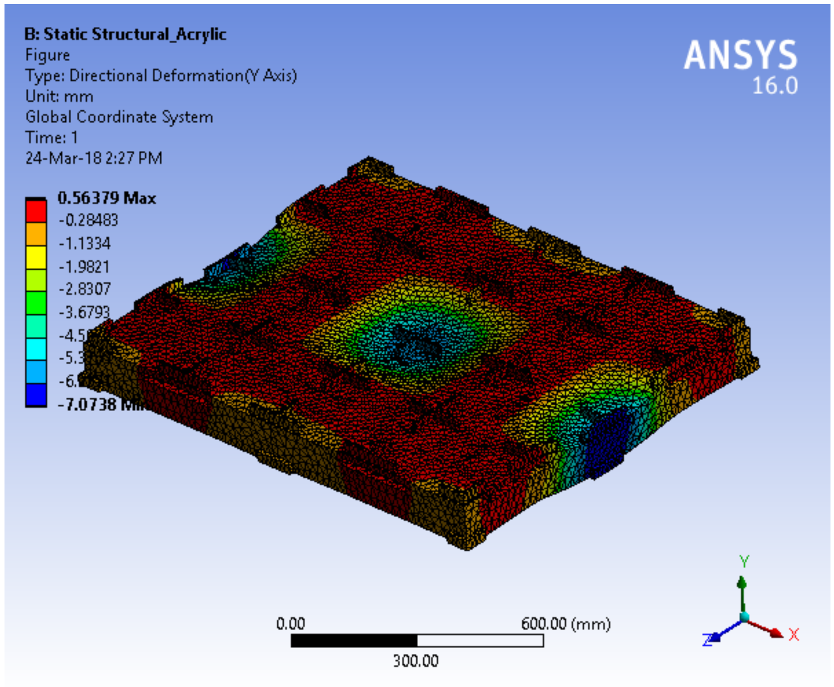


TABLE 13
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]
1.	4.0496e-003	82.598

FIGURE 8
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Stress > Figure

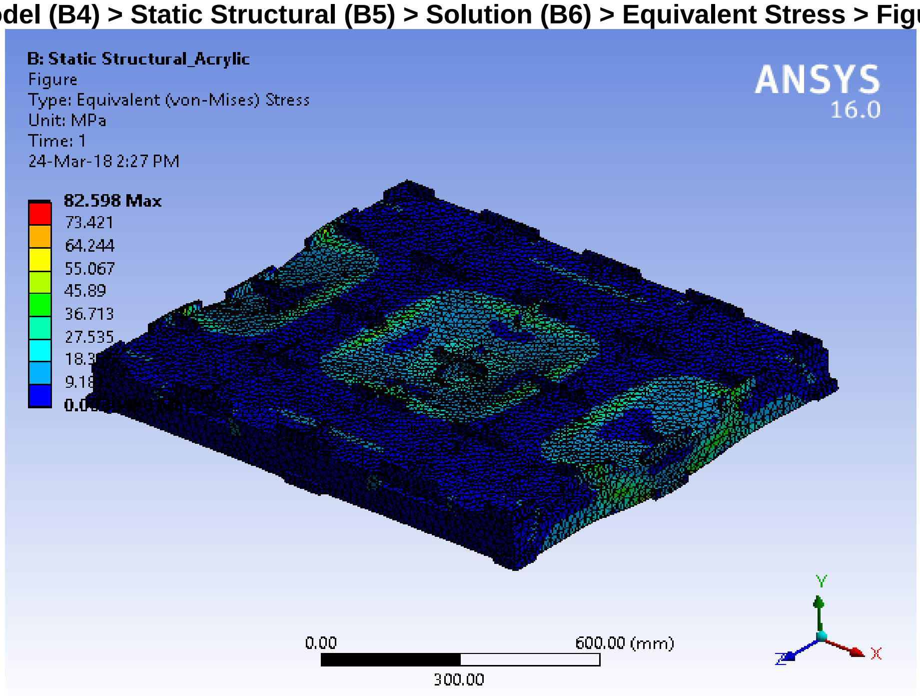


TABLE 14
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]
1.	1.6852e-006	4.2365e-002

FIGURE 10
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain > Figure

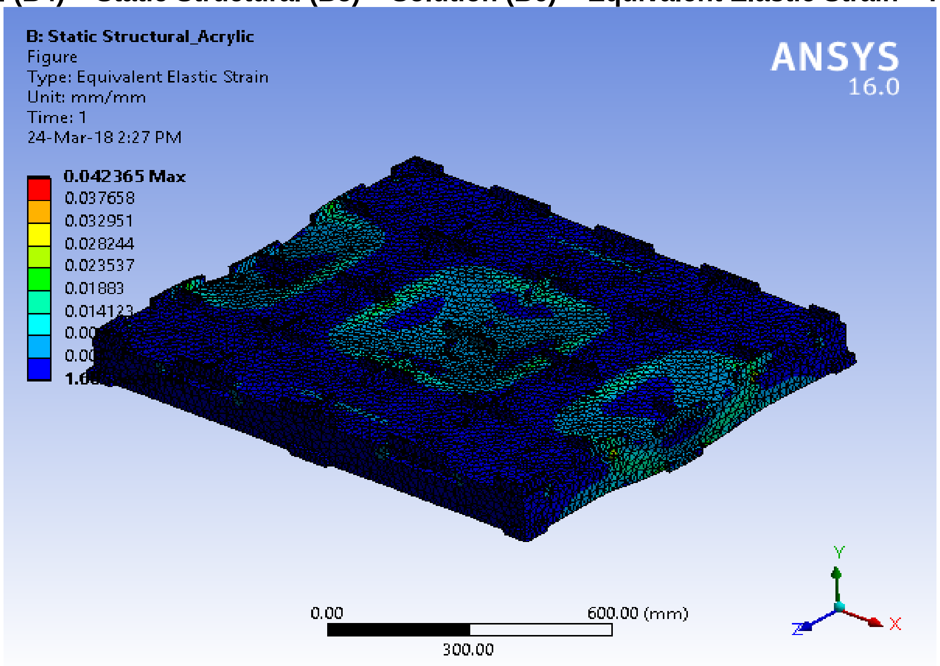


TABLE 15
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Tensile Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 16
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Results

Object Name	*Safety Factor*	*Stress Ratio*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Safety Factor	Stress Ratio
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	

Integration Point Results		
Display Option	Averaged	
Average Across Bodies	No	
Results		
Minimum	1.004	0.
Maximum		0.99606
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	1	

TABLE 17
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	1.004	15.

FIGURE 12
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Safety Factor > Figure

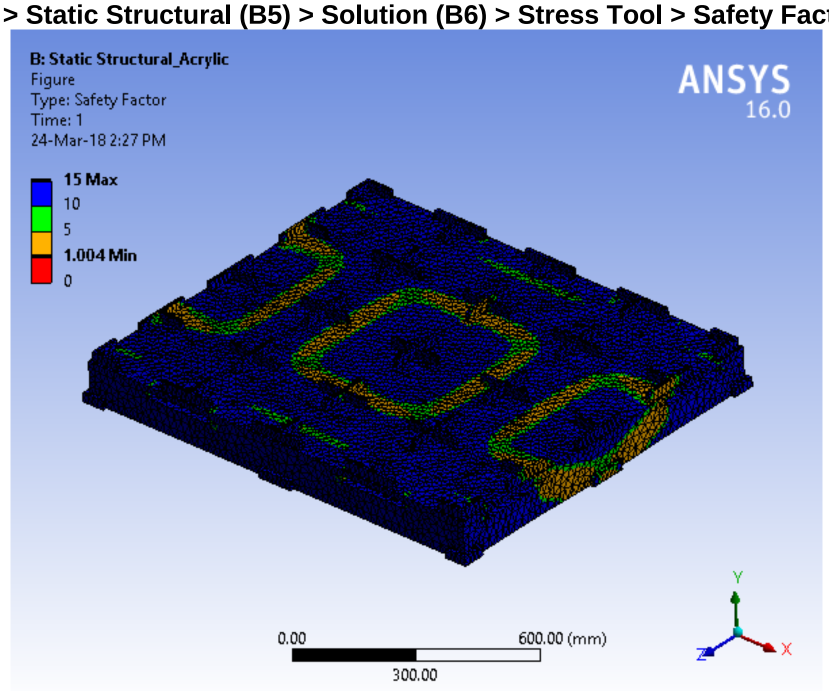
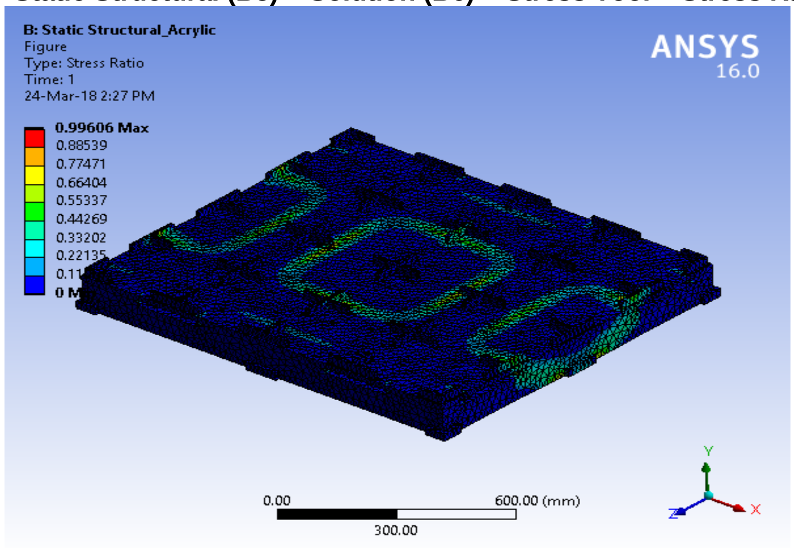


TABLE 18
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Stress Ratio

Time [s]	Minimum	Maximum
1.	0.	0.99606

FIGURE 14
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Stress Ratio > Figure



Material Data

Acryllic Medium High Impact

TABLE 19
Acryllic Medium High Impact > Constants

Density	1.2e-006 kg mm^-3
Coefficient of Thermal Expansion	5.2e-005 C^-1
Thermal Conductivity	2.1e-004 W mm^-1 C^-1

TABLE 20
Acryllic Medium High Impact > Isotropic Secant Coefficient of Thermal Expansion

Reference Temperature C
-0.15

TABLE 21
Acryllic Medium High Impact > Isotropic Elasticity

Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	2403	0.35	2670	890

TABLE 22
Acryllic Medium High Impact > Tensile Yield Strength

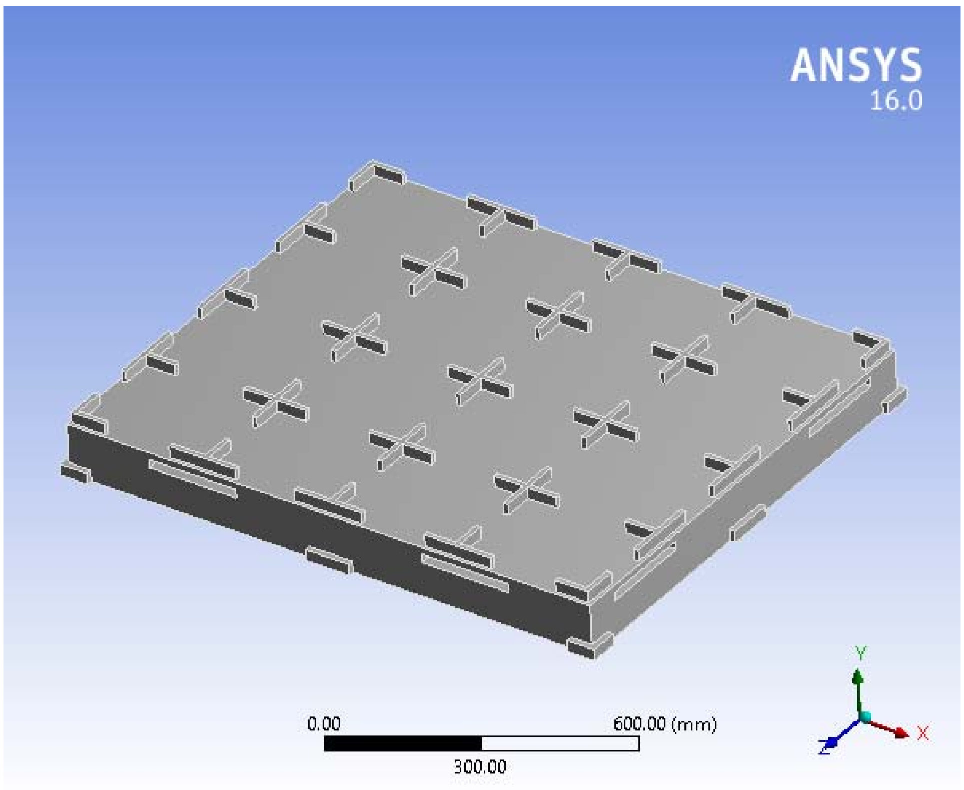
Tensile Yield Strength MPa
73

TABLE 23
Acryllic Medium High Impact > Compressive Yield Strength

Compressive Yield Strength MPa
45

Project

First Saved	Saturday, March 24, 2018
Last Saved	Saturday, March 24, 2018
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (C4)

Geometry

TABLE 2
Model (C4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	1244.6 mm
Length Y	139.7 mm
Length Z	1041.4 mm
Properties	

Volume	5.531e+007 mm³
Mass	66.372 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	101159
Elements	53577
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\jagad\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (C4) > Geometry > Parts

Object Name	*Base Box Pallet 48x40.SLDPRT new for ansys*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Acryllic Medium High Impact
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	1244.6 mm
Length Y	139.7 mm
Length Z	1041.4 mm
Properties	

Volume	5.531e+007 mm³
Mass	66.372 kg
Centroid X	-1.0897e-002 mm
Centroid Y	20.981 mm
Centroid Z	6.0372e-003 mm
Moment of Inertia Ip1	5.8772e+006 kg·mm²
Moment of Inertia Ip2	1.4557e+007 kg·mm²
Moment of Inertia Ip3	8.7611e+006 kg·mm²
Statistics	
Nodes	101159
Elements	53577
Mesh Metric	None

Coordinate Systems

TABLE 4
Model (C4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

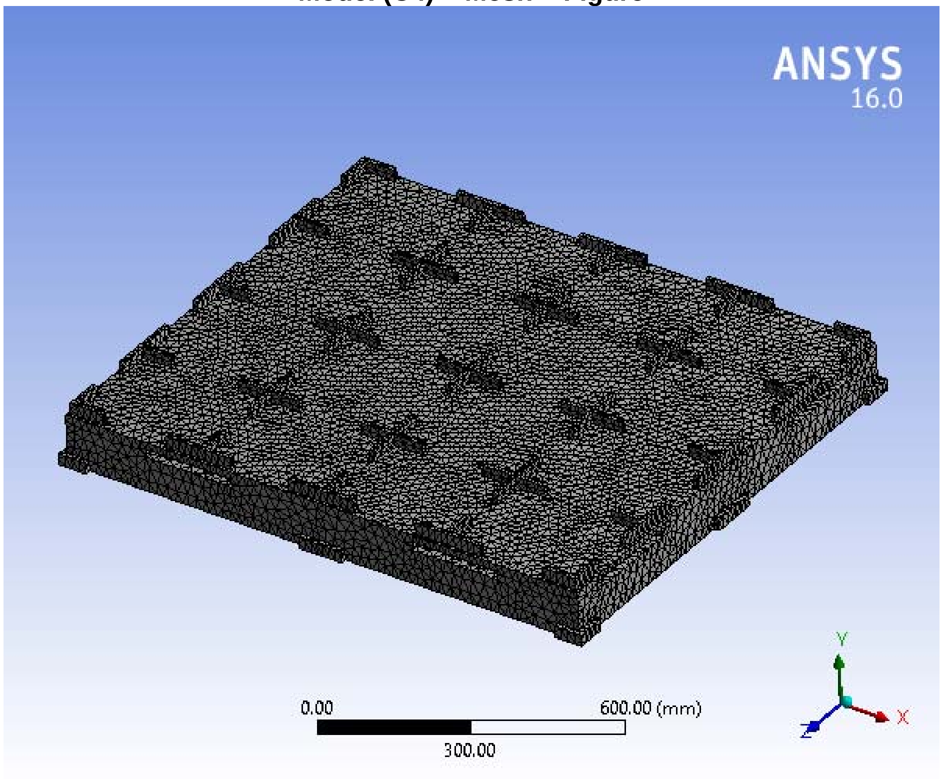
Mesh

TABLE 5
Model (C4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium

Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	10.160 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	101159
Elements	53577
Mesh Metric	None

FIGURE 1
Model (C4) > Mesh > Figure



Static Structural (C5)

TABLE 6
Model (C4) > Analysis

Object Name	*Static Structural (C5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 7
Model (C4) > Static Structural (C5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled

Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\jagad\Desktop\New folder\Static_Base Box Pallet 48x40_files\dp0\SYS-2\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 8
Model (C4) > Static Structural (C5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		

Type	Fixed Support	Force
Suppressed	No	
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. N (ramped)
Y Component		-3.e+005 N (ramped)
Z Component		0. N (ramped)

FIGURE 2
Model (C4) > Static Structural (C5) > Fixed Support > Figure

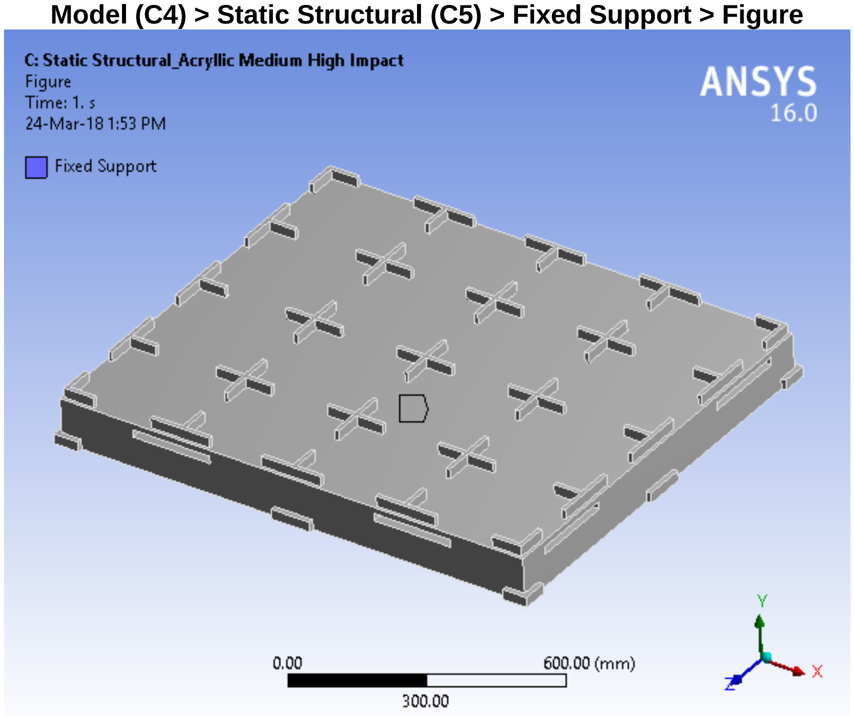


FIGURE 3
Model (C4) > Static Structural (C5) > Force

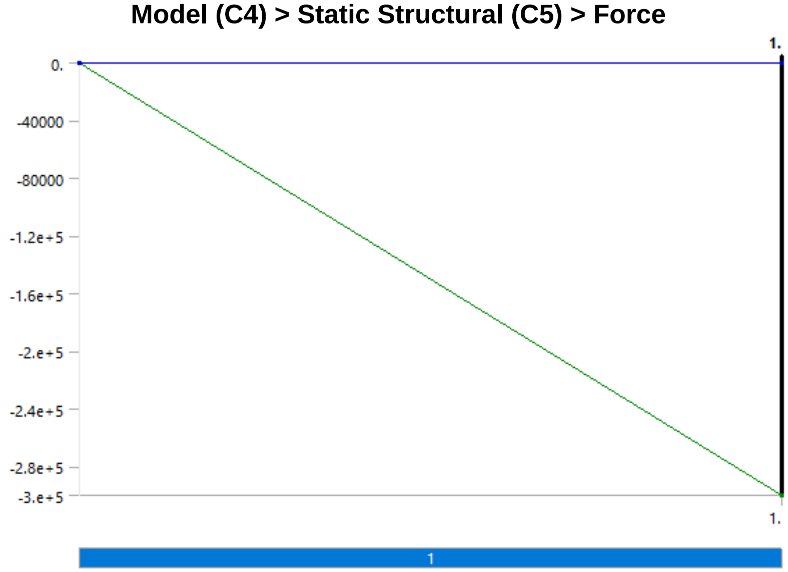
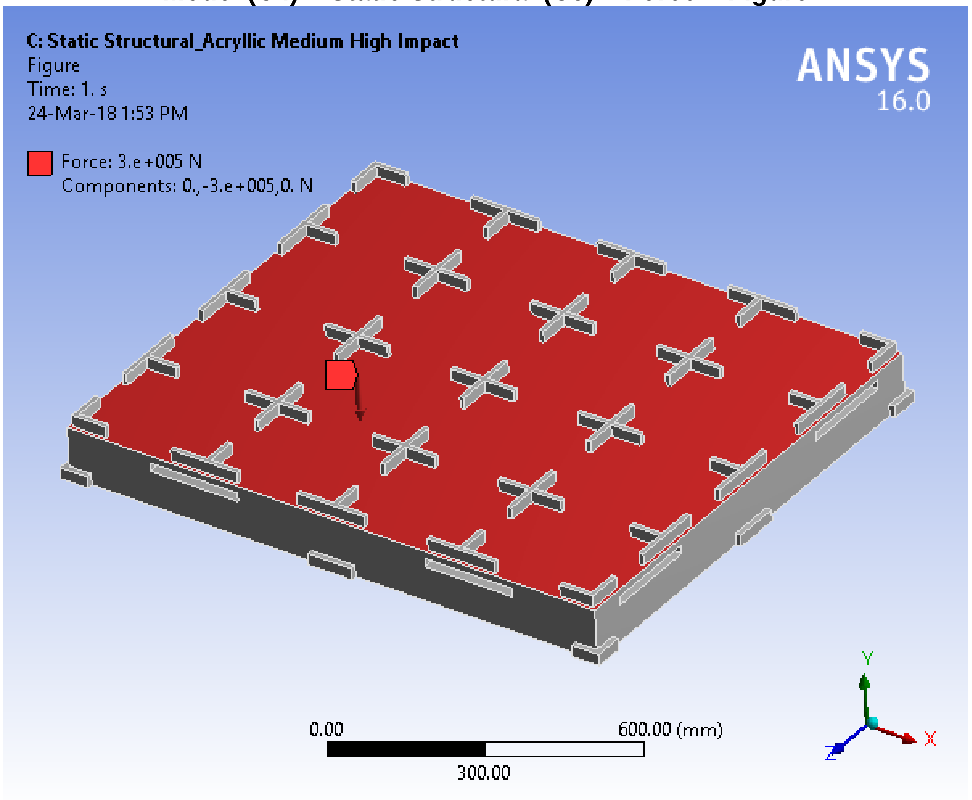


FIGURE 4
Model (C4) > Static Structural (C5) > Force > Figure



Solution (C6)

TABLE 9
Model (C4) > Static Structural (C5) > Solution

Object Name	*Solution (C6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10
Model (C4) > Static Structural (C5) > Solution (C6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All

FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11
Model (C4) > Static Structural (C5) > Solution (C6) > Results

Object Name	*Directional Deformation*	*Equivalent Stress*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Directional Deformation	Equivalent (von-Mises) Stress	Equivalent Elastic Strain
Orientation	Y Axis		
By	Time		
Display Time	Last		
Coordinate System	Global Coordinate System		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	-7.191 mm	3.6106e-002 MPa	1.5026e-005 mm/mm
Maximum	0.14302 mm	34.957 MPa	1.7413e-002 mm/mm
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

TABLE 12
Model (C4) > Static Structural (C5) > Solution (C6) > Directional Deformation

Time [s]	Minimum [mm]	Maximum [mm]
1.	-7.191	0.14302

FIGURE 6

Model (C4) > Static Structural (C5) > Solution (C6) > Directional Deformation > Figure

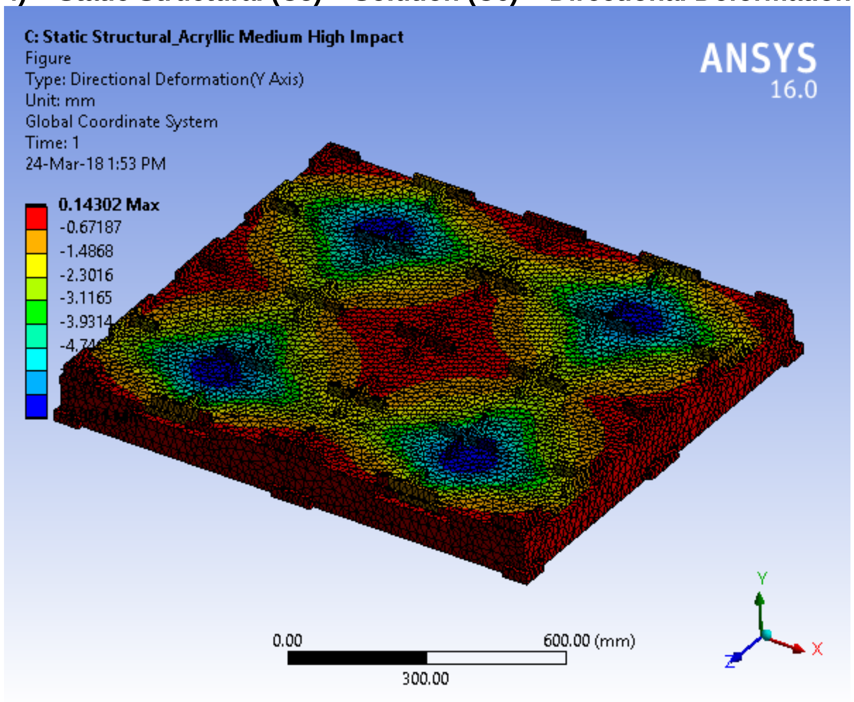


TABLE 13

Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]
1.	3.6106e-002	34.957

FIGURE 8

Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Stress > Figure

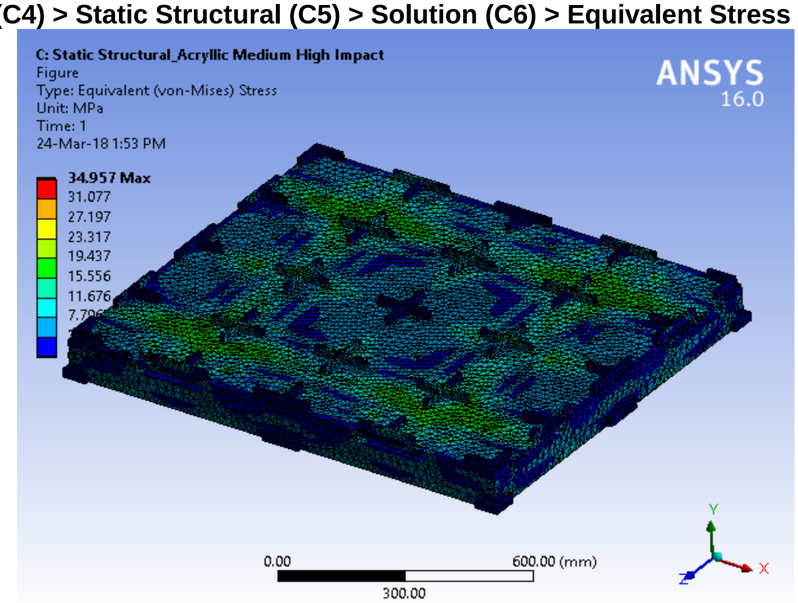


TABLE 14
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]
1.	1.5026e-005	1.7413e-002

FIGURE 10
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Elastic Strain > Figure

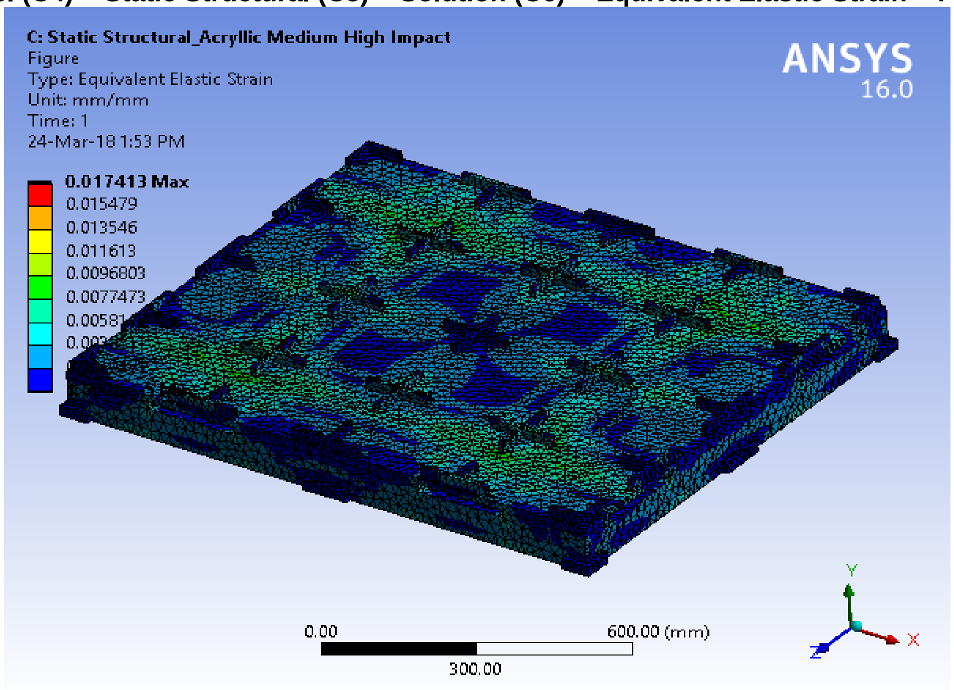


TABLE 15
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Tensile Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 16
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Results

Object Name	*Safety Factor*	*Stress Ratio*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Safety Factor	Stress Ratio
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		

Suppressed	No	
Integration Point Results		
Display Option	Averaged	
Average Across Bodies	No	
Results		
Minimum	3.1427	0.
Maximum		0.3182
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	1	

TABLE 17
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	3.1427	15.

FIGURE 12
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Safety Factor > Figure

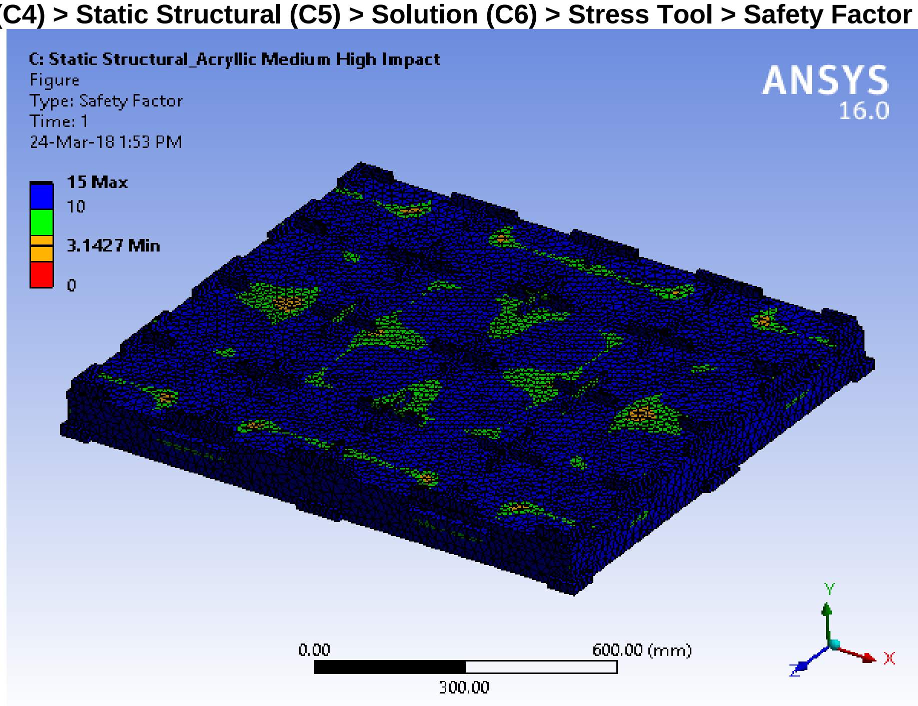
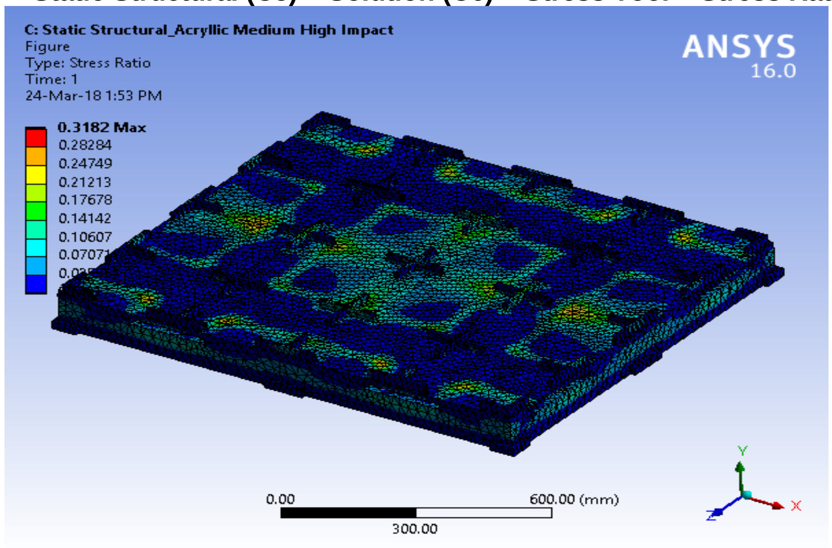


TABLE 18
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Stress Ratio

Time [s]	Minimum	Maximum
1.	0.	0.3182

FIGURE 14
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Stress Ratio > Figure



Material Data

Acryllic Medium High Impact

TABLE 19
Acryllic Medium High Impact > Constants

Density	1.2e-006 kg mm^-3
Coefficient of Thermal Expansion	5.2e-005 C^-1
Thermal Conductivity	2.1e-004 W mm^-1 C^-1

TABLE 20
Acryllic Medium High Impact > Isotropic Secant Coefficient of Thermal Expansion

Reference Temperature C
-0.15

TABLE 21
Acryllic Medium High Impact > Isotropic Elasticity

Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	2403	0.35	2670	890

TABLE 22
Acryllic Medium High Impact > Tensile Yield Strength

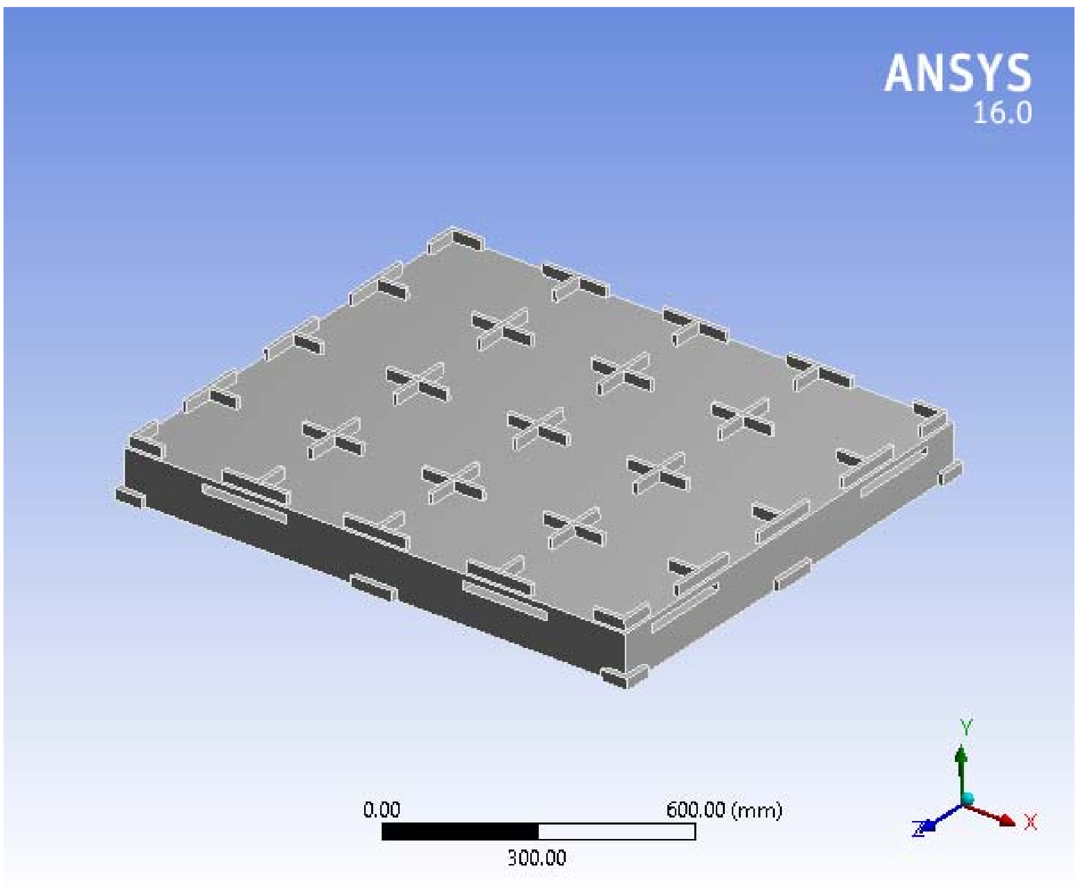
Tensile Yield Strength MPa
73

TABLE 23
Acryllic Medium High Impact > Compressive Yield Strength

Compressive Yield Strength MPa
45

Project

First Saved	Saturday, March 24, 2018
Last Saved	Saturday, March 24, 2018
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	1244.6 mm
Length Y	139.7 mm
Length Z	1041.4 mm
Properties	

Volume	5.531e+007 mm³
Mass	8.8491 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	101197
Elements	53631
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\jagad\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	*Base Box Pallet 48x40.SLDPRT new for ansys*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Balsa
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	1244.6 mm
Length Y	139.7 mm
Length Z	1041.4 mm
Properties	

Volume	5.531e+007 mm³
Mass	8.8491 kg
Centroid X	-1.0897e-002 mm
Centroid Y	20.981 mm
Centroid Z	6.0372e-003 mm
Moment of Inertia Ip1	7.8358e+005 kg·mm²
Moment of Inertia Ip2	1.9408e+006 kg·mm²
Moment of Inertia Ip3	1.1681e+006 kg·mm²
Statistics	
Nodes	101197
Elements	53631
Mesh Metric	None

Coordinate Systems

TABLE 4
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

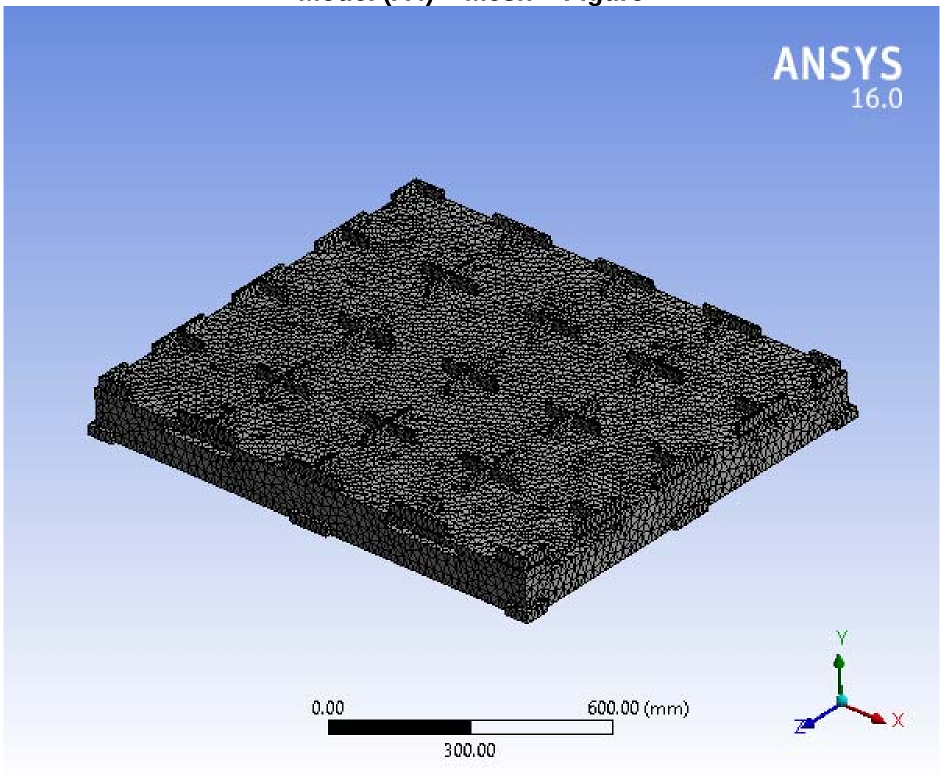
Mesh

TABLE 5
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium

Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	10.160 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	101197
Elements	53631
Mesh Metric	None

FIGURE 1
Model (A4) > Mesh > Figure



Static Structural (A5)

TABLE 6
Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 7
Model (A4) > Static Structural (A5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.

Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No

Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\jagad\AppData\Local\Temp\WB_ _2\\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 8
Model (A4) > Static Structural (A5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. N (ramped)
Y Component		-2.5e+005 N (ramped)
Z Component		0. N (ramped)

FIGURE 2
Model (A4) > Static Structural (A5) > Fixed Support > Figure

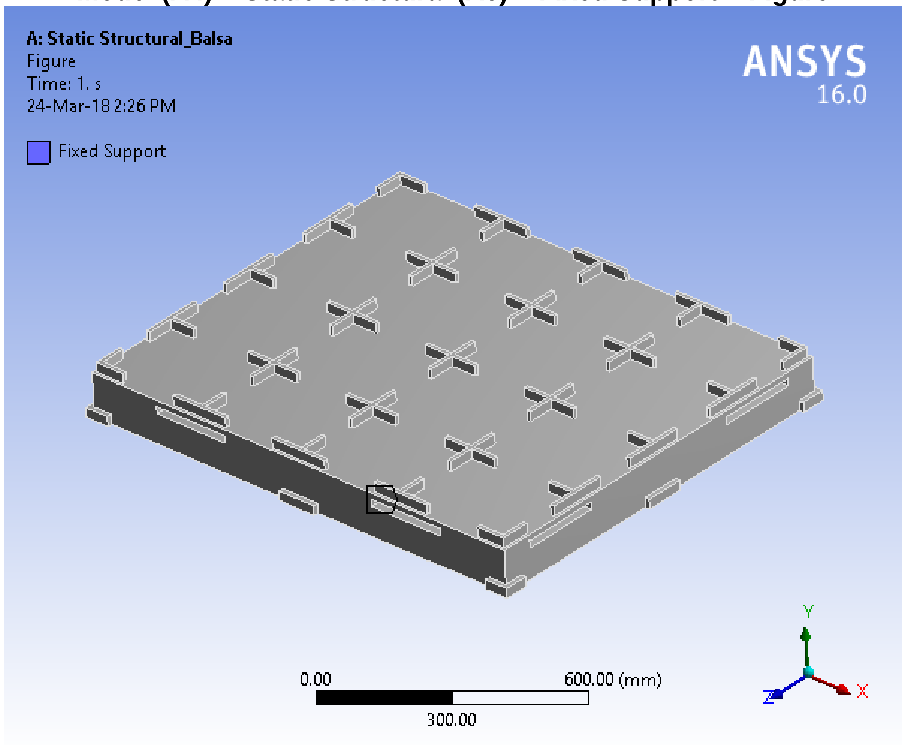


FIGURE 3
Model (A4) > Static Structural (A5) > Force

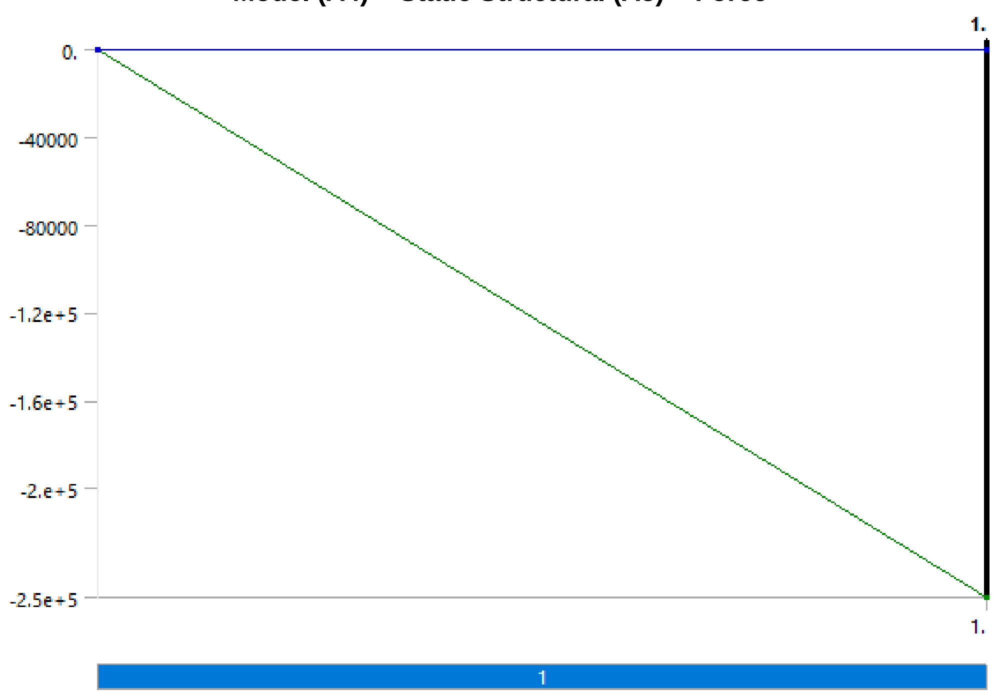
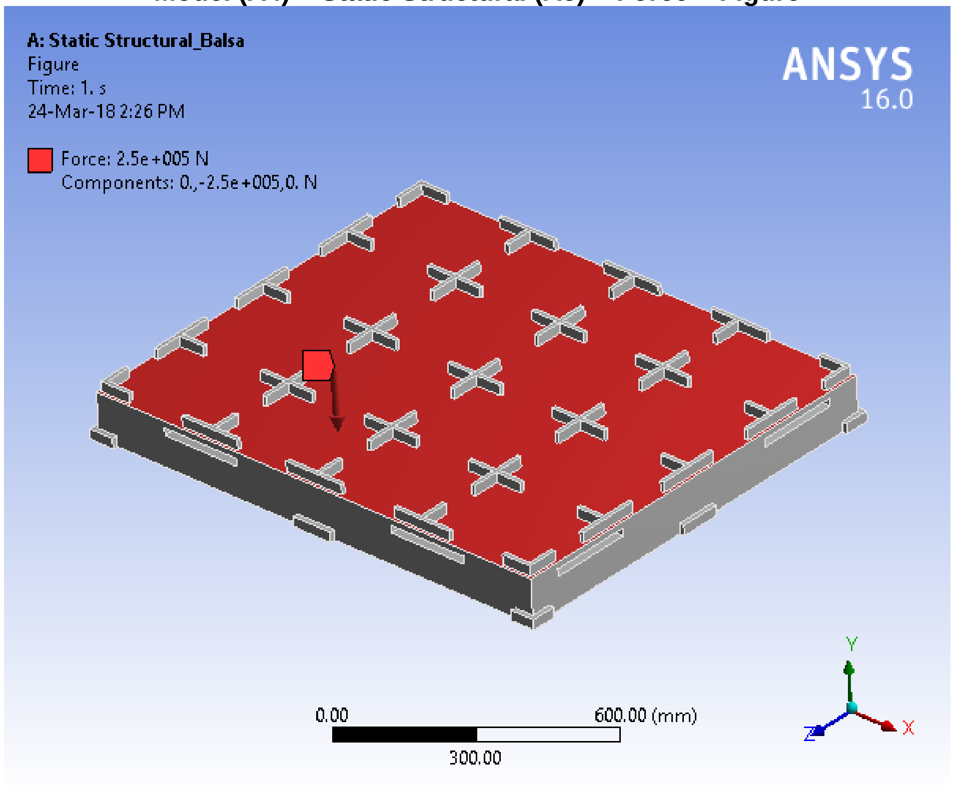


FIGURE 4
Model (A4) > Static Structural (A5) > Force > Figure



Solution (A6)

TABLE 9
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All

FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Directional Deformation*	*Equivalent Stress*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Directional Deformation	Equivalent (von-Mises) Stress	Equivalent Elastic Strain
Orientation	Y Axis		
By	Time		
Display Time	Last		
Coordinate System	Global Coordinate System		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	-1.5449 mm	2.522e-004 MPa	3.2585e-007 mm/mm
Maximum	0.12131 mm	5.7548 MPa	9.9072e-003 mm/mm
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

TABLE 12
Model (A4) > Static Structural (A5) > Solution (A6) > Directional Deformation

Time [s]	Minimum [mm]	Maximum [mm]
1.	-1.5449	0.12131

FIGURE 6
Model (A4) > Static Structural (A5) > Solution (A6) > Directional Deformation > Figure

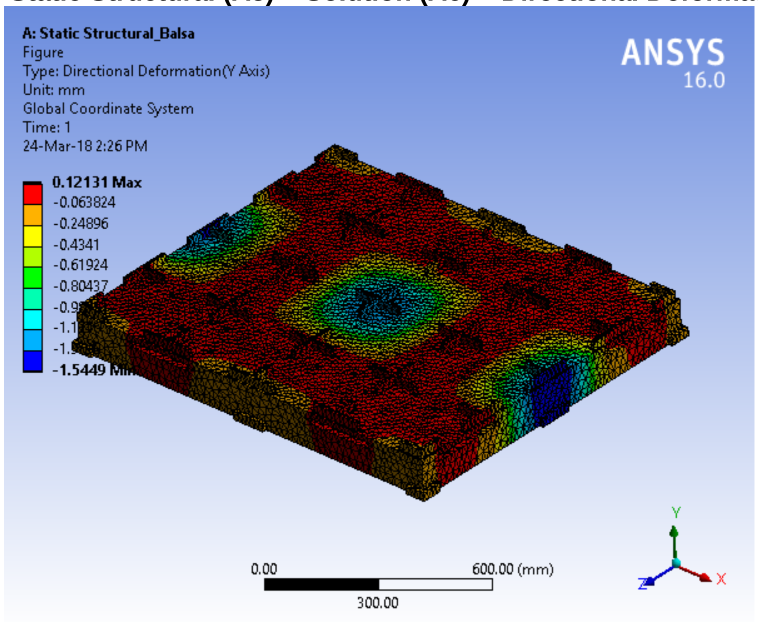


TABLE 13
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]
1.	2.522e-004	5.7548

FIGURE 8
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress > Figure

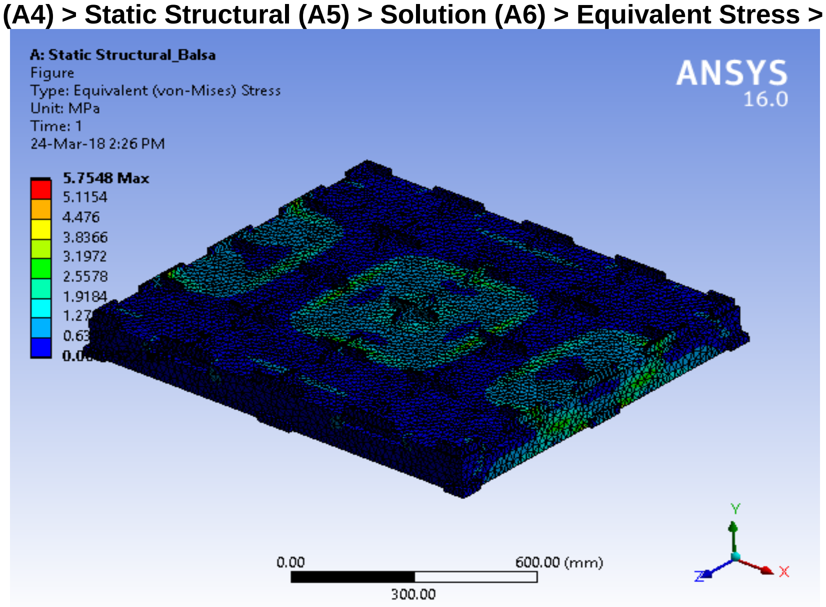


TABLE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]
1.	3.2585e-007	9.9072e-003

FIGURE 10
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain > Figure

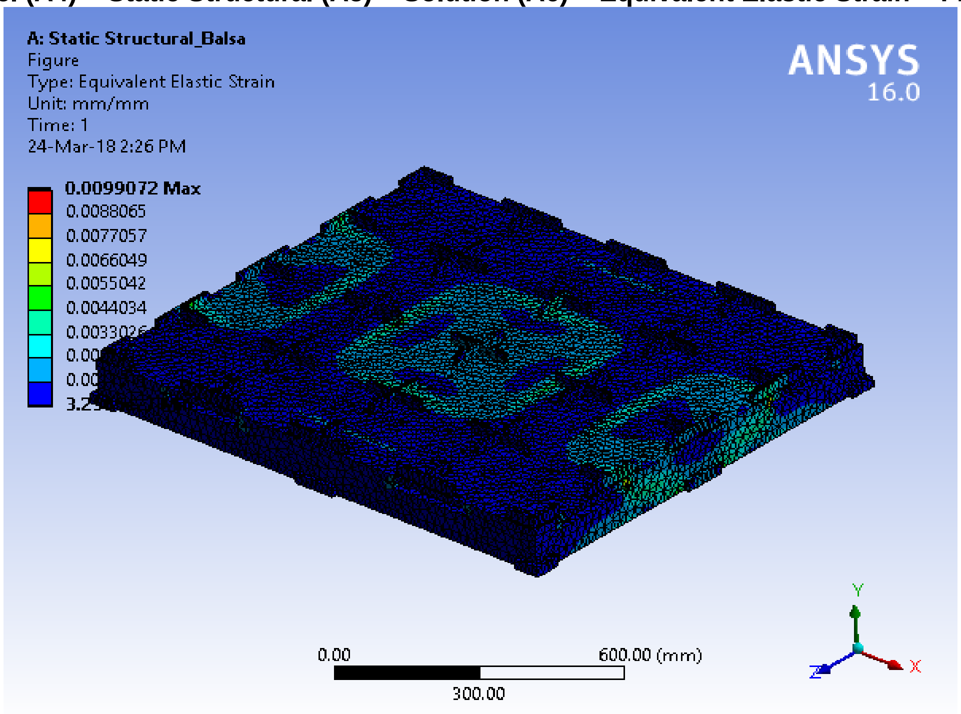


TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Tensile Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Results

Object Name	*Safety Factor*	*Stress Ratio*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Safety Factor	Stress Ratio
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		

Suppressed	No	
Integration Point Results		
Display Option	Averaged	
Average Across Bodies	No	
Results		
Minimum	3.8025	0.
Maximum		0.26298
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	1	

TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	3.8025	15.

FIGURE 12
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor > Figure

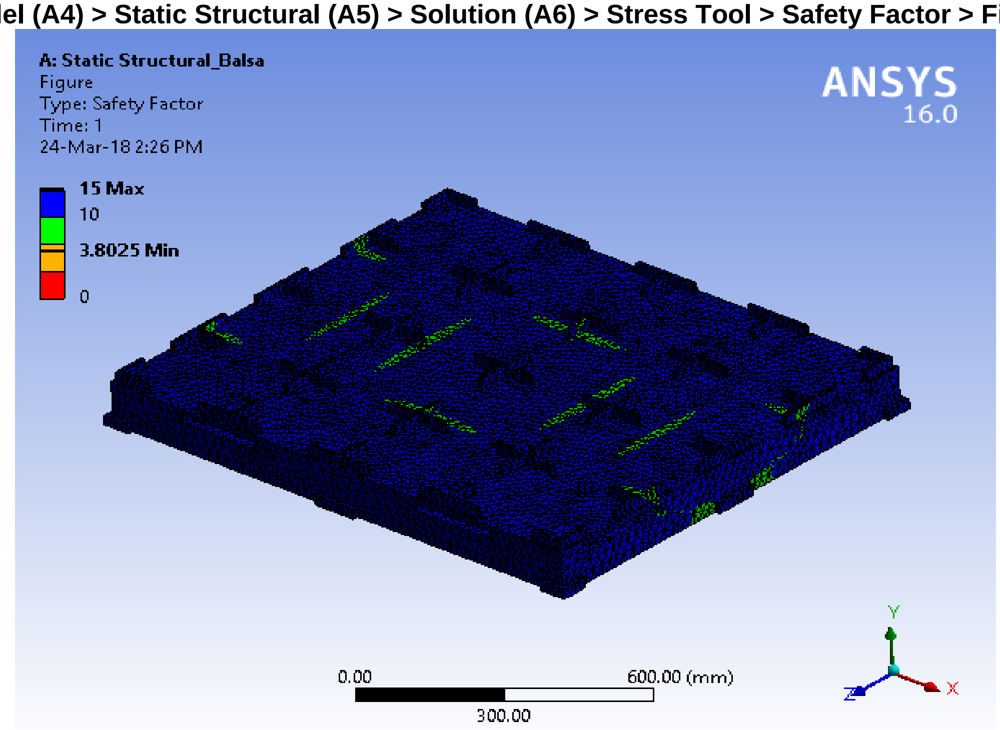
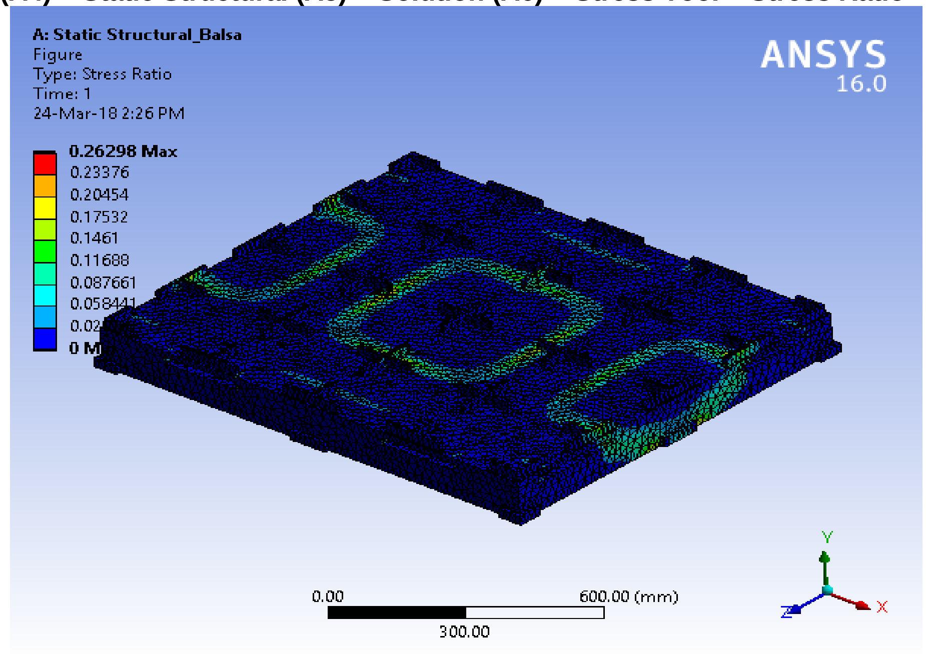


TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Stress Ratio

Time [s]	Minimum	Maximum
1.	0.	0.26298

FIGURE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Stress Ratio > Figure



Material Data

Balsa

TABLE 19
Balsa > Constants

Density	1.5999e-007 kg mm^-3
Thermal Conductivity	5.e-005 W mm^-1 C^-1

TABLE 20
Balsa > Isotropic Elasticity

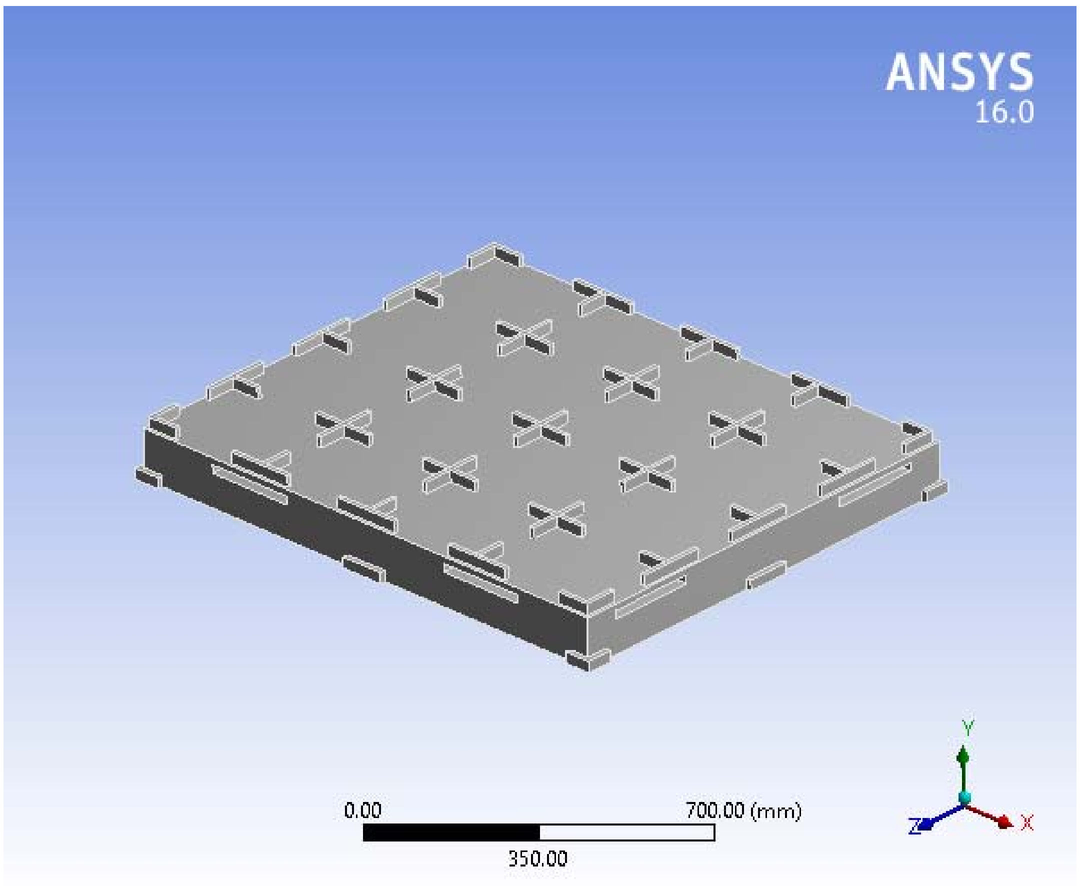
Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	774	0.29	614.29	300

TABLE 21
Balsa > Tensile Yield Strength

Tensile Yield Strength MPa
20

Project

First Saved	Saturday, March 24, 2018
Last Saved	Saturday, March 24, 2018
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	1244.6 mm
Length Y	139.7 mm
Length Z	1041.4 mm
Properties	

Volume	5.531e+007 mm³
Mass	8.8491 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	101159
Elements	53577
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\jagad\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	*Base Box Pallet 48x40.SLDPRT new for ansys*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Balsa
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	1244.6 mm
Length Y	139.7 mm
Length Z	1041.4 mm
Properties	

Volume	5.531e+007 mm³
Mass	8.8491 kg
Centroid X	-1.0897e-002 mm
Centroid Y	20.981 mm
Centroid Z	6.0372e-003 mm
Moment of Inertia Ip1	7.8358e+005 kg·mm²
Moment of Inertia Ip2	1.9408e+006 kg·mm²
Moment of Inertia Ip3	1.1681e+006 kg·mm²
Statistics	
Nodes	101159
Elements	53577
Mesh Metric	None

Coordinate Systems

TABLE 4
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

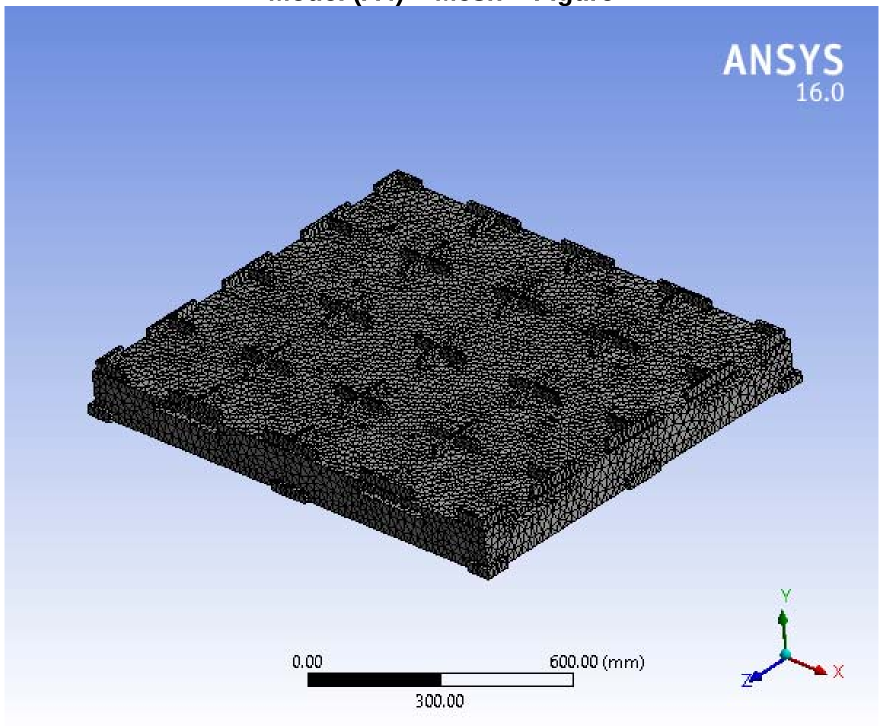
Mesh

TABLE 5
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium

Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	10.160 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	101159
Elements	53577
Mesh Metric	None

FIGURE 1
Model (A4) > Mesh > Figure



Static Structural (A5)

TABLE 6
Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 7
Model (A4) > Static Structural (A5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled

Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\jagad\Desktop\New folder\Static_Base Box Pallet 48x40_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 8
Model (A4) > Static Structural (A5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Components
Coordinate System		Global Coordinate System

X Component		0. N (ramped)
Y Component		-2.5e+005 N (ramped)
Z Component		0. N (ramped)

FIGURE 2
Model (A4) > Static Structural (A5) > Fixed Support > Figure

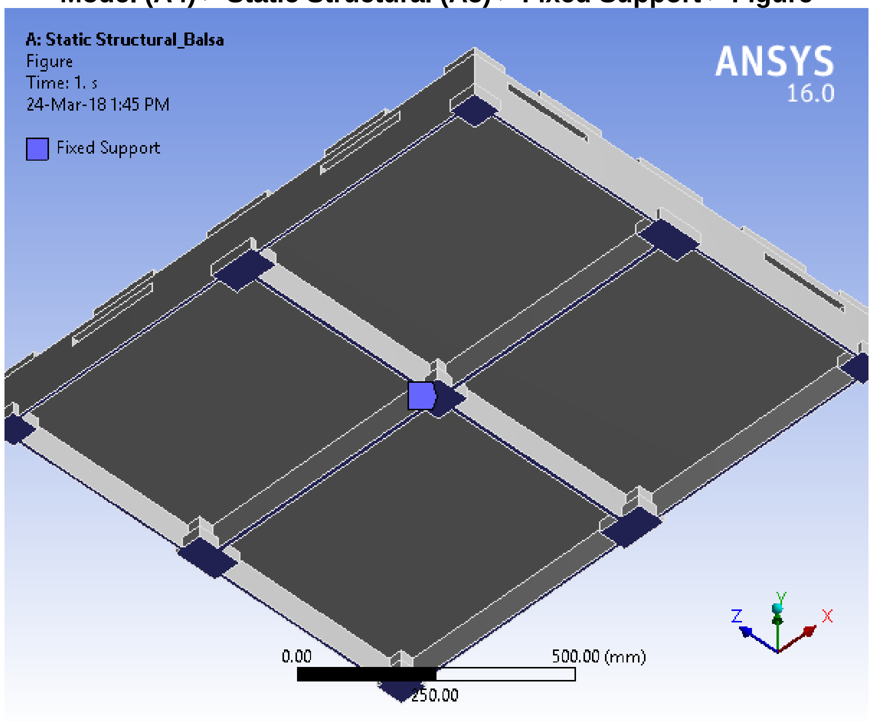


FIGURE 3
Model (A4) > Static Structural (A5) > Force

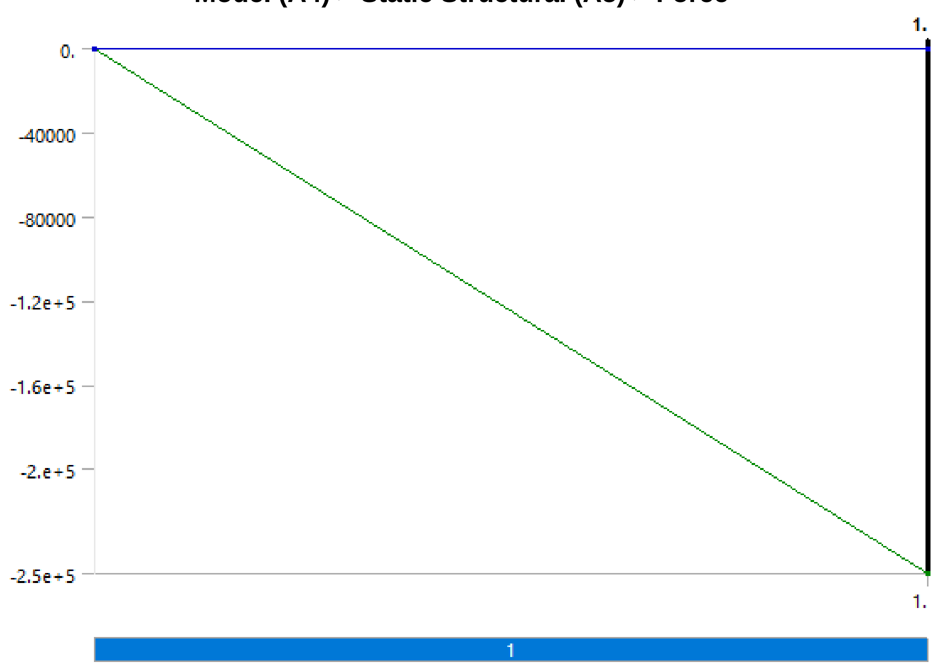
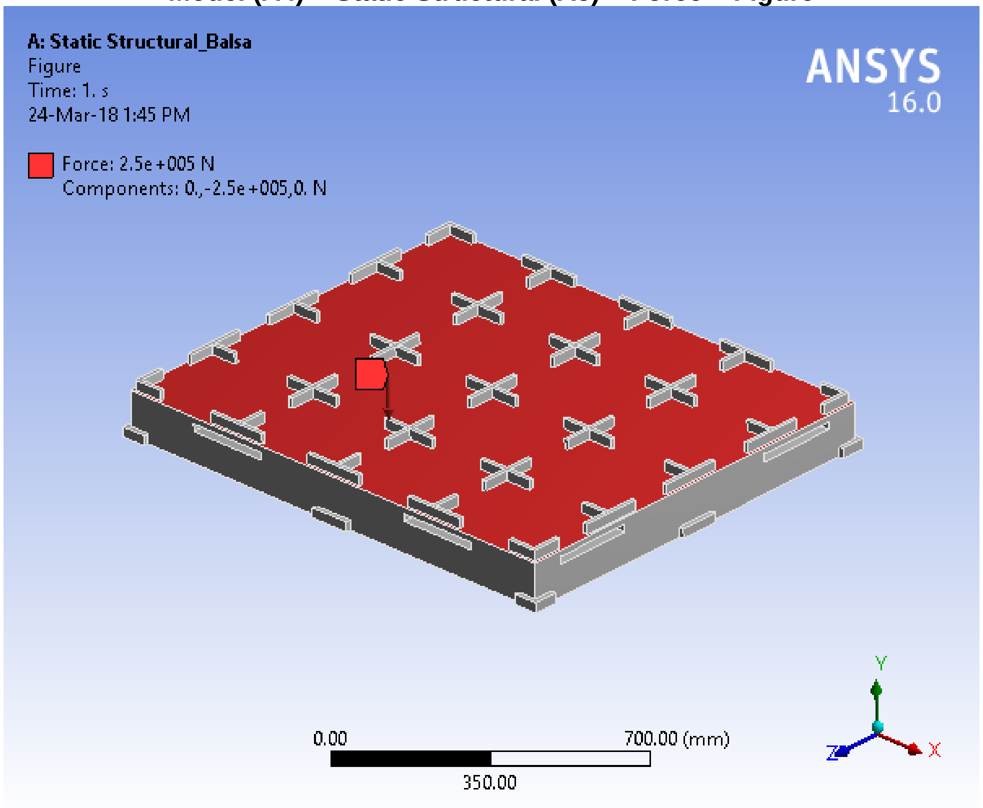


FIGURE 4
Model (A4) > Static Structural (A5) > Force > Figure



Solution (A6)

TABLE 9
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All

FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Directional Deformation*	*Equivalent Stress*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Directional Deformation	Equivalent (von-Mises) Stress	Equivalent Elastic Strain
Orientation	Y Axis		
By	Time		
Display Time	Last		
Coordinate System	Global Coordinate System		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	-19.143 mm	3.0053e-002 MPa	3.8828e-005 mm/mm
Maximum	0.39131 mm	29.136 MPa	4.5826e-002 mm/mm
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

TABLE 12
Model (A4) > Static Structural (A5) > Solution (A6) > Directional Deformation

Time [s]	Minimum [mm]	Maximum [mm]
1.	-19.143	0.39131

FIGURE 6
Model (A4) > Static Structural (A5) > Solution (A6) > Directional Deformation > Figure

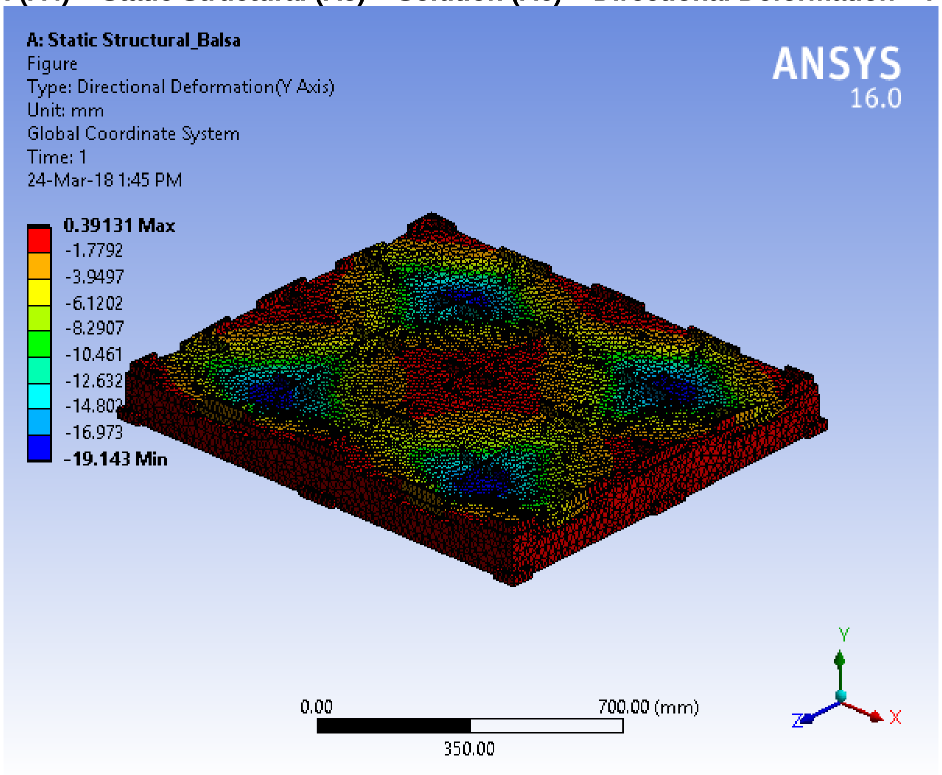


TABLE 13
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]
1.	3.0053e-002	29.136

FIGURE 8
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress > Figure

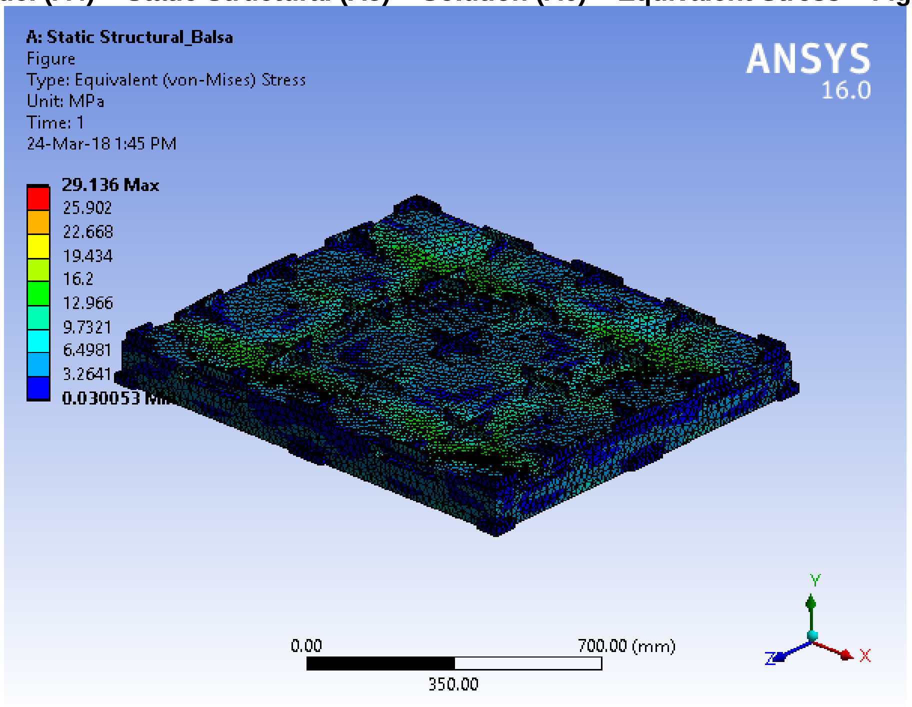


TABLE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]
1.	3.8828e-005	4.5826e-002

FIGURE 10
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain > Figure

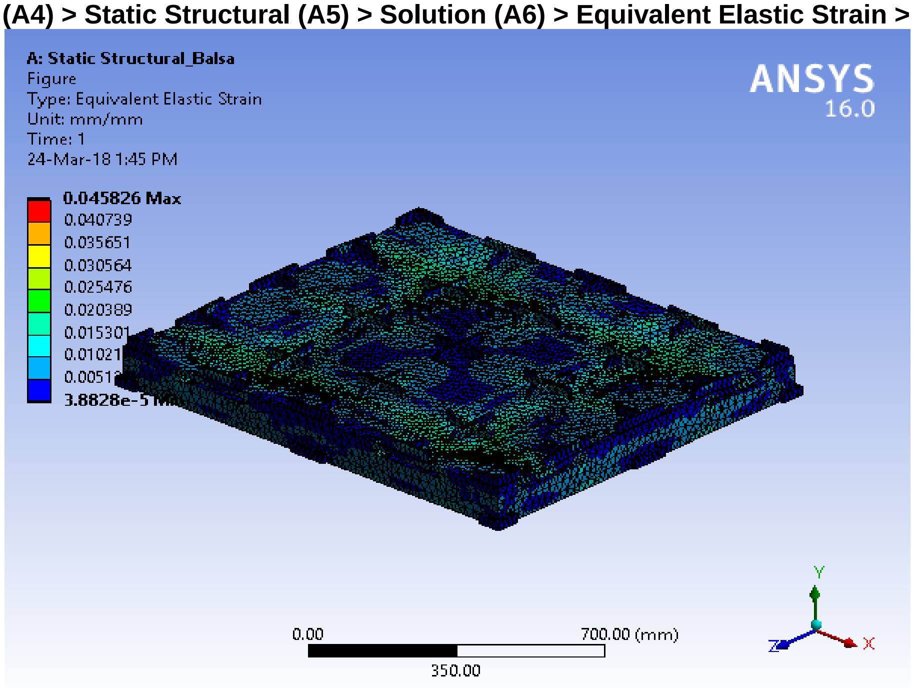


TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Tensile Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Results

Object Name	*Safety Factor*	*Stress Ratio*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Safety Factor	Stress Ratio
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Integration Point Results		
Display Option	Averaged	
Average Across Bodies	No	
Results		
Minimum	1.0491	0.
Maximum		0.95317
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	1	

TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	1.0491	15.

FIGURE 12
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor > Figure

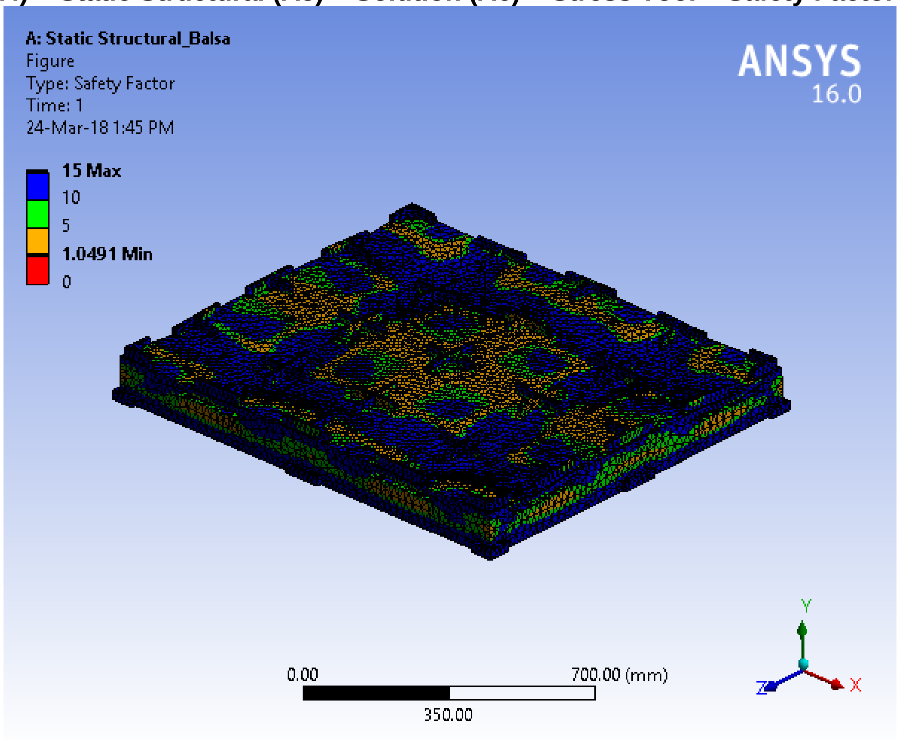
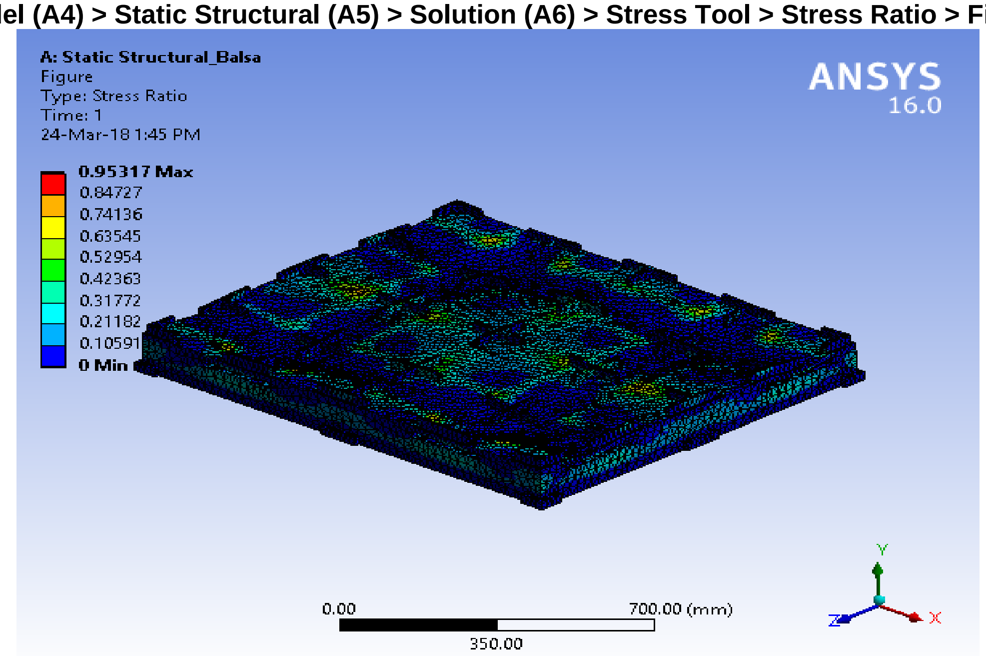


TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Stress Ratio

Time [s]	Minimum	Maximum
1.	0.	0.95317

FIGURE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Stress Ratio > Figure



Material Data

Balsa

TABLE 19
Balsa > Constants

Density	1.5999e-007 kg mm^-3
Thermal Conductivity	5.e-005 W mm^-1 C^-1

TABLE 20
Balsa > Isotropic Elasticity

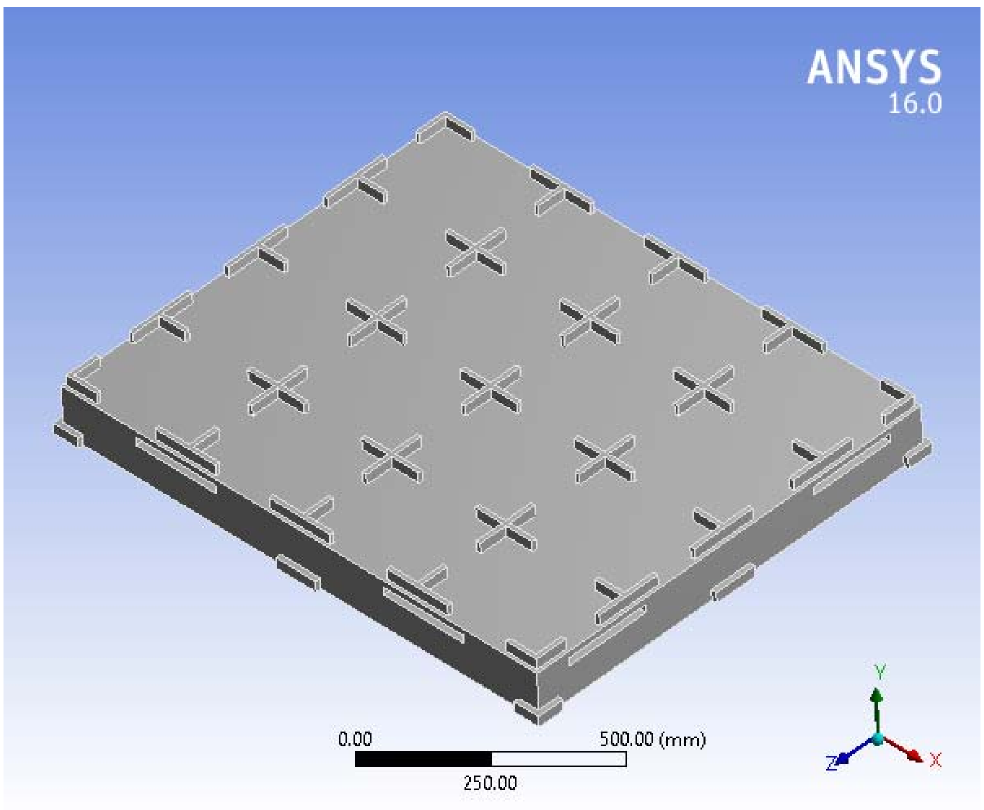
Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	774	0.29	614.29	300

TABLE 21
Balsa > Tensile Yield Strength

Tensile Yield Strength MPa
20

Project

First Saved	Saturday, March 24, 2018
Last Saved	Saturday, March 24, 2018
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (C4)

Geometry

TABLE 2
Model (C4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	1244.6 mm
Length Y	139.7 mm
Length Z	1041.4 mm

Properties	
Volume	5.531e+007 mm³
Mass	50.056 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	12291
Elements	42354
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\jagad\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (C4) > Geometry > Parts

Object Name	*Base Box Pallet 48x40.SLDPRT new for ansys*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Reference Frame	Lagrangian
Material	
Assignment	Very Low Density PE
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	1244.6 mm
Length Y	139.7 mm

Length Z	1041.4 mm
Properties	
Volume	5.531e+007 mm³
Mass	50.056 kg
Centroid X	-1.0897e-002 mm
Centroid Y	20.981 mm
Centroid Z	6.0372e-003 mm
Moment of Inertia Ip1	4.4324e+006 kg·mm²
Moment of Inertia Ip2	1.0978e+007 kg·mm²
Moment of Inertia Ip3	6.6073e+006 kg·mm²
Statistics	
Nodes	12291
Elements	42354
Mesh Metric	None

Coordinate Systems

TABLE 4
Model (C4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

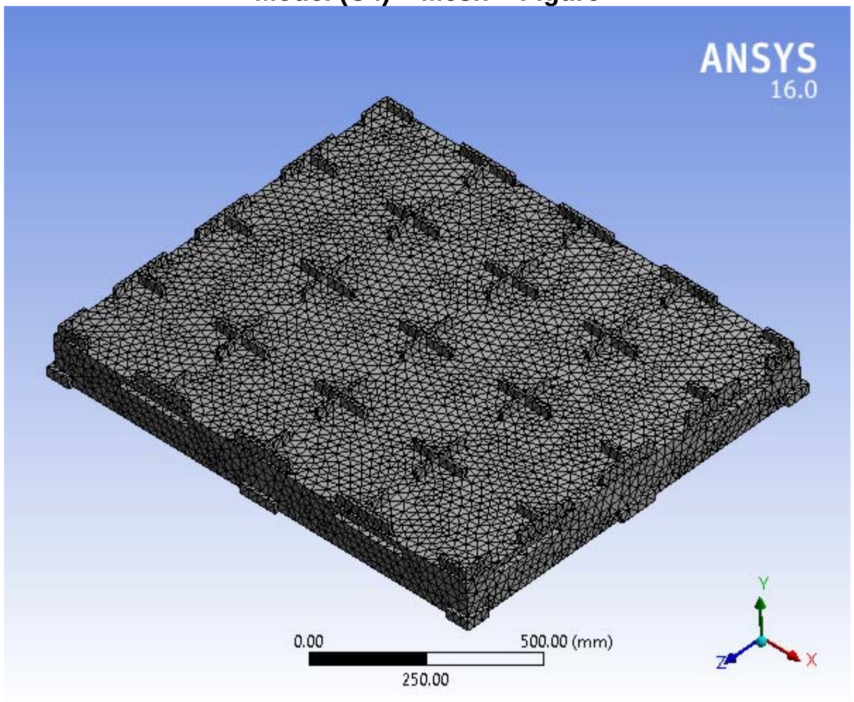
Mesh

TABLE 5
Model (C4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Explicit
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Medium
Element Size	Default

Initial Size Seed	Active Assembly
Smoothing	High
Transition	Slow
Span Angle Center	Coarse
Minimum Edge Length	10.160 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Explicit
Element Midside Nodes	Dropped
Straight Sided Elements	
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Full Mesh
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	12291
Elements	42354
Mesh Metric	None

FIGURE 1
Model (C4) > Mesh > Figure



Explicit Dynamics (C5)

TABLE 6
Model (C4) > Analysis

Object Name	*Explicit Dynamics (C5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Explicit Dynamics
Solver Target	AUTODYN
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 7
Model (C4) > Explicit Dynamics (C5) > Initial Conditions

Object Name	*Initial Conditions*
State	Fully Defined

TABLE 8
Model (C4) > Explicit Dynamics (C5) > Initial Conditions > Initial Condition

Object Name	*Pre-Stress (None)*	*Velocity*
State	Fully Defined	
Definition		
Pre-Stress Environment	None	
Pressure Initialization	From Deformed State	

Input Type		Velocity
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. mm/s
Y Component		580. mm/s
Z Component		0. mm/s
Suppressed		No
Scope		
Scoping Method		Geometry Selection
Geometry		1 Body

FIGURE 2
Model (C4) > Explicit Dynamics (C5) > Initial Conditions > Velocity > Figure

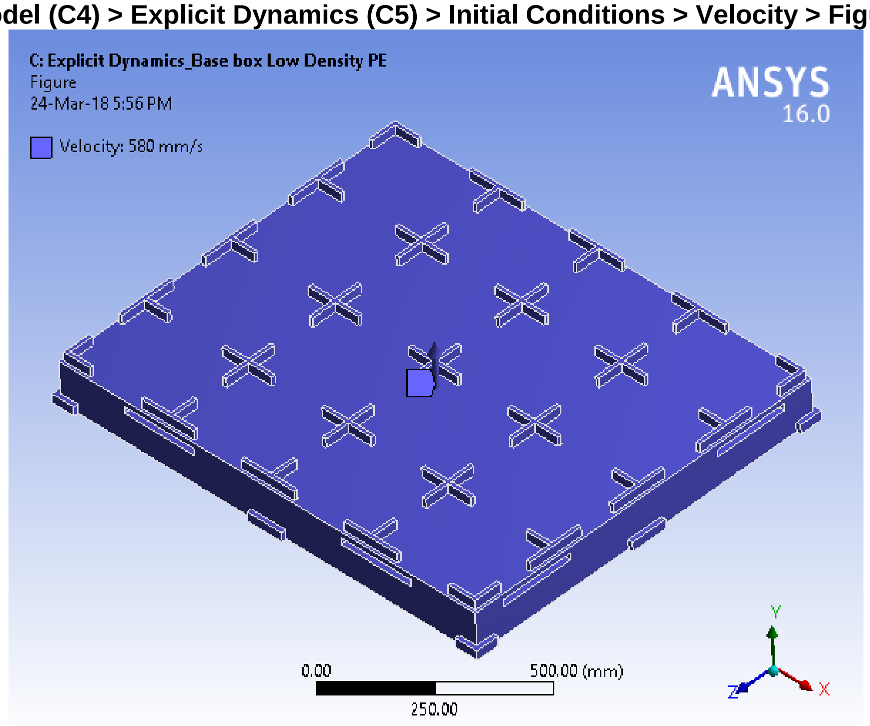


TABLE 9
Model (C4) > Explicit Dynamics (C5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Analysis Settings Preference	
Type	Program Controlled
Step Controls	
Resume From Cycle	0
Maximum Number of Cycles	1e+07
End Time	2.e-004 s
Maximum Energy Error	0.1
Reference Energy Cycle	0
Initial Time Step	Program Controlled
Minimum Time Step	Program Controlled
Maximum Time Step	Program Controlled

Time Step Safety Factor	0.9
Characteristic Dimension	Diagonals
Automatic Mass Scaling	No
Solver Controls	
Solve Units	mm, mg, ms
Beam Solution Type	Bending
Beam Time Step Safety Factor	0.5
Hex Integration Type	Exact
Shell Sublayers	3
Shell Shear Correction Factor	0.8333
Shell BWC Warp Correction	Yes
Shell Thickness Update	Nodal
Tet Integration	Average Nodal Pressure
Shell Inertia Update	Recompute
Density Update	Program Controlled
Minimum Velocity	1.e-003 mm s^-1
Maximum Velocity	1.e+013 mm s^-1
Radius Cutoff	1.e-003
Minimum Strain Rate Cutoff	1.e-010
Euler Domain Controls	
Domain Size Definition	Program Controlled
Display Euler Domain	Yes
Scope	All Bodies
X Scale factor	1.2
Y Scale factor	1.2
Z Scale factor	1.2
Domain Resolution Definition	Total Cells
Total Cells	2.5e+05
Lower X Face	Flow Out
Lower Y Face	Flow Out
Lower Z Face	Flow Out
Upper X Face	Flow Out
Upper Y Face	Flow Out
Upper Z Face	Flow Out
Euler Tracking	By Body
Damping Controls	
Linear Artificial Viscosity	0.2
Quadratic Artificial Viscosity	1.
Linear Viscosity in Expansion	No
Artificial Viscosity For Shells	Yes
Hourglass Damping	AUTODYN Standard
Viscous Coefficient	0.1
Static Damping	0.
Erosion Controls	
On Geometric Strain Limit	Yes
Geometric Strain Limit	1.5
On Material Failure	No
On Minimum Element Time Step	No

Retain Inertia of Eroded Material	Yes
Output Controls	
Save Results on	Equally Spaced Points
Result Number Of Points	20
Save Restart Files on	Equally Spaced Points
Restart Number Of Points	5
Save Result Tracker Data on	Cycles
Tracker Cycles	1
Output Contact Forces	Off
Analysis Data Management	
Solver Files Directory	C:\Users\jagad\AppData\Local\Temp\WB_3988_2\unsaved_project_files\dp0\SYS-2\MECH\
Scratch Solver Files Directory	

TABLE 10
Model (C4) > Explicit Dynamics (C5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. N (step applied)
Y Component		-1.2e+007 N (step applied)
Z Component		0. N (step applied)

FIGURE 3
Model (C4) > Explicit Dynamics (C5) > Fixed Support > Figure

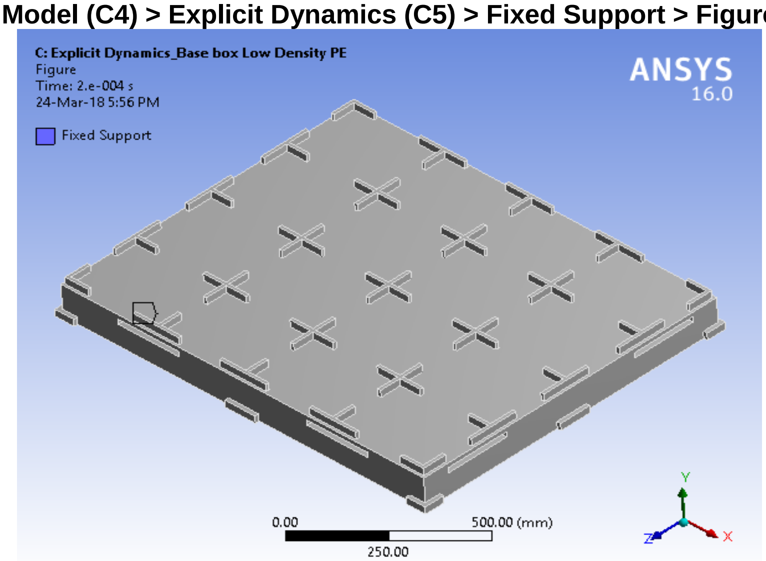


FIGURE 4
Model (C4) > Explicit Dynamics (C5) > Force

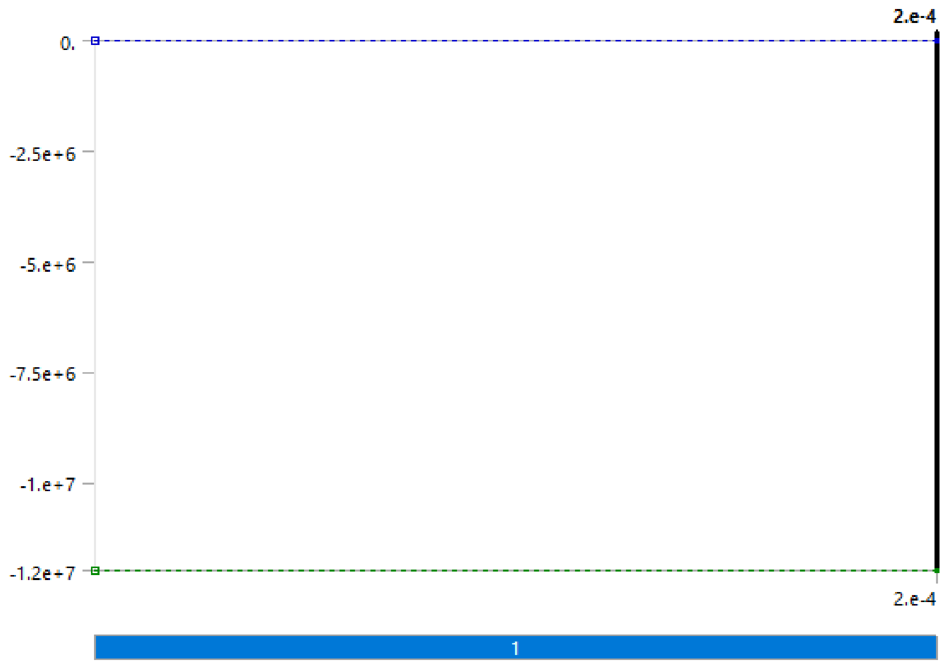
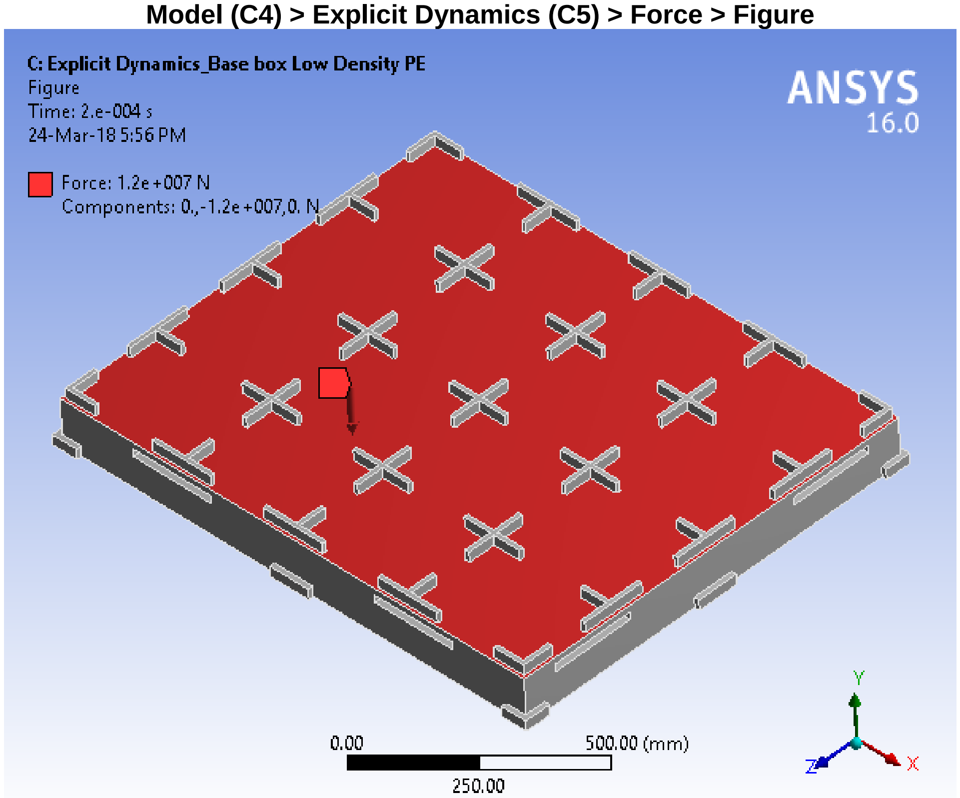


FIGURE 5
Model (C4) > Explicit Dynamics (C5) > Force > Figure



Solution (C6)

TABLE 11
Model (C4) > Explicit Dynamics (C5) > Solution

Object Name	*Solution (C6)*
State	Solved
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 12
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Update Interval	2.5 s
Display Points	All
Display Filter During Solve	Yes

TABLE 13
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Results

Object Name	*Directional Deformation*	*Equivalent Stress*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Directional Deformation	Equivalent (von-Mises) Stress	Equivalent Elastic Strain
Orientation	Y Axis		
By	Time		
Display Time	Last		
Coordinate System	Global Coordinate System		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	-14.003 mm	3.0365e-003 MPa	1.8447e-005 mm/mm
Maximum	0.44066 mm	56.707 MPa	0.33188 mm/mm
Minimum Value Over Time			
Minimum	-14.003 mm	0. MPa	0. mm/mm
Maximum	0. mm	3.0365e-003 MPa	1.8447e-005 mm/mm

Maximum Value Over Time			
Minimum	0. mm	0. MPa	0. mm/mm
Maximum	0.64283 mm	67.036 MPa	0.41264 mm/mm
Information			
Time	2.0003e-004 s		
Set	21		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

FIGURE 6
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Directional Deformation

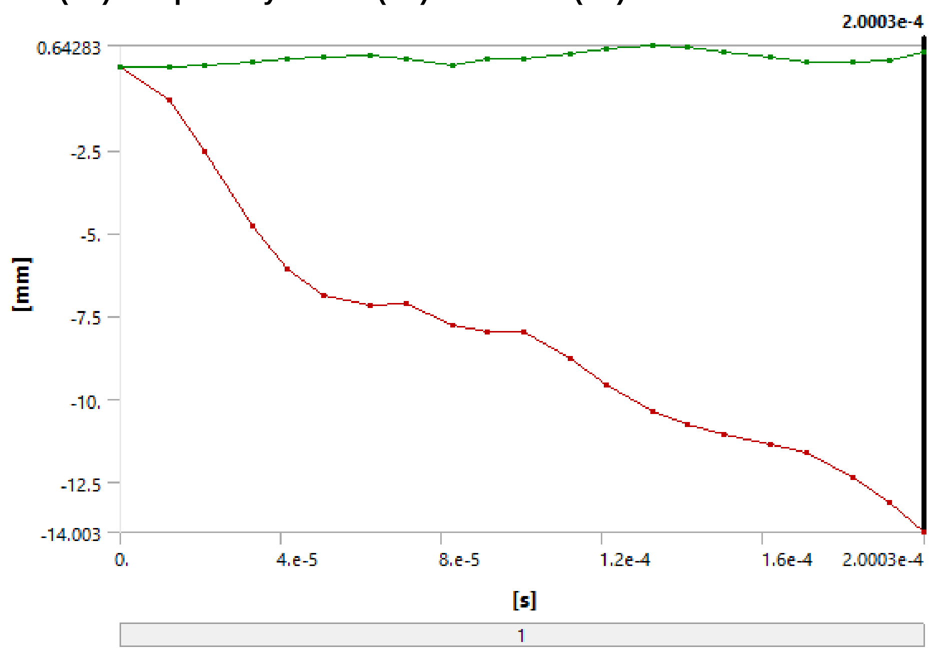


TABLE 14
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Directional Deformation

Time [s]	Minimum [mm]	Maximum [mm]
1.1755e-038	0.	0.
1.2441e-005	-1.016	1.125e-002
2.1161e-005	-2.5242	3.9398e-002
3.2888e-005	-4.7666	0.12984
4.1683e-005	-6.0964	0.22464
5.0478e-005	-6.8933	0.31474
6.2205e-005	-7.2014	0.3528
7.1001e-005	-7.142	0.25247
8.2728e-005	-7.7699	6.487e-002
9.1523e-005	-7.9671	0.22781
1.0032e-004	-7.9991	0.25632
1.1205e-004	-8.7969	0.40109
1.2084e-004	-9.5576	0.56353

1.3257e-004	-10.354	0.64283
1.4137e-004	-10.775	0.57625
1.5017e-004	-11.08	0.45459
1.619e-004	-11.383	0.28008
1.7069e-004	-11.596	0.13375
1.8243e-004	-12.345	0.15727
1.9123e-004	-13.106	0.17544
2.0003e-004	-14.003	0.44066

FIGURE 7
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Directional Deformation > Figure

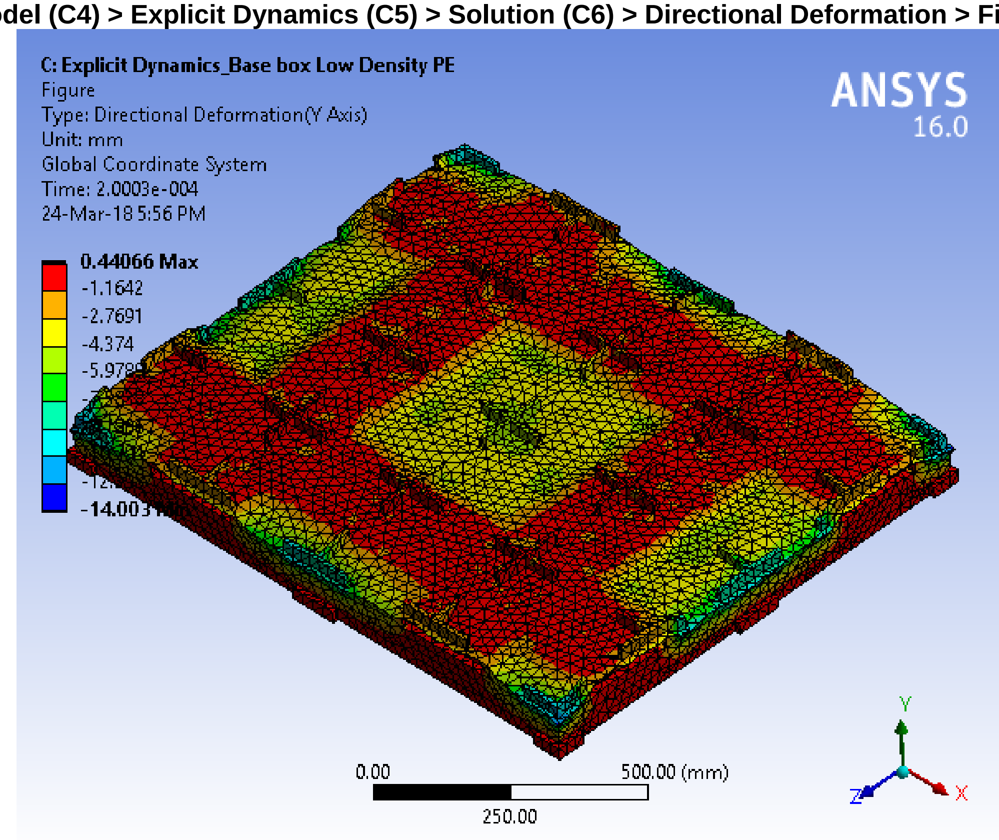


FIGURE 8
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Equivalent Stress

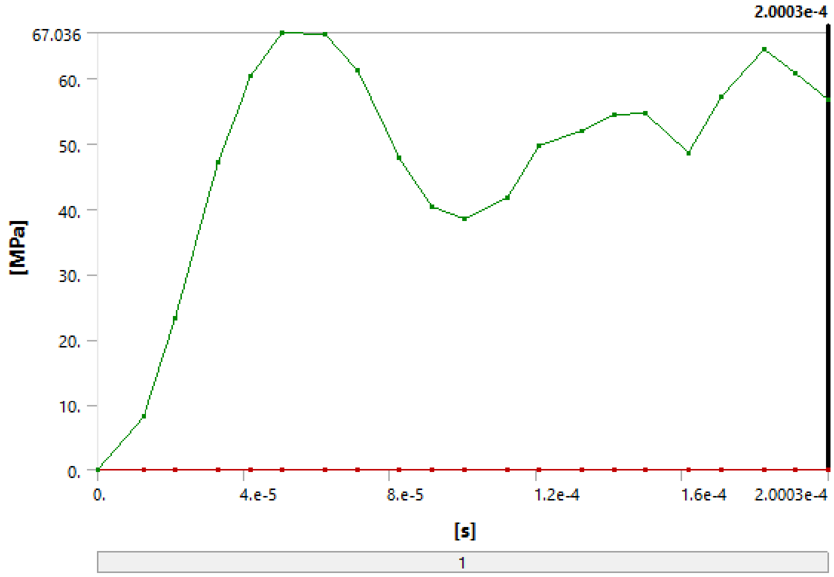


TABLE 15
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]
1.1755e-038	0.	0.
1.2441e-005		8.2329
2.1161e-005		23.362
3.2888e-005		47.301
4.1683e-005		60.469
5.0478e-005		67.036
6.2205e-005	1.0916e-008	66.841
7.1001e-005	1.2863e-007	61.35
8.2728e-005	3.9478e-007	47.926
9.1523e-005	6.4679e-007	40.267
1.0032e-004	1.3439e-006	38.431
1.1205e-004	6.1006e-006	41.815
1.2084e-004	7.9914e-006	49.695
1.3257e-004	2.4935e-005	51.92
1.4137e-004	6.4825e-005	54.468
1.5017e-004	1.5142e-004	54.737
1.619e-004	3.9965e-004	48.585
1.7069e-004	7.4608e-004	57.208
1.8243e-004	1.35e-003	64.599
1.9123e-004	2.0429e-003	60.95
2.0003e-004	3.0365e-003	56.707

FIGURE 9
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Equivalent Stress > Figure

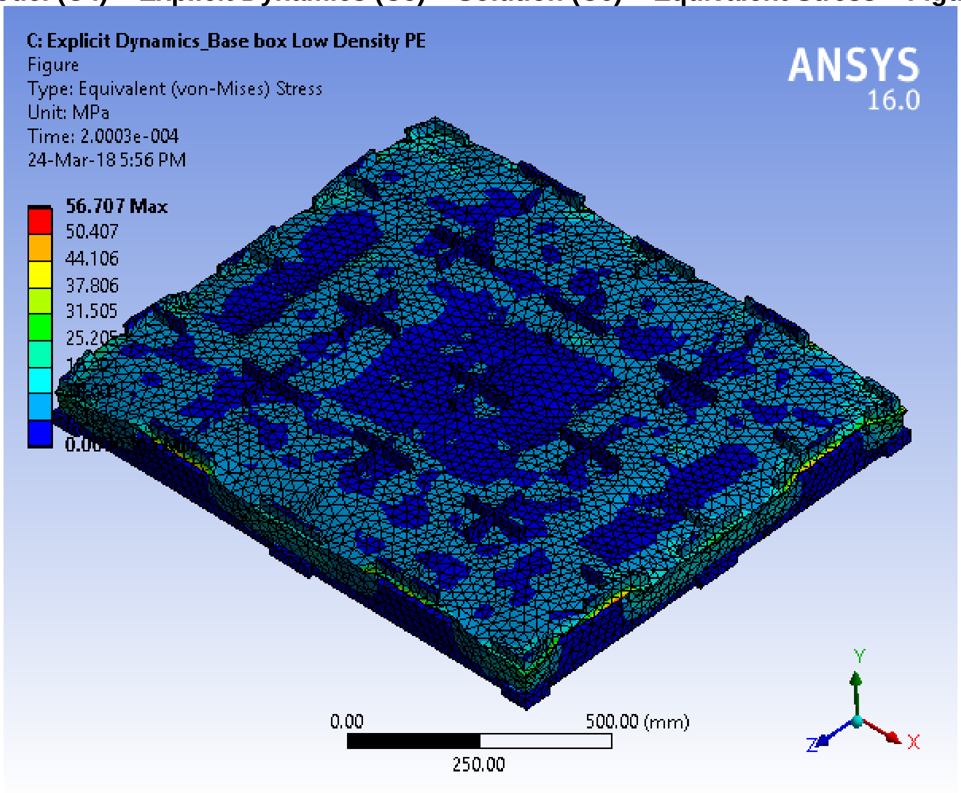


FIGURE 10
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Equivalent Elastic Strain

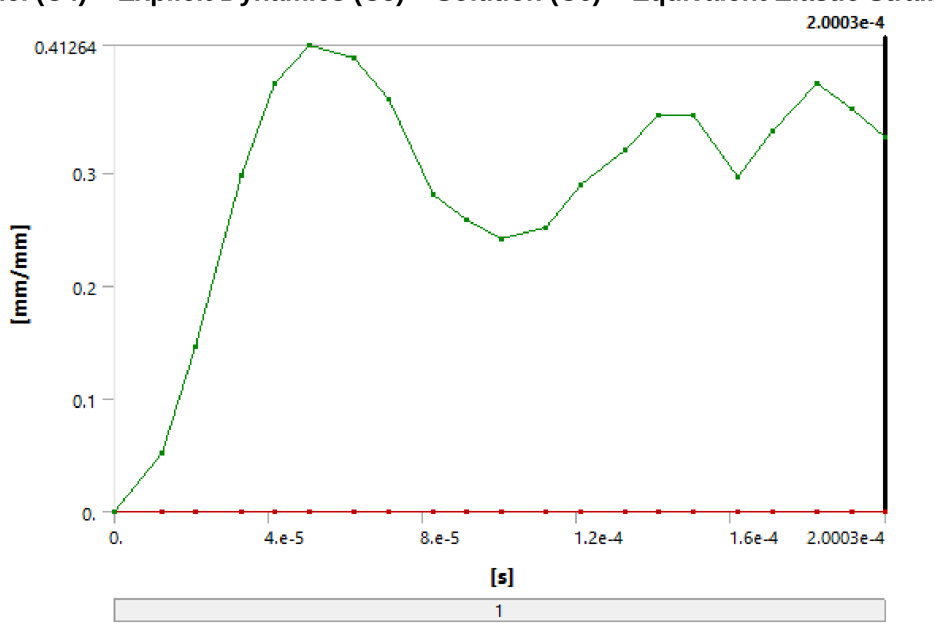


TABLE 16
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]
1.1755e-038	0.	0.
1.2441e-005		5.1469e-002
2.1161e-005		0.14657
3.2888e-005		0.29746
4.1683e-005		0.37846
5.0478e-005		0.41264
6.2205e-005	6.3329e-011	0.40202
7.1001e-005	8.8644e-010	0.36472
8.2728e-005	5.0544e-009	0.28075
9.1523e-005	1.3913e-008	0.25806
1.0032e-004	3.3524e-008	0.24192
1.1205e-004	8.6447e-008	0.25077
1.2084e-004	1.7401e-007	0.28981
1.3257e-004	4.1479e-007	0.32001
1.4137e-004	7.0774e-007	0.35067
1.5017e-004	1.2634e-006	0.35021
1.619e-004	2.7918e-006	0.29569
1.7069e-004	4.5841e-006	0.33661
1.8243e-004	8.2322e-006	0.37882
1.9123e-004	1.2442e-005	0.35598
2.0003e-004	1.8447e-005	0.33188

FIGURE 11
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Equivalent Elastic Strain > Figure

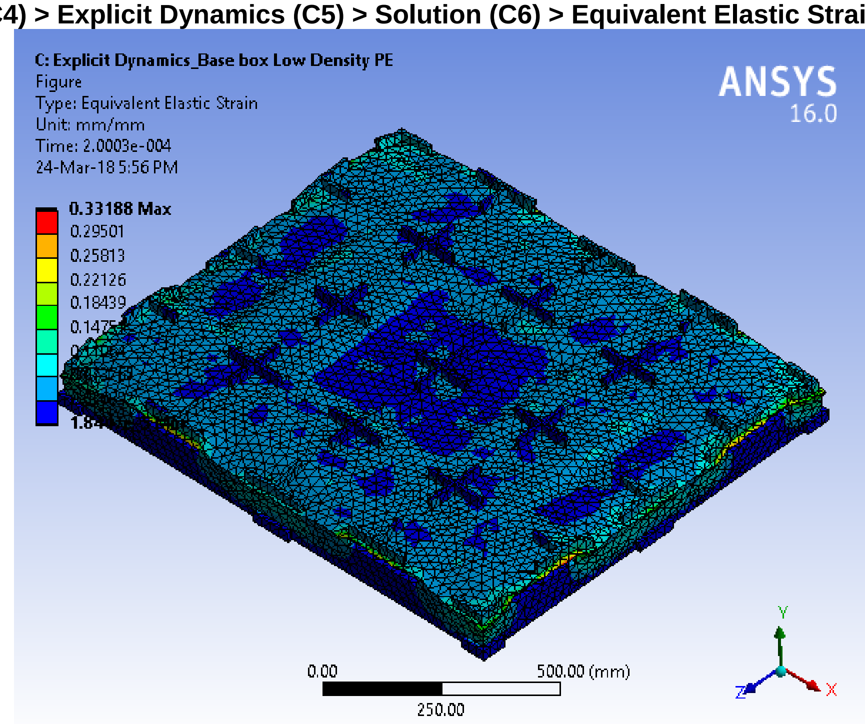


TABLE 17
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Tensile Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 18
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Stress Tool > Results

Object Name	*Safety Factor*	*Stress Ratio*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Safety Factor	Stress Ratio
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Integration Point Results		
Display Option	Averaged	
Average Across Bodies	No	
Results		
Minimum	1.4528	0.
Maximum		0.68834
Minimum Value Over Time		
Minimum	0.98921	0.
Maximum	15.	0.
Maximum Value Over Time		
Minimum	15.	0.
Maximum	15.	1.0109
Information		
Time	2.0003e-004 s	
Set	21	

FIGURE 12
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Stress Tool > Safety Factor

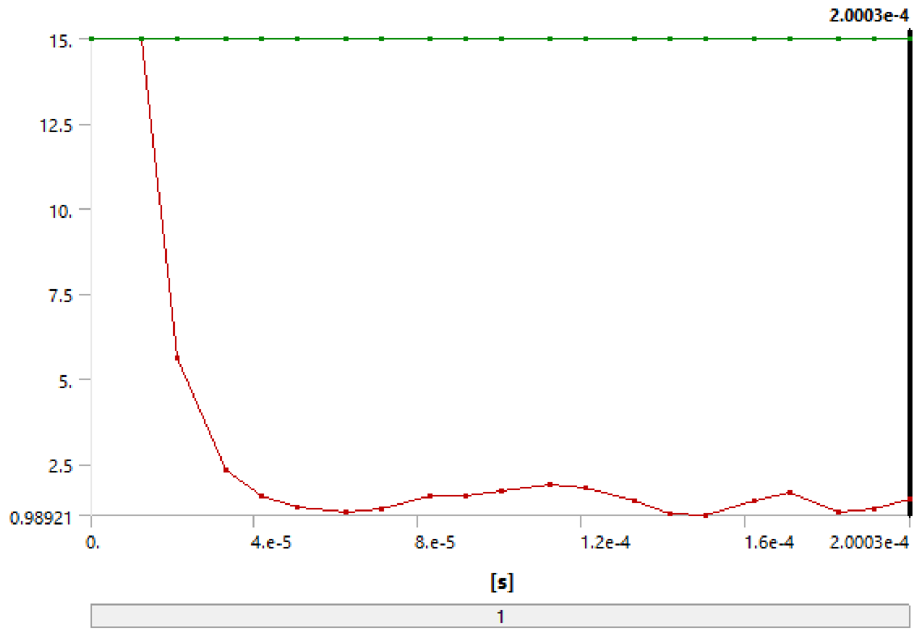


TABLE 19
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.1755e-038	15.	15.
1.2441e-005		
2.1161e-005	5.6239	
3.2888e-005	2.3275	
4.1683e-005	1.5593	
5.0478e-005	1.2172	
6.2205e-005	1.0784	
7.1001e-005	1.1576	
8.2728e-005	1.5697	
9.1523e-005	1.5792	
1.0032e-004	1.6879	
1.1205e-004	1.8712	
1.2084e-004	1.7943	
1.3257e-004	1.4212	
1.4137e-004	1.035	
1.5017e-004	0.98921	
1.619e-004	1.4002	
1.7069e-004	1.6801	
1.8243e-004	1.1082	
1.9123e-004	1.1875	
2.0003e-004	1.4528	

FIGURE 13
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Stress Tool > Safety Factor > Figure

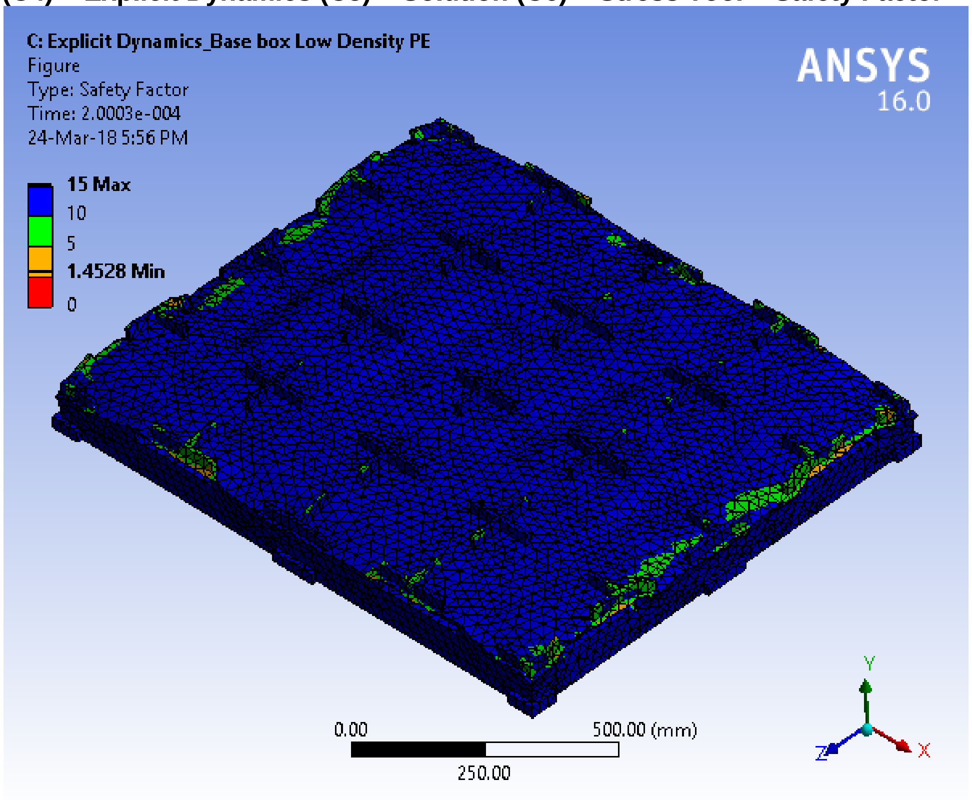


FIGURE 14
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Stress Tool > Stress Ratio

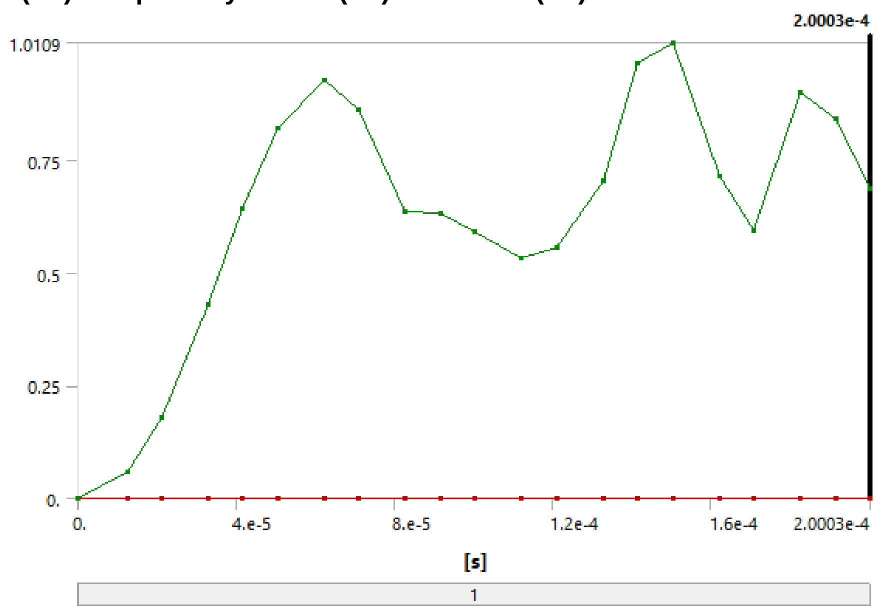
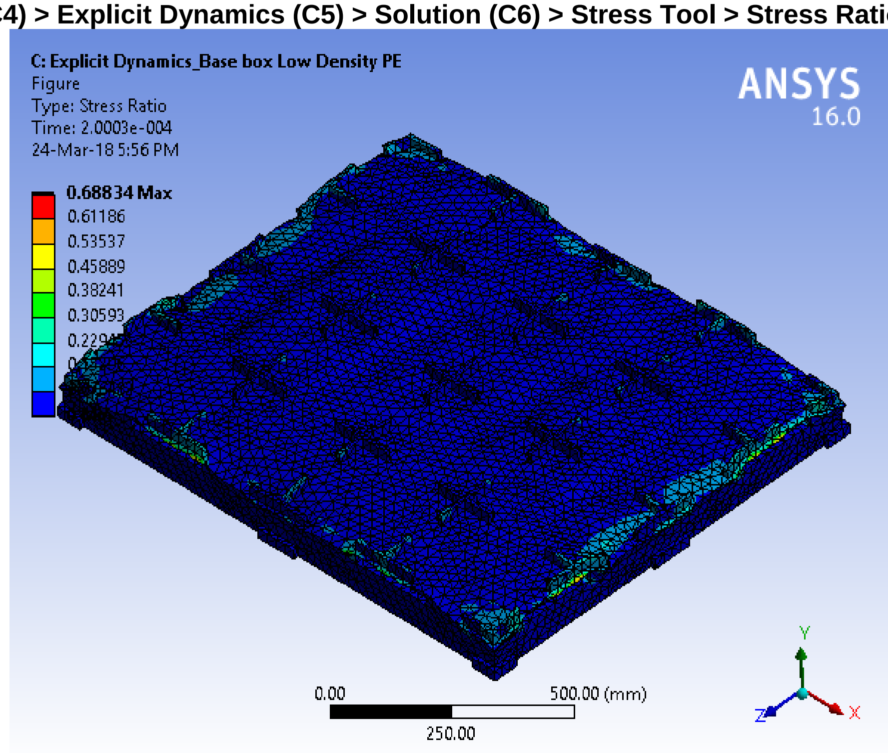


TABLE 20
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Stress Tool > Stress Ratio

Time [s]	Minimum	Maximum
1.1755e-038		0.
1.2441e-005		5.7234e-002
2.1161e-005		0.17781
3.2888e-005		0.42965
4.1683e-005		0.64132
5.0478e-005		0.82159
6.2205e-005		0.92733
7.1001e-005		0.86385
8.2728e-005		0.63708
9.1523e-005		0.63324
1.0032e-004	0.	0.59246
1.1205e-004		0.53442
1.2084e-004		0.55731
1.3257e-004		0.70364
1.4137e-004		0.96616
1.5017e-004		1.0109
1.619e-004		0.71418
1.7069e-004		0.59522
1.8243e-004		0.90237
1.9123e-004		0.84209
2.0003e-004		0.68834

FIGURE 15
Model (C4) > Explicit Dynamics (C5) > Solution (C6) > Stress Tool > Stress Ratio > Figure



Material Data

Very Low Density PE

TABLE 21
Very Low Density PE > Constants

Density	9.05e-007 kg mm^-3

TABLE 22
Very Low Density PE > Isotropic Elasticity

Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	172.37	0.3	143.64	66.296

TABLE 23
Very Low Density PE > Tensile Yield Strength

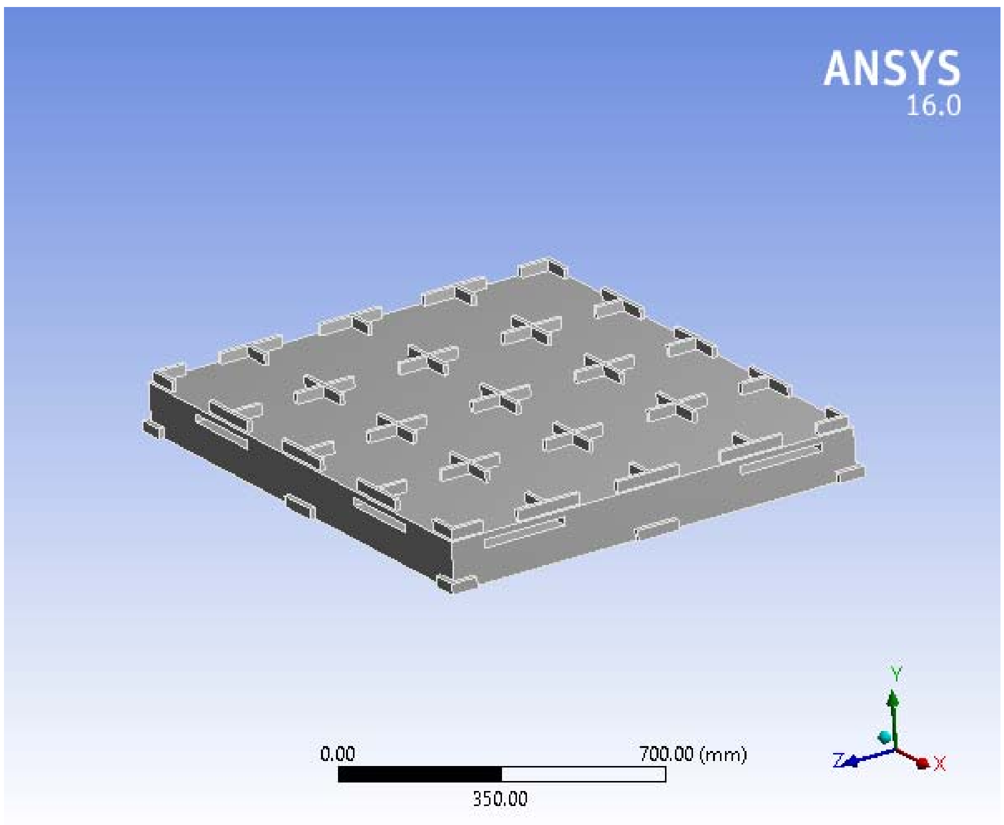
Tensile Yield Strength MPa
34

TABLE 24
Very Low Density PE > Compressive Yield Strength

Compressive Yield Strength MPa
6.8948

Project

First Saved	Saturday, March 24, 2018
Last Saved	Saturday, March 24, 2018
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (C4)

Geometry

TABLE 2
Model (C4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	1244.6 mm
Length Y	139.7 mm
Length Z	1041.4 mm
Properties	

Volume	5.531e+007 mm³
Mass	50.056 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	101197
Elements	53631
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\jagad\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (C4) > Geometry > Parts

Object Name	*Base Box Pallet 48x40.SLDPRT new for ansys*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Very Low Density PE
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	1244.6 mm
Length Y	139.7 mm
Length Z	1041.4 mm
Properties	

Volume	5.531e+007 mm³
Mass	50.056 kg
Centroid X	-1.0897e-002 mm
Centroid Y	20.981 mm
Centroid Z	6.0372e-003 mm
Moment of Inertia Ip1	4.4324e+006 kg·mm²
Moment of Inertia Ip2	1.0978e+007 kg·mm²
Moment of Inertia Ip3	6.6073e+006 kg·mm²
Statistics	
Nodes	101197
Elements	53631
Mesh Metric	None

Coordinate Systems

TABLE 4
Model (C4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

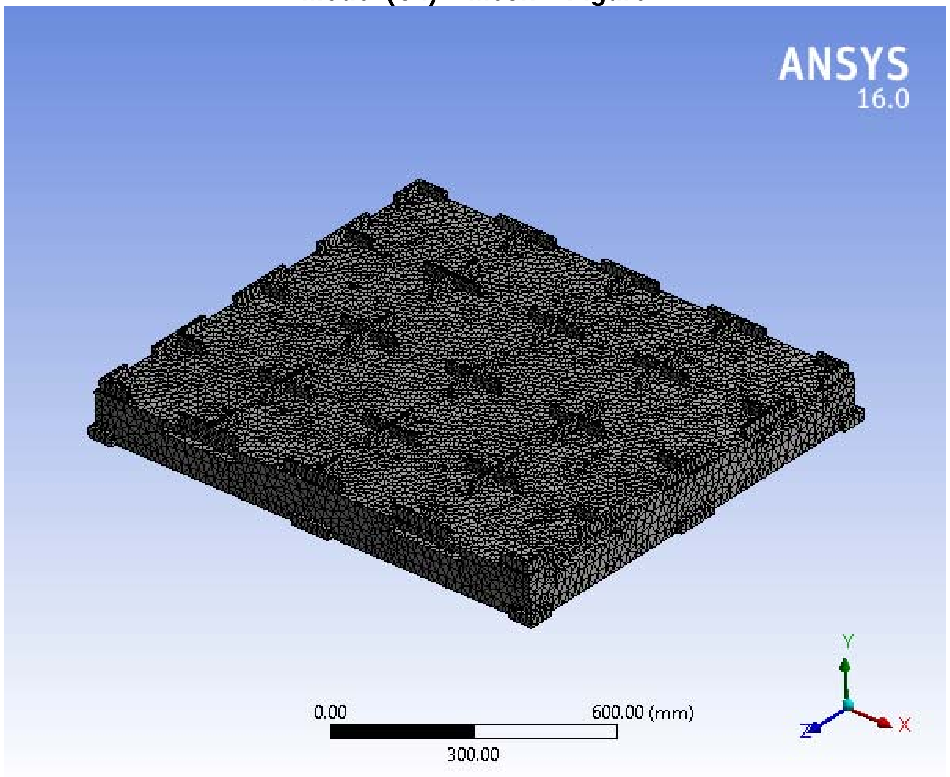
Mesh

TABLE 5
Model (C4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium

Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	10.160 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	101197
Elements	53631
Mesh Metric	None

FIGURE 1
Model (C4) > Mesh > Figure



Static Structural (C5)

TABLE 6
Model (C4) > Analysis

Object Name	*Static Structural (C5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 7
Model (C4) > Static Structural (C5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled

Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\jagad\AppData\Local\Temp\WB_ _3720_2\unsaved_project_files\dp0\SYS-2\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 8
Model (C4) > Static Structural (C5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force

Suppressed	No	
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. N (ramped)
Y Component		-1.5e+006 N (ramped)
Z Component		0. N (ramped)

FIGURE 2
Model (C4) > Static Structural (C5) > Fixed Support > Figure

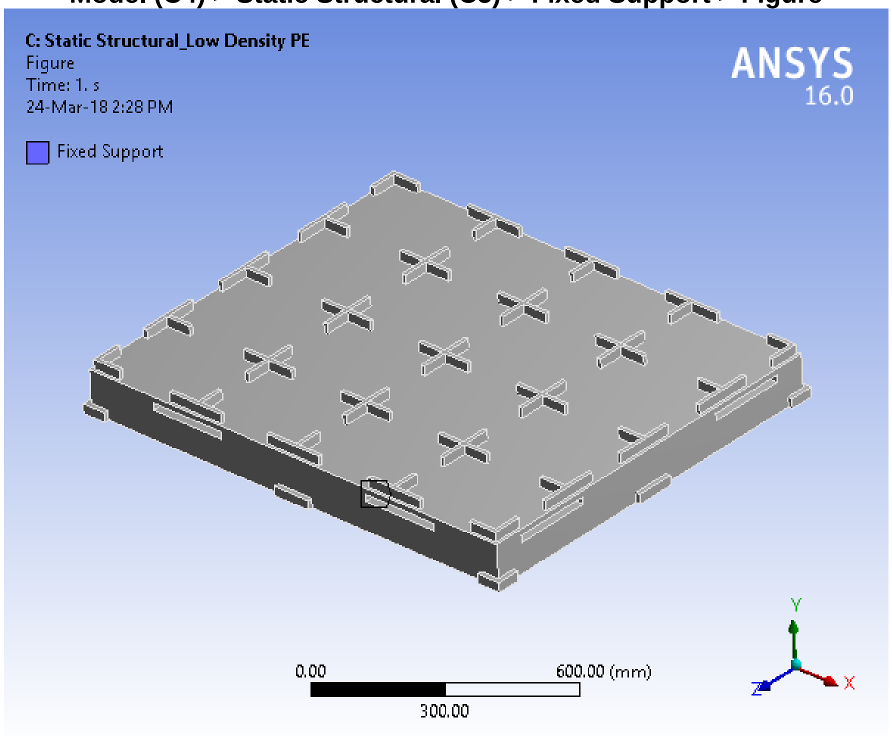


FIGURE 3
Model (C4) > Static Structural (C5) > Force

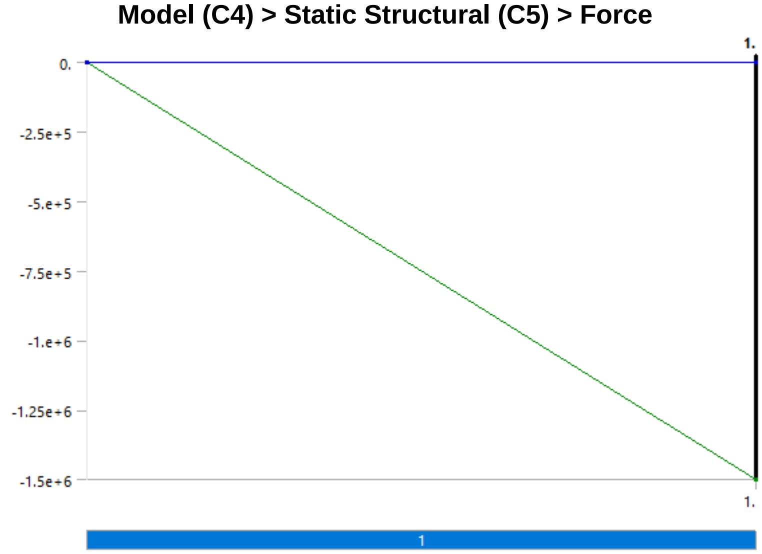
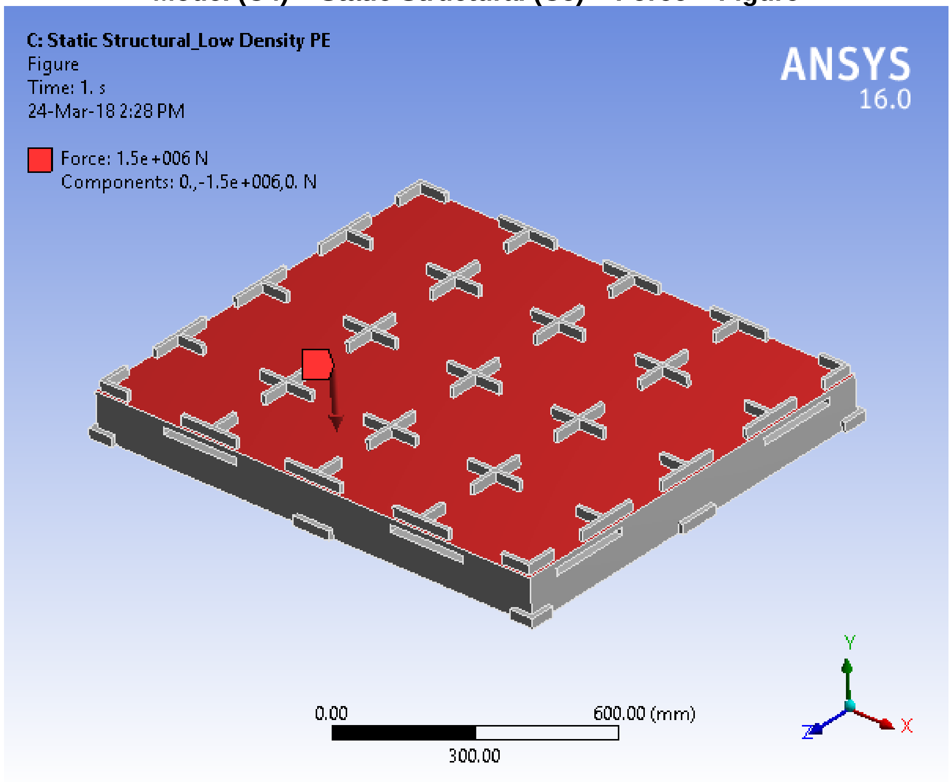


FIGURE 4
Model (C4) > Static Structural (C5) > Force > Figure



Solution (C6)

TABLE 9
Model (C4) > Static Structural (C5) > Solution

Object Name	*Solution (C6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10
Model (C4) > Static Structural (C5) > Solution (C6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s

Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11
Model (C4) > Static Structural (C5) > Solution (C6) > Results

Object Name	*Directional Deformation*	*Equivalent Stress*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Directional Deformation	Equivalent (von-Mises) Stress	Equivalent Elastic Strain
Orientation	Y Axis		
By	Time		
Display Time	Last		
Coordinate System	Global Coordinate System		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	-41.738 mm	1.4879e-003 MPa	8.632e-006 mm/mm
Maximum	3.2845 mm	34.653 MPa	0.26479 mm/mm
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

TABLE 12
Model (C4) > Static Structural (C5) > Solution (C6) > Directional Deformation

Time [s]	Minimum [mm]	Maximum [mm]
1.	-41.738	3.2845

FIGURE 6
Model (C4) > Static Structural (C5) > Solution (C6) > Directional Deformation > Figure

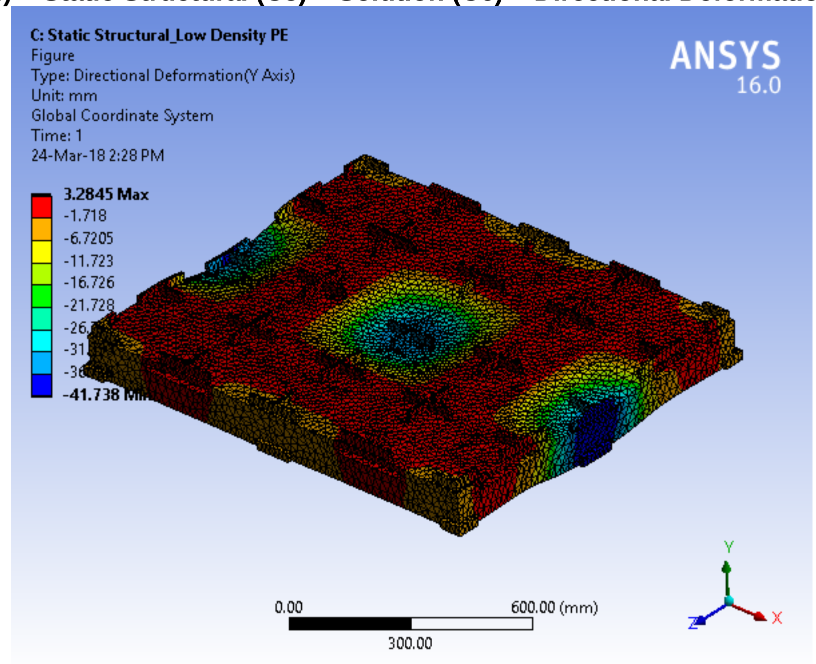


TABLE 13
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]
1.	1.4879e-003	34.653

FIGURE 8
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Stress > Figure

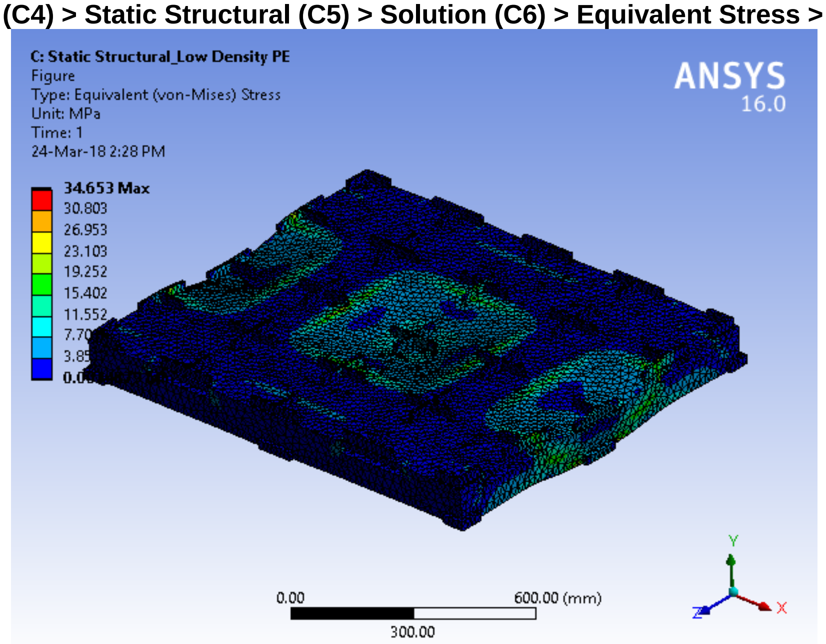


TABLE 14
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]
1.	8.632e-006	0.26479

FIGURE 10
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Elastic Strain > Figure

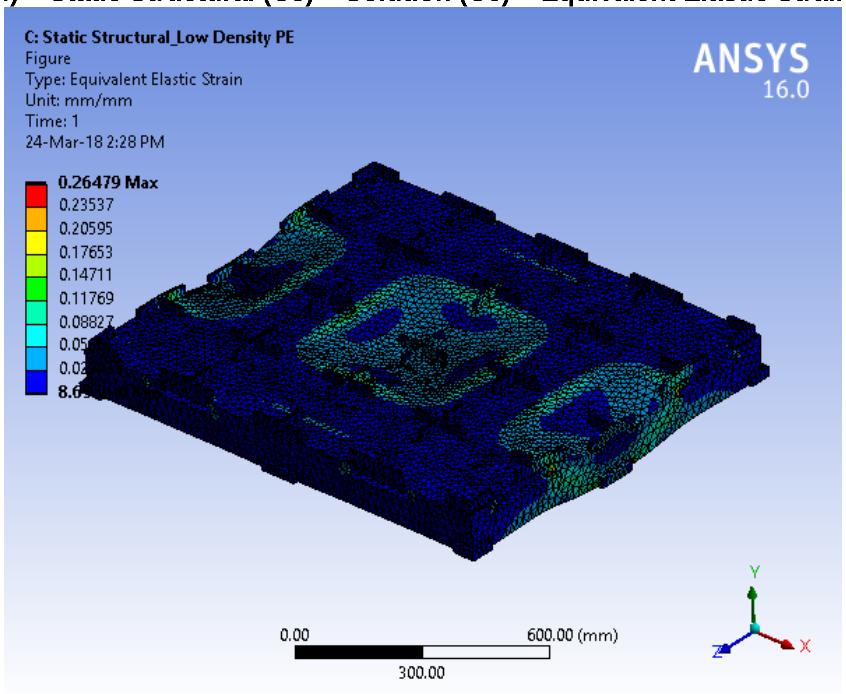


TABLE 15
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Tensile Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 16
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Results

Object Name	*Safety Factor*	*Stress Ratio*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Safety Factor	Stress Ratio
By	Time	
Display Time	Last	

Calculate Time History	Yes	
Identifier		
Suppressed	No	
Integration Point Results		
Display Option	Averaged	
Average Across Bodies	No	
Results		
Minimum	1.08	0.
Maximum		0.92592
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	1	

TABLE 17
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	1.08	15.

FIGURE 12
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Safety Factor > Figure

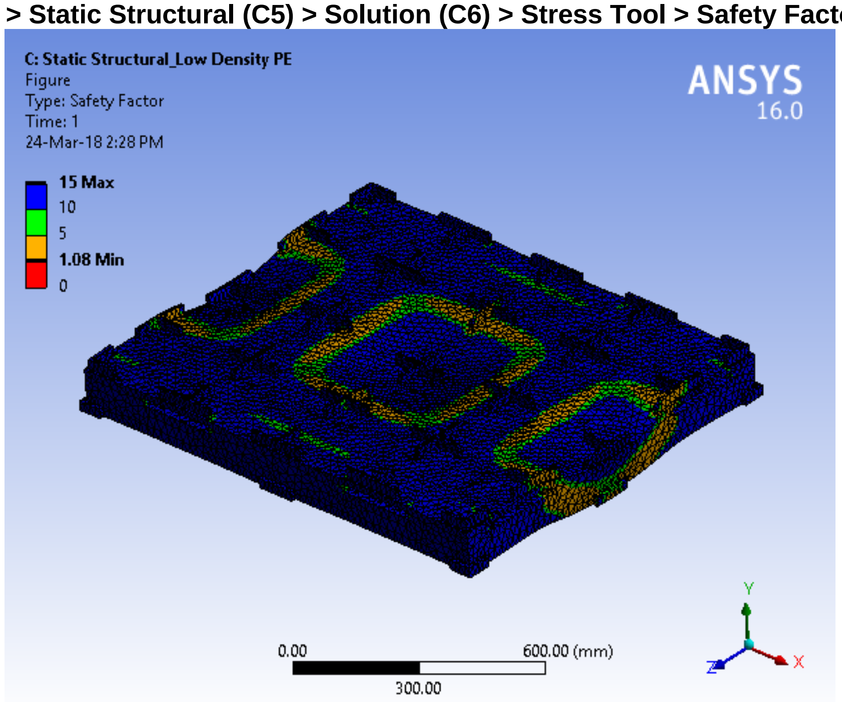
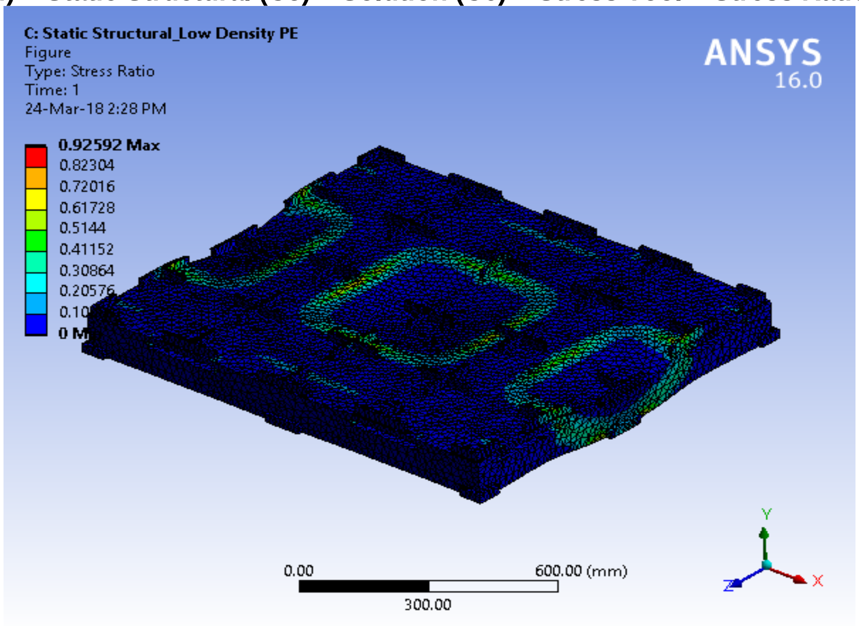


TABLE 18
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Stress Ratio

Time [s]	Minimum	Maximum
1.	0.	0.92592

FIGURE 14
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Stress Ratio > Figure



Material Data

Very Low Density PE

TABLE 19
Very Low Density PE > Constants

Density	9.05e-007 kg mm^-3

TABLE 20
Very Low Density PE > Isotropic Elasticity

Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	172.37	0.3	143.64	66.296

TABLE 21
Very Low Density PE > Tensile Yield Strength

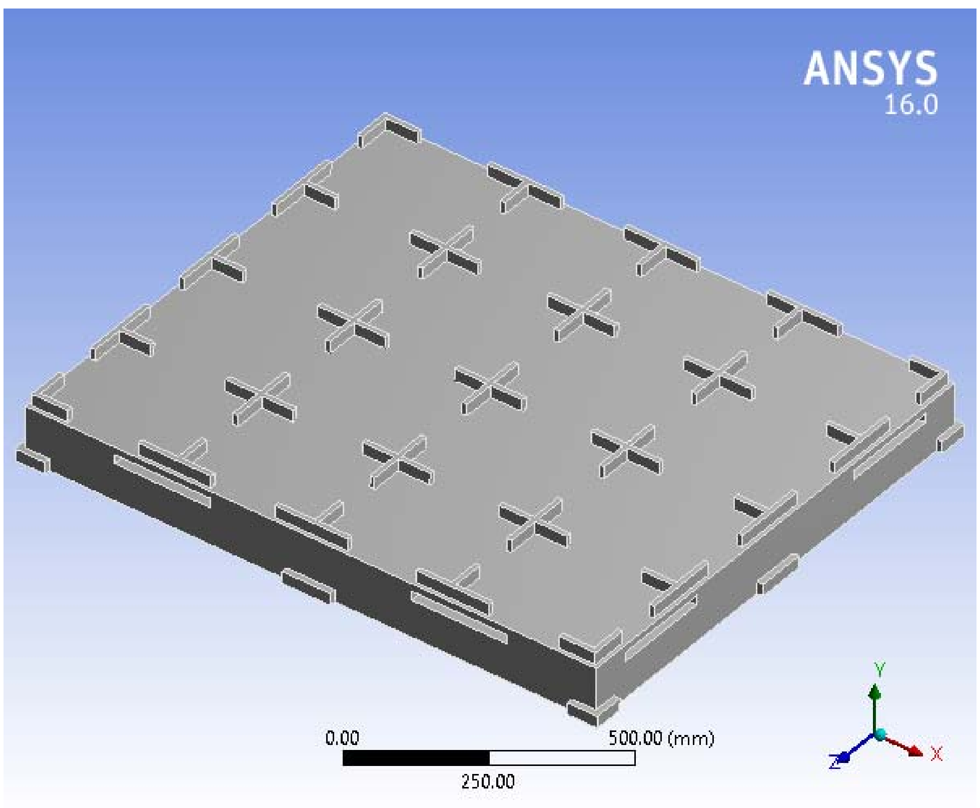
Tensile Yield Strength MPa
34

TABLE 22
Very Low Density PE > Compressive Yield Strength

Compressive Yield Strength MPa
6.8948

Project

First Saved	Saturday, March 24, 2018
Last Saved	Saturday, March 24, 2018
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (B4)

Geometry

TABLE 2
Model (B4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	1244.6 mm
Length Y	139.7 mm
Length Z	1041.4 mm
Properties	

Volume	5.531e+007 mm³
Mass	50.056 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	101159
Elements	53577
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\jagad\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (B4) > Geometry > Parts

Object Name	*Base Box Pallet 48x40.SLDPRT new for ansys*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Very Low Density PE
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	1244.6 mm
Length Y	139.7 mm
Length Z	1041.4 mm
Properties	

Volume	5.531e+007 mm³
Mass	50.056 kg
Centroid X	-1.0897e-002 mm
Centroid Y	20.981 mm
Centroid Z	6.0372e-003 mm
Moment of Inertia Ip1	4.4324e+006 kg·mm²
Moment of Inertia Ip2	1.0978e+007 kg·mm²
Moment of Inertia Ip3	6.6073e+006 kg·mm²
Statistics	
Nodes	101159
Elements	53577
Mesh Metric	None

Coordinate Systems

TABLE 4
Model (B4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

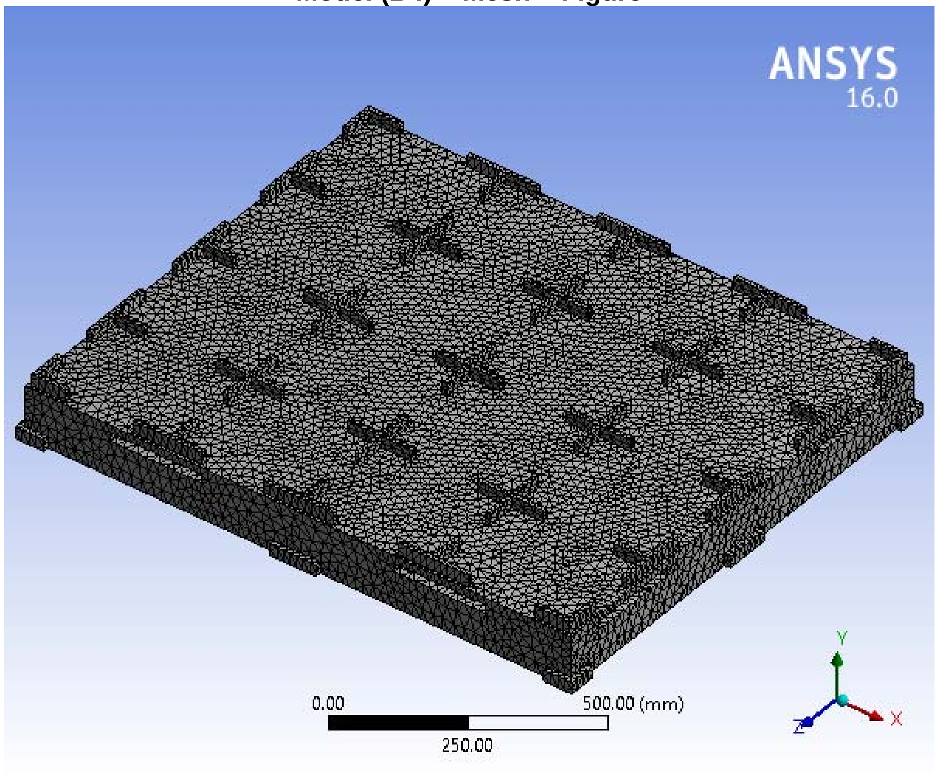
Mesh

TABLE 5
Model (B4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium

Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	10.160 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	101159
Elements	53577
Mesh Metric	None

FIGURE 1
Model (B4) > Mesh > Figure



Static Structural (B5)

TABLE 6
Model (B4) > Analysis

Object Name	*Static Structural (B5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 7
Model (B4) > Static Structural (B5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled

Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\jagad\Desktop\New folder\Static_Base Box Pallet 48x40_files\dp0\SYS-1\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 8
Model (B4) > Static Structural (B5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Components

Coordinate System		Global Coordinate System
X Component		0. N (ramped)
Y Component		-3.e+005 N (ramped)
Z Component		0. N (ramped)

FIGURE 2
Model (B4) > Static Structural (B5) > Fixed Support > Figure

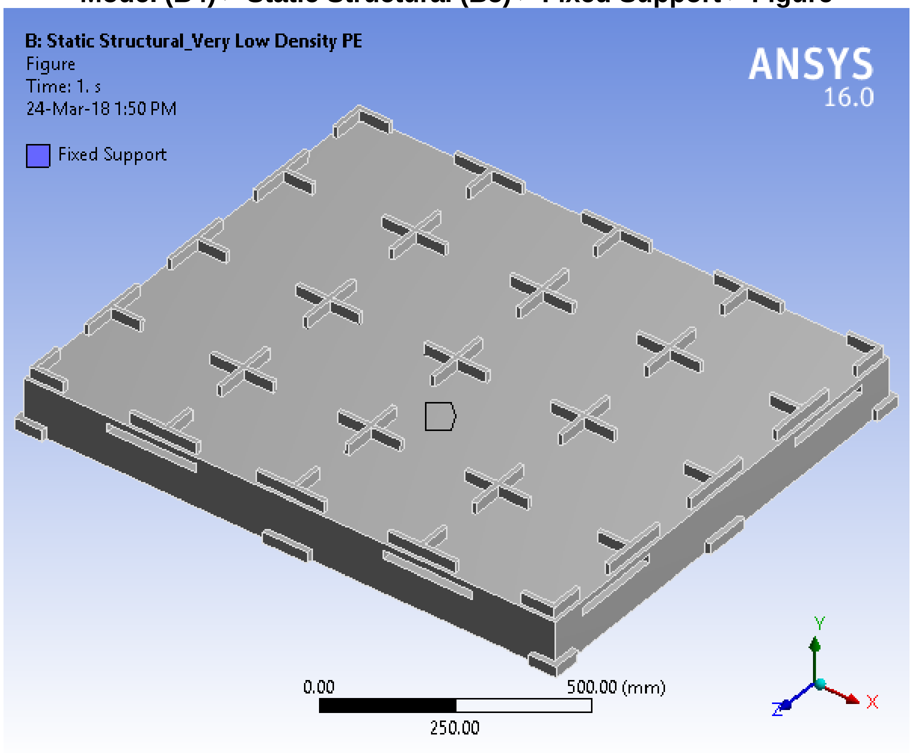


FIGURE 3
Model (B4) > Static Structural (B5) > Force

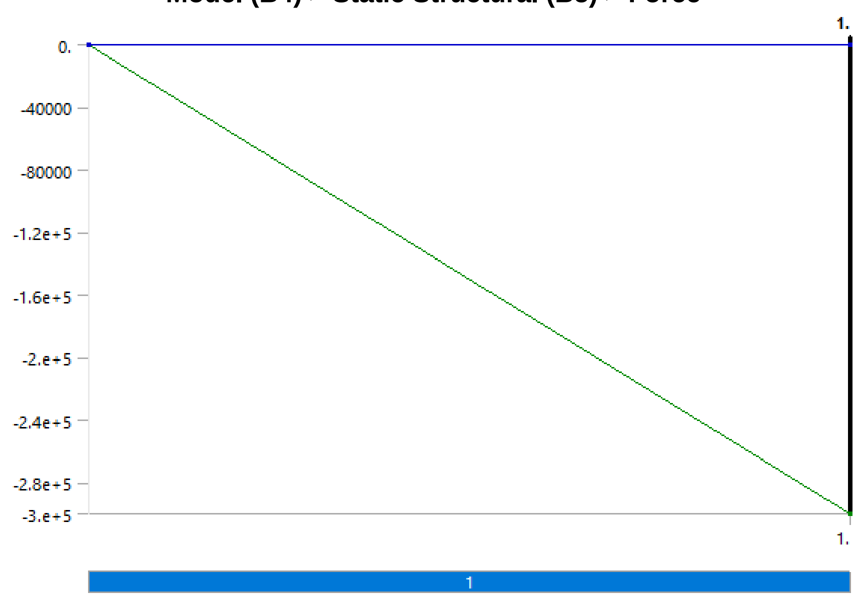
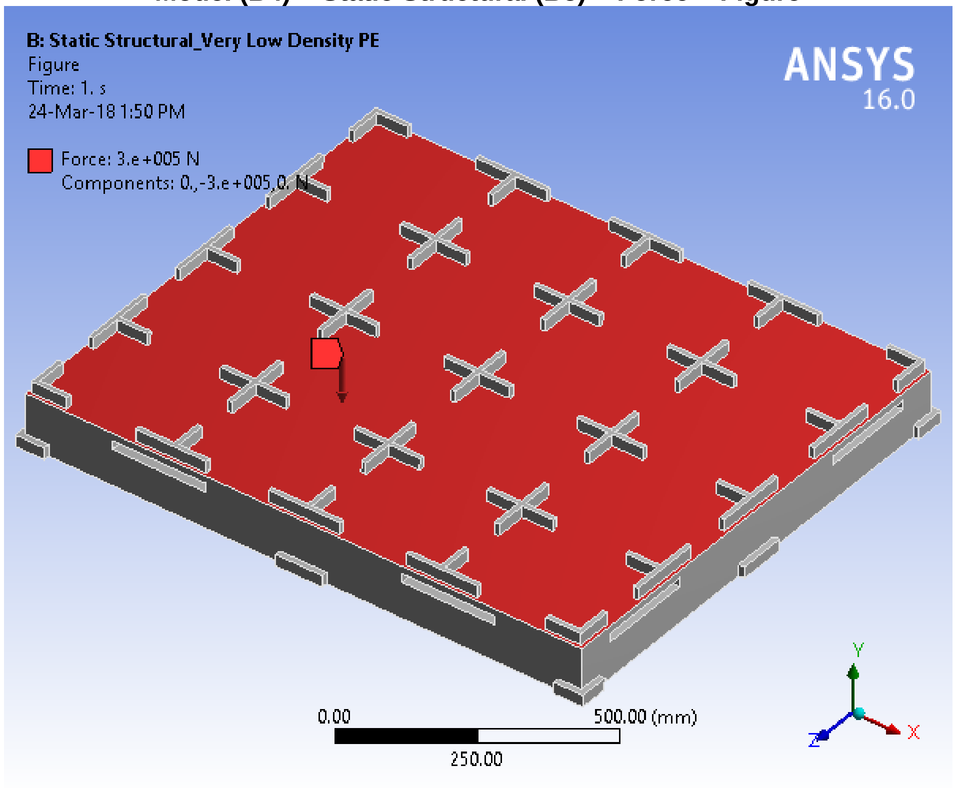


FIGURE 4
Model (B4) > Static Structural (B5) > Force > Figure



Solution (B6)

TABLE 9
Model (B4) > Static Structural (B5) > Solution

Object Name	*Solution (B6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10
Model (B4) > Static Structural (B5) > Solution (B6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All

FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11
Model (B4) > Static Structural (B5) > Solution (B6) > Results

Object Name	*Directional Deformation*	*Equivalent Stress*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Directional Deformation	Equivalent (von-Mises) Stress	Equivalent Elastic Strain
Orientation	Y Axis		
By	Time		
Display Time	Last		
Coordinate System	Global Coordinate System		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	-102.72 mm	3.6823e-002 MPa	2.1363e-004 mm/mm
Maximum	2.0895 mm	34.963 MPa	0.24628 mm/mm
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

TABLE 12
Model (B4) > Static Structural (B5) > Solution (B6) > Directional Deformation

Time [s]	Minimum [mm]	Maximum [mm]
1.	-102.72	2.0895

FIGURE 6
Model (B4) > Static Structural (B5) > Solution (B6) > Directional Deformation > Figure

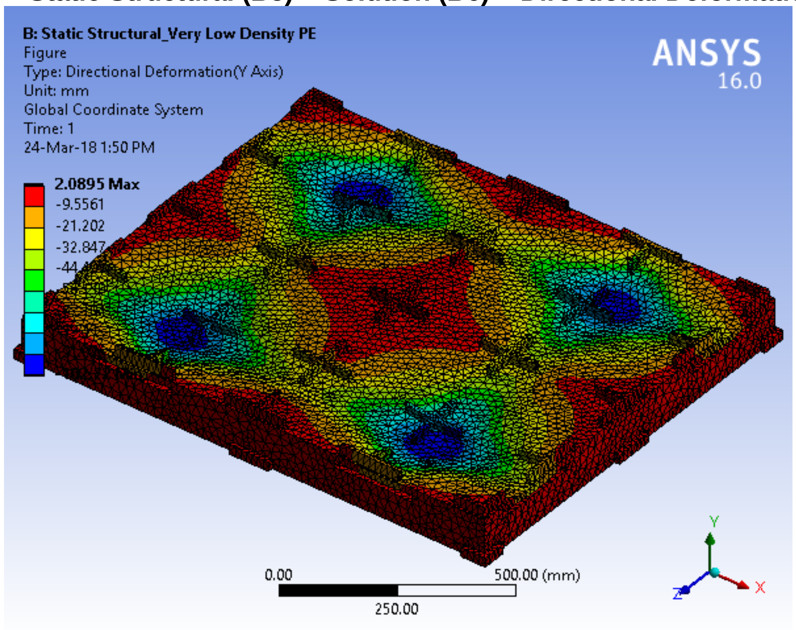


TABLE 13
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]
1.	3.6823e-002	34.963

FIGURE 8
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Stress > Figure

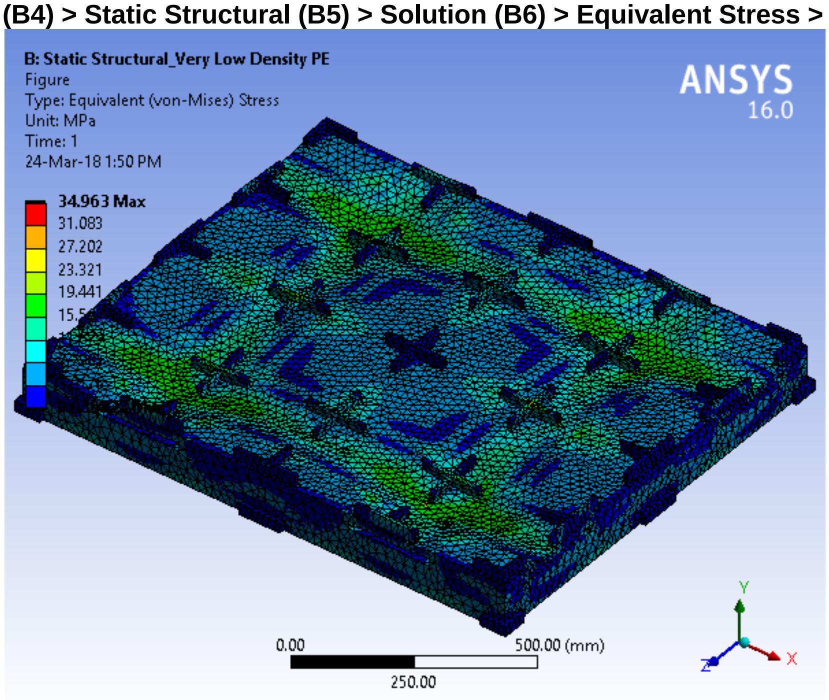


TABLE 14
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]
1.	2.1363e-004	0.24628

FIGURE 10
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain > Figure

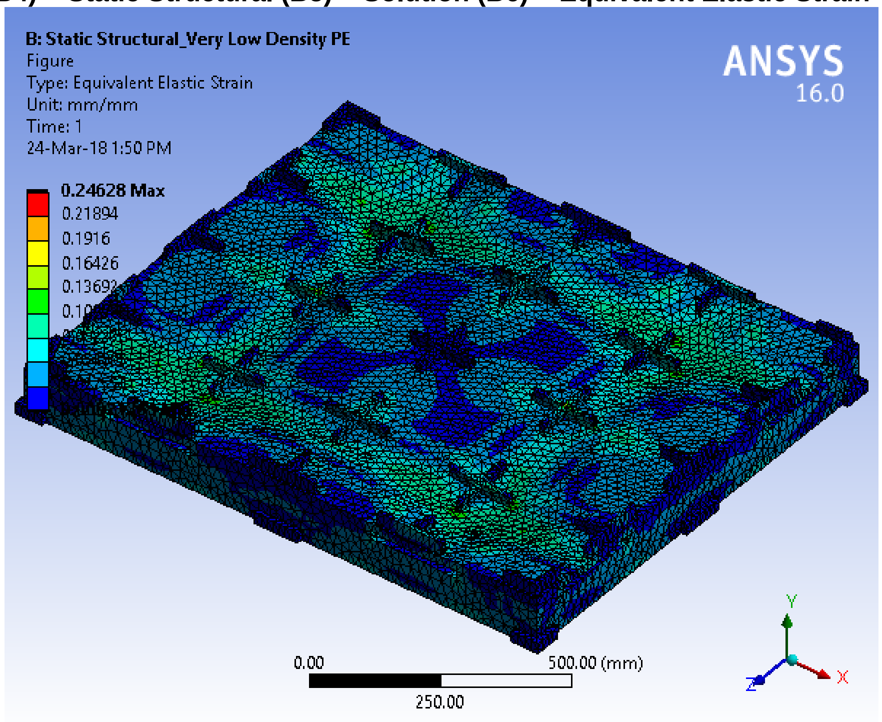


TABLE 15
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Tensile Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 16
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Results

Object Name	*Safety Factor*	*Stress Ratio*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Safety Factor	Stress Ratio
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		

Suppressed	No	
Integration Point Results		
Display Option	Averaged	
Average Across Bodies	No	
Results		
Minimum	1.4823	0.
Maximum		0.67464
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	1	

TABLE 17
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	1.4823	15.

FIGURE 12
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Safety Factor > Figure

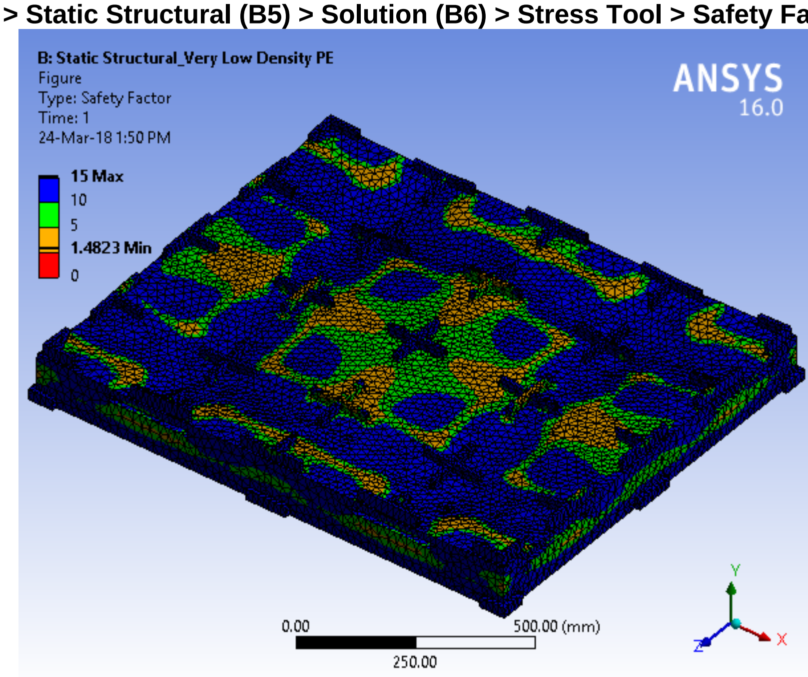
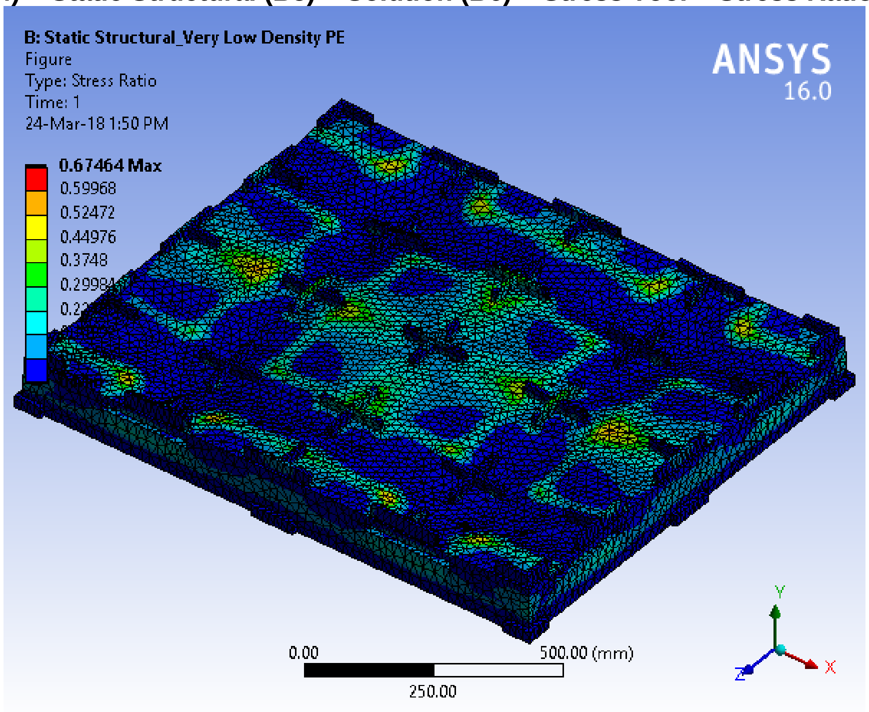


TABLE 18
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Stress Ratio

Time [s]	Minimum	Maximum
1.	0.	0.67464

FIGURE 14
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Stress Ratio > Figure



Material Data

Very Low Density PE

TABLE 19
Very Low Density PE > Constants

Density	9.05e-007 kg mm^-3

TABLE 20
Very Low Density PE > Isotropic Elasticity

Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	172.37	0.3	143.64	66.296

TABLE 21
Very Low Density PE > Tensile Yield Strength

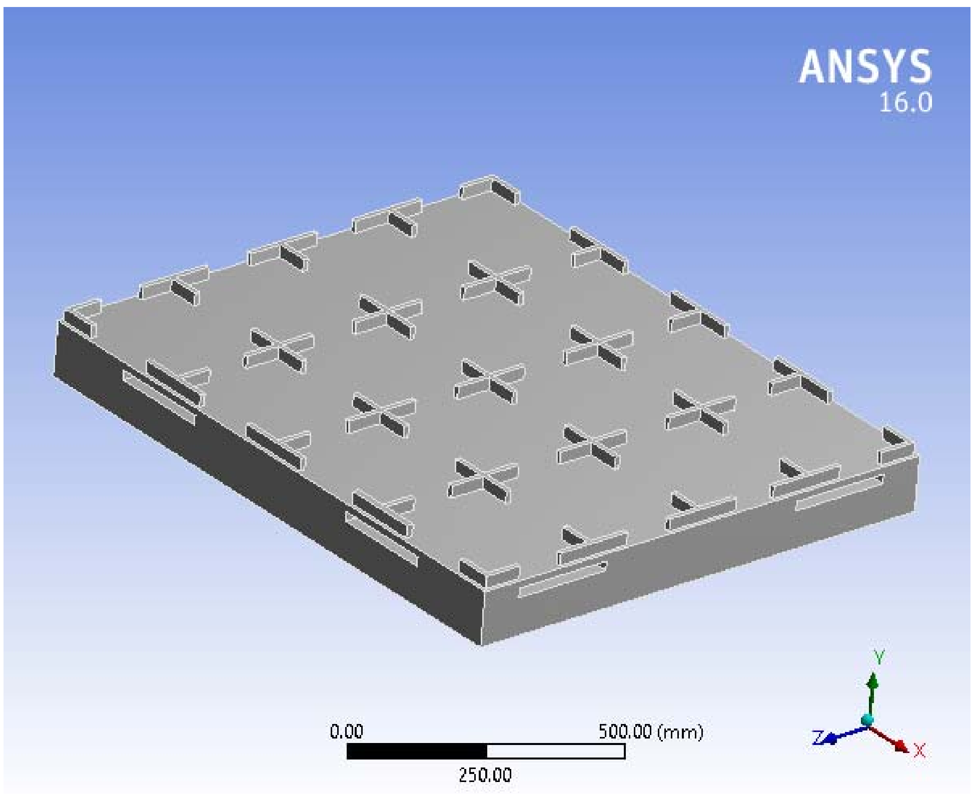
Tensile Yield Strength MPa
34

TABLE 22
Very Low Density PE > Compressive Yield Strength

Compressive Yield Strength MPa
6.8948

Project

First Saved	Saturday, March 24, 2018
Last Saved	Saturday, March 24, 2018
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (B4)

Geometry

TABLE 2
Model (B4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	1219.2 mm
Length Y	139.7 mm
Length Z	1016. mm
Properties	

Volume	5.3963e+007 mm³
Mass	64.756 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	110946
Elements	58877
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\jagad\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (B4) > Geometry > Parts

Object Name	*Top Box Pallet 48x40.SLDPRT new for ansys*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Acryllic Medium High Impact
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	1219.2 mm
Length Y	139.7 mm
Length Z	1016. mm
Properties	

Volume	5.3963e+007 mm³
Mass	64.756 kg
Centroid X	0.18626 mm
Centroid Y	23.125 mm
Centroid Z	0.29796 mm
Moment of Inertia Ip1	5.7428e+006 kg·mm²
Moment of Inertia Ip2	1.4222e+007 kg·mm²
Moment of Inertia Ip3	8.54e+006 kg·mm²
Statistics	
Nodes	110946
Elements	58877
Mesh Metric	None

Coordinate Systems

TABLE 4
Model (B4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

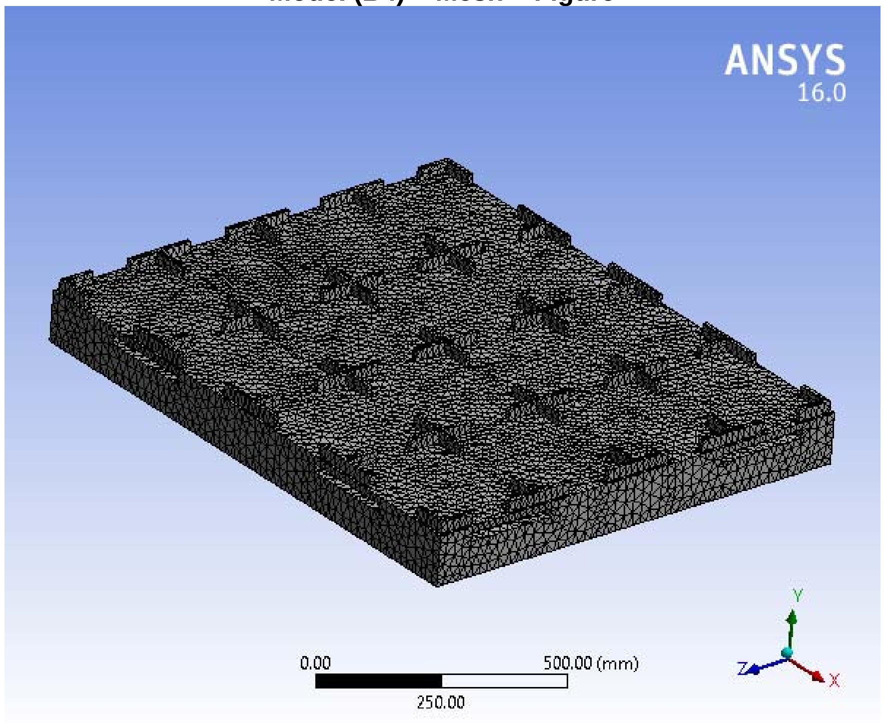
Mesh

TABLE 5
Model (B4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium

Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	10.160 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	110946
Elements	58877
Mesh Metric	None

FIGURE 1
Model (B4) > Mesh > Figure



Static Structural (B5)

TABLE 6
Model (B4) > Analysis

Object Name	*Static Structural (B5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 7
Model (B4) > Static Structural (B5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s

Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\jagad\AppData\Local\Temp\WB13964_2\unsaved_project_files\dp0\SYS-1\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL	No

db	
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 8
Model (B4) > Static Structural (B5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. N (ramped)
Y Component		-2.e+006 N (ramped)
Z Component		0. N (ramped)

FIGURE 2
Model (B4) > Static Structural (B5) > Fixed Support > Figure

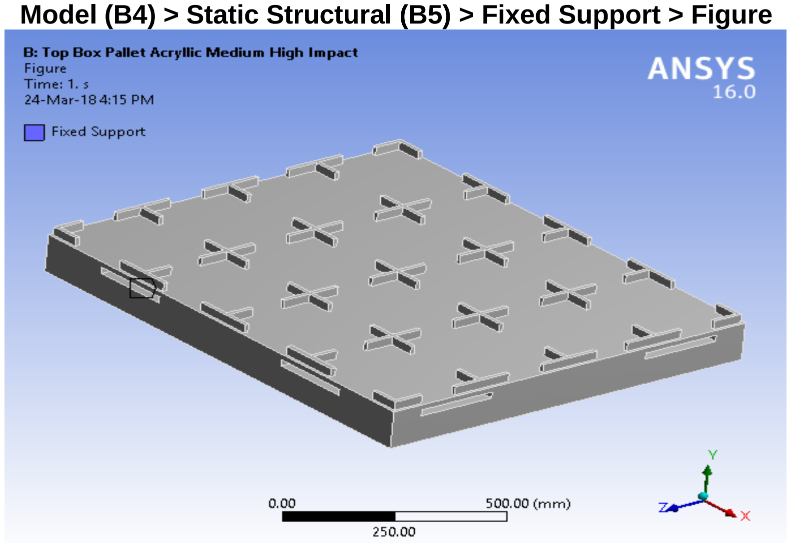


FIGURE 3
Model (B4) > Static Structural (B5) > Force

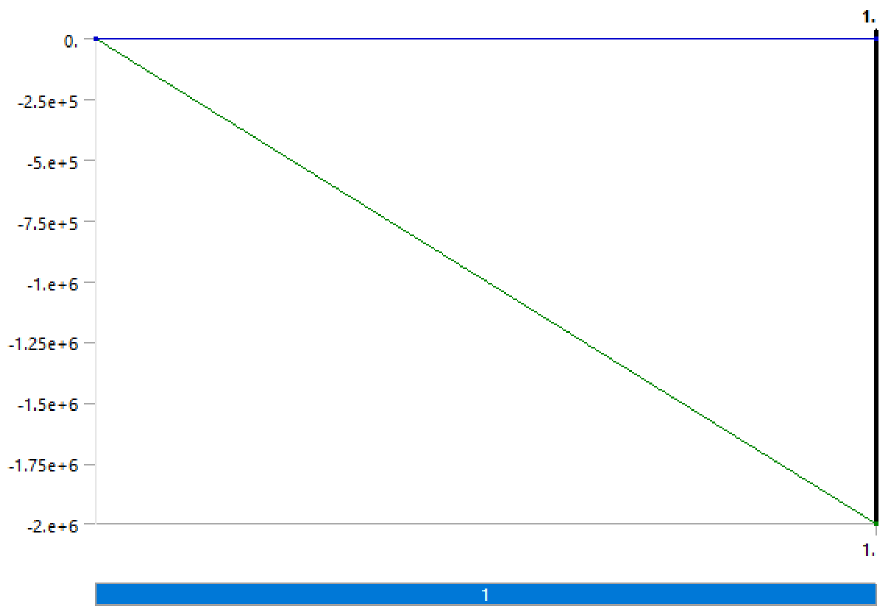
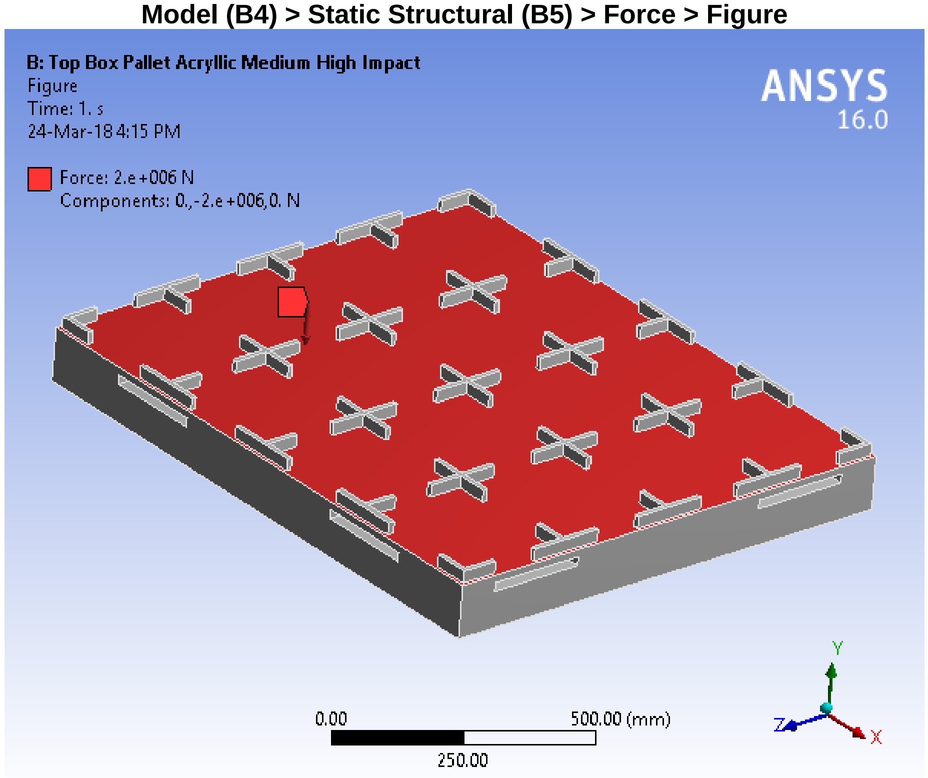


FIGURE 4
Model (B4) > Static Structural (B5) > Force > Figure



Solution (B6)

TABLE 9
Model (B4) > Static Structural (B5) > Solution

Object Name	*Solution (B6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10
Model (B4) > Static Structural (B5) > Solution (B6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11
Model (B4) > Static Structural (B5) > Solution (B6) > Results

Object Name	*Directional Deformation*	*Equivalent Stress*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Directional Deformation	Equivalent (von-Mises) Stress	Equivalent Elastic Strain
Orientation	Y Axis		
By	Time		
Display Time	Last		
Coordinate System	Global Coordinate System		
Calculate Time History	Yes		
Identifier			

Suppressed	No		
Results			
Minimum	-4.6305 mm	3.7018e-003 MPa	2.5589e-006 mm/mm
Maximum	0.74121 mm	48.692 MPa	2.328e-002 mm/mm
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

TABLE 12
Model (B4) > Static Structural (B5) > Solution (B6) > Directional Deformation

Time [s]	Minimum [mm]	Maximum [mm]
1.	-4.6305	0.74121

FIGURE 6
Model (B4) > Static Structural (B5) > Solution (B6) > Directional Deformation > Figure

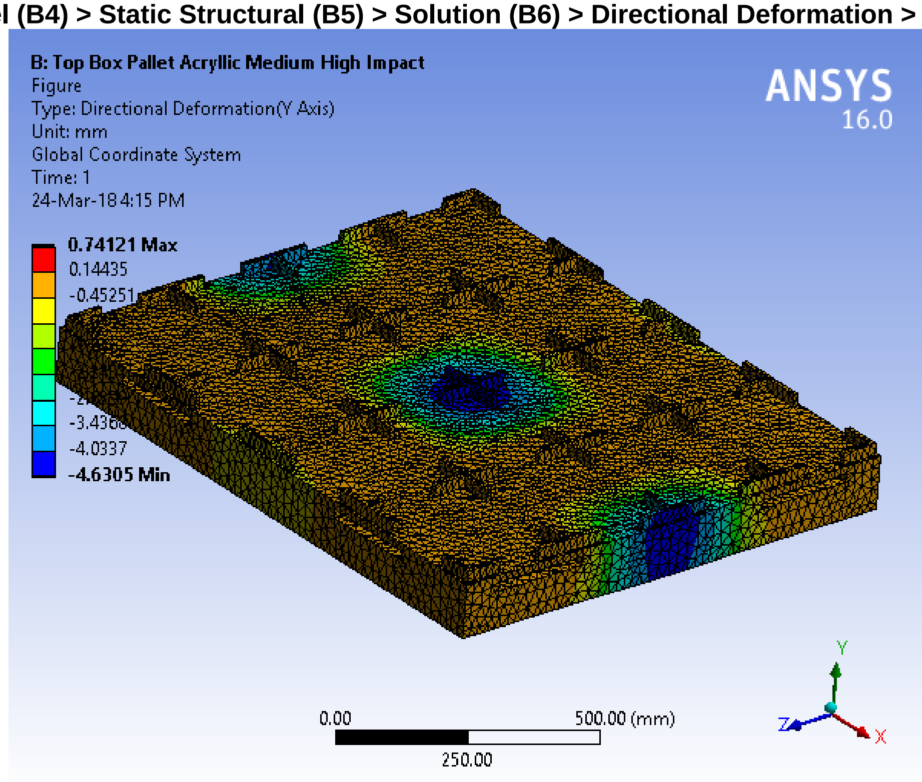


TABLE 13
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]
1.	3.7018e-003	48.692

FIGURE 8
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Stress > Figure

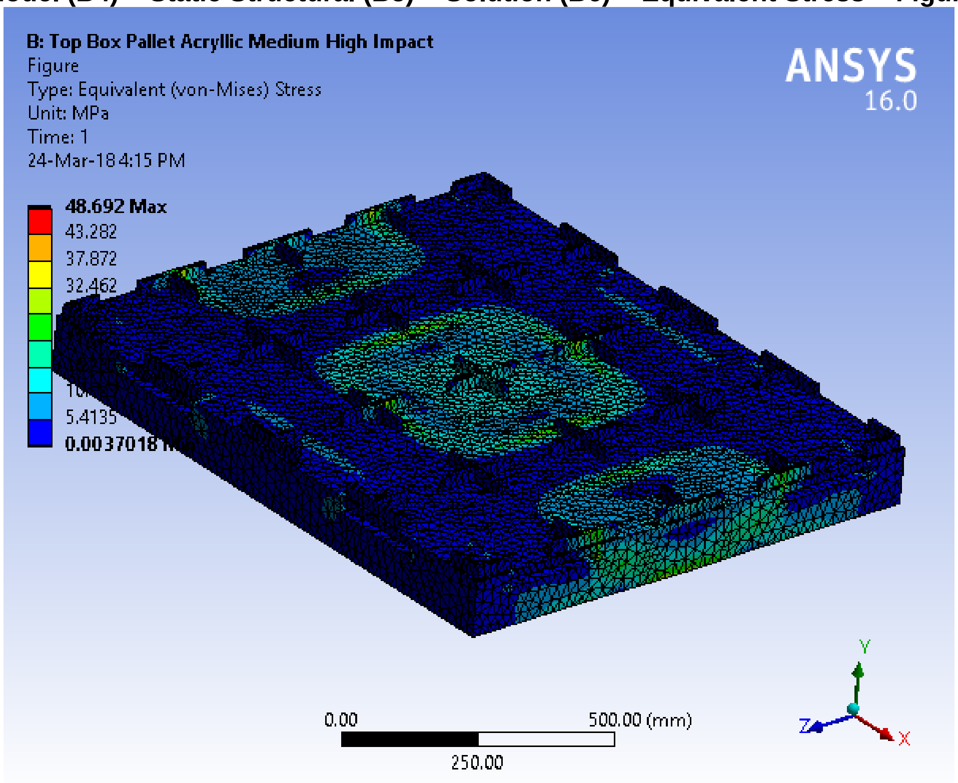


TABLE 14
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]
1.	2.5589e-006	2.328e-002

FIGURE 10
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain > Figure

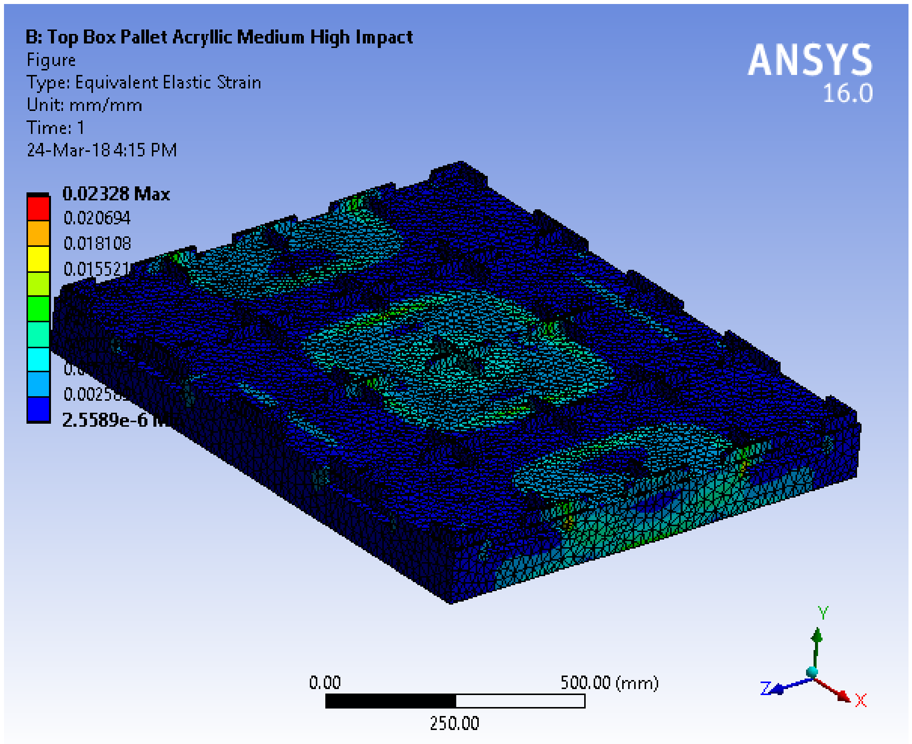


TABLE 15
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Tensile Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 16
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Results

Object Name	*Safety Factor*	*Stress Ratio*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Safety Factor	Stress Ratio
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Integration Point Results		
Display Option	Averaged	
Average Across Bodies	No	
Results		

Minimum	1.5676	0.
Maximum		0.63791
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	1	

TABLE 17
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	1.5676	15.

FIGURE 12
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Safety Factor > Figure

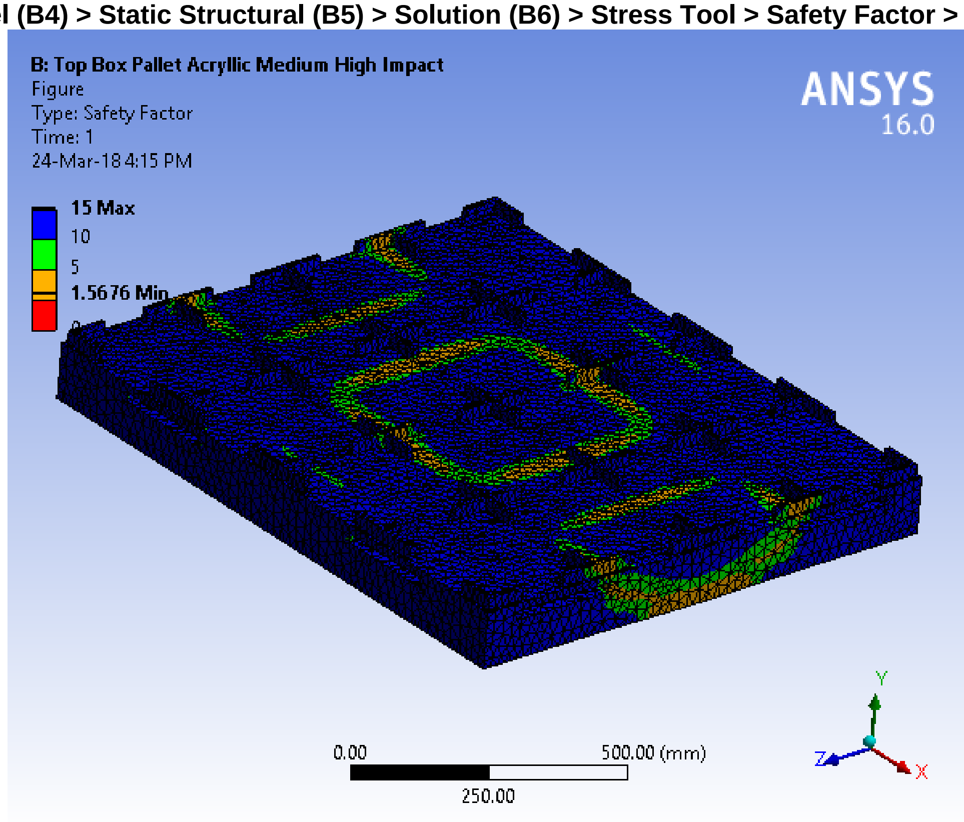
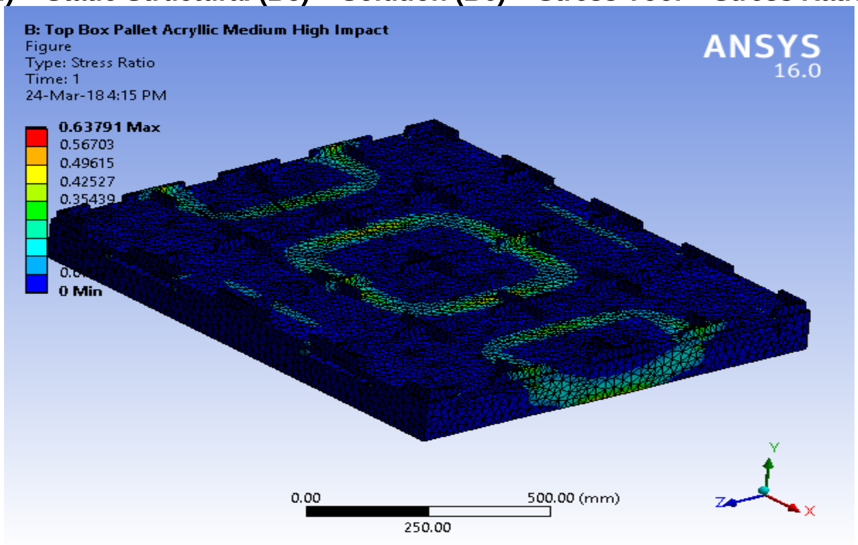


TABLE 18
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Stress Ratio

Time [s]	Minimum	Maximum
1.	0.	0.63791

FIGURE 14
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Stress Ratio > Figure



Material Data

Acryllic Medium High Impact

TABLE 19
Acryllic Medium High Impact > Constants

Density	1.2e-006 kg mm^-3
Coefficient of Thermal Expansion	5.2e-005 C^-1
Thermal Conductivity	2.1e-004 W mm^-1 C^-1

TABLE 20
Acryllic Medium High Impact > Isotropic Secant Coefficient of Thermal Expansion

Reference Temperature C
-0.15

TABLE 21
Acryllic Medium High Impact > Isotropic Elasticity

Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	2403	0.35	2670	890

TABLE 22
Acryllic Medium High Impact > Tensile Yield Strength

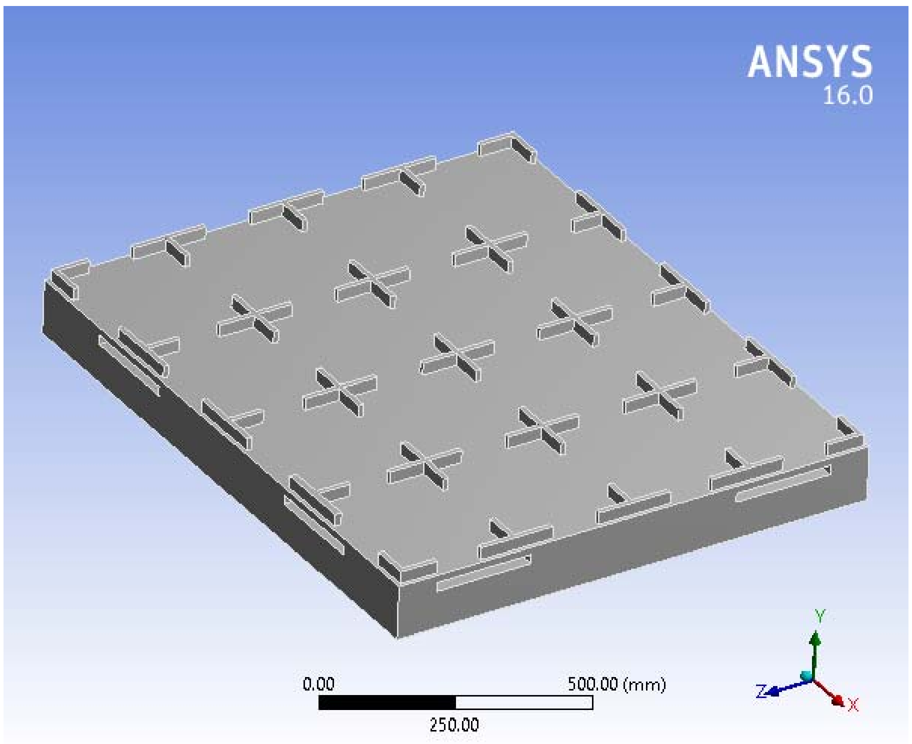
Tensile Yield Strength MPa
73

TABLE 23
Acryllic Medium High Impact > Compressive Yield Strength

Compressive Yield Strength MPa
45

Project

First Saved	Saturday, March 24, 2018
Last Saved	Saturday, March 24, 2018
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (B4)

Geometry

TABLE 2
Model (B4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	1219.2 mm
Length Y	139.7 mm
Length Z	1016. mm
Properties	

Volume	5.3963e+007 mm³
Mass	64.756 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	111118
Elements	58975
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\jagad\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (B4) > Geometry > Parts

Object Name	*Top Box Pallet 48x40.SLDPRT new for ansys*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Acryllic Medium High Impact
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	1219.2 mm
Length Y	139.7 mm
Length Z	1016. mm
Properties	

Volume	5.3963e+007 mm³
Mass	64.756 kg
Centroid X	0.18626 mm
Centroid Y	23.125 mm
Centroid Z	0.29796 mm
Moment of Inertia Ip1	5.7428e+006 kg·mm²
Moment of Inertia Ip2	1.4222e+007 kg·mm²
Moment of Inertia Ip3	8.54e+006 kg·mm²
Statistics	
Nodes	111118
Elements	58975
Mesh Metric	None

Coordinate Systems

TABLE 4
Model (B4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

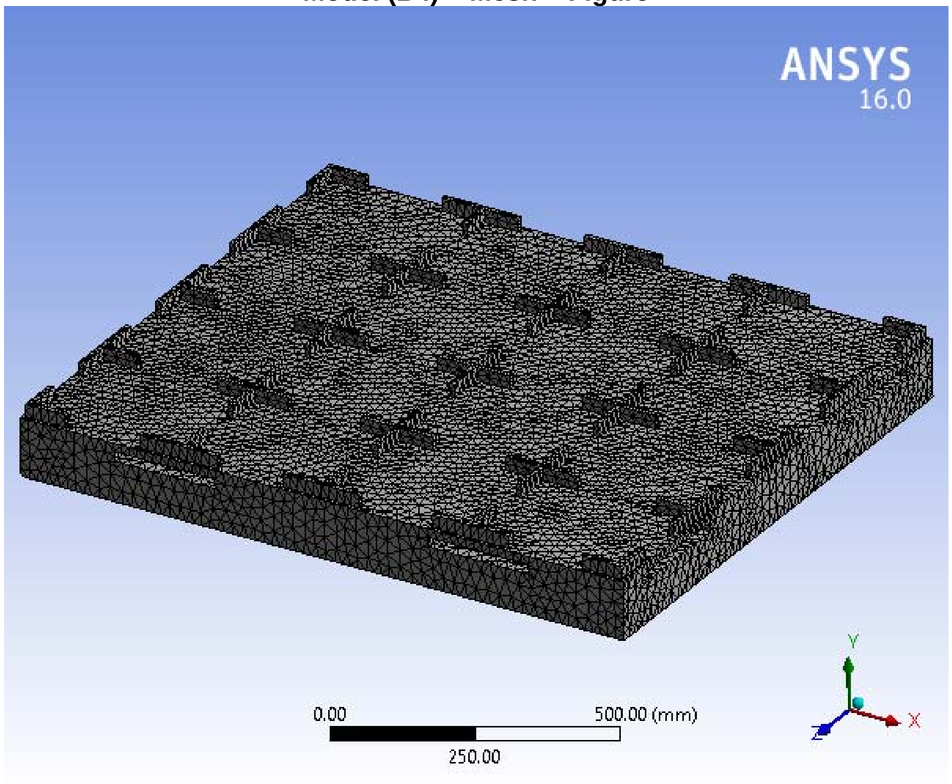
Mesh

TABLE 5
Model (B4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium

Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	10.160 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	111118
Elements	58975
Mesh Metric	None

FIGURE 1
Model (B4) > Mesh > Figure



Static Structural (B5)

TABLE 6
Model (B4) > Analysis

Object Name	*Static Structural (B5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 7
Model (B4) > Static Structural (B5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled

Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\jagad\AppData\Local\Temp\WB_ _5660_2\unsaved_project_files\dp0\SYS-1\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 8
Model (B4) > Static Structural (B5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force

Suppressed	No	
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. N (ramped)
Y Component		-70000 N (ramped)
Z Component		0. N (ramped)

FIGURE 2
Model (B4) > Static Structural (B5) > Fixed Support > Figure

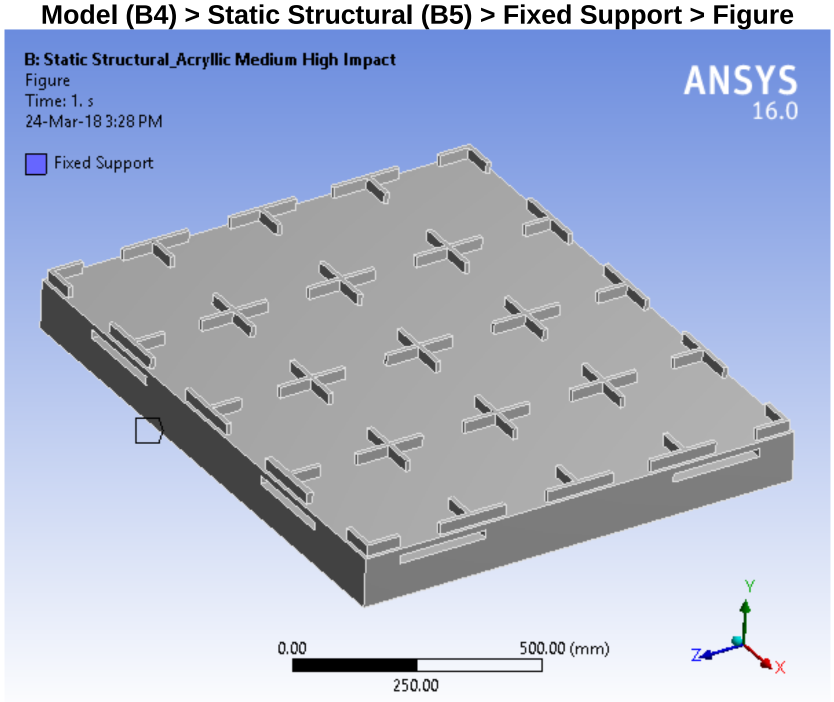


FIGURE 3
Model (B4) > Static Structural (B5) > Force

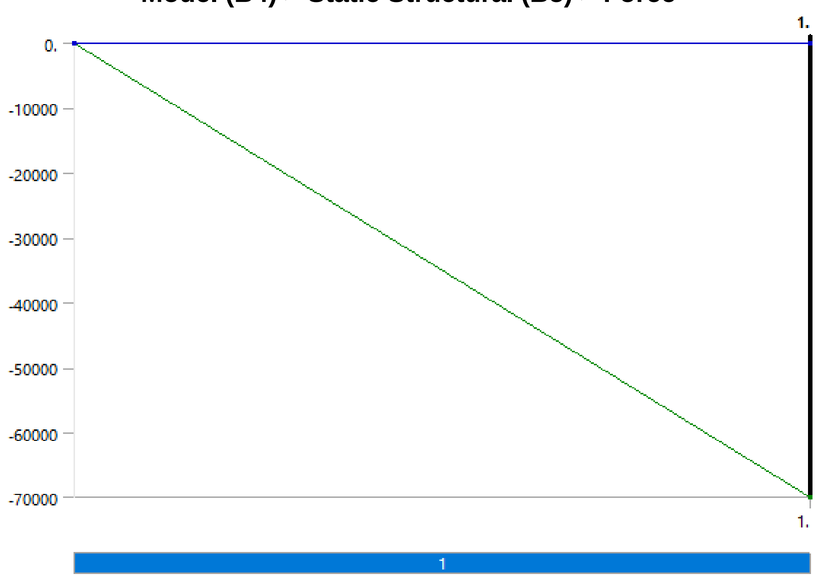
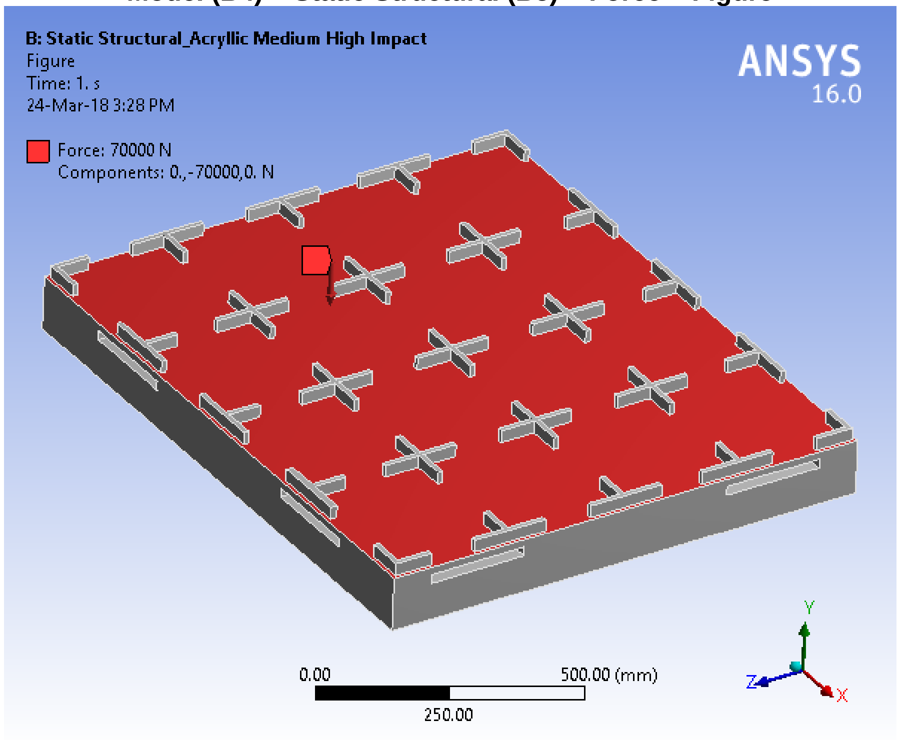


FIGURE 4
Model (B4) > Static Structural (B5) > Force > Figure



Solution (B6)

TABLE 9
Model (B4) > Static Structural (B5) > Solution

Object Name	*Solution (B6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10
Model (B4) > Static Structural (B5) > Solution (B6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes

Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11
Model (B4) > Static Structural (B5) > Solution (B6) > Results

Object Name	*Directional Deformation*	*Equivalent Stress*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Directional Deformation	Equivalent (von-Mises) Stress	Equivalent Elastic Strain
Orientation	Y Axis		
By	Time		
Display Time	Last		
Coordinate System	Global Coordinate System		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	-13.276 mm	8.5091e-003 MPa	3.541e-006 mm/mm
Maximum	0.15009 mm	29.574 MPa	1.378e-002 mm/mm
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

TABLE 12
Model (B4) > Static Structural (B5) > Solution (B6) > Directional Deformation

Time [s]	Minimum [mm]	Maximum [mm]
1.	-13.276	0.15009

FIGURE 6
Model (B4) > Static Structural (B5) > Solution (B6) > Directional Deformation > Figure

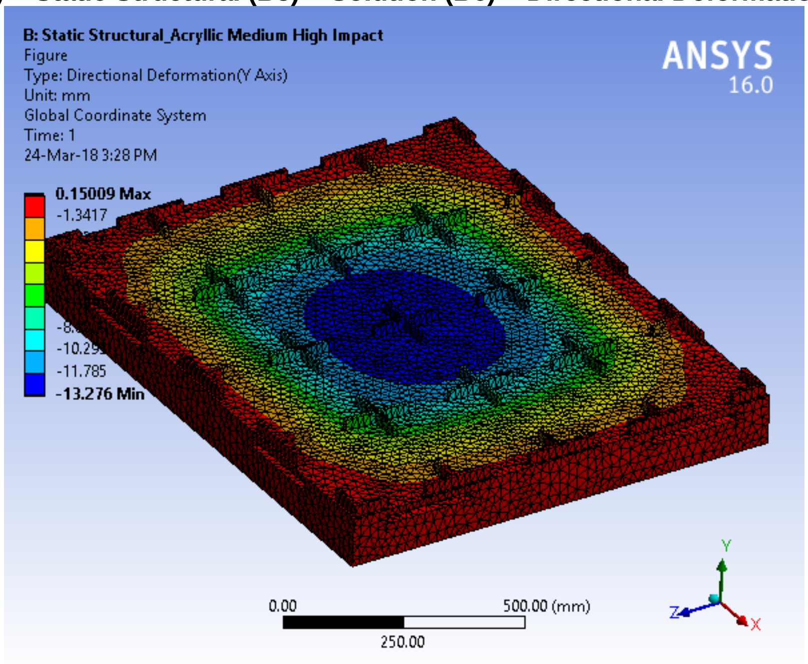


TABLE 13
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]
1.	8.5091e-003	29.574

FIGURE 8
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Stress > Figure

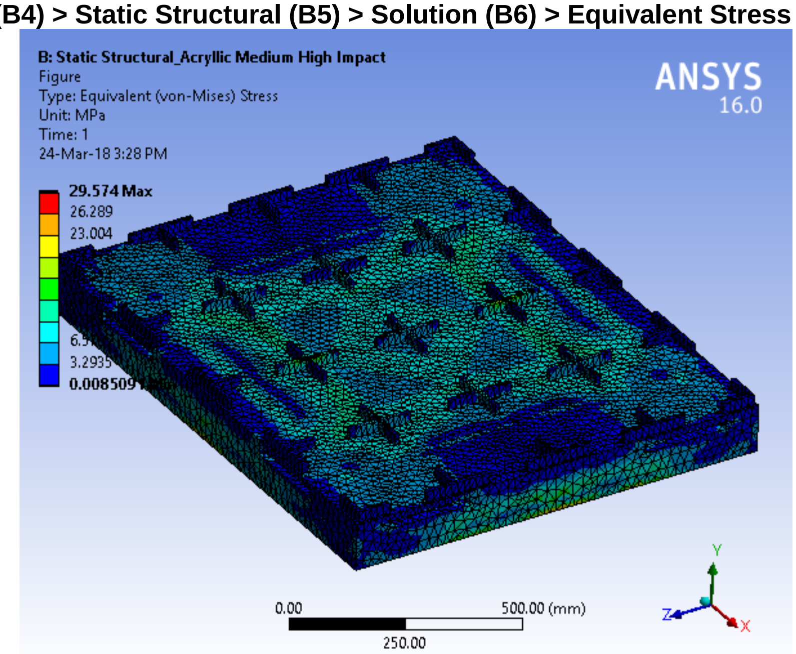


TABLE 14
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]
1.	3.541e-006	1.378e-002

FIGURE 10
Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain > Figure

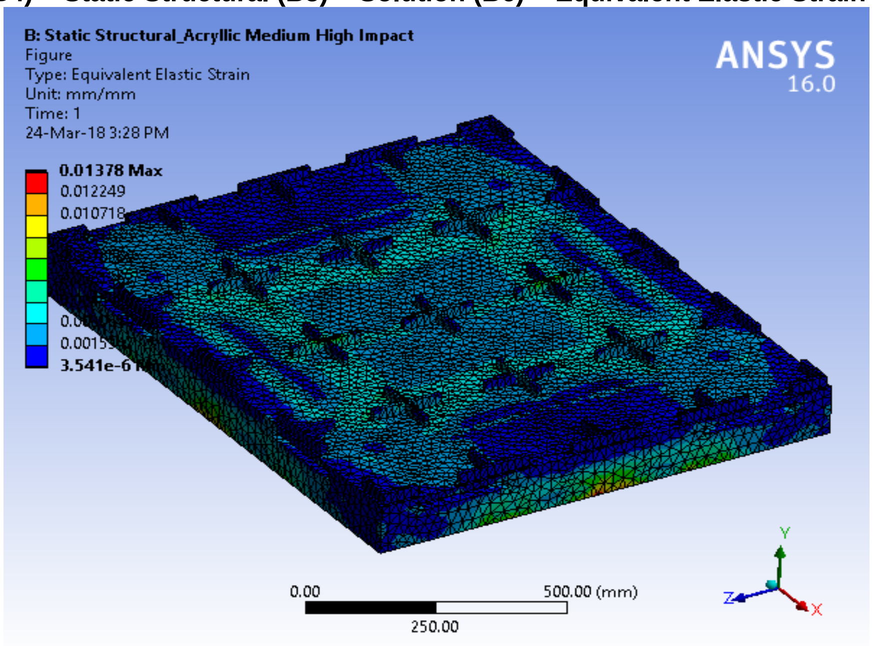


TABLE 15
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Tensile Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 16
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Results

Object Name	*Safety Factor*	*Stress Ratio*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Safety Factor	Stress Ratio
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Integration Point Results		

Display Option	Averaged	
Average Across Bodies	No	
Results		
Minimum	1.7902	0.
Maximum		0.55861
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	1	

TABLE 17
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	1.7902	15.

FIGURE 12
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Safety Factor > Figure

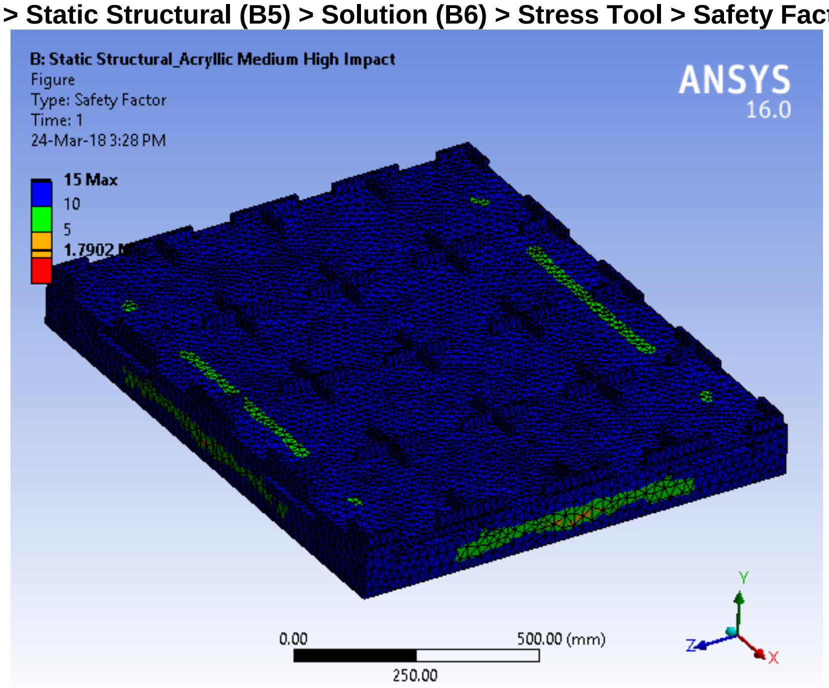
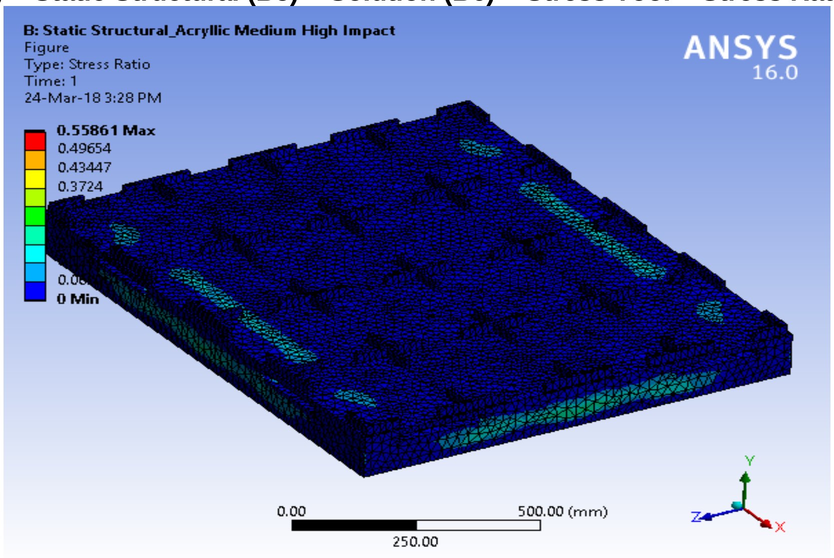


TABLE 18
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Stress Ratio

Time [s]	Minimum	Maximum
1.	0.	0.55861

FIGURE 14
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Stress Ratio > Figure



Material Data

Acryllic Medium High Impact

TABLE 19
Acryllic Medium High Impact > Constants

Density	1.2e-006 kg mm^-3
Coefficient of Thermal Expansion	5.2e-005 C^-1
Thermal Conductivity	2.1e-004 W mm^-1 C^-1

TABLE 20
Acryllic Medium High Impact > Isotropic Secant Coefficient of Thermal Expansion

Reference Temperature C
-0.15

TABLE 21
Acryllic Medium High Impact > Isotropic Elasticity

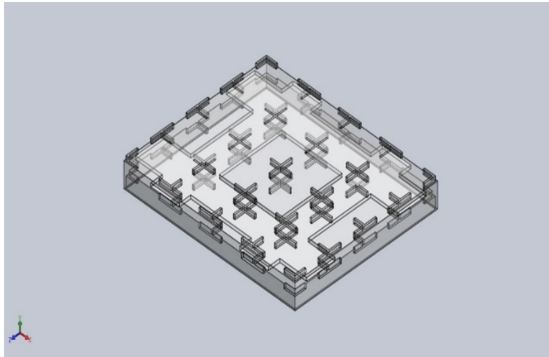
Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	2403	0.35	2670	890

TABLE 22
Acryllic Medium High Impact > Tensile Yield Strength

Tensile Yield Strength MPa
73

TABLE 23
Acryllic Medium High Impact > Compressive Yield Strength

Compressive Yield Strength MPa
45

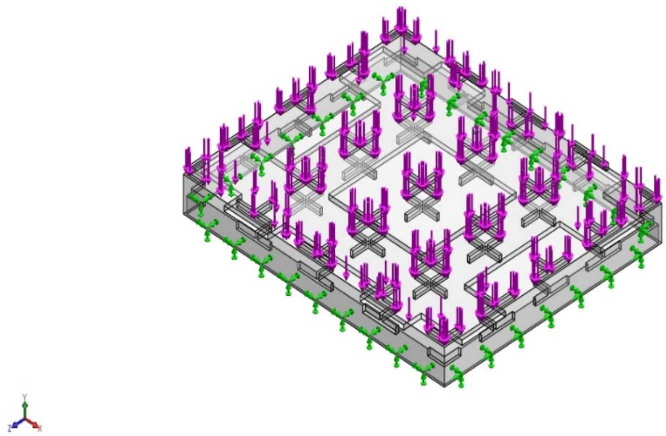


Simulation of Top Box Pallet 48x40

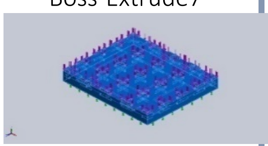
Date: Thursday, March 15, 2018
Designer: Solidworks
Study name: Static 1
Analysis type: Static

Table of Contents

Model Information



Model name: Top Box Pallet 48x40
Current Configuration: Default

Solid Bodies			
Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Boss-Extrude7 	Solid Body	Mass:65.7873 kg Volume:0.0548227 m^3 Density:1200 kg/m^3 Weight:644.715 N	C:\Users\2690526\Documents\Top Box Pallet 48x40.SLDPRT Mar 15 15:18:00 2018

Study Properties

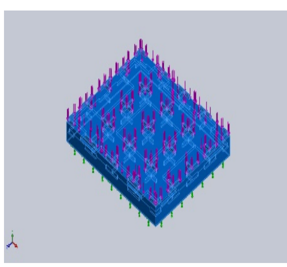
Study name	Static 1
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	FFEPlus
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On

Friction	Off
Use Adaptive Method:	Off
Result folder	SOLIDWORKS document (C:\Users\2690526\Documents)

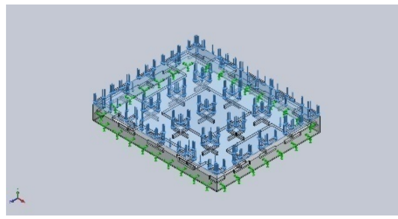
Units

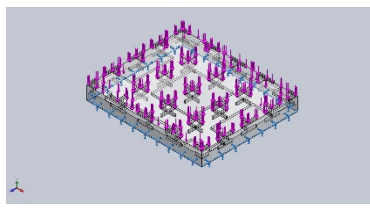
Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m^2

Material Properties

Model Reference	Properties	Components
	Name: **Acrylic (Medium-high impact)** Model type: **Linear Elastic Isotropic** Default failure criterion: **Max von Mises Stress** Yield strength: **4.5e+007 N/m^2** Tensile strength: **7.3e+007 N/m^2** Elastic modulus: **3e+009 N/m^2** Poisson's ratio: **0.35** Mass density: **1200 kg/m^3** Shear modulus: **8.9e+008 N/m^2** Thermal expansion coefficient: **5.2e-005 /Kelvin**	**SolidBody 1(Boss-Extrude7)(Top Box Pallet 48x40)**
Curve Data: N/A		

Loads and Fixtures

Load name	Load Image	Load Details
Force-1		**Entities:** 1 face(s) **Type:** Apply normal force **Value:** 28000 lbf

Fixture name	Fixture Image	Fixture Details
Fixed-1		**Entities:** 4 edge(s) **Type:** Fixed Geometry

Resultant Forces

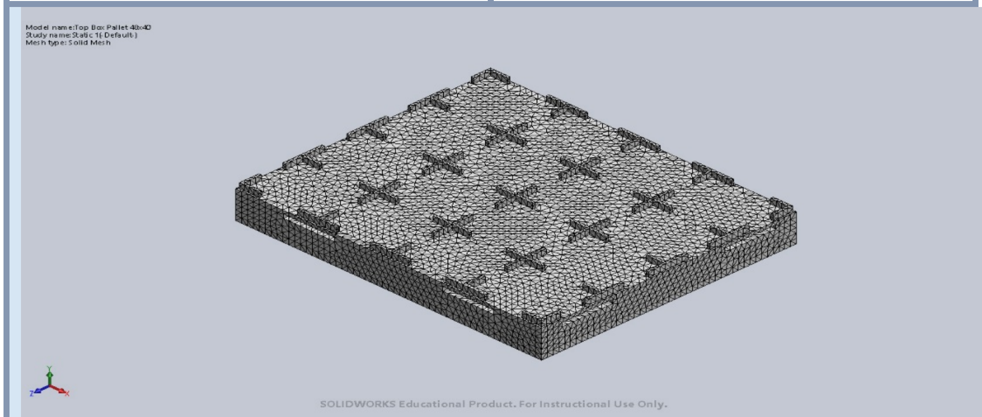
Components	X	Y	Z	Resultant
Reaction force(N)	**-0.974354**	**124550**	**1.43686**	**124550**
Reaction Moment(N.m)	**0**	**0**	**0**	**0**

Mesh information

Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off
Jacobian points	4 Points
Element Size	0.927647 in
Tolerance	0.0463823 in
Mesh Quality Plot	High

Mesh information - Details

Total Nodes	79761
Total Elements	42578
Maximum Aspect Ratio	9.9027
% of elements with Aspect Ratio < 3	89.2
% of elements with Aspect Ratio > 10	0
% of distorted elements(Jacobian)	0
Time to complete mesh(hh;mm;ss):	00:00:10
Computer name:	MSL-REF-70



Resultant Forces

Reaction forces

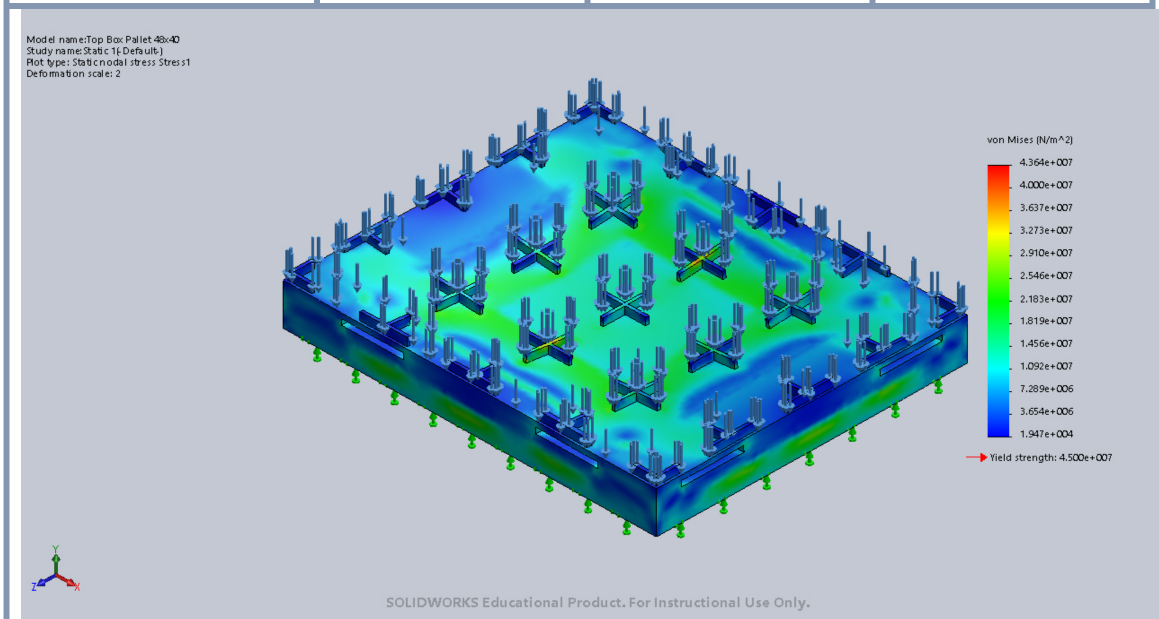
Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	-0.974354	124550	1.43686	124550

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

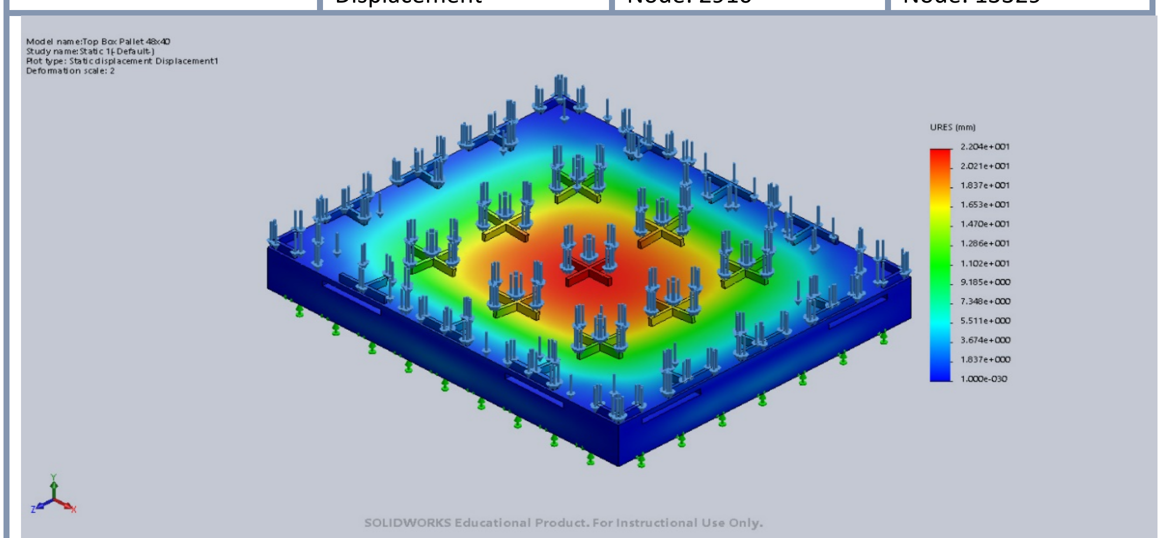
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	1.947e+004N/m^2 Node: 50375	4.364e+007N/m^2 Node: 33793



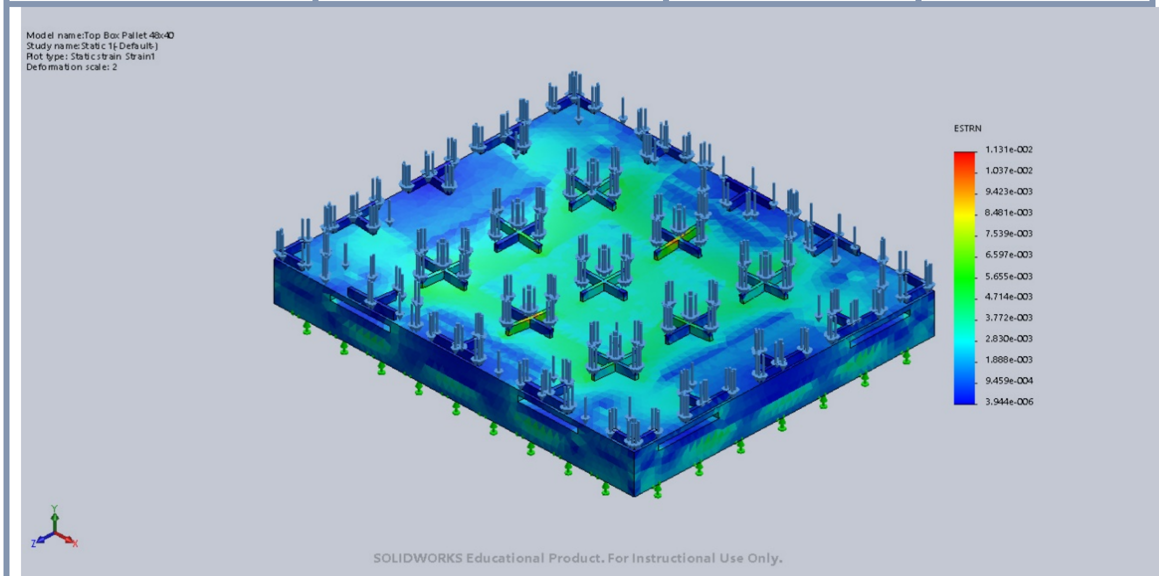
Top Box Pallet 48x40-Static 1-Stress-Stress1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+000mm Node: 2910	2.204e+001mm Node: 13329



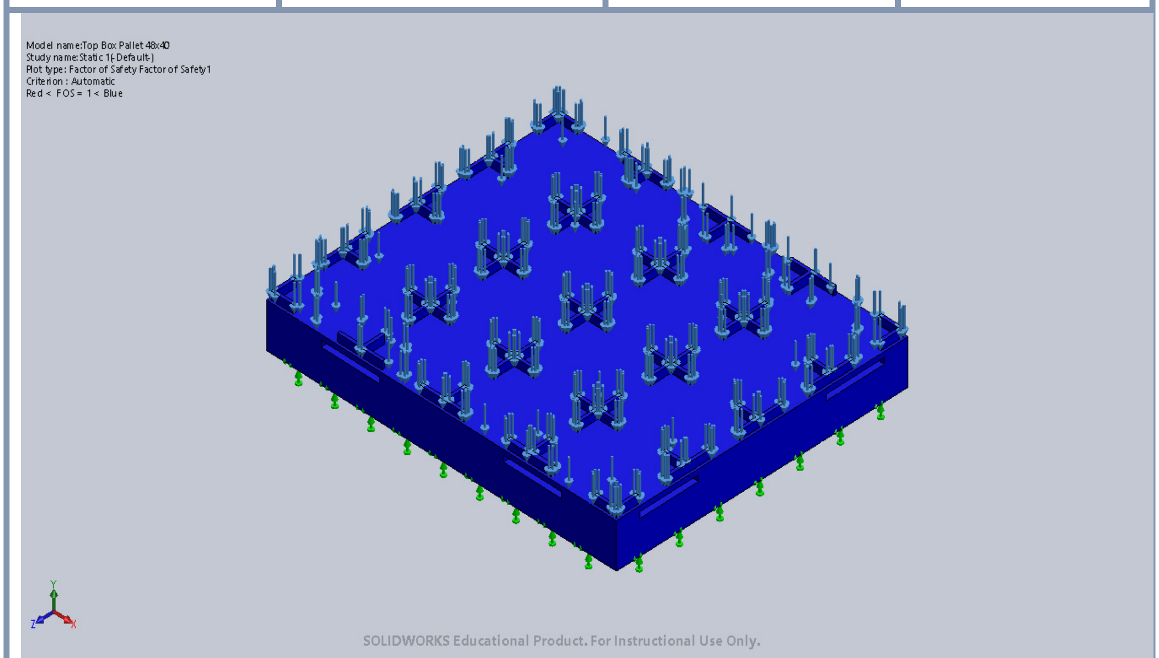
Top Box Pallet 48x40-Static 1-Displacement-Displacement1

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	3.944e-006 Element: 12579	1.131e-002 Element: 31900

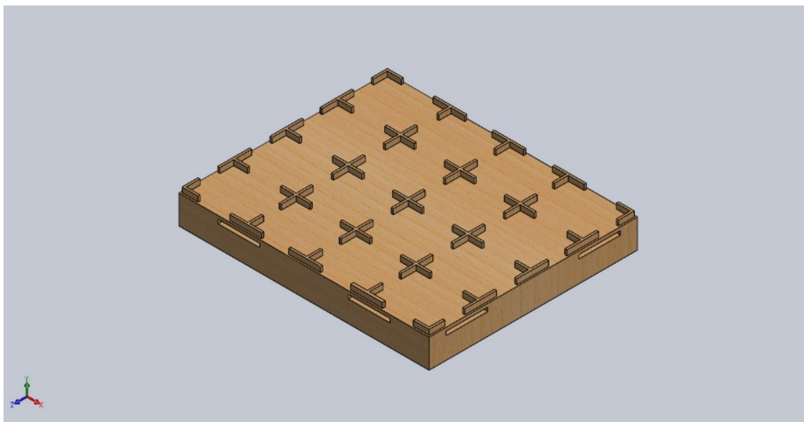


Top Box Pallet 48x40-Static 1-Strain-Strain1

Name	Type	Min	Max
Factor of Safety1	Automatic	1.031e+000 Node: 33793	2.311e+003 Node: 50375



Top Box Pallet 48x40-Static 1-Factor of Safety-Factor of Safety1

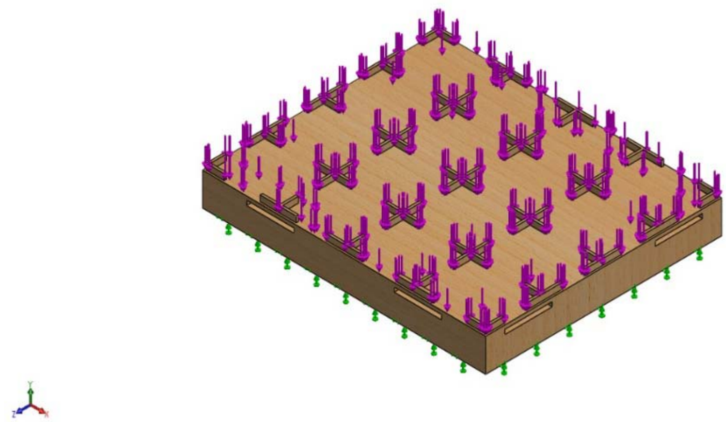


Simulation of Top Box Pallet 48x40

Date: Thursday, March 15, 2018
Designer: Solidworks
Study name: Static 1
Analysis type: Static

Table of Contents

Model Information



Model name: Top Box Pallet 48x40
Current Configuration: Default

Solid Bodies			
Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Boss-Extrude7 	Solid Body	Mass:8.77108 kg Volume:0.0548227 m^3 Density:159.99 kg/m^3 Weight:85.9566 N	C:\Users\2690526\Documents\Top Box Pallet 48x40.SLDPRT Mar 15 15:18:00 2018

Study Properties

Study name	Static 1
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	FFEPlus
Inplane Effect:	Off
Soft Spring:	Off
Inertial Relief:	Off

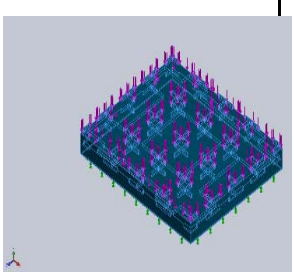
Loads and Fixtures

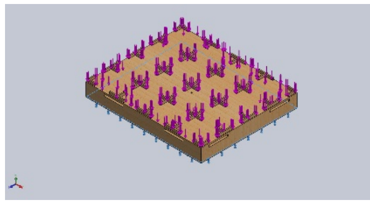
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off
Result folder	SOLIDWORKS document (C:\Users\2690526\Documents)

Units

Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m^2

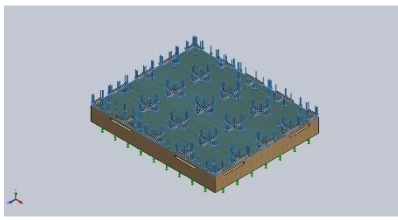
Material Properties

Model Reference	Properties	Components
	Name: **Balsa** Model type: **Linear Elastic Isotropic** Default failure criterion: **Unknown** Yield strength: **2e+007 N/m^2** Elastic modulus: **3e+009 N/m^2** Poisson's ratio: **0.29** Mass density: **159.99 kg/m^3** Shear modulus: **3e+008 N/m^2**	**Solid Body 1(Boss-Extrude7)(Top Box Pallet 48x40)**
Curve Data: N/A		

Fixture name	Fixture Image	Fixture Details
Fixed-1		**Entities:** 4 edge(s) **Type:** Fixed Geometry

Resultant Forces

Components	X	Y	Z	Resultant
Reaction force(N)	0.115229	35585.4	-0.0687065	35585.4
Reaction Moment(N.m)	0	0	0	0

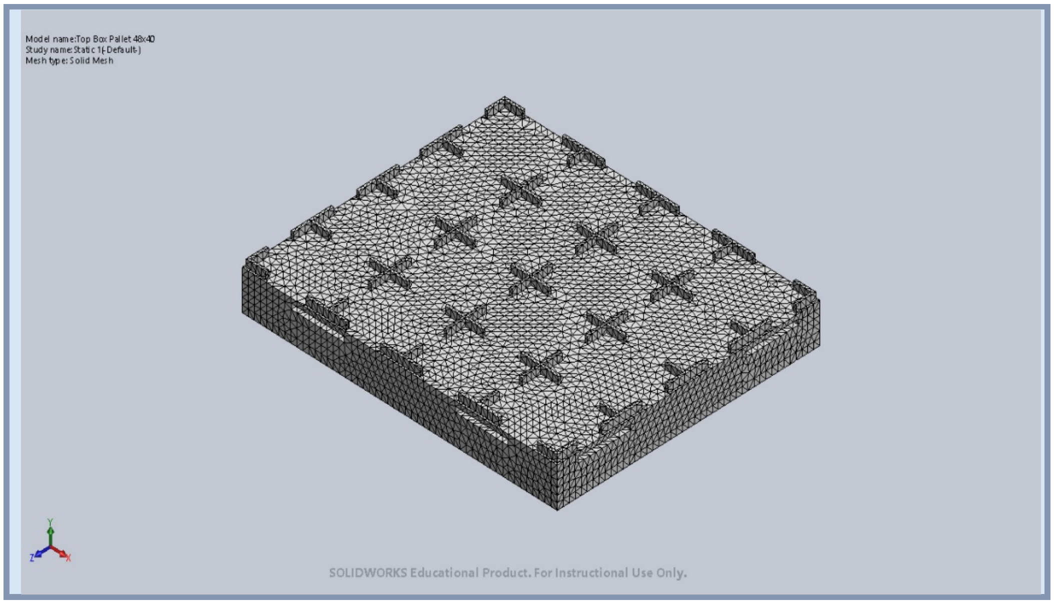
Load name	Load Image	Load Details
Force-1		**Entities:** 1 face(s) **Type:** Apply normal force **Value:** 8000 lbf

Mesh information

Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off
Jacobian points	4 Points
Element Size	0.927647 in
Tolerance	0.0463823 in
Mesh Quality Plot	High

Mesh information - Details

Total Nodes	79761
Total Elements	42578
Maximum Aspect Ratio	9.9027
% of elements with Aspect Ratio < 3	89.2
% of elements with Aspect Ratio > 10	0
% of distorted elements(Jacobian)	0
Time to complete mesh(hh;mm;ss):	00:00:10
Computer name:	MSL-REF-70



Resultant Forces

Reaction forces

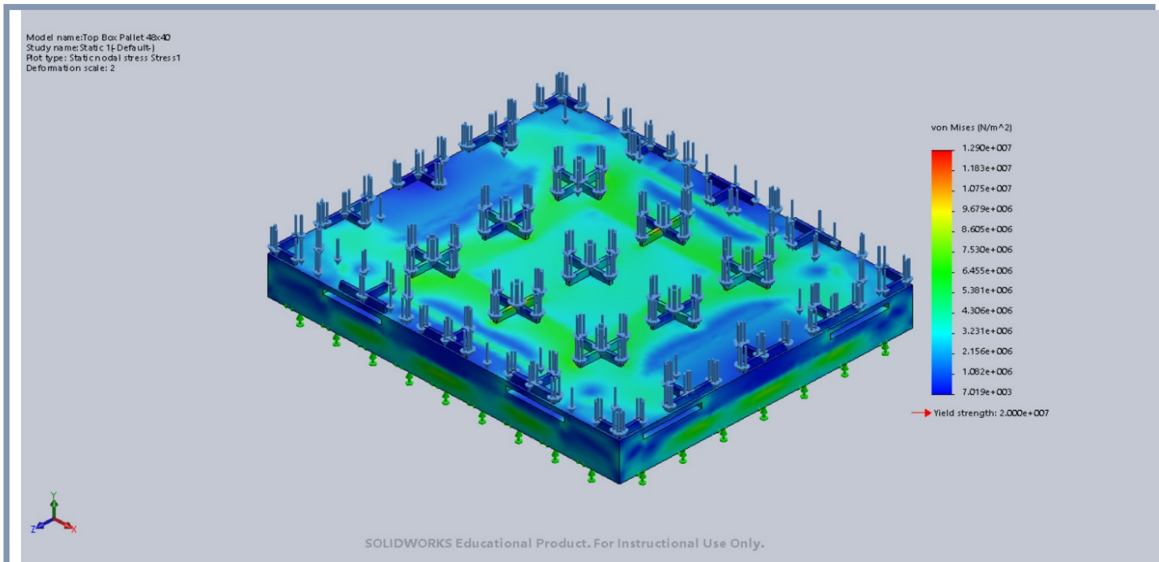
Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	0.115229	35585.4	-0.0687065	35585.4

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

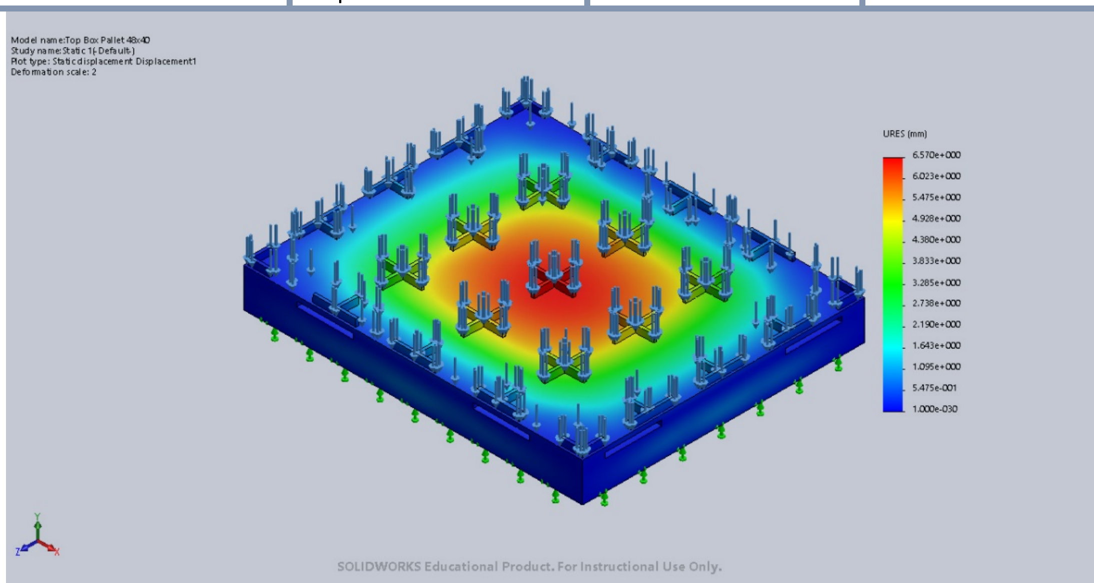
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	7.019e+003N/m^2 Node: 50375	1.290e+007N/m^2 Node: 30073



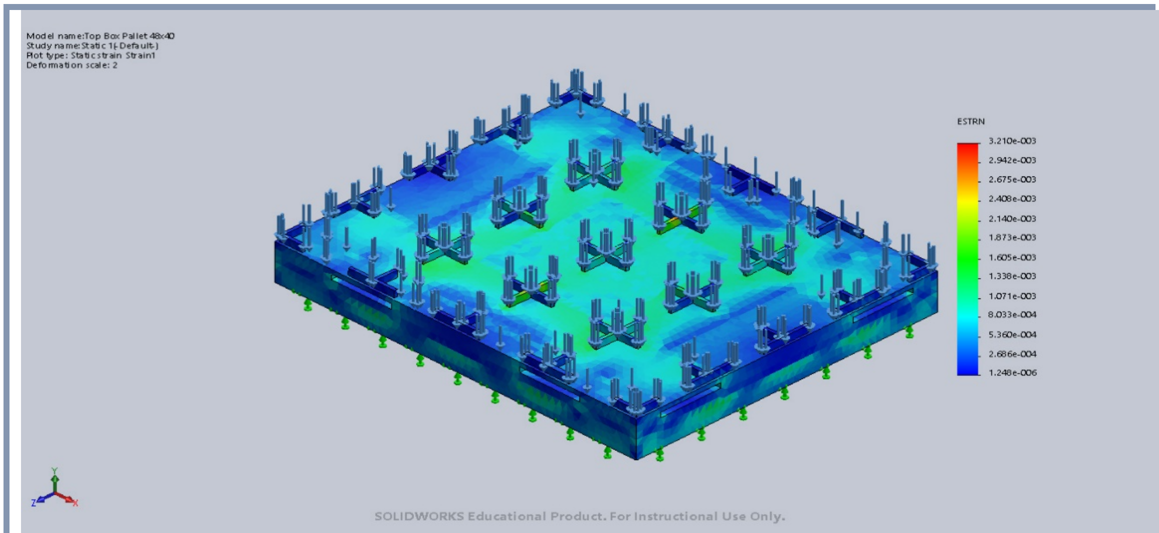
Top Box Pallet 48x40-Static 1-Stress-Stress1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+000mm Node: 2910	6.570e+000mm Node: 13329



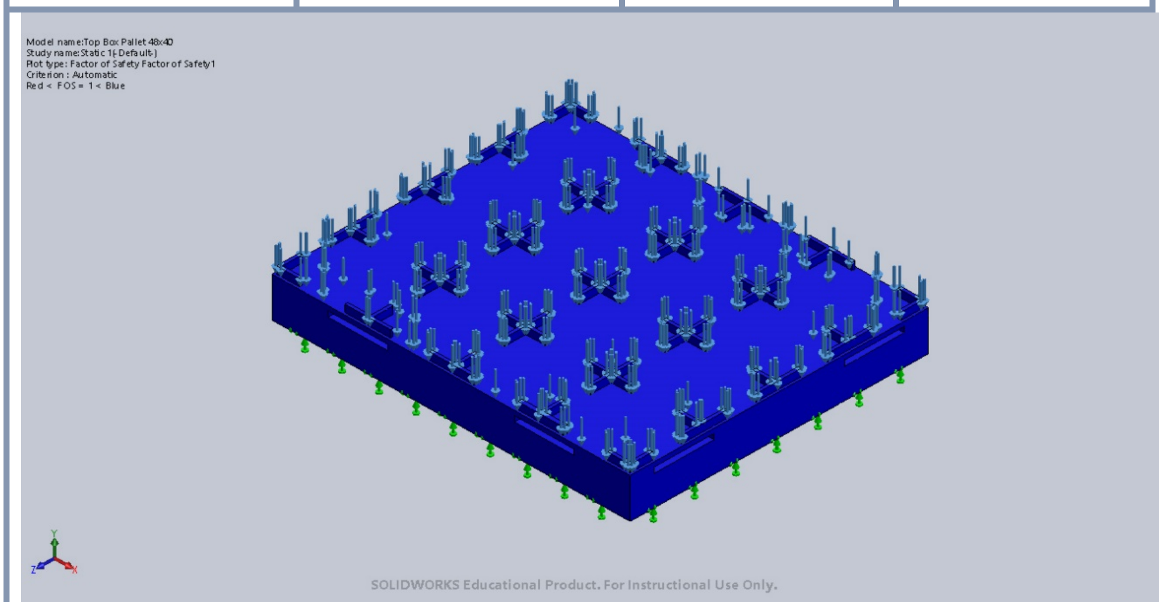
Top Box Pallet 48x40-Static 1-Displacement-Displacement1

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	1.248e-006 Element: 18541	3.210e-003 Element: 31900

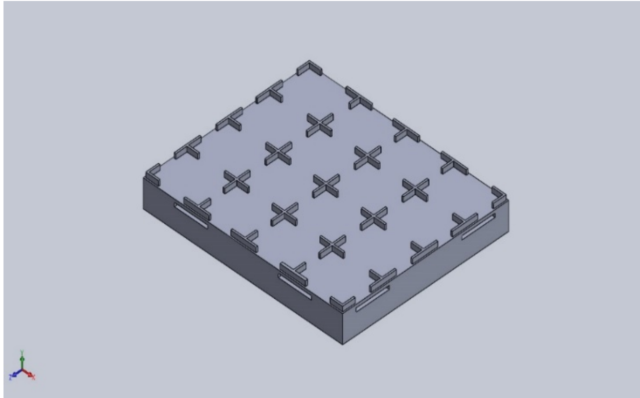


Top Box Pallet 48x40-Static 1-Strain-Strain1

Name	Type	Min	Max
Factor of Safety1	Automatic	1.550e+000 Node: 30073	2.849e+003 Node: 50375



Top Box Pallet 48x40-Static 1-Factor of Safety-Factor of Safety1

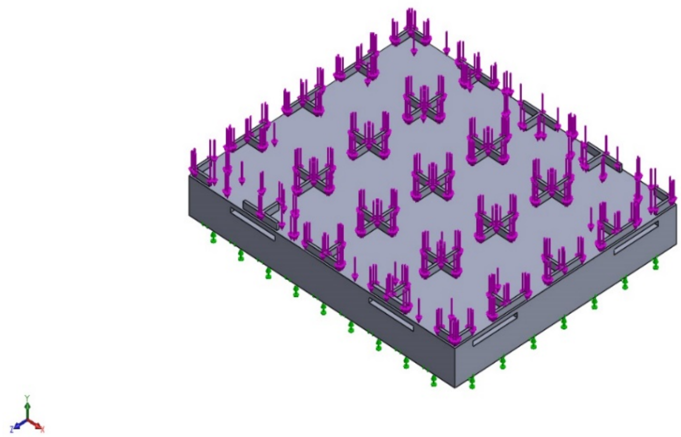


Simulation of Top Box Pallet 48x40

Date: Thursday, March 15, 2018
Designer: Solidworks
Study name: Static 1
Analysis type: Static

Table of Contents

Model Information



Model name: Top Box Pallet 48x40
Current Configuration: Default

Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Boss-Extrude7 	Solid Body	Mass:49.6146 kg Volume:0.0548227 m^3 Density:905 kg/m^3 Weight:486.223 N	C:\Users\2690526\Documents\Top Box Pallet 48x40.SLDPRT Mar 15 15:18:00 2018

Study Properties

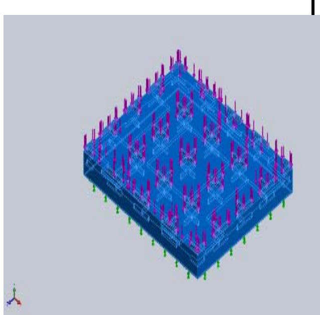
Study name	Static 1
Analysis type	Static
Mesh type	Solid Mesh
Thermal Effect:	On
Thermal option	Include temperature loads
Zero strain temperature	298 Kelvin
Include fluid pressure effects from SOLIDWORKS Flow Simulation	Off
Solver type	FFEPlus
Inplane Effect:	Off
Soft Spring:	Off

Inertial Relief:	Off
Incompatible bonding options	Automatic
Large displacement	Off
Compute free body forces	On
Friction	Off
Use Adaptive Method:	Off
Result folder	SOLIDWORKS document (C:\Users\2690526\Documents)

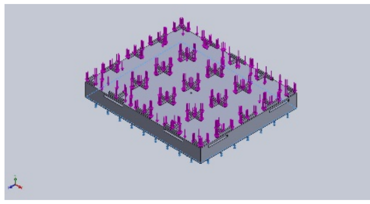
Units

Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m^2

Material Properties

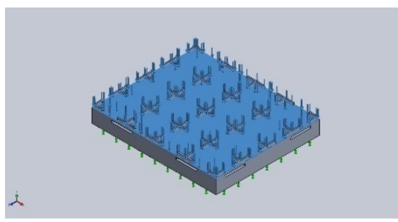
Model Reference	Properties	Components
	Name: **Very Low Density PE (SS)** Model type: **Linear Elastic Isotropic** Default failure criterion: **Max von Mises Stress** Yield strength: **6.89476e+006 N/m^2** Tensile strength: **3.4e+007 N/m^2** Elastic modulus: **1.72369e+008 N/m^2** Poisson's ratio: **0.3** Mass density: **905 kg/m^3**	**SolidBody 1(Boss-Extrude7)(Top Box Pallet 48x40)**
Curve Data:N/A		

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details
Fixed-1		**Entities:** 4 edge(s) **Type:** Fixed Geometry

Resultant Forces

Components	X	Y	Z	Resultant
Reaction force(N)	-0.133505	13344.6	0.0592976	13344.6
Reaction Moment(N.m)	0	0	0	0

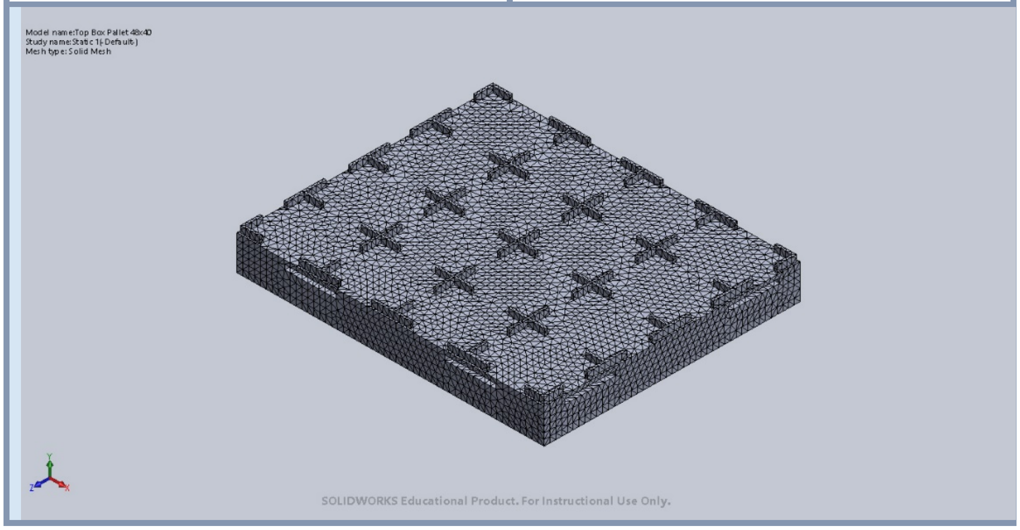
Load name	Load Image	Load Details
Force-1		**Entities:** 1 face(s) **Type:** Apply normal force **Value:** 3000 lbf

Mesh information

Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off
Jacobian points	4 Points
Element Size	0.927647 in
Tolerance	0.0463823 in
Mesh Quality Plot	High

Mesh information - Details

Total Nodes	79761
Total Elements	42578
Maximum Aspect Ratio	9.9027
% of elements with Aspect Ratio < 3	89.2
% of elements with Aspect Ratio > 10	0
% of distorted elements(Jacobian)	0
Time to complete mesh(hh;mm;ss):	00:00:10
Computer name:	MSL-REF-70



Resultant Forces

Reaction forces

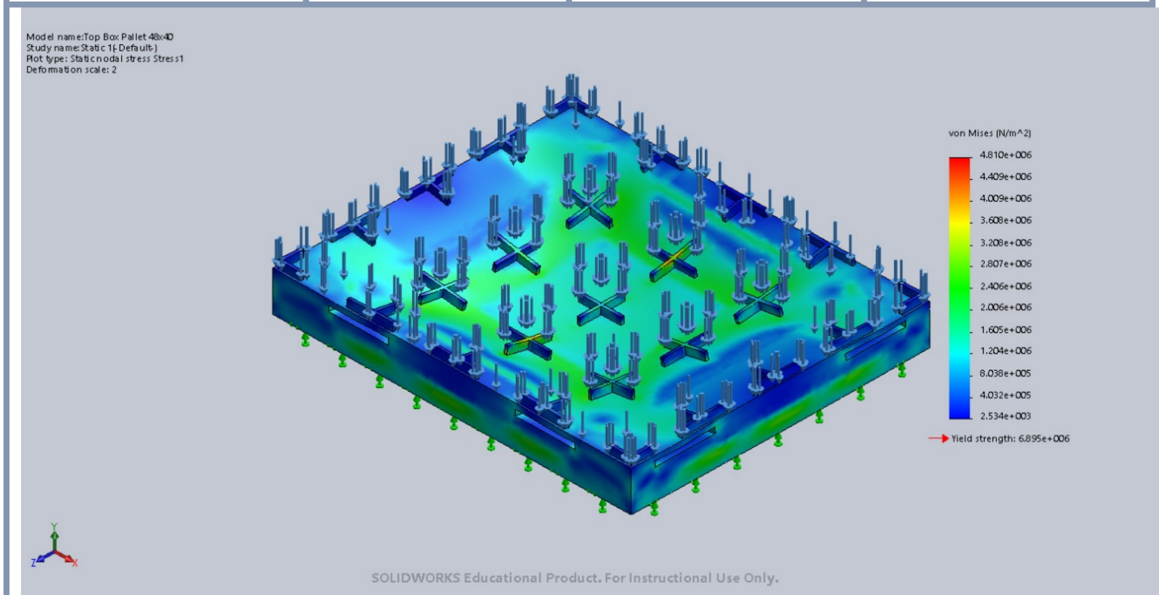
Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	-0.133505	13344.6	0.0592976	13344.6

Reaction Moments

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N.m	0	0	0	0

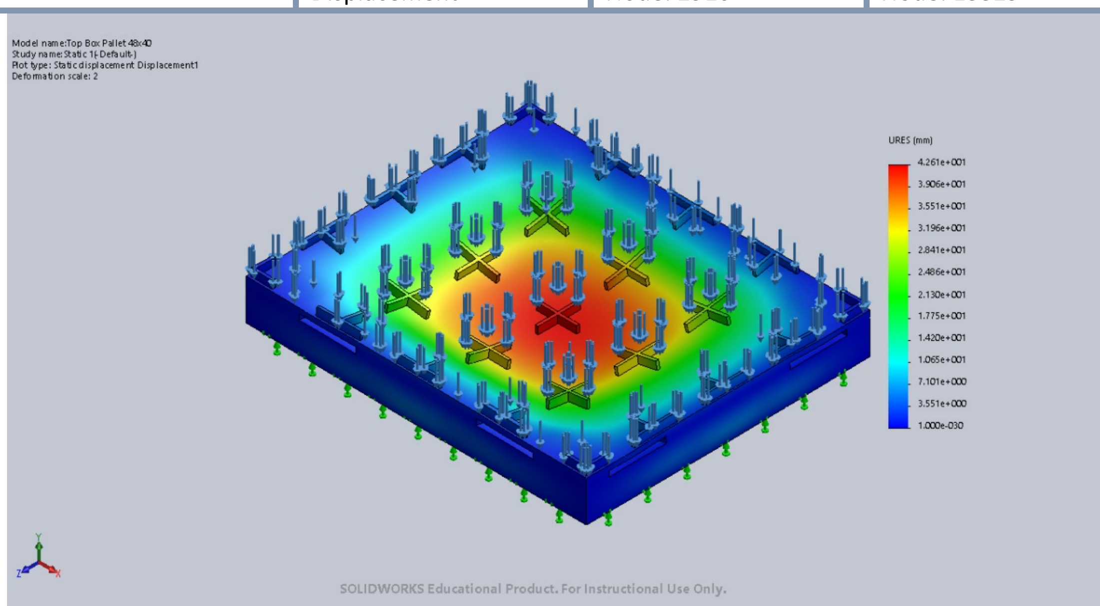
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	2.534e+003N/m^2 Node: 50375	4.810e+006N/m^2 Node: 30073



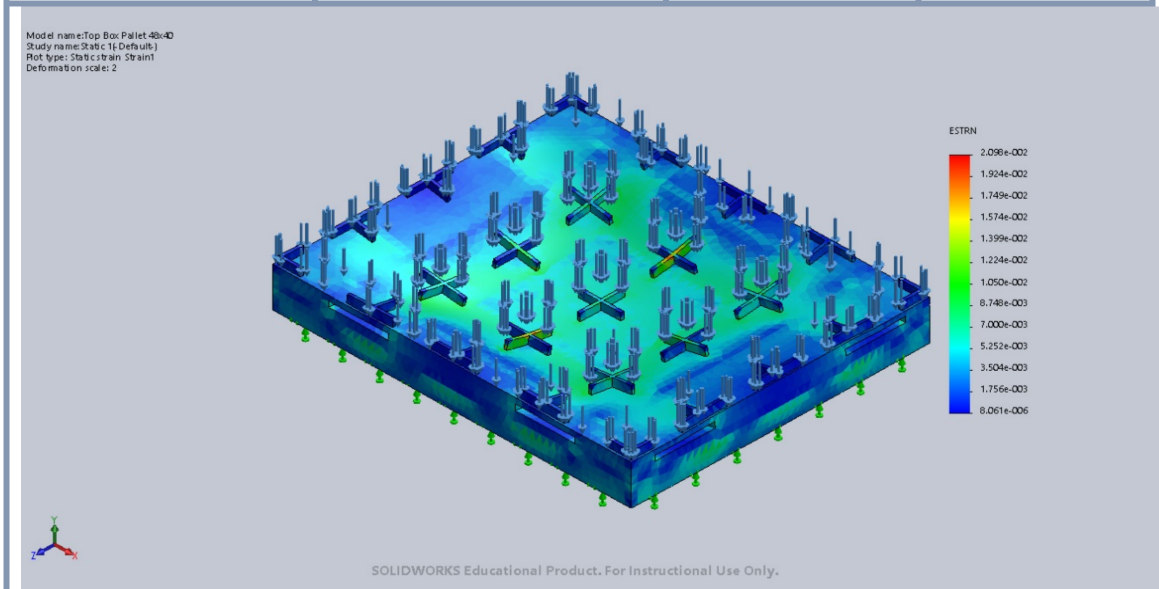
Top Box Pallet 48x40-Static 1-Stress-Stress1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.000e+000mm Node: 2910	4.261e+001mm Node: 13329



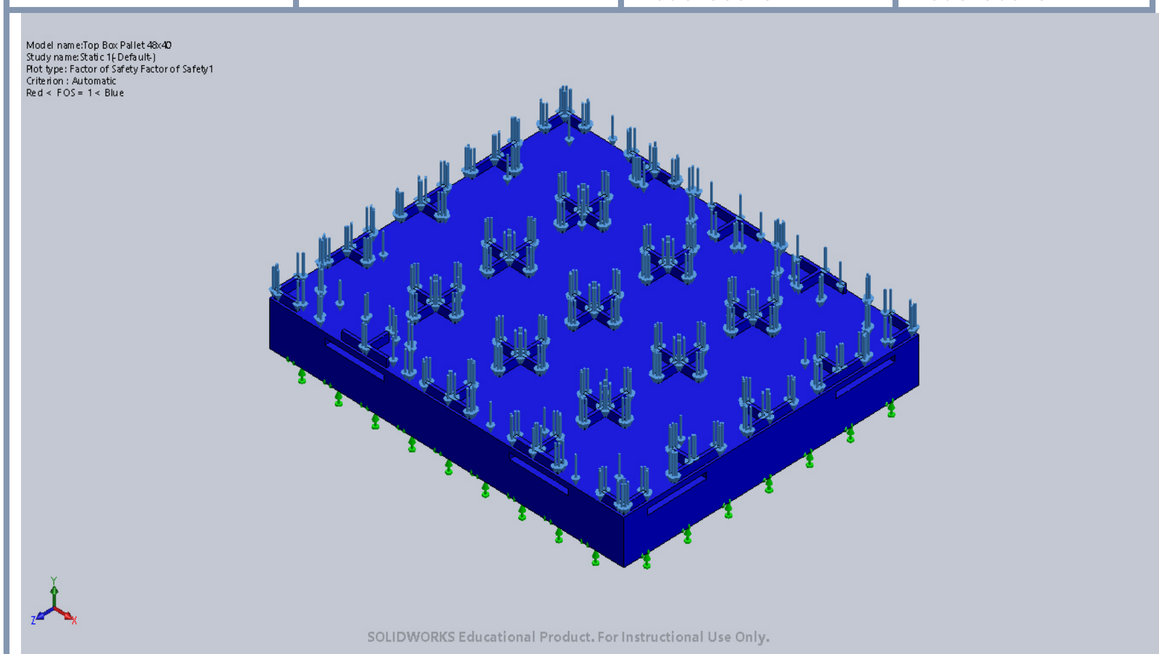
Top Box Pallet 48x40-Static 1-Displacement-Displacement1

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	8.061e-006 Element: 18541	2.098e-002 Element: 31900



Top Box Pallet 48x40-Static 1-Strain-Strain1

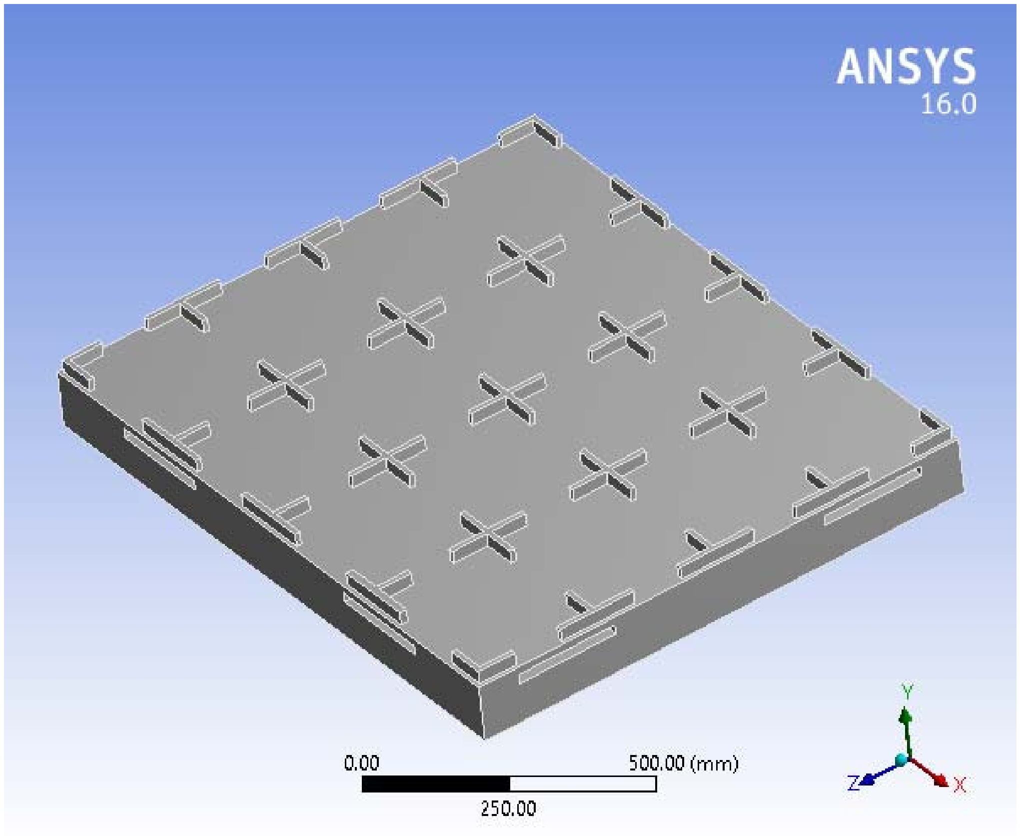
Name	Type	Min	Max
Factor of Safety1	Automatic	1.433e+000 Node: 30073	2.721e+003 Node: 50375



Top Box Pallet 48x40-Static 1-Factor of Safety-Factor of Safety1

Project

First Saved	Saturday, March 24, 2018
Last Saved	Saturday, March 24, 2018
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No


ANSYS
16.0
0.00
500.00 (mm)
250.00
Y
Z
X

Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	1219.2 mm
Length Y	139.7 mm
Length Z	1016. mm
Properties	

Volume	5.3963e+007 mm³
Mass	8.6336 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	110946
Elements	58877
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\jagad\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	*Top Box Pallet 48x40.SLDPRT new for ansys*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Balsa
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	1219.2 mm
Length Y	139.7 mm
Length Z	1016. mm
Properties	

Volume	5.3963e+007 mm³
Mass	8.6336 kg
Centroid X	0.18626 mm
Centroid Y	23.125 mm
Centroid Z	0.29796 mm
Moment of Inertia Ip1	7.6566e+005 kg·mm²
Moment of Inertia Ip2	1.8962e+006 kg·mm²
Moment of Inertia Ip3	1.1386e+006 kg·mm²
Statistics	
Nodes	110946
Elements	58877
Mesh Metric	None

Coordinate Systems

TABLE 4
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

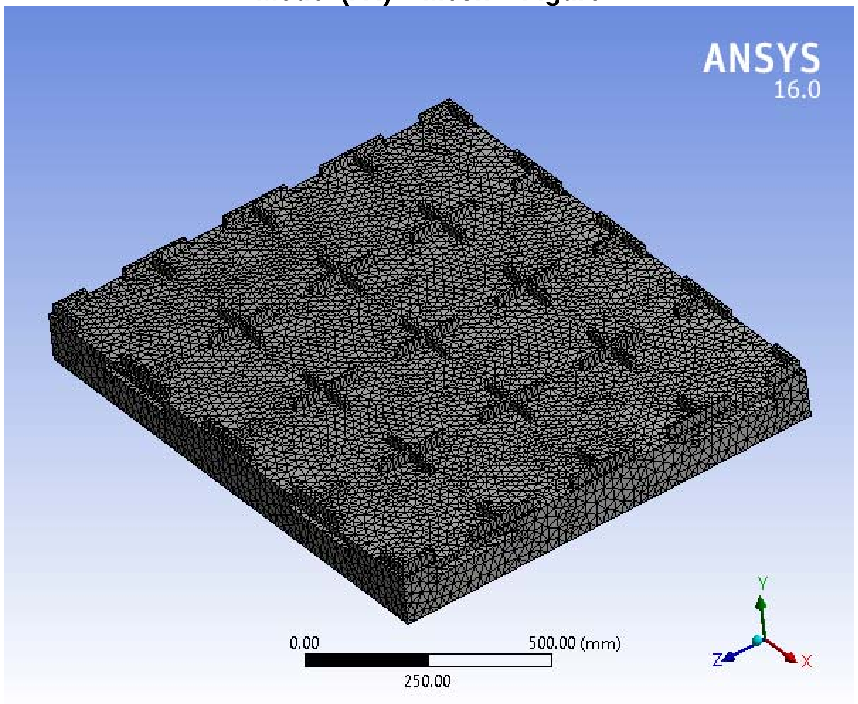
Mesh

TABLE 5
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium

Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	10.160 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	110946
Elements	58877
Mesh Metric	None

FIGURE 1
Model (A4) > Mesh > Figure



Static Structural (A5)

TABLE 6
Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 7
Model (A4) > Static Structural (A5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled

Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\jagad\AppData\Local\Temp\WB _13964_2\unsaved_project_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 8
Model (A4) > Static Structural (A5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Components

Coordinate System		Global Coordinate System
X Component		0. N (ramped)
Y Component		-5.e+005 N (ramped)
Z Component		0. N (ramped)

FIGURE 2
Model (A4) > Static Structural (A5) > Fixed Support > Figure

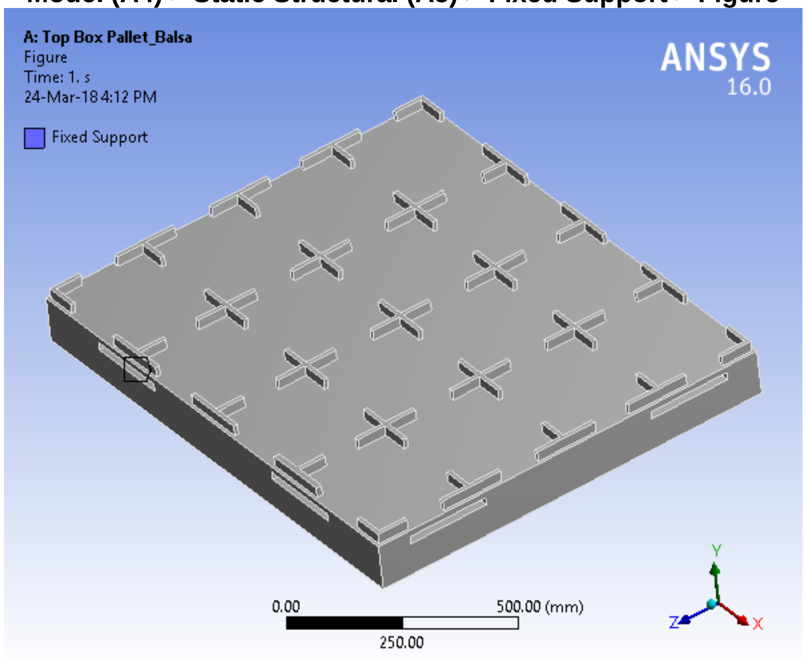


FIGURE 3
Model (A4) > Static Structural (A5) > Force

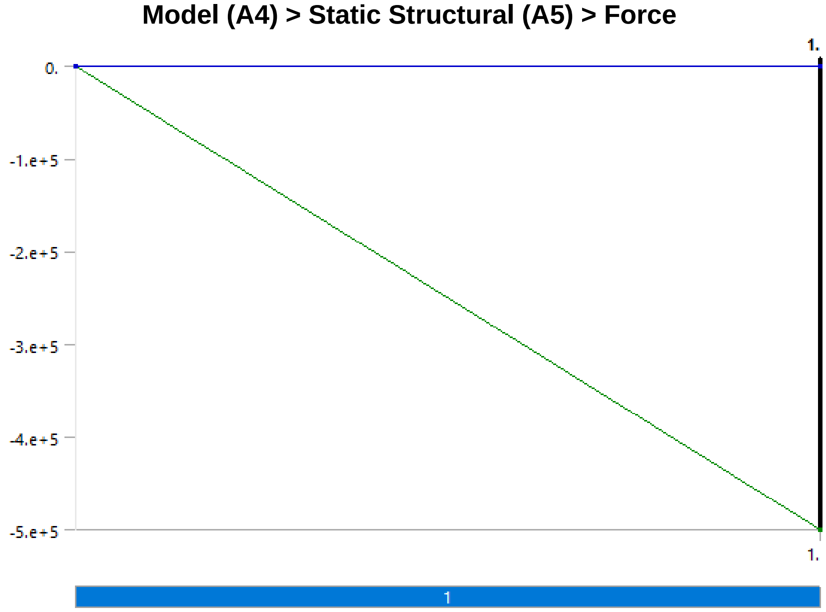
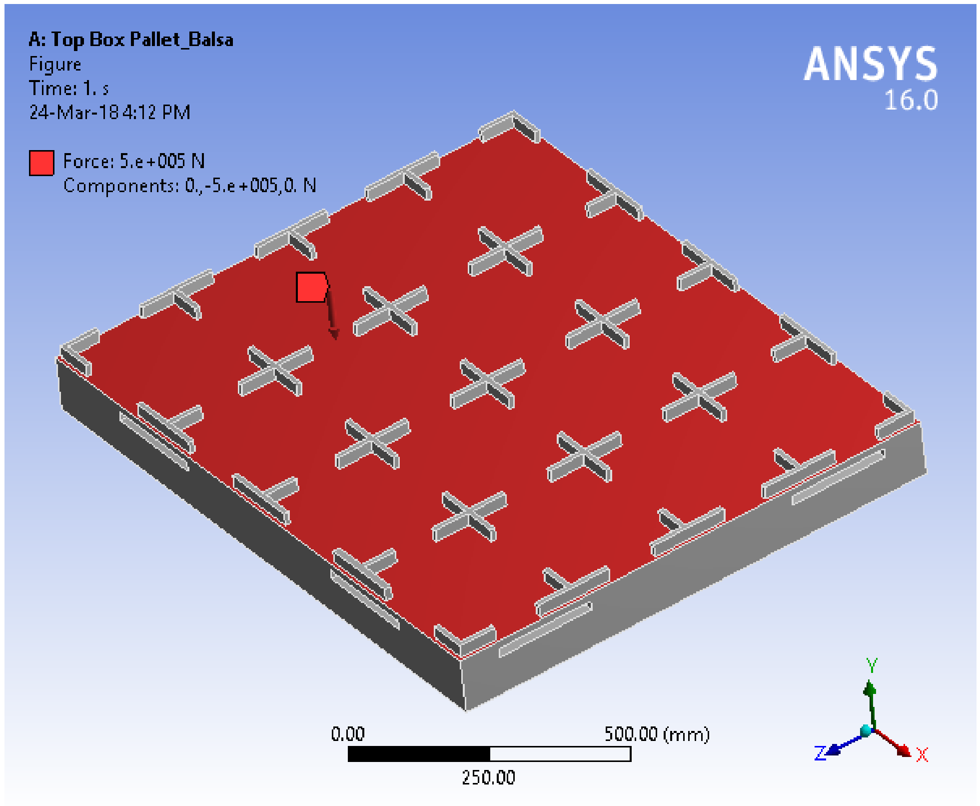


FIGURE 4
Model (A4) > Static Structural (A5) > Force > Figure



Solution (A6)

TABLE 9
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	

Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Directional Deformation*	*Equivalent Stress*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Directional Deformation	Equivalent (von-Mises) Stress	Equivalent Elastic Strain
Orientation	Y Axis		
By	Time		
Display Time	Last		
Coordinate System	Global Coordinate System		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	-3.687 mm	7.9581e-004 MPa	1.0282e-006 mm/mm
Maximum	0.59593 mm	11.834 MPa	1.9116e-002 mm/mm
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

TABLE 12
Model (A4) > Static Structural (A5) > Solution (A6) > Directional Deformation

Time [s]	Minimum [mm]	Maximum [mm]
1.	-3.687	0.59593

FIGURE 6
Model (A4) > Static Structural (A5) > Solution (A6) > Directional Deformation > Figure

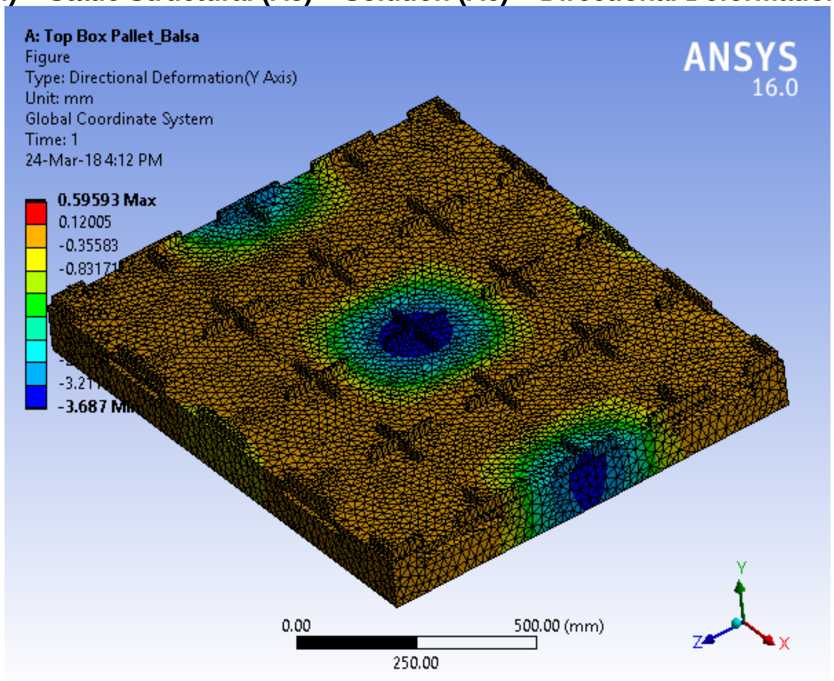


TABLE 13
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]
1.	7.9581e-004	11.834

FIGURE 8
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress > Figure

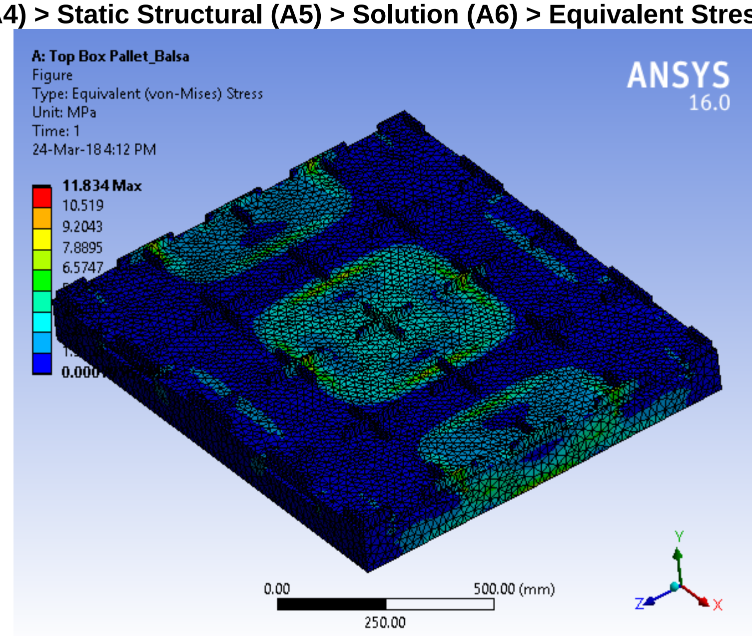


TABLE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]
1.	1.0282e-006	1.9116e-002

FIGURE 10
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain > Figure

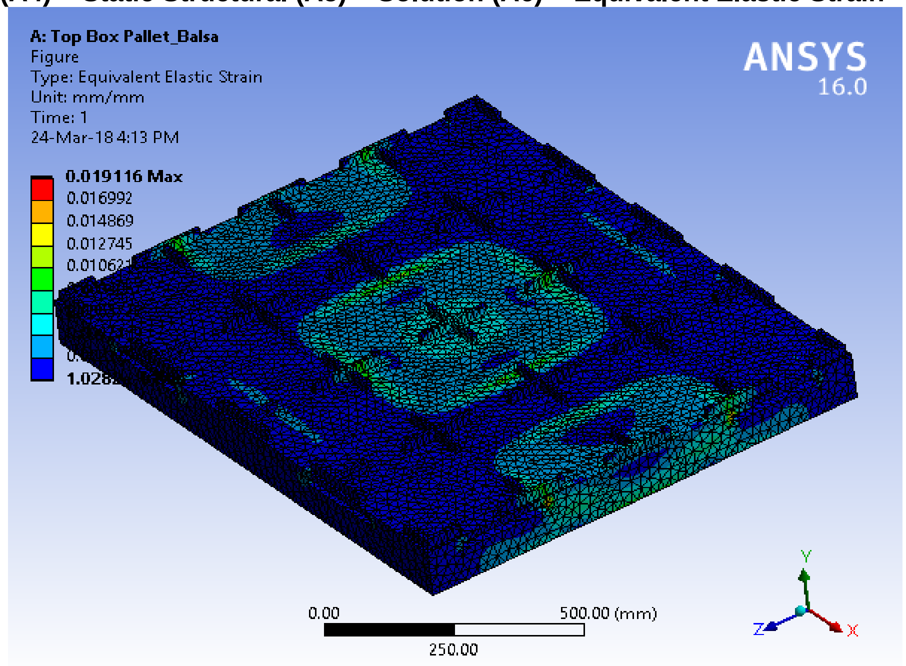


TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Tensile Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Results

Object Name	*Safety Factor*	*Stress Ratio*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Safety Factor	Stress Ratio
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	

Integration Point Results		
Display Option	Averaged	
Average Across Bodies	No	
Results		
Minimum	1.7305	0.
Maximum		0.57788
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	1	

TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	1.7305	15.

FIGURE 12
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor > Figure

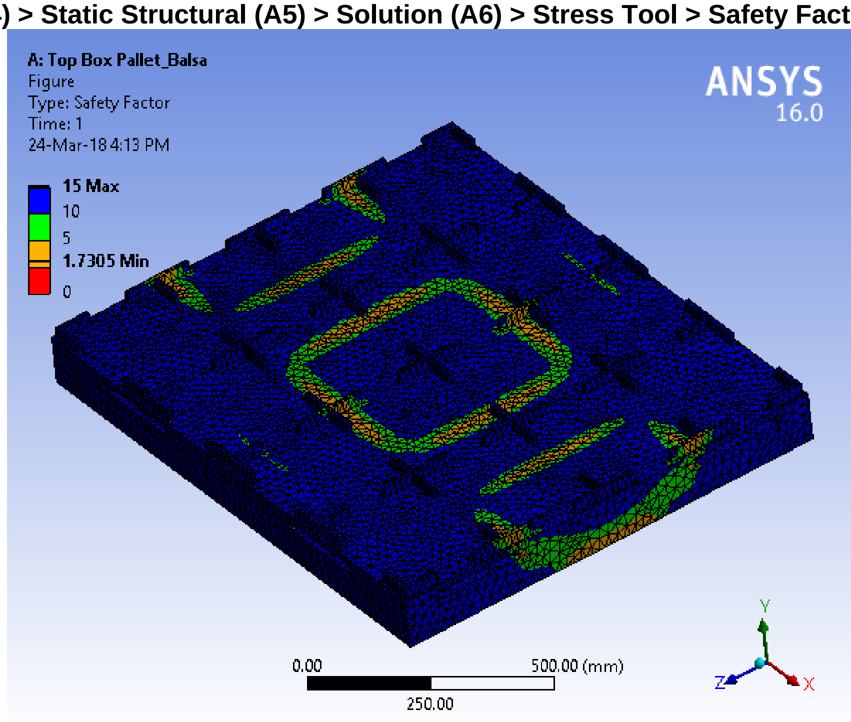
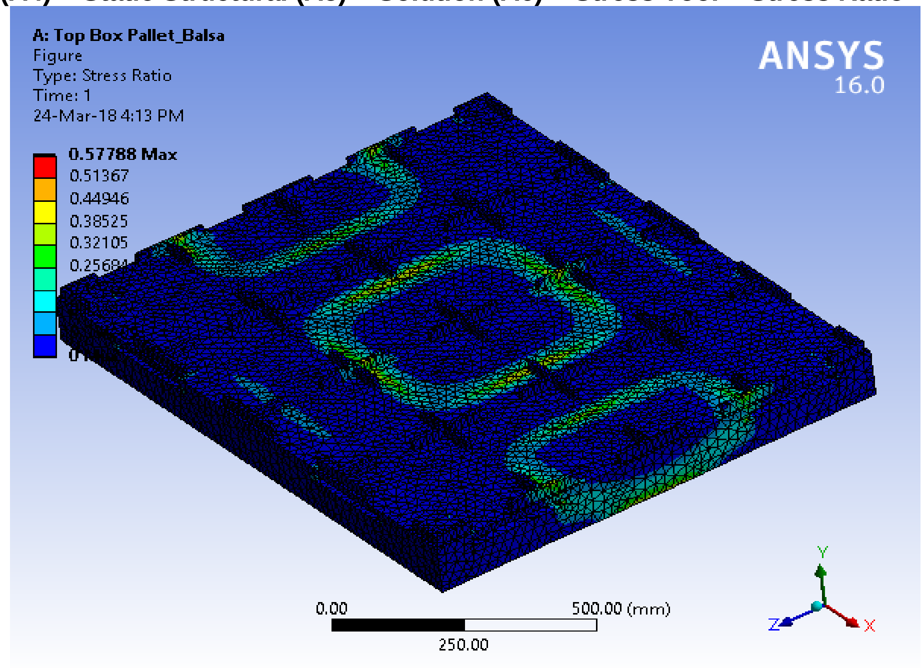


TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Stress Ratio

Time [s]	Minimum	Maximum
1.	0.	0.57788

FIGURE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Stress Ratio > Figure



Material Data

Balsa

TABLE 19
Balsa > Constants

Density	1.5999e-007 kg mm^-3
Thermal Conductivity	5.e-005 W mm^-1 C^-1

TABLE 20
Balsa > Isotropic Elasticity

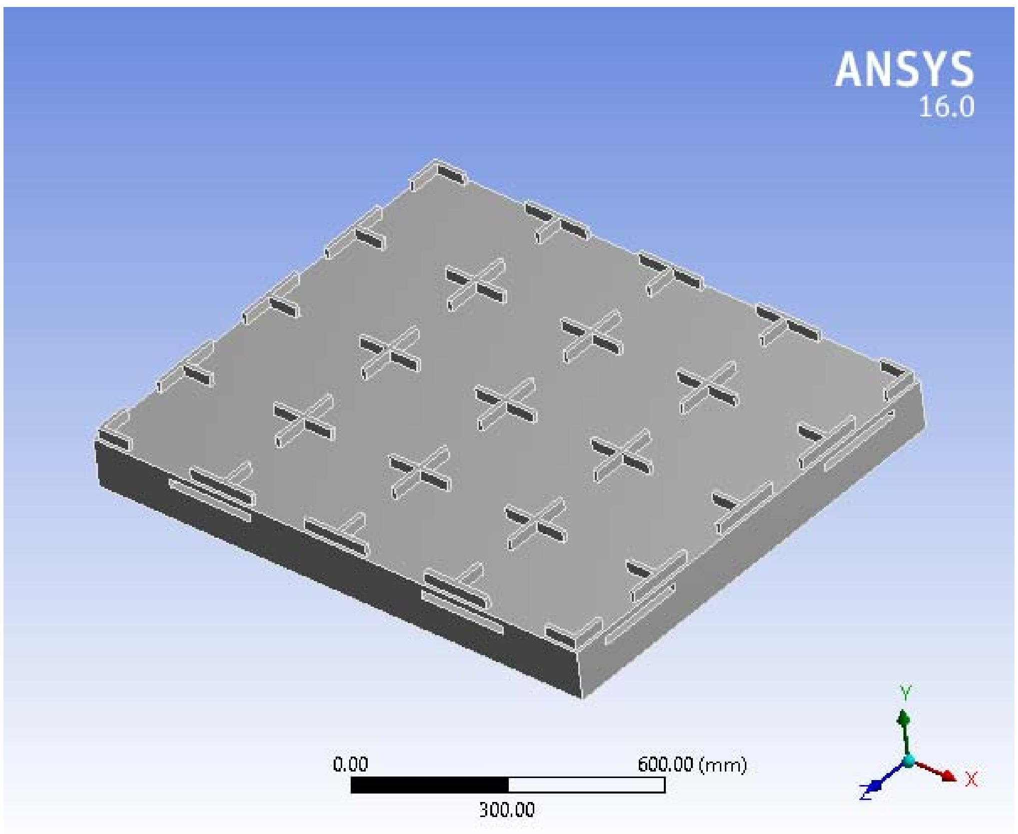
Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	774	0.29	614.29	300

TABLE 21
Balsa > Tensile Yield Strength

Tensile Yield Strength MPa
20

Project

First Saved	Saturday, March 24, 2018
Last Saved	Saturday, March 24, 2018
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	1219.2 mm
Length Y	139.7 mm
Length Z	1016. mm
Properties	

Volume	5.3963e+007 mm³
Mass	8.6336 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	111118
Elements	58975
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\jagad\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	*Top Box Pallet 48x40.SLDPRT new for ansys*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Balsa
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	1219.2 mm
Length Y	139.7 mm
Length Z	1016. mm
Properties	

Volume	5.3963e+007 mm³
Mass	8.6336 kg
Centroid X	0.18626 mm
Centroid Y	23.125 mm
Centroid Z	0.29796 mm
Moment of Inertia Ip1	7.6566e+005 kg·mm²
Moment of Inertia Ip2	1.8962e+006 kg·mm²
Moment of Inertia Ip3	1.1386e+006 kg·mm²
Statistics	
Nodes	111118
Elements	58975
Mesh Metric	None

Coordinate Systems

TABLE 4
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

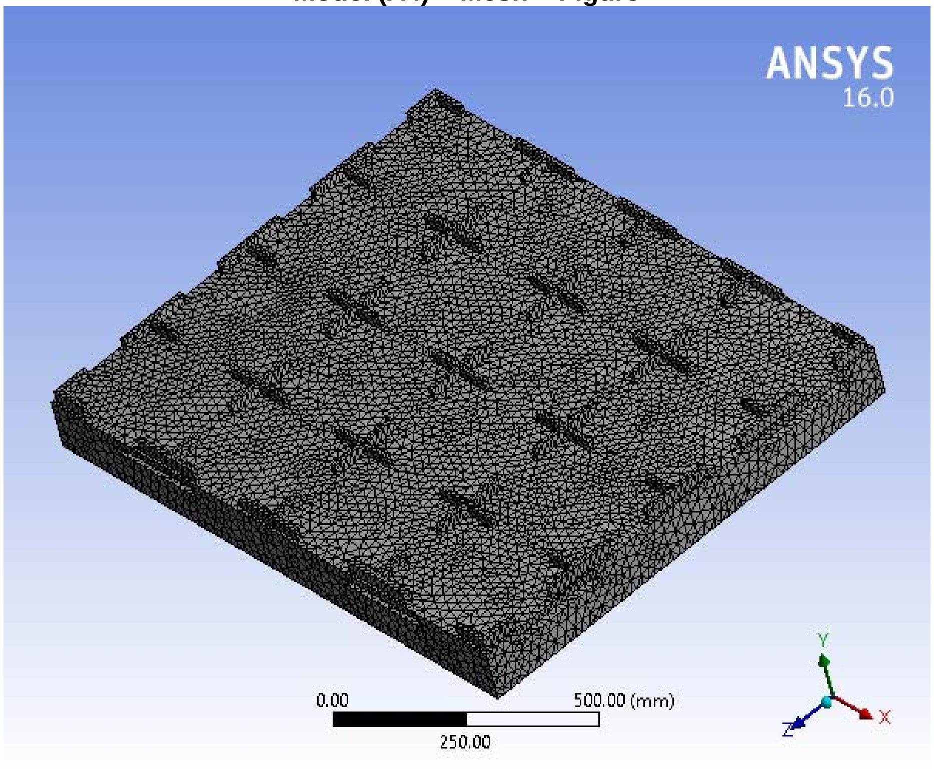
Mesh

TABLE 5
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium

Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	10.160 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	111118
Elements	58975
Mesh Metric	None

FIGURE 1
Model (A4) > Mesh > Figure



Static Structural (A5)

TABLE 6
Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 7
Model (A4) > Static Structural (A5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	

Solver Type	Program Controlled
Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\jagad\AppData\Local\Temp\WB_ _5660_2\unsaved_project_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 8
Model (A4) > Static Structural (A5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	

Define By		Components
Coordinate System		Global Coordinate System
X Component		0. N (ramped)
Y Component		-30000 N (ramped)
Z Component		0. N (ramped)

FIGURE 2
Model (A4) > Static Structural (A5) > Fixed Support > Figure

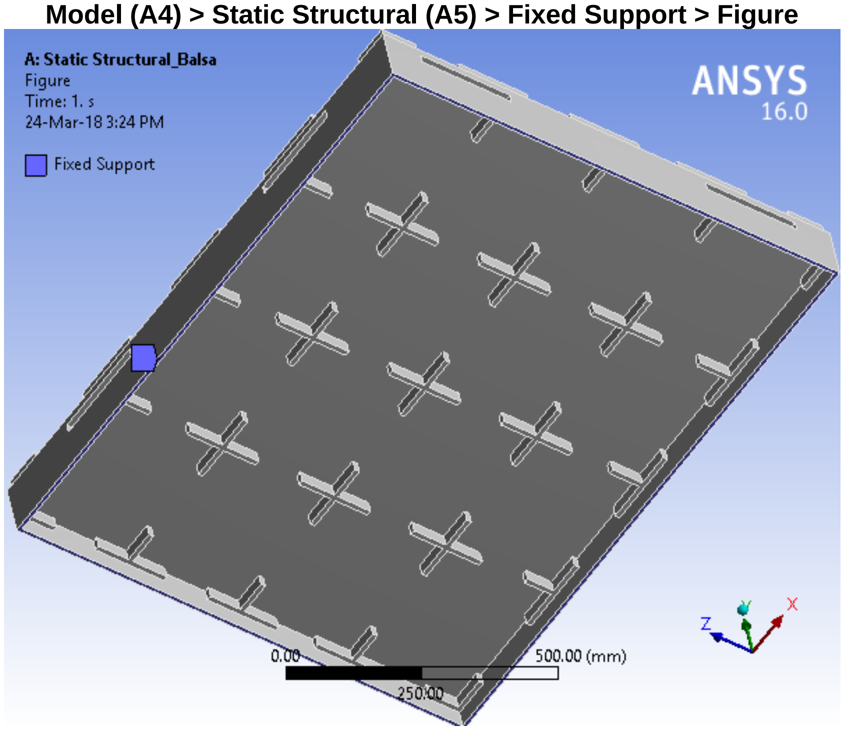


FIGURE 3
Model (A4) > Static Structural (A5) > Force

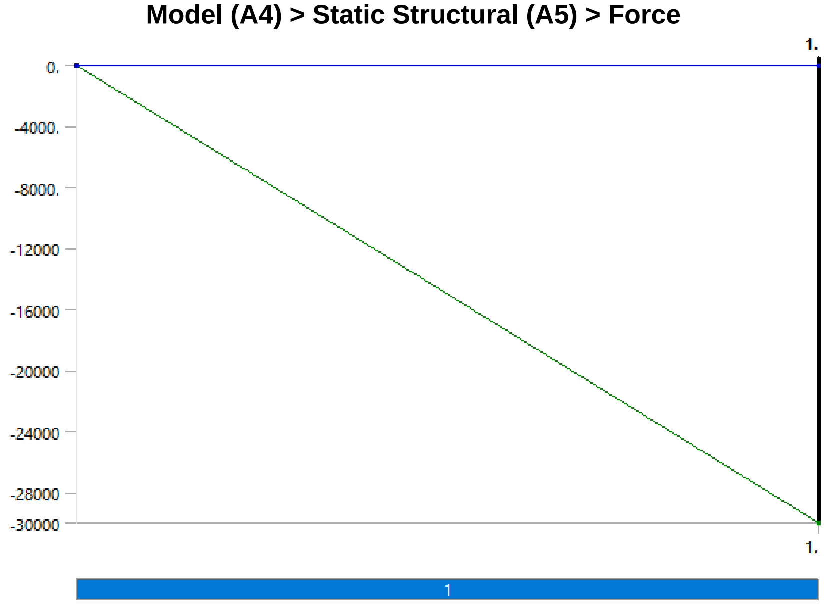
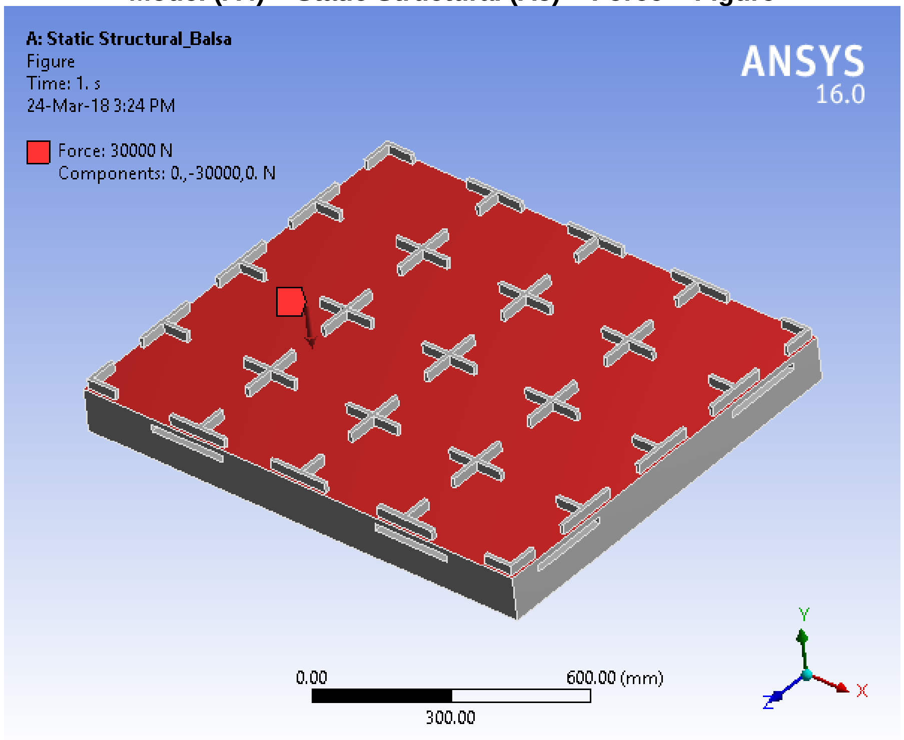


FIGURE 4
Model (A4) > Static Structural (A5) > Force > Figure



Solution (A6)

TABLE 9
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes

Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11
Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Directional Deformation*	*Equivalent Stress*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Directional Deformation	Equivalent (von-Mises) Stress	Equivalent Elastic Strain
Orientation	Y Axis		
By	Time		
Display Time	Last		
Coordinate System	Global Coordinate System		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	-18.421 mm	2.9784e-003 MPa	3.8481e-006 mm/mm
Maximum	0.21318 mm	13.792 MPa	1.9485e-002 mm/mm
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

TABLE 12
Model (A4) > Static Structural (A5) > Solution (A6) > Directional Deformation

Time [s]	Minimum [mm]	Maximum [mm]
1.	-18.421	0.21318

FIGURE 6
Model (A4) > Static Structural (A5) > Solution (A6) > Directional Deformation > Figure

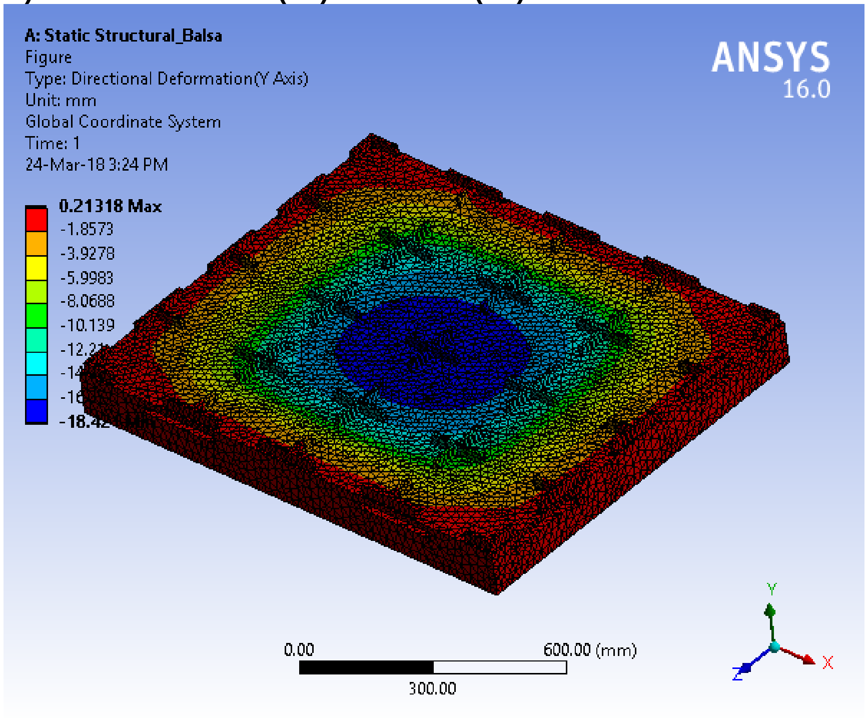


TABLE 13
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]
1.	2.9784e-003	13.792

FIGURE 8
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress > Figure

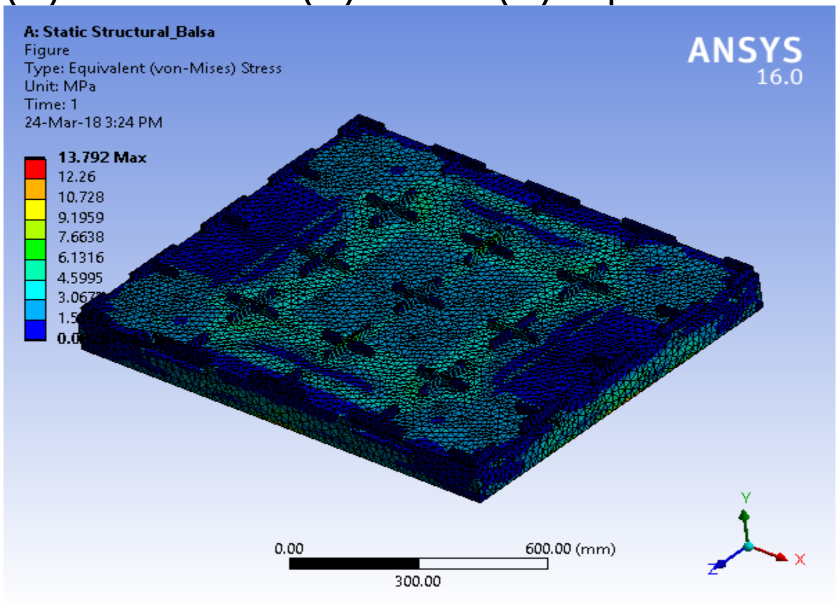


TABLE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]
1.	3.8481e-006	1.9485e-002

FIGURE 10
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain > Figure

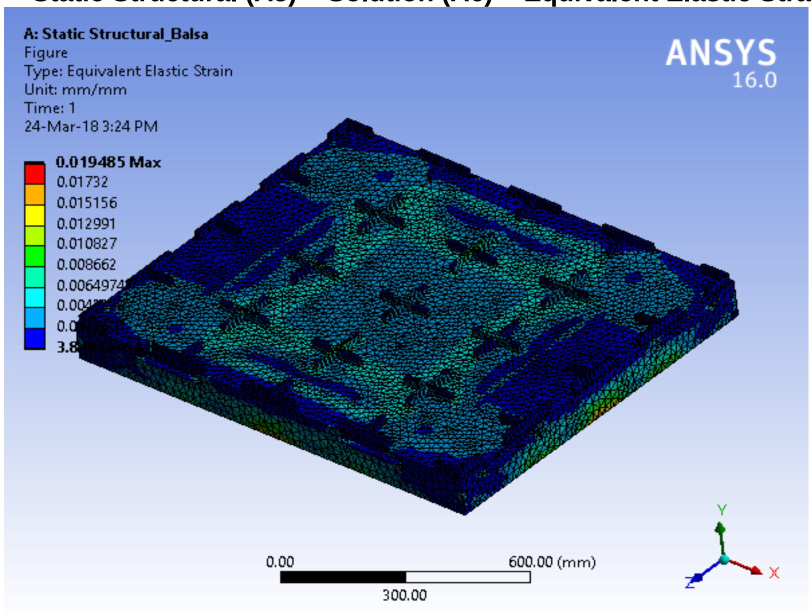


TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Tensile Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Results

Object Name	*Safety Factor*	*Stress Ratio*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Safety Factor	Stress Ratio
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Integration Point Results		
Display Option	Averaged	

Average Across Bodies	No	
Results		
Minimum	1.2632	0.
Maximum		0.79164
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	1	

TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	1.2632	15.

FIGURE 12
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor > Figure

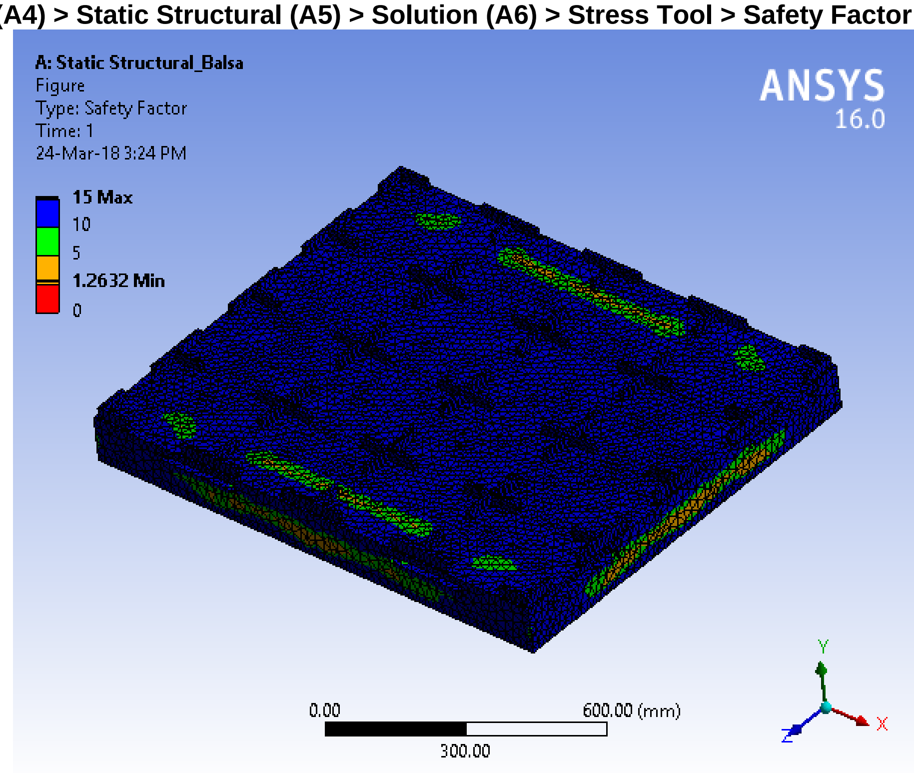
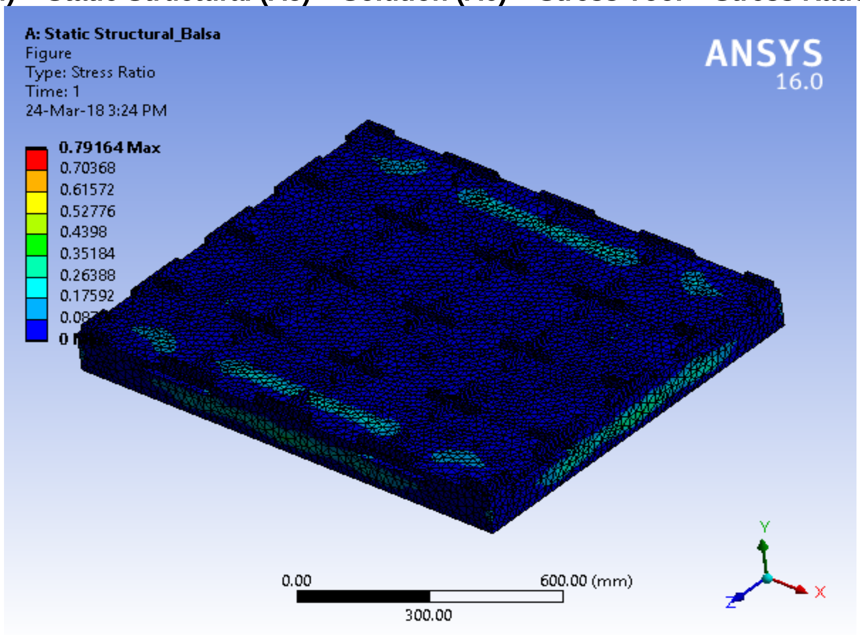


TABLE 18
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Stress Ratio

Time [s]	Minimum	Maximum
1.	0.	0.79164

FIGURE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Stress Ratio > Figure



Material Data

Balsa

TABLE 19
Balsa > Constants

Density	1.5999e-007 kg mm^-3
Thermal Conductivity	5.e-005 W mm^-1 C^-1

TABLE 20
Balsa > Isotropic Elasticity

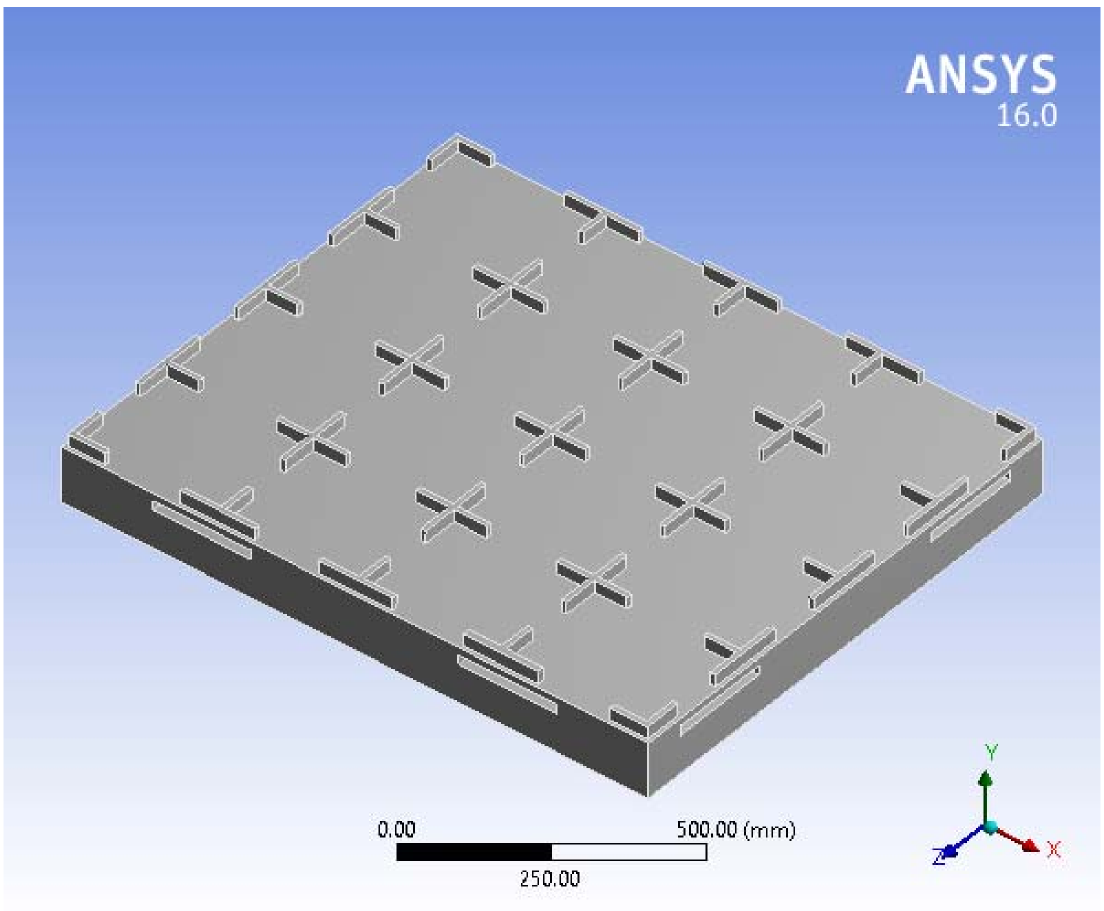
Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	774	0.29	614.29	300

TABLE 21
Balsa > Tensile Yield Strength

Tensile Yield Strength MPa
20

Project

First Saved	Saturday, March 24, 2018
Last Saved	Saturday, March 24, 2018
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (C4)

Geometry

TABLE 2
Model (C4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	1219.2 mm
Length Y	139.7 mm
Length Z	1016. mm
Properties	

Volume	5.3963e+007 mm³
Mass	48.837 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	110946
Elements	58877
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\jagad\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (C4) > Geometry > Parts

Object Name	*Top Box Pallet 48x40.SLDPRT new for ansys*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Very Low Density PE
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	1219.2 mm
Length Y	139.7 mm
Length Z	1016. mm
Properties	

Volume	5.3963e+007 mm³
Mass	48.837 kg
Centroid X	0.18626 mm
Centroid Y	23.125 mm
Centroid Z	0.29796 mm
Moment of Inertia Ip1	4.3311e+006 kg·mm²
Moment of Inertia Ip2	1.0726e+007 kg·mm²
Moment of Inertia Ip3	6.4405e+006 kg·mm²
Statistics	
Nodes	110946
Elements	58877
Mesh Metric	None

Coordinate Systems

TABLE 4
Model (C4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

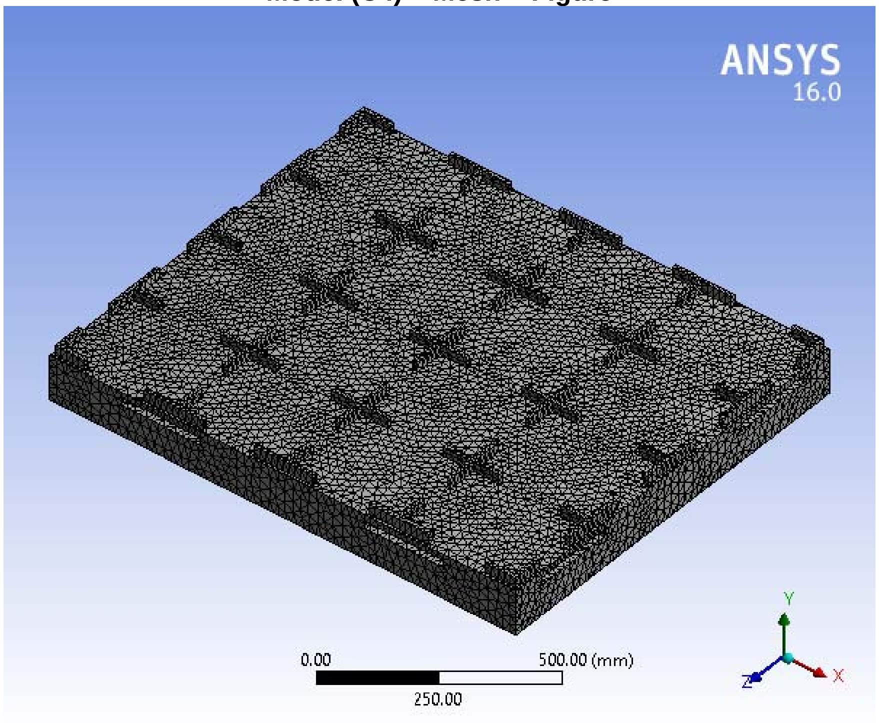
Mesh

TABLE 5
Model (C4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium

Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	10.160 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	110946
Elements	58877
Mesh Metric	None

FIGURE 1
Model (C4) > Mesh > Figure



Static Structural (C5)

TABLE 6
Model (C4) > Analysis

Object Name	*Static Structural (C5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 7
Model (C4) > Static Structural (C5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled

Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\jagad\AppData\Local\Temp\WB _13964_2\unsaved_project_files\dp0\SYS-2\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 8
Model (C4) > Static Structural (C5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Components

Coordinate System		Global Coordinate System
X Component		0. N (ramped)
Y Component		-1.25e+006 N (ramped)
Z Component		0. N (ramped)

FIGURE 2
Model (C4) > Static Structural (C5) > Fixed Support > Figure

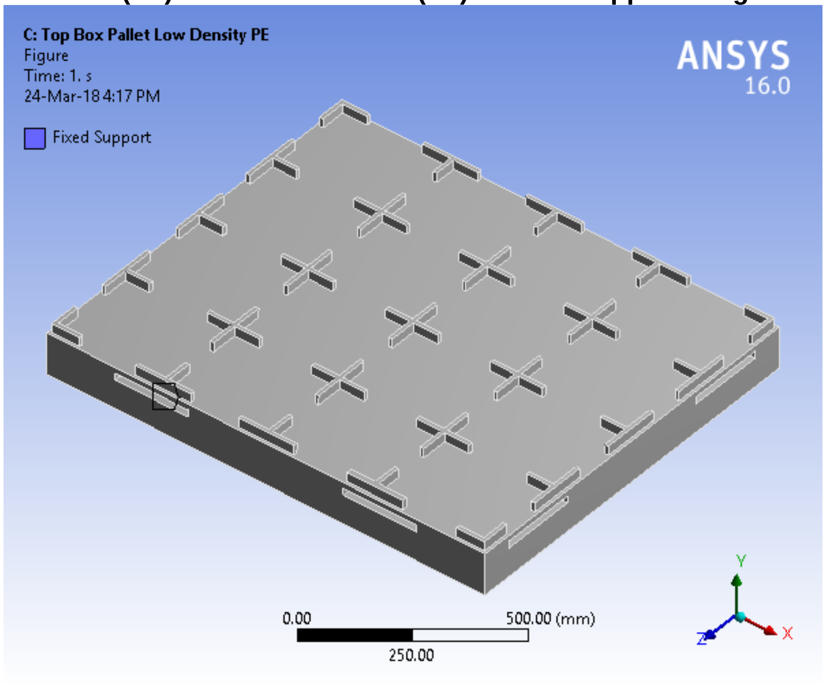


FIGURE 3
Model (C4) > Static Structural (C5) > Force

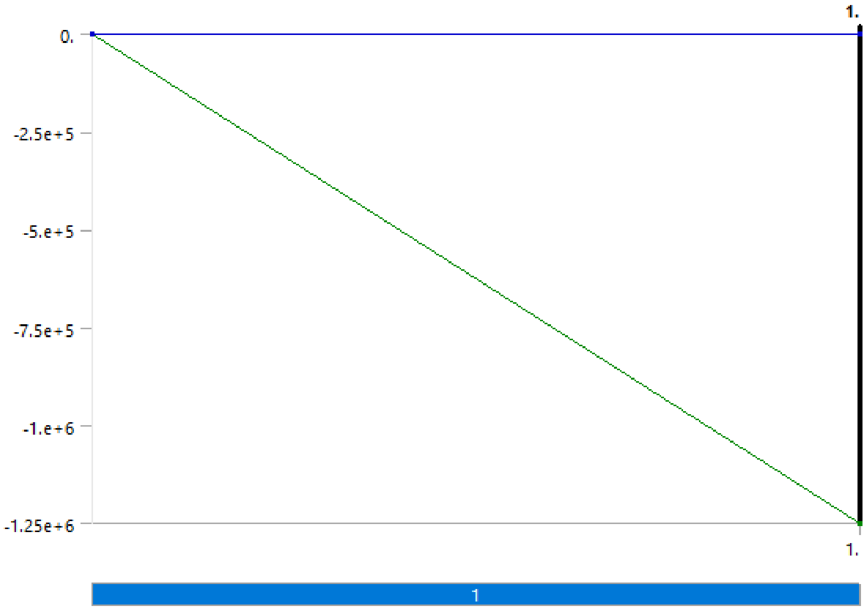
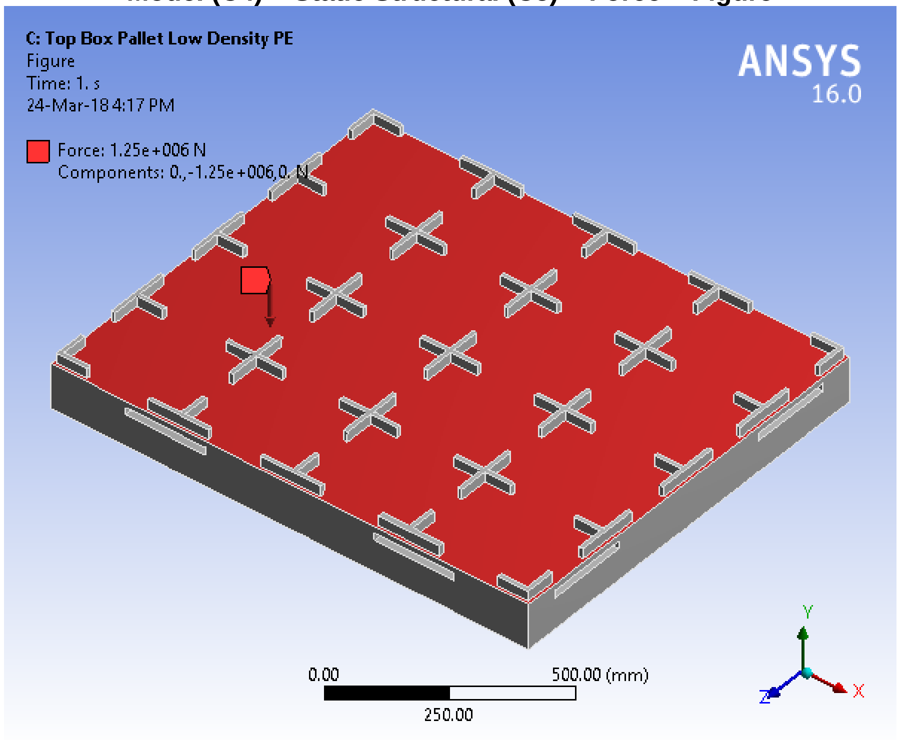


FIGURE 4
Model (C4) > Static Structural (C5) > Force > Figure



Solution (C6)

TABLE 9
Model (C4) > Static Structural (C5) > Solution

Object Name	*Solution (C6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10
Model (C4) > Static Structural (C5) > Solution (C6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes

Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11
Model (C4) > Static Structural (C5) > Solution (C6) > Results

Object Name	*Directional Deformation*	*Equivalent Stress*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Directional Deformation	Equivalent (von-Mises) Stress	Equivalent Elastic Strain
Orientation	Y Axis		
By	Time		
Display Time	Last		
Coordinate System	Global Coordinate System		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	-41.237 mm	2.2577e-003 MPa	1.3098e-005 mm/mm
Maximum	6.6537 mm	29.707 MPa	0.21279 mm/mm
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

TABLE 12
Model (C4) > Static Structural (C5) > Solution (C6) > Directional Deformation

Time [s]	Minimum [mm]	Maximum [mm]
1.	-41.237	6.6537

FIGURE 6
Model (C4) > Static Structural (C5) > Solution (C6) > Directional Deformation > Figure

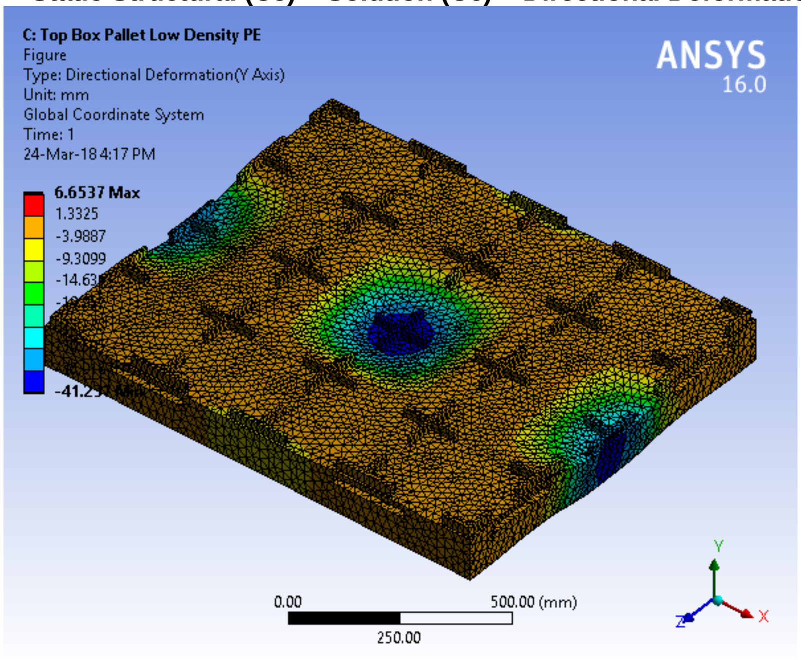


TABLE 13
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]
1.	2.2577e-003	29.707

FIGURE 8
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Stress > Figure

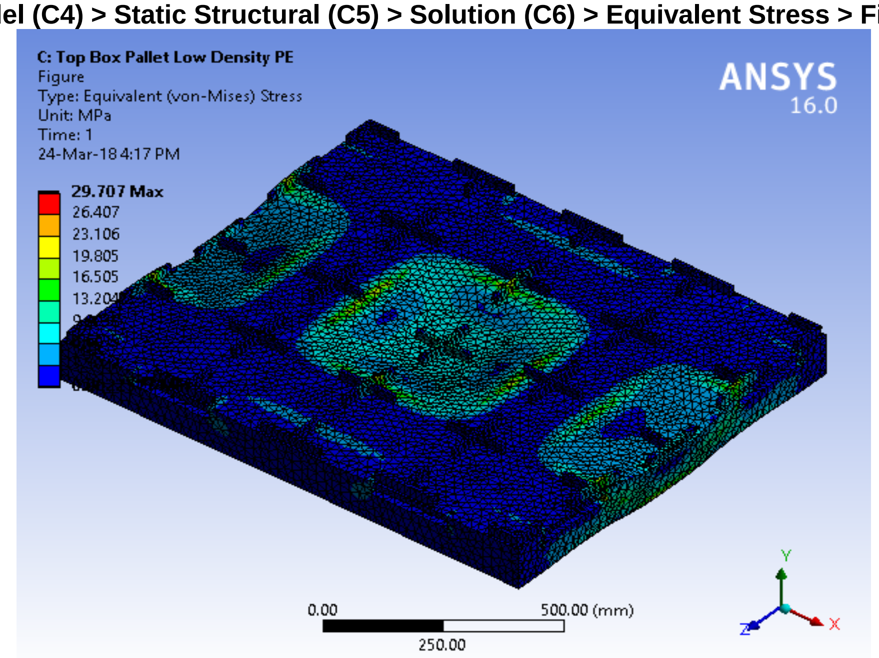


TABLE 14
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]
1.	1.3098e-005	0.21279

FIGURE 10
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Elastic Strain > Figure

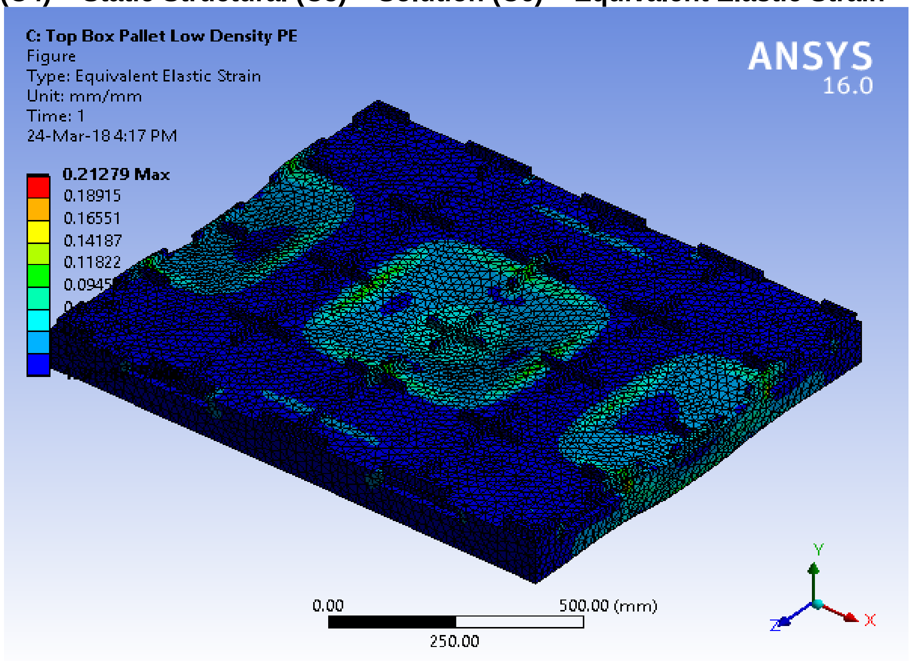


TABLE 15
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Tensile Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 16
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Results

Object Name	*Safety Factor*	*Stress Ratio*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Safety Factor	Stress Ratio
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	

Integration Point Results		
Display Option	Averaged	
Average Across Bodies	No	
Results		
Minimum	1.1757	0.
Maximum		0.85059
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	1	

TABLE 17
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	1.1757	15.

FIGURE 12
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Safety Factor > Figure

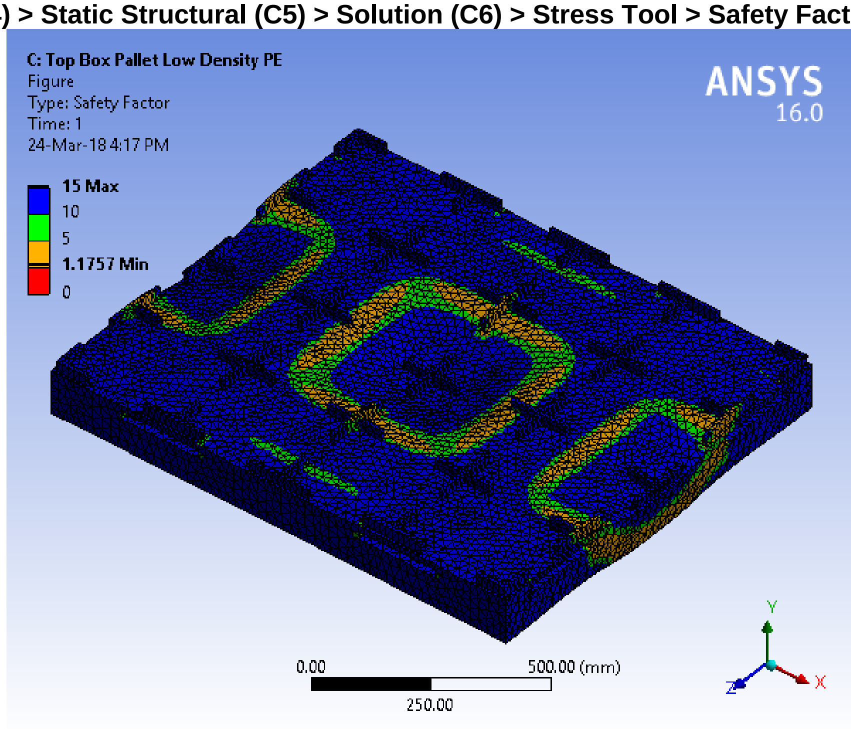
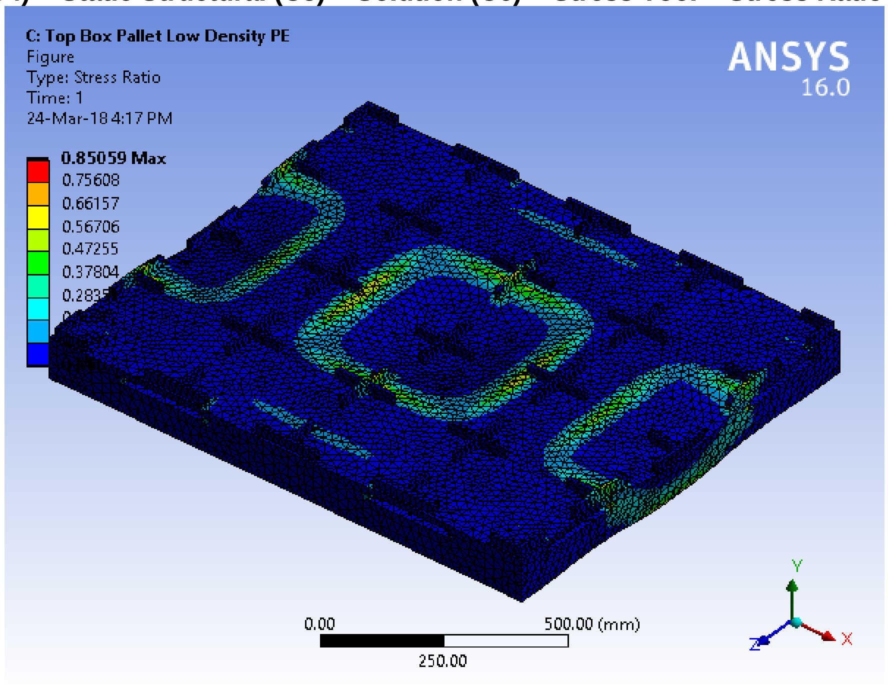


TABLE 18
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Stress Ratio

Time [s]	Minimum	Maximum
1.	0.	0.85059

FIGURE 14
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Stress Ratio > Figure



Material Data

Very Low Density PE

TABLE 19
Very Low Density PE > Constants

Density	9.05e-007 kg mm^-3

TABLE 20
Very Low Density PE > Isotropic Elasticity

Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	172.37	0.3	143.64	66.296

TABLE 21
Very Low Density PE > Tensile Yield Strength

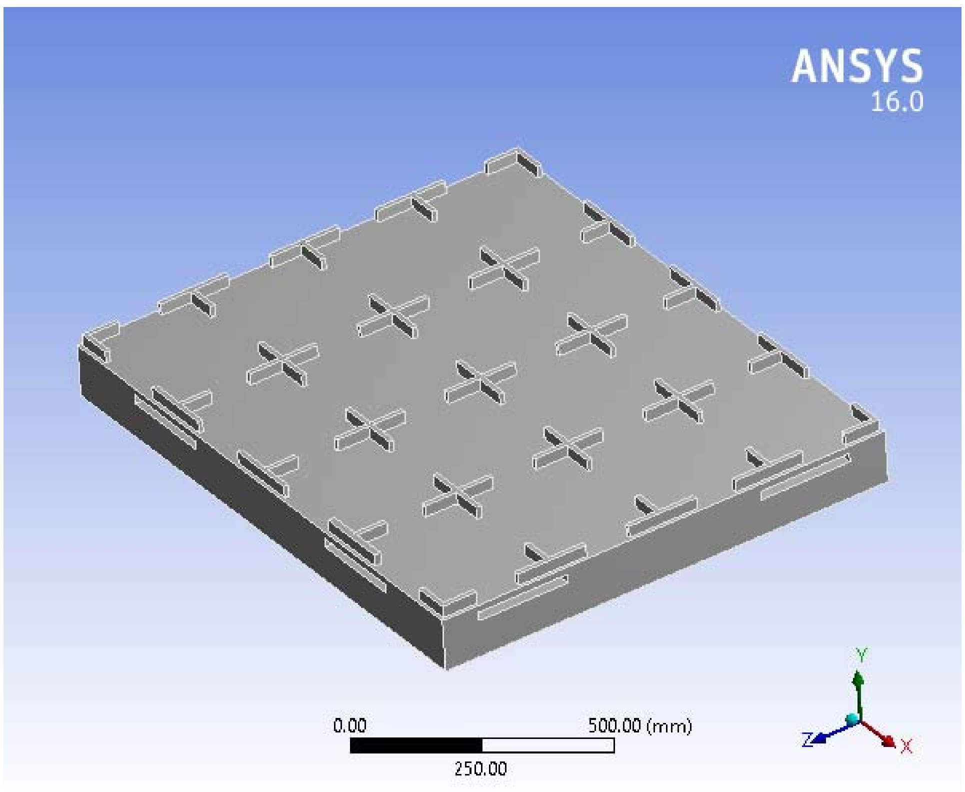
Tensile Yield Strength MPa
34

TABLE 22
Very Low Density PE > Compressive Yield Strength

Compressive Yield Strength MPa
6.8948

Project

First Saved	Saturday, March 24, 2018
Last Saved	Saturday, March 24, 2018
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	Metric (mm, kg, N, s, mV, mA) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Model (C4)

Geometry

TABLE 2
Model (C4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	1219.2 mm
Length Y	139.7 mm
Length Z	1016. mm
Properties	

Volume	5.3963e+007 mm³
Mass	48.837 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	111118
Elements	58975
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\jagad\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (C4) > Geometry > Parts

Object Name	*Top Box Pallet 48x40.SLDPRT new for ansys*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Very Low Density PE
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	1219.2 mm
Length Y	139.7 mm
Length Z	1016. mm
Properties	

Volume	5.3963e+007 mm³
Mass	48.837 kg
Centroid X	0.18626 mm
Centroid Y	23.125 mm
Centroid Z	0.29796 mm
Moment of Inertia Ip1	4.3311e+006 kg·mm²
Moment of Inertia Ip2	1.0726e+007 kg·mm²
Moment of Inertia Ip3	6.4405e+006 kg·mm²
Statistics	
Nodes	111118
Elements	58975
Mesh Metric	None

Coordinate Systems

TABLE 4
Model (C4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. mm
Origin Y	0. mm
Origin Z	0. mm
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

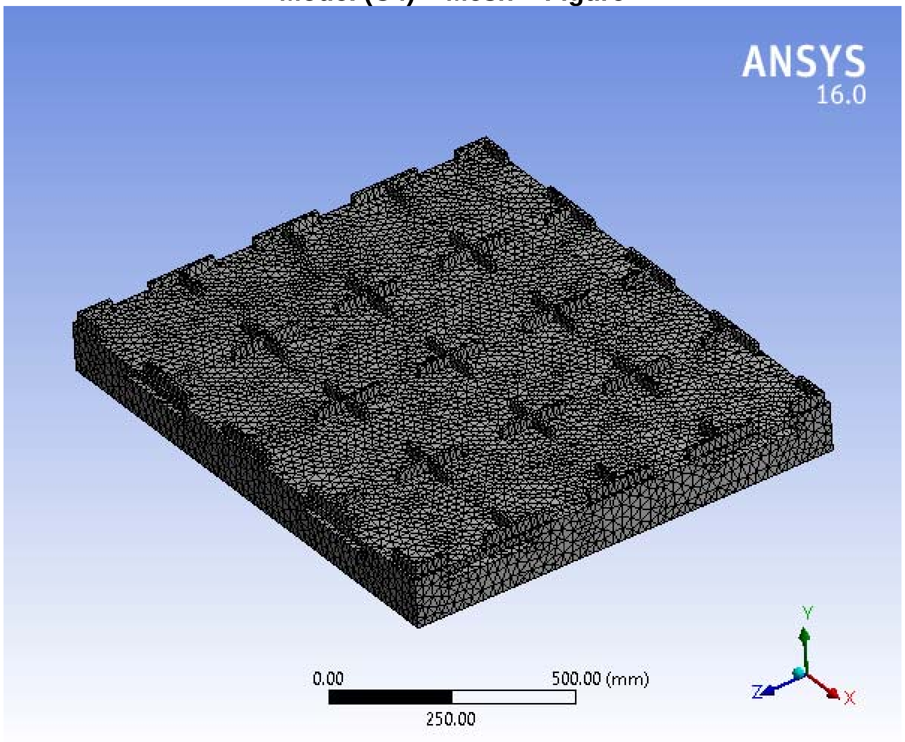
Mesh

TABLE 5
Model (C4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium

Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	10.160 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	111118
Elements	58975
Mesh Metric	None

FIGURE 1
Model (C4) > Mesh > Figure



Static Structural (C5)

TABLE 6
Model (C4) > Analysis

Object Name	*Static Structural (C5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	22. °C
Generate Input Only	No

TABLE 7
Model (C4) > Static Structural (C5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	

Solver Type	Program Controlled
Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\jagad\AppData\Local\Temp\WB _5660_2\unsaved_project_files\dp0\SYS-2\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	nmm

TABLE 8
Model (C4) > Static Structural (C5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	

Define By		Components
Coordinate System		Global Coordinate System
X Component		0. N (ramped)
Y Component		-40000 N (ramped)
Z Component		0. N (ramped)

FIGURE 2
Model (C4) > Static Structural (C5) > Fixed Support > Figure

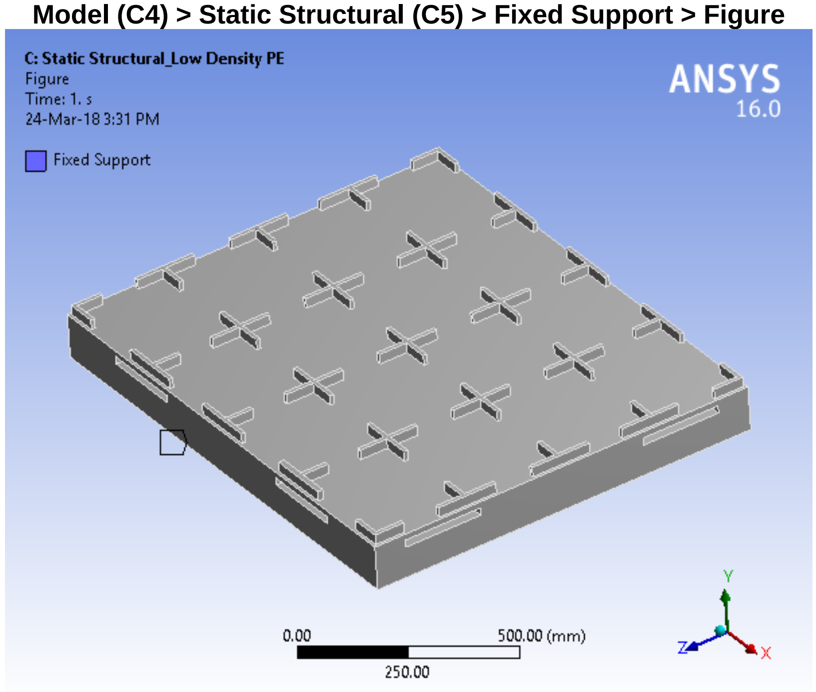


FIGURE 3
Model (C4) > Static Structural (C5) > Force

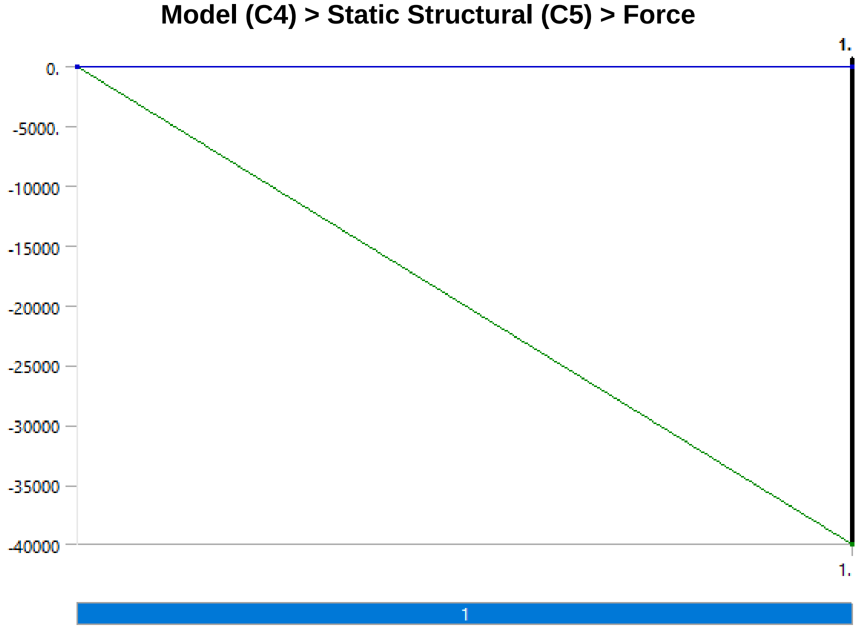
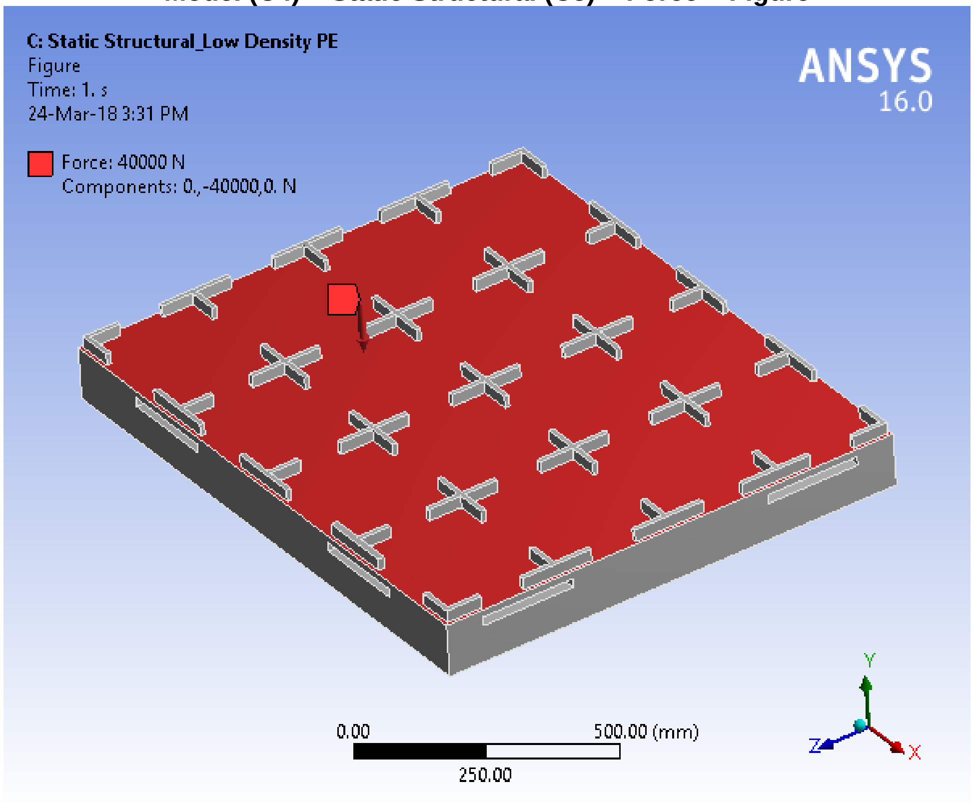


FIGURE 4
Model (C4) > Static Structural (C5) > Force > Figure



Solution (C6)

TABLE 9
Model (C4) > Static Structural (C5) > Solution

Object Name	*Solution (C6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10
Model (C4) > Static Structural (C5) > Solution (C6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All

FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11
Model (C4) > Static Structural (C5) > Solution (C6) > Results

Object Name	*Directional Deformation*	*Equivalent Stress*	*Equivalent Elastic Strain*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Directional Deformation	Equivalent (von-Mises) Stress	Equivalent Elastic Strain
Orientation	Y Axis		
By	Time		
Display Time	Last		
Coordinate System	Global Coordinate System		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Results			
Minimum	-109.6 mm	4.0962e-003 MPa	2.3764e-005 mm/mm
Maximum	1.2632 mm	18.123 MPa	0.11558 mm/mm
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

TABLE 12
Model (C4) > Static Structural (C5) > Solution (C6) > Directional Deformation

Time [s]	Minimum [mm]	Maximum [mm]
1.	-109.6	1.2632

FIGURE 6
Model (C4) > Static Structural (C5) > Solution (C6) > Directional Deformation > Figure

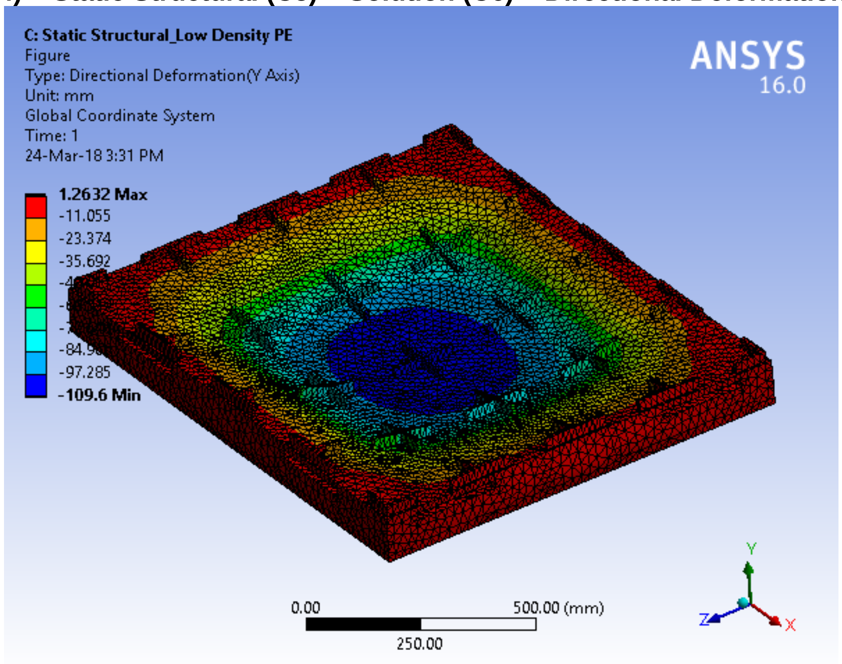


TABLE 13
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]
1.	4.0962e-003	18.123

FIGURE 8
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Stress > Figure

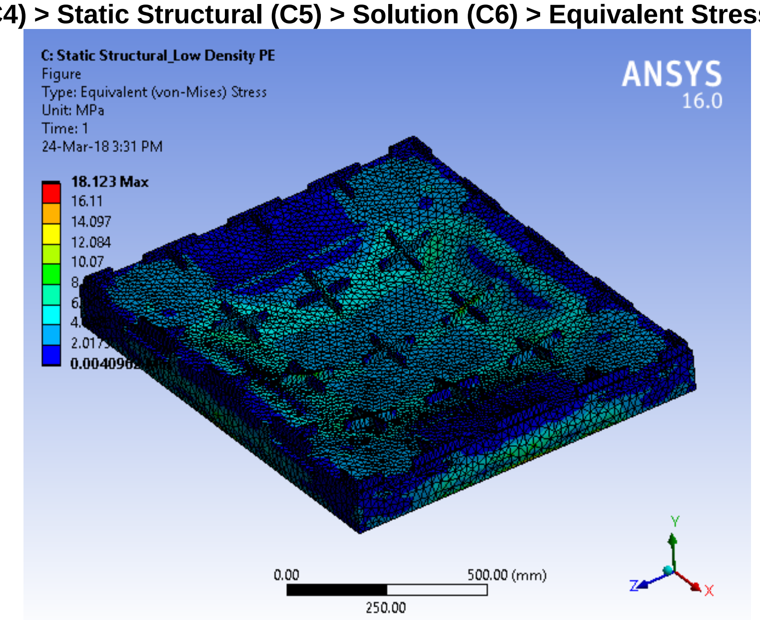


TABLE 14
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]
1.	2.3764e-005	0.11558

FIGURE 10
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Elastic Strain > Figure

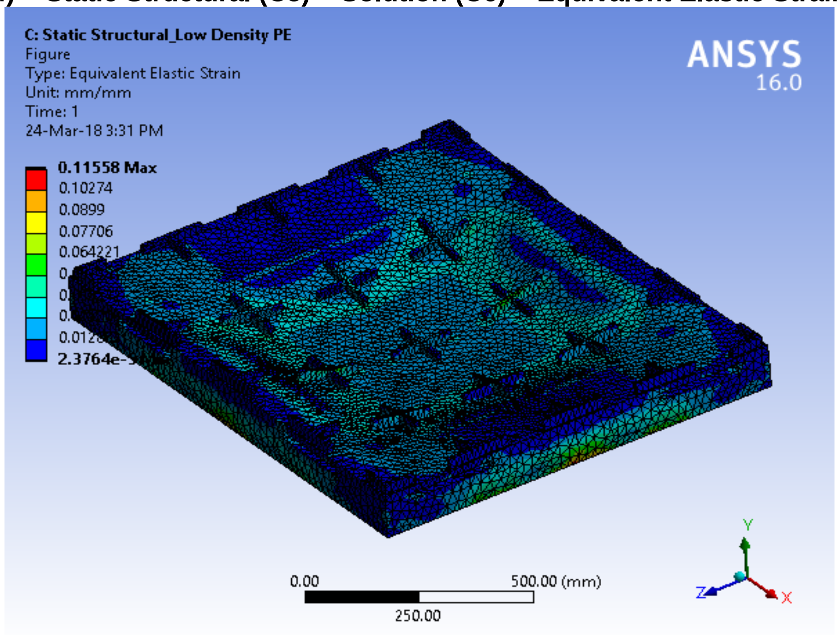


TABLE 15
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Tensile Stress
Stress Limit Type	Tensile Yield Per Material

TABLE 16
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Results

Object Name	*Safety Factor*	*Stress Ratio*
State	Solved	
Scope		
Scoping Method	Geometry Selection	
Geometry	All Bodies	
Definition		
Type	Safety Factor	Stress Ratio
By	Time	
Display Time	Last	
Calculate Time History	Yes	
Identifier		
Suppressed	No	
Integration Point Results		

Display Option	Averaged	
Average Across Bodies	No	
Results		
Minimum	1.5901	0.
Maximum		0.62889
Information		
Time	1. s	
Load Step	1	
Substep	1	
Iteration Number	1	

TABLE 17
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	1.5901	15.

FIGURE 12
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Safety Factor > Figure

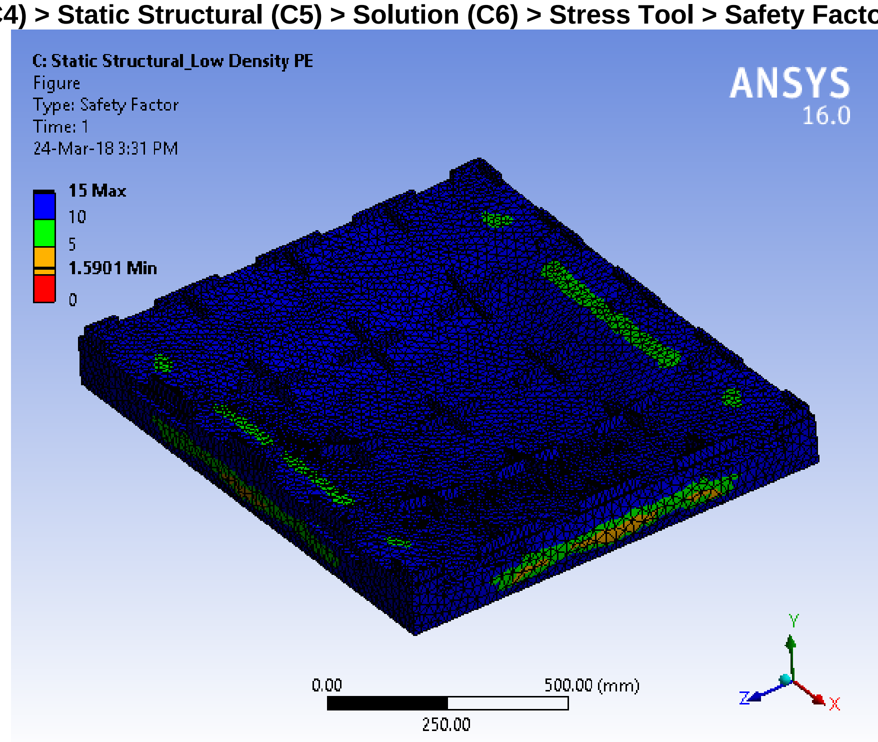
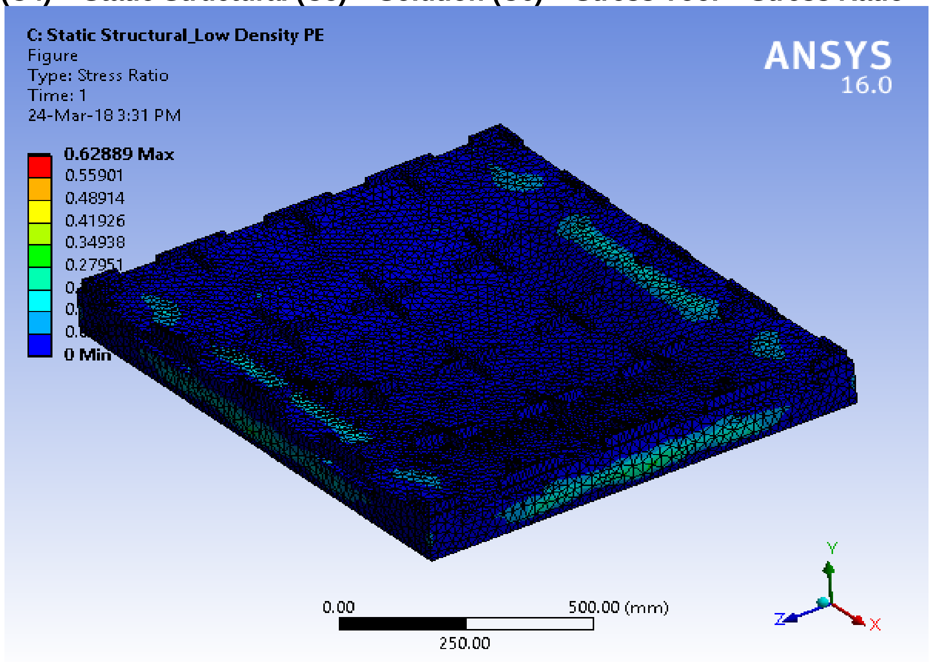


TABLE 18
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Stress Ratio

Time [s]	Minimum	Maximum
1.	0.	0.62889

FIGURE 14
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Stress Ratio > Figure



Material Data

Very Low Density PE

TABLE 19
Very Low Density PE > Constants

Density	9.05e-007 kg mm^-3

TABLE 20
Very Low Density PE > Isotropic Elasticity

Temperature C	Young's Modulus MPa	Poisson's Ratio	Bulk Modulus MPa	Shear Modulus MPa
	172.37	0.3	143.64	66.296

TABLE 21
Very Low Density PE > Tensile Yield Strength

Tensile Yield Strength MPa
34

TABLE 22
Very Low Density PE > Compressive Yield Strength

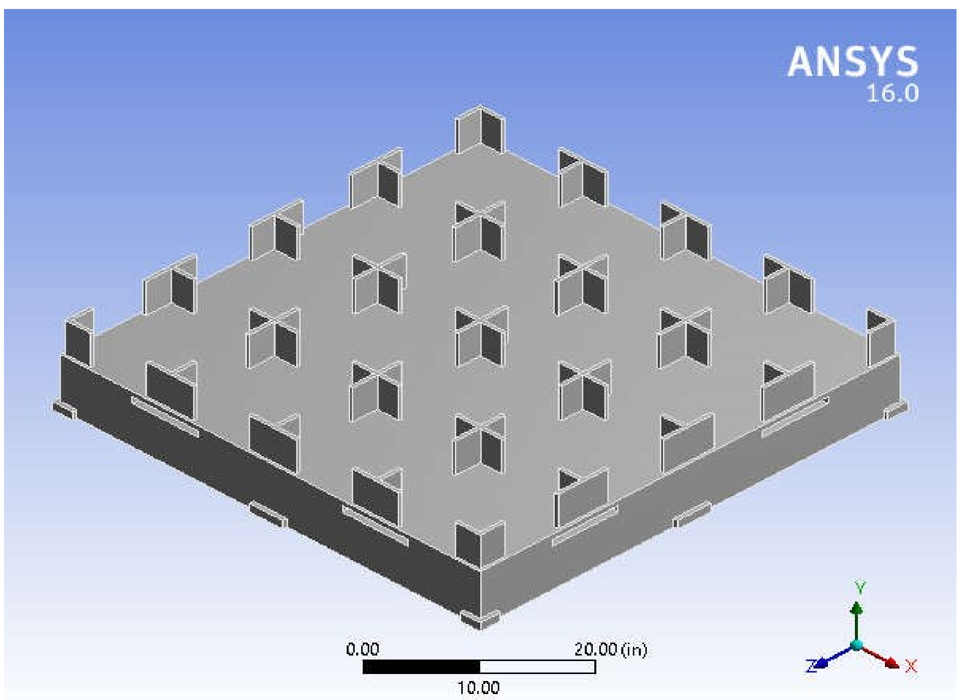
Compressive Yield Strength MPa
6.8948

APPENDIX B

ORIGINAL DESIGN SIMULATIONS

Project

First Saved	Thursday, November 2, 2017
Last Saved	Friday, November 3, 2017
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	U.S. Customary (in, lbm, lbf, s, V, A) Degrees rad/s Fahrenheit
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Fahrenheit

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\Desktop\New folder\Base Box Pallet.SLDPRT
Type	SolidWorks
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	52. in
Length Y	10.5 in

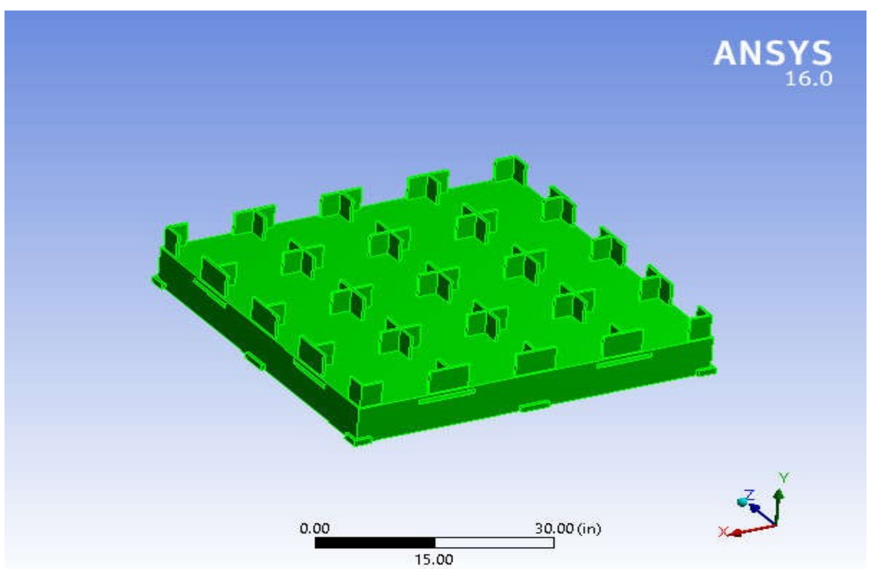
Length Z	52. in
Properties	
Volume	5223.1 in³
Mass	522.68 lbm
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	112862
Elements	58940
Mesh Metric	None
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	No
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\CHAITRA\AppData\Local\Temp
Analysis Type	3-D
Mixed Import Resolution	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	*Base Box Pallet*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No

Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Aluminum Alloy
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	52. in
Length Y	10.5 in
Length Z	52. in
Properties	
Volume	5223.1 in³
Mass	522.68 lbm
Centroid X	7.6469e-016 in
Centroid Y	-1.2315 in
Centroid Z	1.8687e-003 in
Moment of Inertia Ip1	1.2492e+005 lbm·in²
Moment of Inertia Ip2	2.4721e+005 lbm·in²
Moment of Inertia Ip3	1.2511e+005 lbm·in²
Statistics	
Nodes	112862
Elements	58940
Mesh Metric	None

FIGURE 1
Model (A4) > Geometry > Base Box Pallet > Figure



Coordinate Systems

TABLE 4

Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. in
Origin Y	0. in
Origin Z	0. in
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

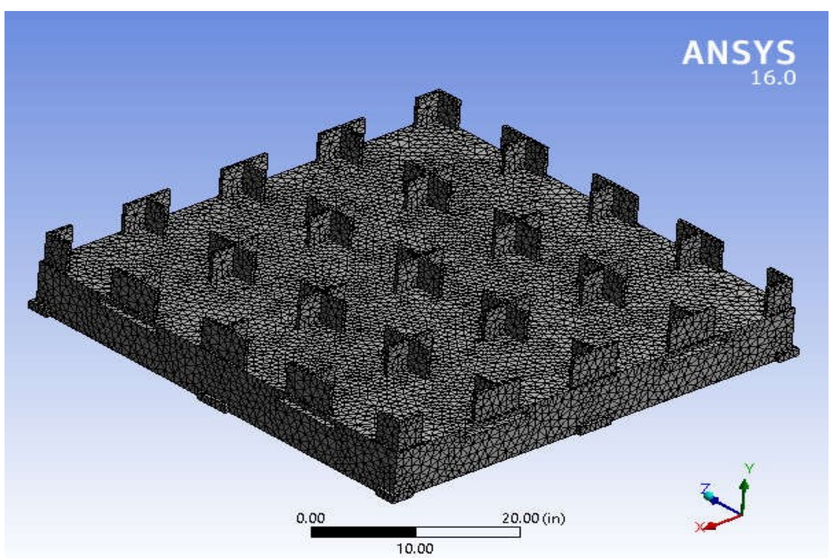
Mesh

TABLE 5 Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	0.40 in
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5

Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	112862
Elements	58940
Mesh Metric	None

FIGURE 2



Model (A4) > Mesh > Figure

Static Structural (A5)

TABLE 6 Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	71.6 °F
Generate Input Only	No

TABLE 7
Model (A4) > Static Structural (A5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No

Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\Desktop\AL-6061_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	Bin

TABLE 8 Model (A4) > Static Structural (A5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. lbf (ramped)
Y Component		-1000. lbf (ramped)
Z Component		0. lbf (ramped)

FIGURE 3

Model (A4) > Static Structural (A5) > Fixed Support > Figure

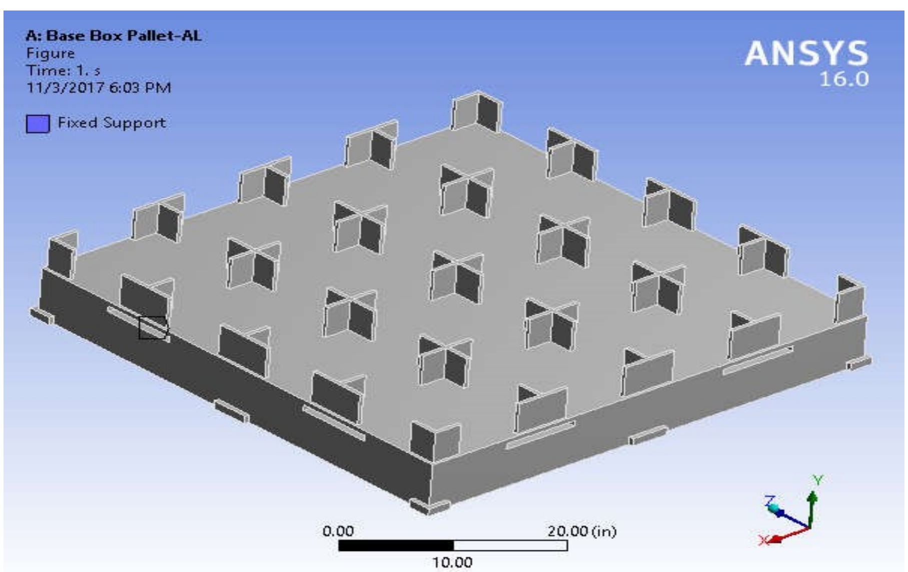
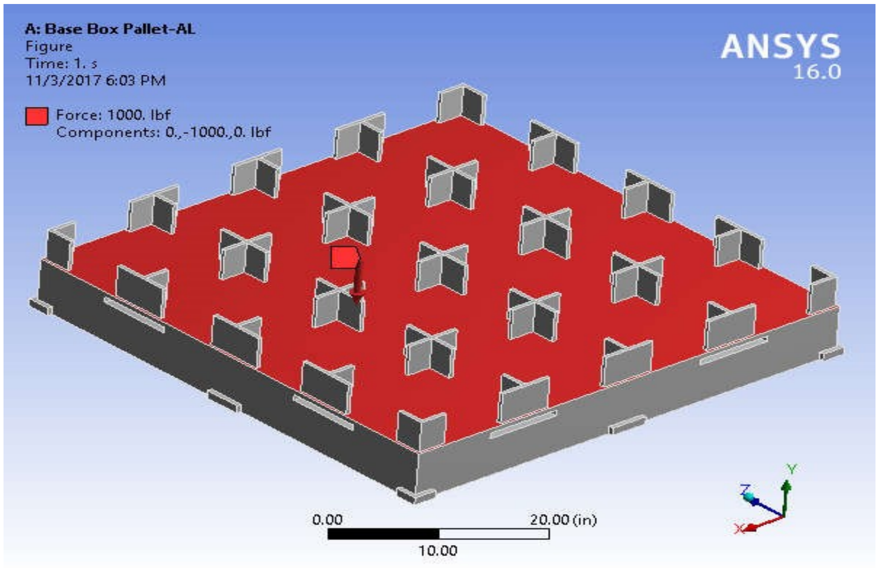


FIGURE 5
Model (A4) > Static Structural (A5) > Force > Figure



Solution (A6)

TABLE 9 Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10 Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	

Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11 Model (A4) > Static Structural (A5) > Solution (A6) > Results

Object Name	*Equivalent Stress*	*Equivalent Elastic Strain*	*Total Deformation*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Equivalent (von-Mises) Stress	Equivalent Elastic Strain	Total Deformation
By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Integration Point Results			
Display Option	Averaged		
Average Across Bodies	No		
Results			
Minimum	2.0899e-005 psi	6.0204e-012 in/in	0. in
Maximum	14.998 psi	1.689e-006 in/in	1.1679e-005 in
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		

TABLE 12 Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress

Time [s]	Minimum [psi]	Maximum [psi]
1.	2.0899e-005	14.998

FIGURE 7

Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress > Figure

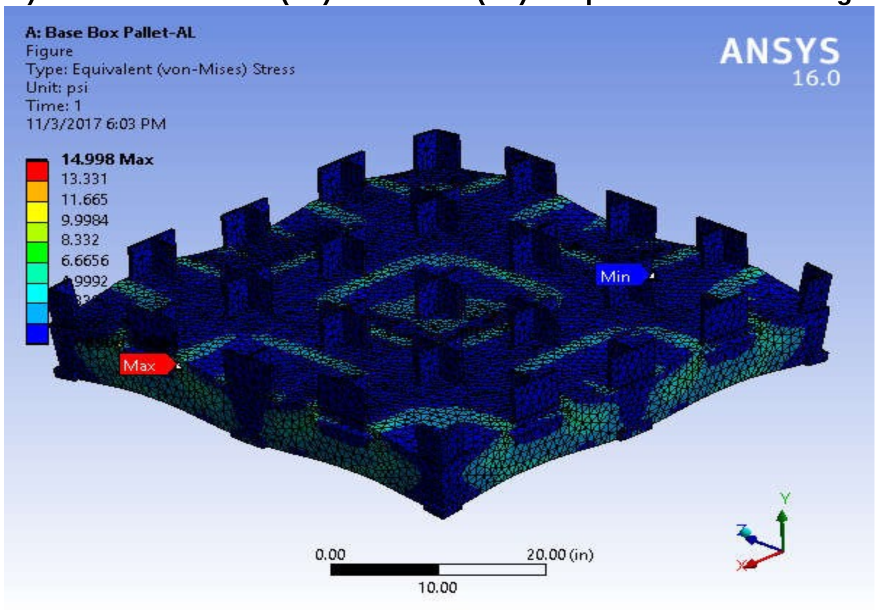


TABLE 13

Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

Time [s]	Minimum [in/in]	Maximum [in/in]
1.	6.0204e-012	1.689e-006

FIGURE 9

Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain > Figur

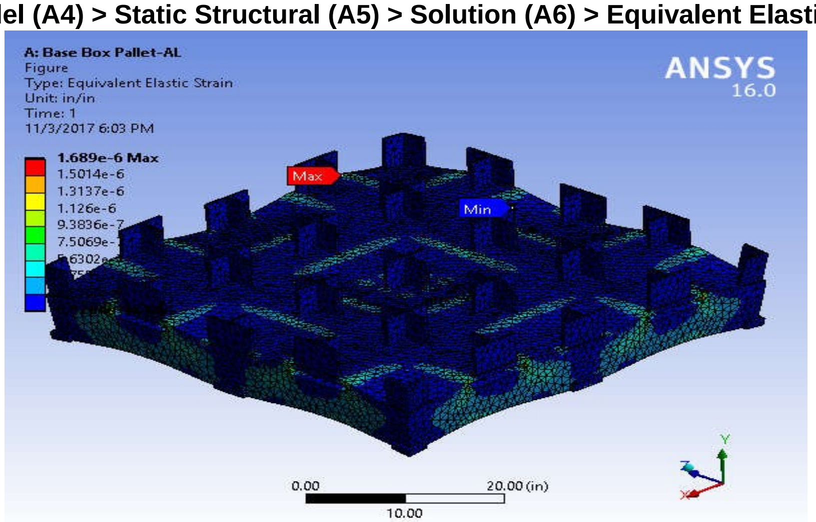


TABLE 14

Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

Time [s]	Minimum [in]	Maximum [in]
1.	0.	1.1679e-005

FIGURE 11

Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation > Figure

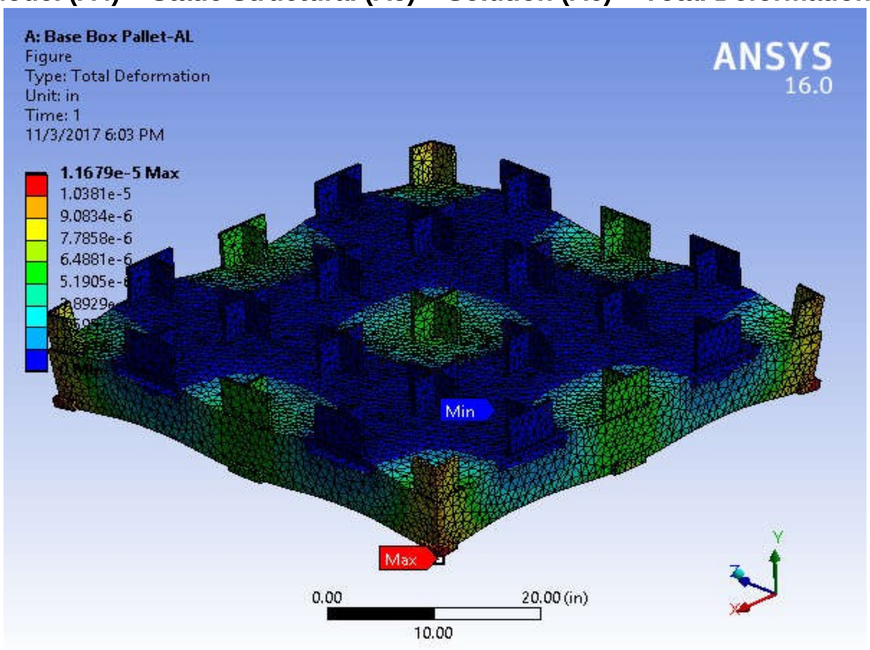


TABLE 15

Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Custom Value
Stress Limit	200. psi

TABLE 16

Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	

Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	> 10
Information	
Time	1. s
Load Step	1
Substep	1
Iteration Number	1

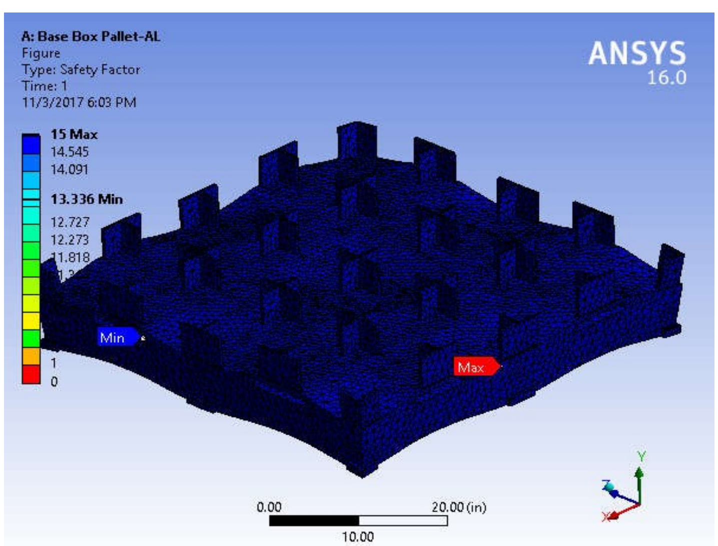
TABLE 17

Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	13.336	15.

FIGURE 13

Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor > Figure



Material Data

Aluminum Alloy

TABLE 18

Aluminum Alloy > Constants

Density	0.10007 lbm in^-3
Coefficient of Thermal Expansion	1.2778e-005 F^-1
Specific Heat	0.20899 BTU lbm^-1 F^-1

TABLE 19

Aluminum Alloy > Compressive Ultimate Strength

Compressive Ultimate Strength psi
0

TABLE 20 Aluminum Alloy > Compressive Yield Strength

Compressive Yield Strength psi
40611

TABLE 21

Aluminum Alloy > Tensile Yield Strength

Tensile Yield Strength psi
40611

TABLE 22 Aluminum Alloy > Tensile Ultimate Strength

Tensile Ultimate Strength psi
44962

TABLE 23

Aluminum Alloy > Isotropic Secant Coefficient of Thermal Expansion

Reference Temperature F
71.6

TABLE 24 Aluminum Alloy > Isotropic Thermal Conductivity

Thermal Conductivity BTU s^-1 in^-1 F^-1	Temperature F
1.5247e-003	-148
1.926e-003	32

2.2068e-003	212
2.3406e-003	392

TABLE 25 Aluminum Alloy > Alternating Stress R-Ratio

Alternating Stress psi	Cycles	R-Ratio
40001	1700	-1
34998	5000	-1
29994	34000	-1
25004	1.4e+005	-1
20001	8.e+005	-1
16998	2.4e+006	-1
13000	5.5e+007	-1
12000	1.e+008	-1
24743	50000	-0.5
20247	3.5e+005	-0.5
15751	3.7e+006	-0.5
12750	1.4e+007	-0.5
11251	5.e+007	-0.5
10499	1.e+008	-0.5
21001	50000	0
17506	1.9e+005	0
14997	1.3e+006	0
13500	4.4e+006	0
12499	1.2e+007	0
10499	1.e+008	0
10750	3.e+005	0.5
10250	1.5e+006	0.5
9624.7	1.2e+007	0.5
8999.6	1.e+008	0.5

TABLE 26

Aluminum Alloy > Isotropic Resistivity

Resistivity ohm cmil in^-1	Temperature F
1.2184	32
1.3387	68
1.82	212

TABLE 27

Aluminum Alloy > Isotropic Elasticity

Temperature F	Young's Modulus psi	Poisson's Ratio	Bulk Modulus psi	Shear Modulus psi
	1.0298e+007	0.33	1.0096e+007	3.8713e+006

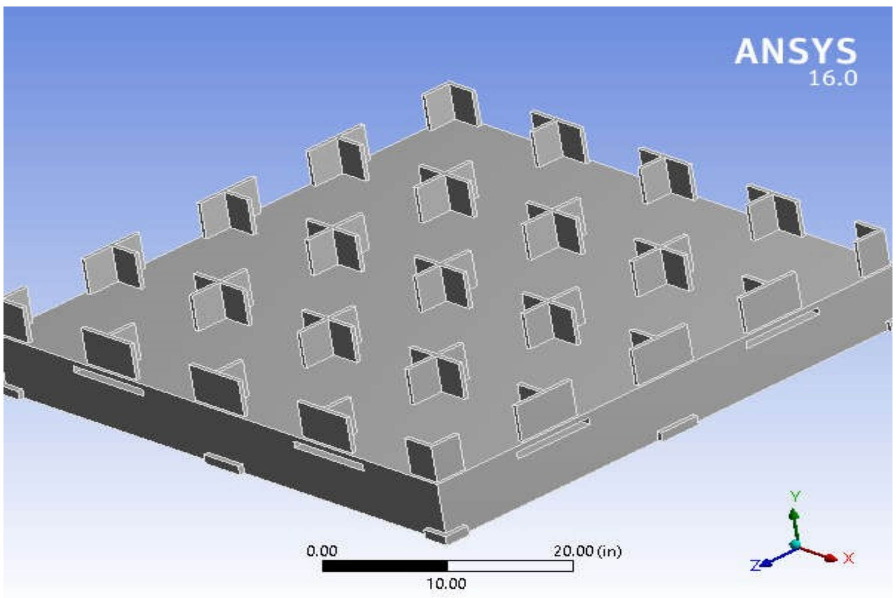
TABLE 28

Aluminum Alloy > Isotropic Relative Permeability

Relative Permeability
1

Project

First Saved	Saturday, November 4, 2017
Last Saved	Saturday, November 4, 2017
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	U.S. Customary (in, lbm, lbf, s, V, A) Degrees rad/s Fahrenheit
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Fahrenheit

Model (A4)

Geometry

TABLE 2
Model (A4) > Geometry

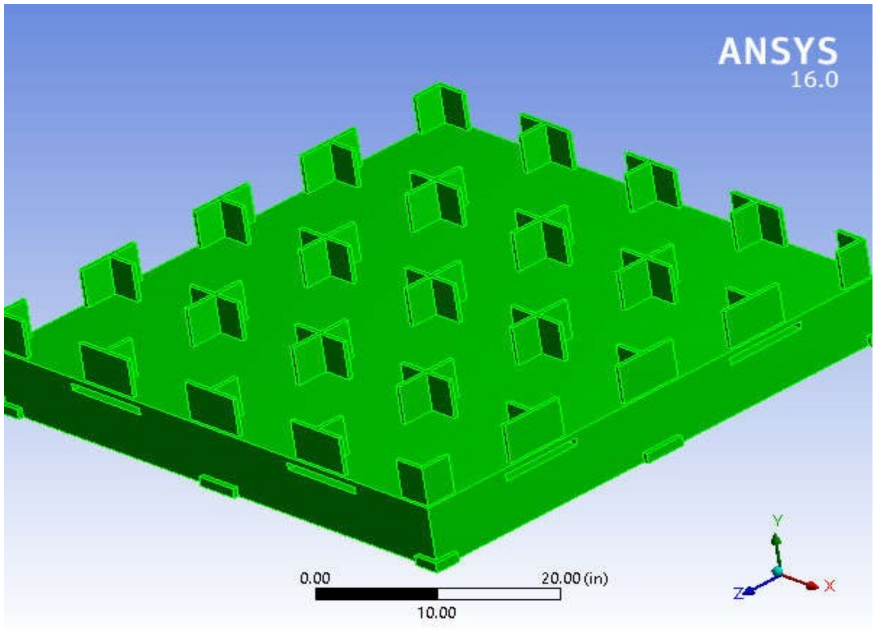
Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\ Desktop\New folder\Base Box Pallet.SLDPRT
Type	SolidWorks
Length Unit	Meters
Element Control	Program Controlled

Display Style	Body Color
Bounding Box	
Length X	52. in
Length Y	10.5 in
Length Z	52. in
Properties	
Volume	5223.1 in^3
Mass	179.26 lbm
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	112862
Elements	58940
Mesh Metric	None
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	No
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\AppData\Local\Temp
Analysis Type	3-D
Mixed Import Resolution	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (A4) > Geometry > Parts

Object Name	*Base Box Pallet*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Polyethylene
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	52. in
Length Y	10.5 in
Length Z	52. in
Properties	
Volume	5223.1 in^3
Mass	179.26 lbm
Centroid X	7.6469e-016 in
Centroid Y	-1.2315 in
Centroid Z	1.8687e-003 in
Moment of Inertia Ip1	42842 lbm·in^2
Moment of Inertia Ip2	84783 lbm·in^2
Moment of Inertia Ip3	42908 lbm·in^2
Statistics	
Nodes	112862
Elements	58940
Mesh Metric	None

FIGURE 1



Model (A4) > Geometry > Base Box Pallet > Figure

Coordinate Systems

TABLE 4
Model (A4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. in
Origin Y	0. in
Origin Z	0. in
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

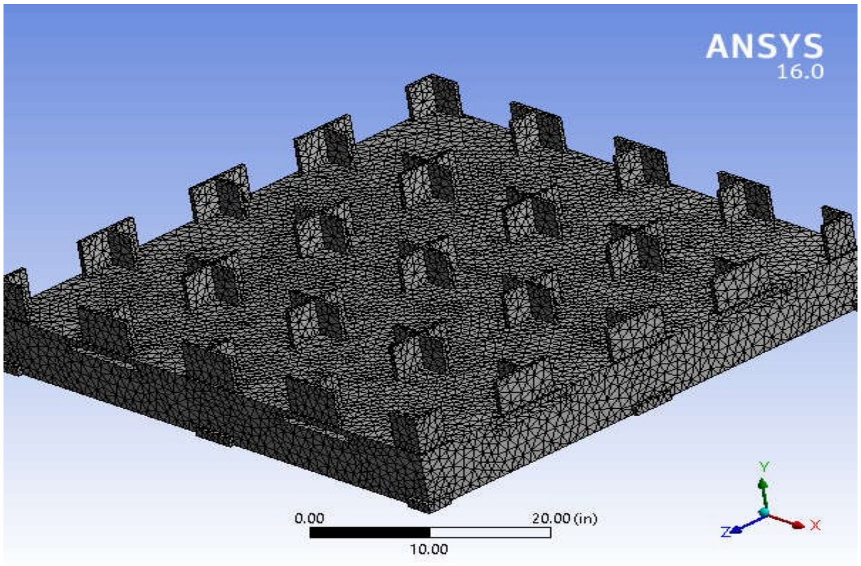
Mesh

TABLE 5
Model (A4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color

Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	0.40 in
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	112862
Elements	58940
Mesh Metric	None

FIGURE 2 Model (A4) > Mesh > Figure



Static Structural (A5)

TABLE 6
Model (A4) > Analysis

Object Name	*Static Structural (A5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	71.6 °F
Generate Input Only	No

TABLE 7
Model (A4) > Static Structural (A5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled

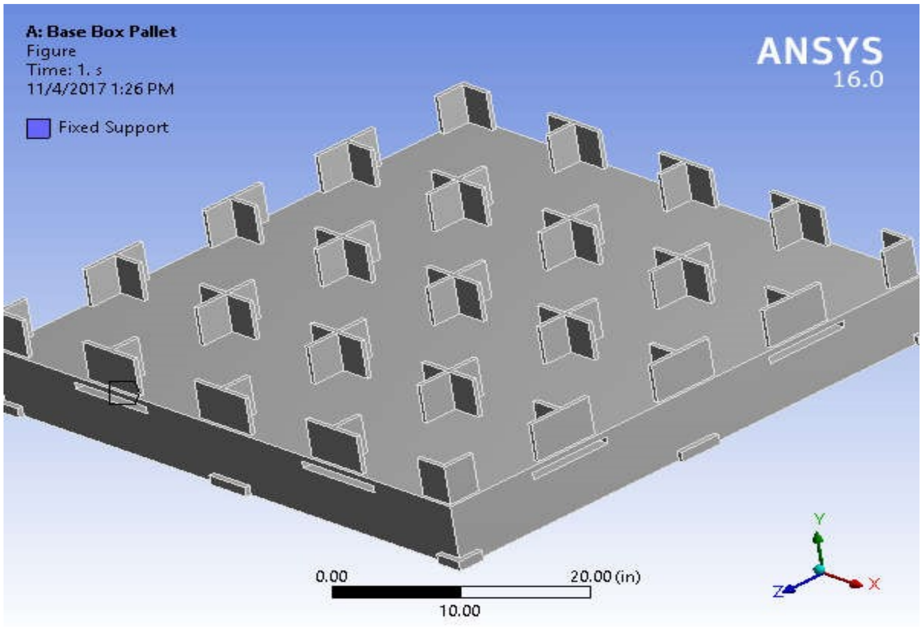
Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users \Desktop\Plastic_files\dp0\SYS\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	Bin

TABLE 8
Model (A4) > Static Structural (A5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	

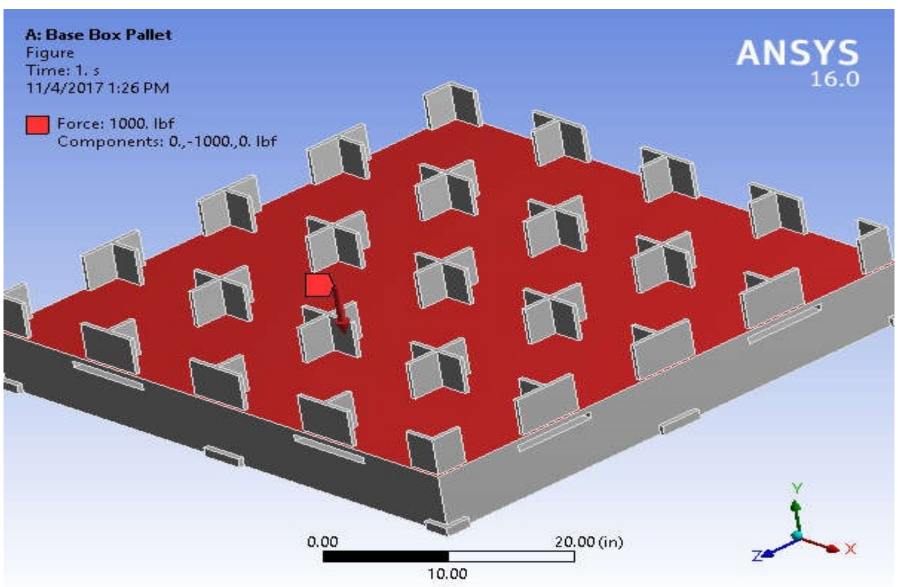
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. lbf (ramped)
Y Component		-1000. lbf (ramped)
Z Component		0. lbf (ramped)

FIGURE 3



Model (A4) > Static Structural (A5) > Fixed Support > Figure

FIGURE 5
Model (A4) > Static Structural (A5) > Force > Figure



Solution (A6)

TABLE 9
Model (A4) > Static Structural (A5) > Solution

Object Name	*Solution (A6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10
Model (A4) > Static Structural (A5) > Solution (A6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11
Model (A4) > Static Structural (A5) > Solution (A6) > Results

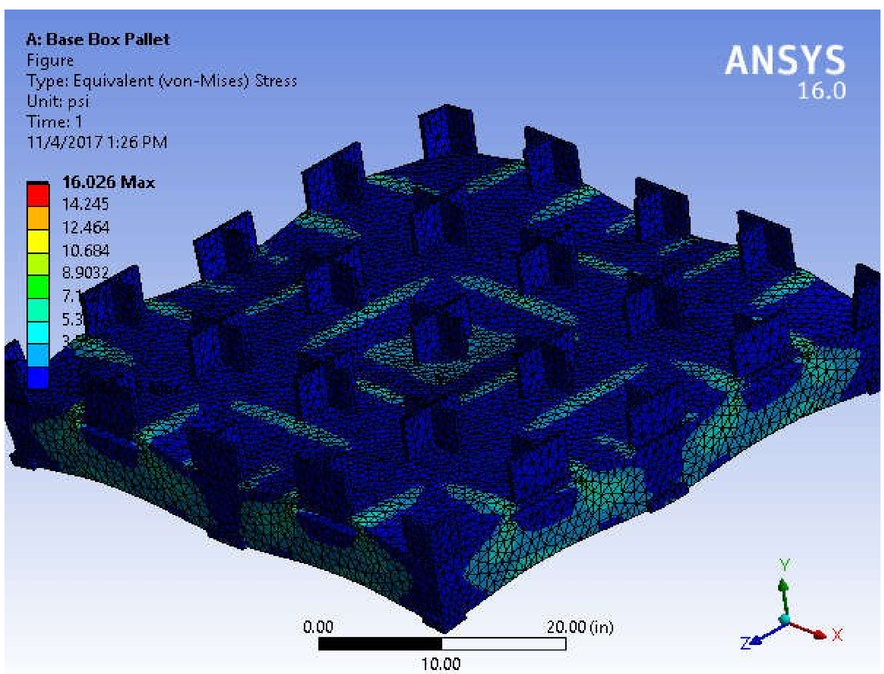
Object Name	*Equivalent Stress*	*Equivalent Elastic Strain*	*Total Deformation*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Equivalent (von-Mises) Stress	Equivalent Elastic Strain	Total Deformation
By	Time		
Display Time	Last		
Calculate Time	Yes		

History			
Identifier			
Suppressed	No		
Integration Point Results			
Display Option	Averaged		
Average Across Bodies	No		
Results			
Minimum	1.9247e-005 psi	2.6205e-010 in/in	0. in
Maximum	16.026 psi	1.0324e-004 in/in	7.6607e-004 in
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		

TABLE 12
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress

Time [s]	Minimum [psi]	Maximum [psi]
1.	1.9247e-005	16.026

FIGURE 7

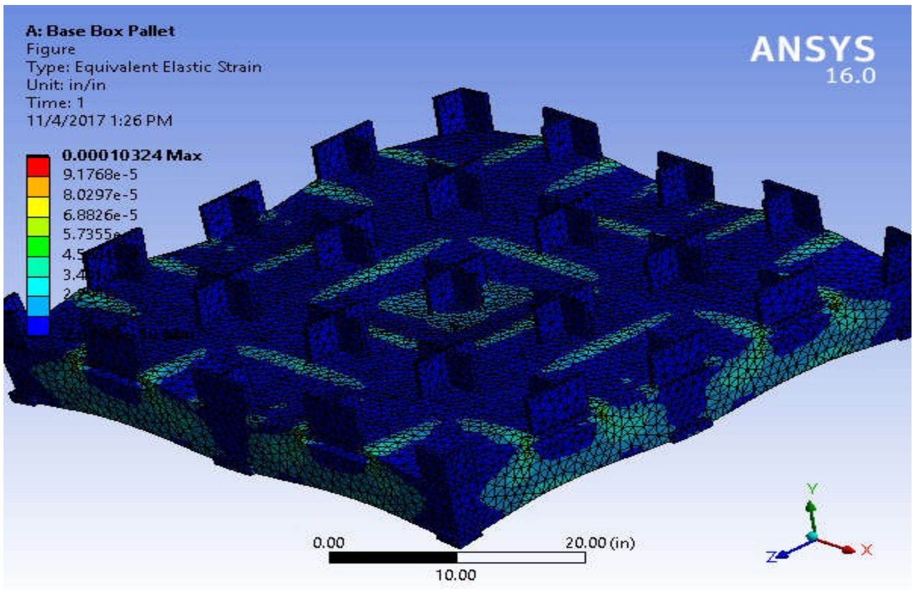


Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Stress > Figure

TABLE 13
Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain

Time [s]	Minimum [in/in]	Maximum [in/in]
1.	2.6205e-010	1.0324e-004

FIGURE 9



Model (A4) > Static Structural (A5) > Solution (A6) > Equivalent Elastic Strain > Figure

TABLE 14
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation

Time [s]	Minimum [in]	Maximum [in]
1.	0.	7.6607e-004

FIGURE 11
Model (A4) > Static Structural (A5) > Solution (A6) > Total Deformation > Figure

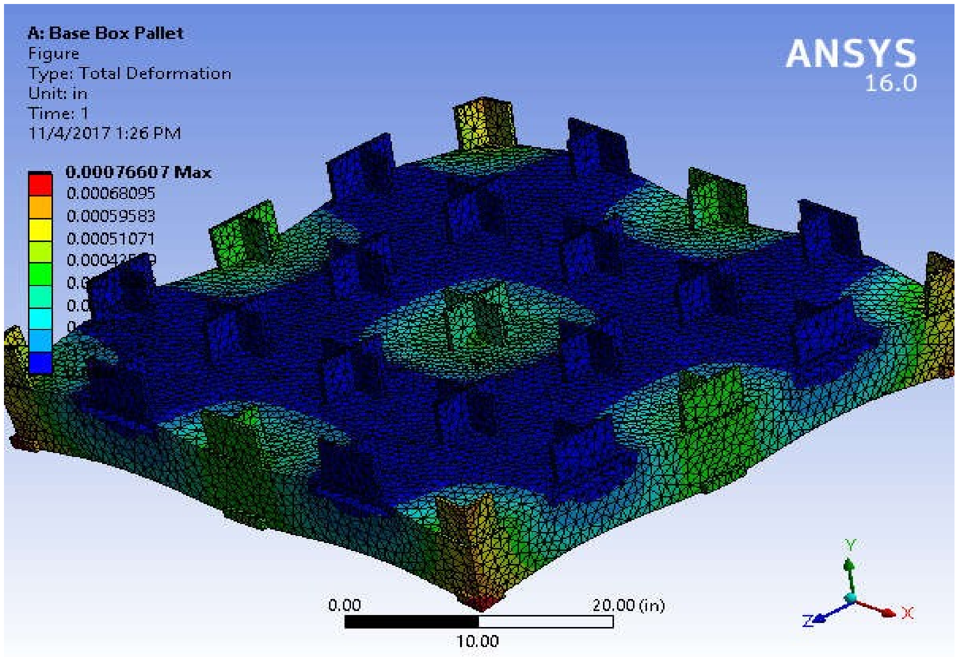


TABLE 15
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Custom Value
Stress Limit	200. psi

TABLE 16
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Results

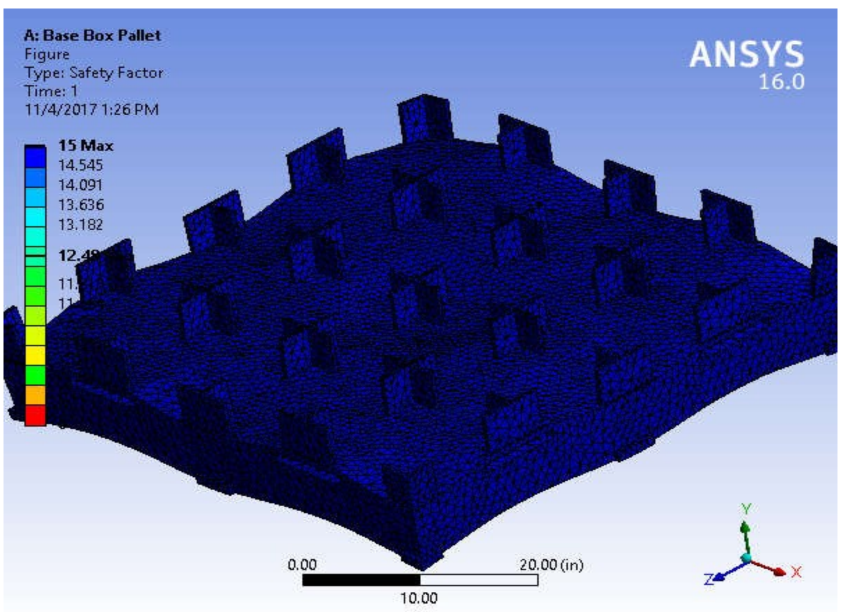
Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last

Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	> 10
Information	
Time	1. s
Load Step	1
Substep	1
Iteration Number	1

TABLE 17
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	12.48	15.

FIGURE 13
Model (A4) > Static Structural (A5) > Solution (A6) > Stress Tool > Safety Factor > Figure



Material Data

Polyethylene

TABLE 18
Polyethylene > Constants

Density	3.4321e-002 lbm in^-3
Coefficient of Thermal Expansion	1.2778e-004 F^-1
Specific Heat	7.0698e-002 BTU lbm^-1 F^-1
Thermal Conductivity	3.7449e-006 BTU s^-1 in^-1 F^-1

TABLE 19
Polyethylene > Compressive Ultimate Strength

Compressive Ultimate Strength psi
0

TABLE 20
Polyethylene > Compressive Yield Strength

Compressive Yield Strength psi
0

TABLE 21
Polyethylene > Tensile Yield Strength

Tensile Yield Strength psi
3625.9

TABLE 22
Polyethylene > Tensile Ultimate Strength

Tensile Ultimate Strength psi
4786.2

TABLE 23
Polyethylene > Isotropic Secant Coefficient of Thermal Expansion

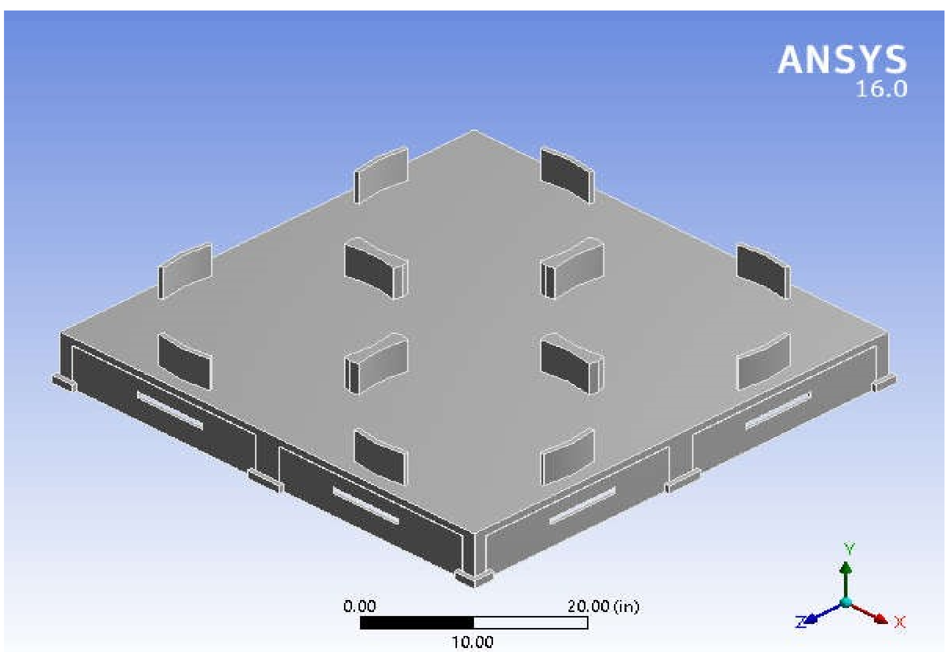
Reference Temperature F
71.6

TABLE 24
Polyethylene > Isotropic Elasticity

Temperature F	Young's Modulus psi	Poisson's Ratio	Bulk Modulus psi	Shear Modulus psi
	1.5954e+005	0.42	3.3238e+005	56177

Project

First Saved	Thursday, November 2, 2017
Last Saved	Friday, November 3, 2017
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	U.S. Customary (in, lbm, lbf, s, V, A) Degrees rad/s Fahrenheit
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Fahrenheit

Model (B4)

Geometry

TABLE 2
Model (B4) > Geometry

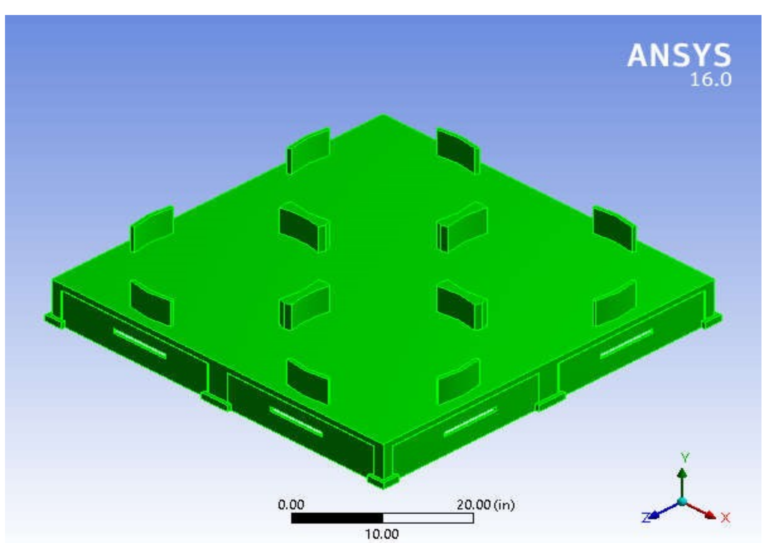
Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users \Desktop\New folder\Base Drum Pallet.SLDPRT
Type	SolidWorks

Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	52.3 in
Length Y	10.5 in
Length Z	52.3 in
Properties	
Volume	3642.9 in³
Mass	364.56 lbm
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	108263
Elements	58164
Mesh Metric	None
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	No
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users \AppData\Local\Temp
Analysis Type	3-D
Mixed Import Resolution	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (B4) > Geometry > Parts

Object Name	*Base Drum Pallet*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Aluminum Alloy
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	52.3 in
Length Y	10.5 in
Length Z	52.3 in
Properties	
Volume	3642.9 in³
Mass	364.56 lbm
Centroid X	2.8023e-003 in
Centroid Y	-1.0616 in
Centroid Z	-3.1303e-003 in
Moment of Inertia Ip1	87921 lbm·in²
Moment of Inertia Ip2	1.7345e+005 lbm·in²
Moment of Inertia Ip3	87921 lbm·in²
Statistics	
Nodes	108263
Elements	58164
Mesh Metric	None

FIGURE 1
Model (B4) > Geometry > Base Drum Pallet > Figure



Coordinate Systems

TABLE 4

Model (B4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. in
Origin Y	0. in
Origin Z	0. in
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

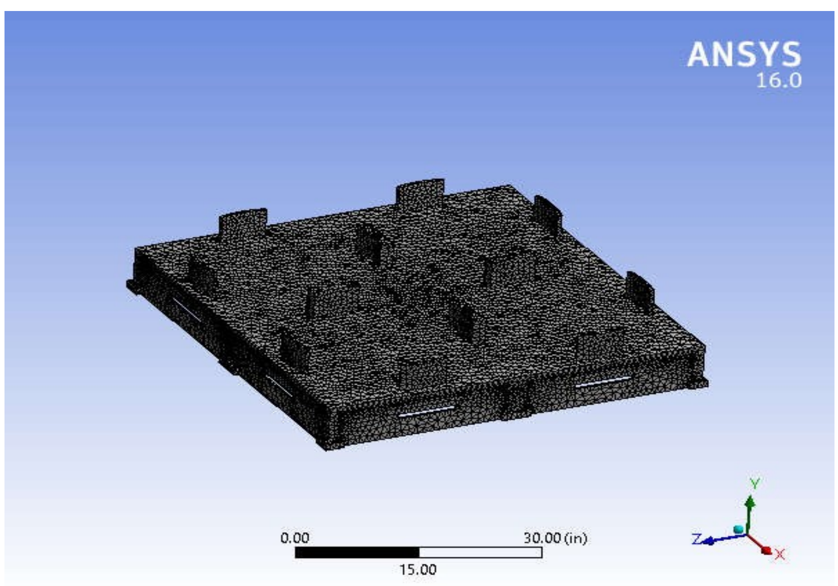
Mesh

TABLE 5 Model (B4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	5.e-002 in
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272

Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	108263
Elements	58164
Mesh Metric	None

FIGURE 2
Model (B4) > Mesh > Figure



Static Structural (B5)

TABLE 6 Model (B4) > Analysis

Object Name	*Static Structural (B5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	71.6 °F
Generate Input Only	No

TABLE 7
Model (B4) > Static Structural (B5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes

Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users \Desktop\AL-6061_files\dp0\SYS-1\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	Bin

TABLE 8 Model (B4) > Static Structural (B5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	12 Faces	1 Face
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. lbf (ramped)
Y Component		-1000. lbf (ramped)
Z Component		0. lbf (ramped)

FIGURE 3

Model (B4) > Static Structural (B5) > Fixed Support > Figure

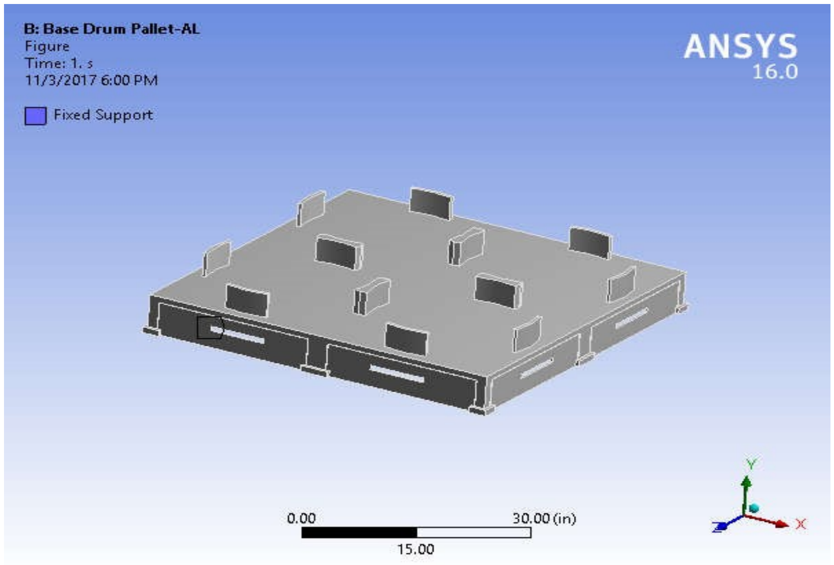
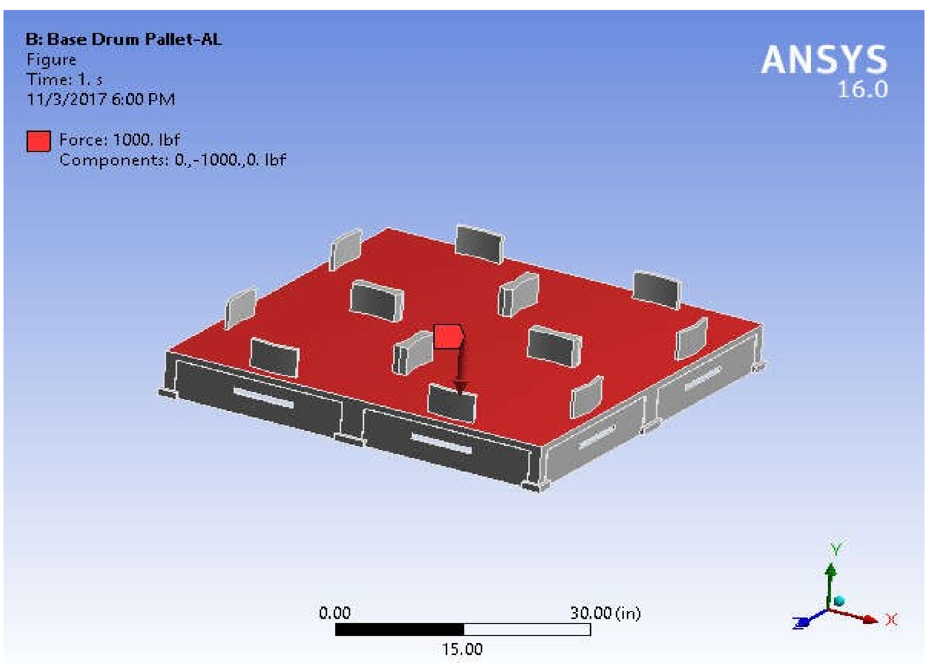


FIGURE 5
Model (B4) > Static Structural (B5) > Force > Figure



Solution (B6)

TABLE 9 Model (B4) > Static Structural (B5) > Solution

Object Name	*Solution (B6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10 Model (B4) > Static Structural (B5) > Solution (B6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11 Model (B4) > Static Structural (B5) > Solution (B6) > Results

Object Name	*Equivalent Stress*	*Equivalent Elastic Strain*	*Total Deformation*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Equivalent (von-Mises) Stress	Equivalent Elastic Strain	Total Deformation

By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Integration Point Results			
Display Option	Averaged		
Average Across Bodies	No		
Results			
Minimum	9.8701e-003 psi	1.5753e-009 in/in	0. in
Maximum	128.63 psi	1.7471e-005 in/in	3.1e-004 in
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		

TABLE 12 Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Stress

Time [s]	Minimum [psi]	Maximum [psi]
1.	9.8701e-003	128.63

FIGURE 7

Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Stress > Figure

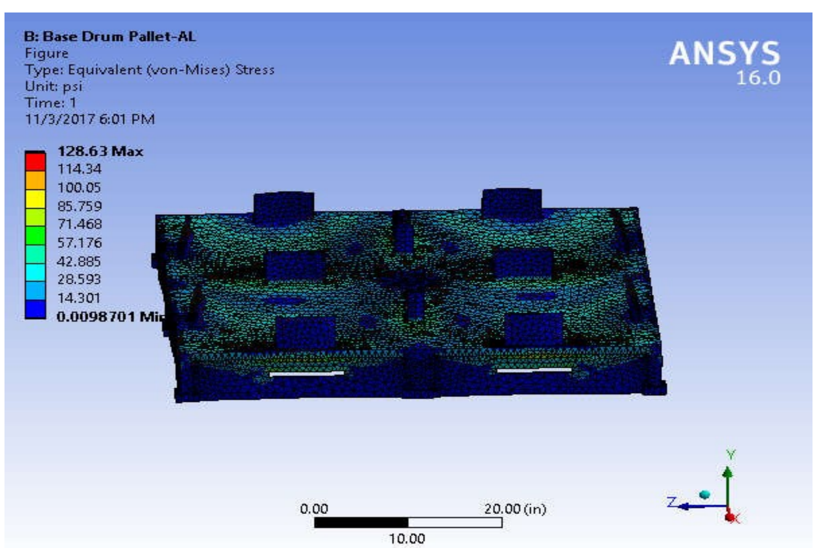


TABLE 13

Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain

Time [s]	Minimum [in/in]	Maximum [in/in]
1.	1.5753e-009	1.7471e-005

FIGURE 9

Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain >

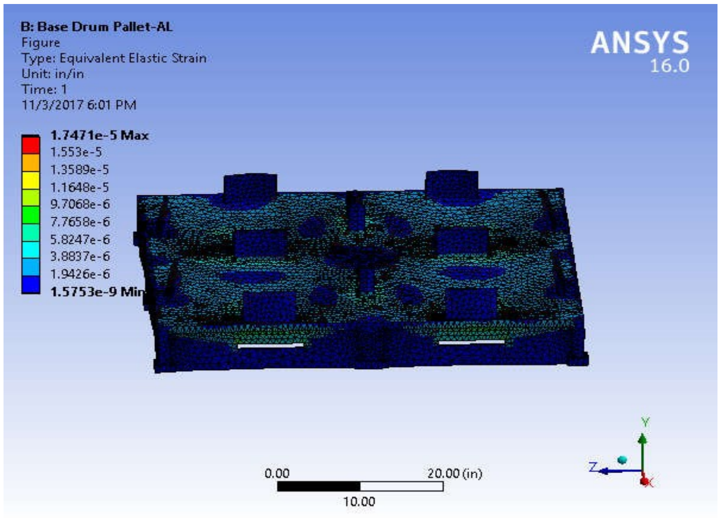


TABLE 14

Model (B4) > Static Structural (B5) > Solution (B6) > Total Deformation

Time [s]	Minimum [in]	Maximum [in]
1.	0.	3.1e-004

FIGURE 11

Model (B4) > Static Structural (B5) > Solution (B6) > Total Deformation > Figure

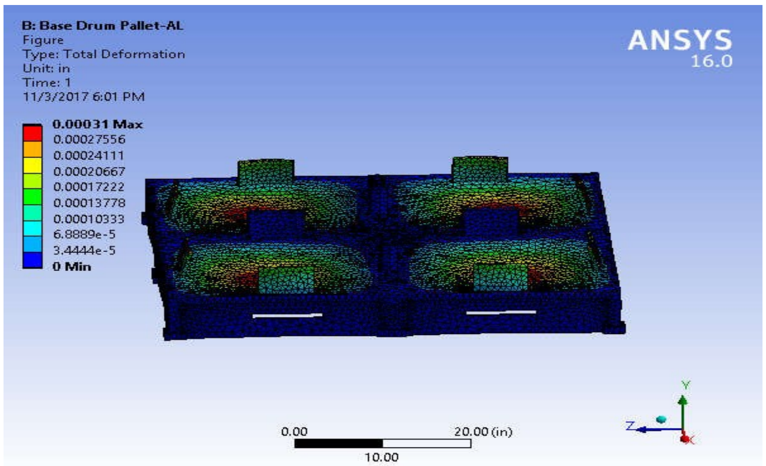


TABLE 15
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Custom Value
Stress Limit	200. psi

TABLE 16
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	1.5548
Information	
Time	1. s
Load Step	1
Substep	1
Iteration Number	1

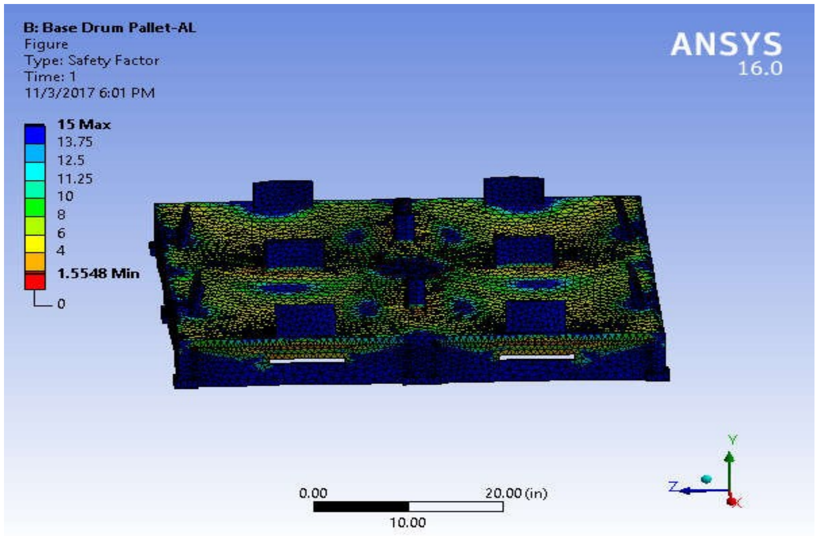
TABLE 17

Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	1.5548	15.

FIGURE 13

Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Safety Factor >



Material Data

Aluminum Alloy

TABLE 18

Aluminum Alloy > Constants

Density	0.10007 lbm in^-3
Coefficient of Thermal Expansion	1.2778e-005 F^-1
Specific Heat	0.20899 BTU lbm^-1 F^-1

TABLE 19

Aluminum Alloy > Compressive Ultimate Strength

Compressive Ultimate Strength psi
0

TABLE 20 Aluminum Alloy > Compressive Yield Strength

Compressive Yield Strength psi
40611

TABLE 21

Aluminum Alloy > Tensile Yield Strength

Tensile Yield Strength psi
40611

TABLE 22 Aluminum Alloy > Tensile Ultimate Strength

Tensile Ultimate Strength psi
44962

TABLE 23

Aluminum Alloy > Isotropic Secant Coefficient of Thermal Expansion

Reference Temperature F
71.6

TABLE 24 Aluminum Alloy > Isotropic Thermal Conductivity

Thermal Conductivity BTU s^-1 in^-1 F^-1	Temperature F
1.5247e-003	-148
1.926e-003	32
2.2068e-003	212
2.3406e-003	392

TABLE 25 Aluminum Alloy > Alternating Stress R-Ratio

Alternating Stress psi	Cycles	R-Ratio
40001	1700	-1
34998	5000	-1
29994	34000	-1
25004	1.4e+005	-1
20001	8.e+005	-1
16998	2.4e+006	-1
13000	5.5e+007	-1
12000	1.e+008	-1
24743	50000	-0.5
20247	3.5e+005	-0.5
15751	3.7e+006	-0.5
12750	1.4e+007	-0.5
11251	5.e+007	-0.5
10499	1.e+008	-0.5
21001	50000	0
17506	1.9e+005	0

14997	1.3e+006	0
13500	4.4e+006	0
12499	1.2e+007	0
10499	1.e+008	0
10750	3.e+005	0.5
10250	1.5e+006	0.5
9624.7	1.2e+007	0.5
8999.6	1.e+008	0.5

TABLE 26

Aluminum Alloy > Isotropic Resistivity

Resistivity ohm cmil in^-1	Temperature F
1.2184	32
1.3387	68
1.82	212

TABLE 27

Aluminum Alloy > Isotropic Elasticity

Temperature F	Young's Modulus psi	Poisson's Ratio	Bulk Modulus psi	Shear Modulus psi
	1.0298e+007	0.33	1.0096e+007	3.8713e+006

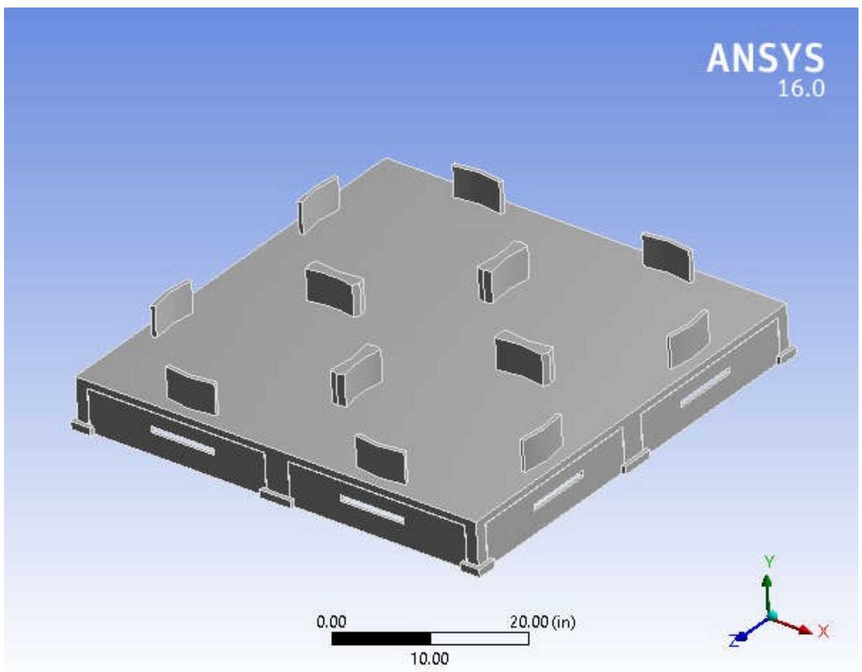
TABLE 28

Aluminum Alloy > Isotropic Relative Permeability

Relative Permeability
1

Project

First Saved	Saturday, November 4, 2017
Last Saved	Saturday, November 4, 2017
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	U.S. Customary (in, lbm, lbf, s, V, A) Degrees rad/s Fahrenheit
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Fahrenheit

Model (B4)

Geometry

TABLE 2
Model (B4) > Geometry

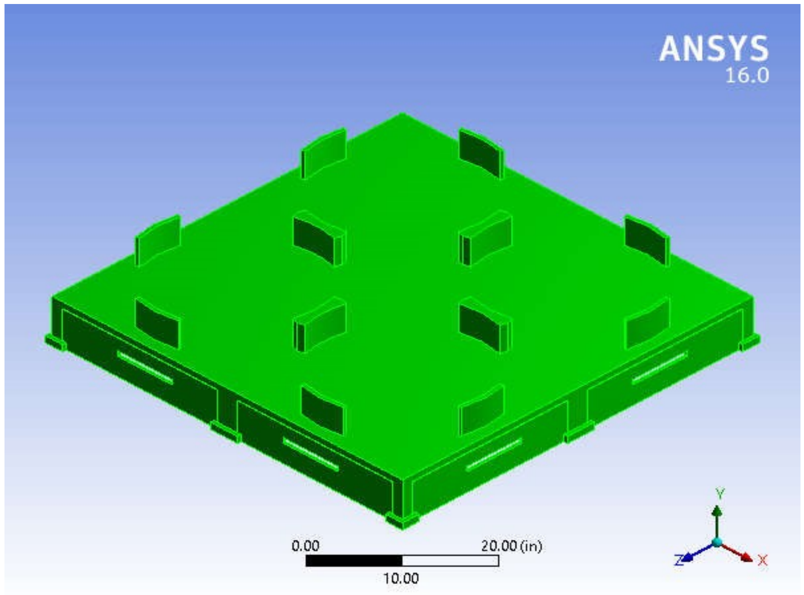
Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\Desktop\New folder\Base Drum Pallet.SLDPRT
Type	SolidWorks
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color

Bounding Box	
Length X	52.3 in
Length Y	10.5 in
Length Z	52.3 in
Properties	
Volume	3642.9 in³
Mass	1033.1 lbm
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	108263
Elements	58164
Mesh Metric	None
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	No
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\ AppData\Local\Temp
Analysis Type	3-D
Mixed Import Resolution	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (B4) > Geometry > Parts

Object Name	*Base Drum Pallet*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Structural Steel
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	52.3 in
Length Y	10.5 in
Length Z	52.3 in
Properties	
Volume	3642.9 in³
Mass	1033.1 lbm
Centroid X	2.8023e-003 in
Centroid Y	-1.0616 in
Centroid Z	-3.1303e-003 in
Moment of Inertia Ip1	2.4916e+005 lbm·in²
Moment of Inertia Ip2	4.9156e+005 lbm·in²
Moment of Inertia Ip3	2.4916e+005 lbm·in²
Statistics	
Nodes	108263
Elements	58164
Mesh Metric	None

FIGURE 1
Model (B4) > Geometry > Base Drum Pallet > Figure



Coordinate Systems

TABLE 4

Model (B4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. in
Origin Y	0. in
Origin Z	0. in
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

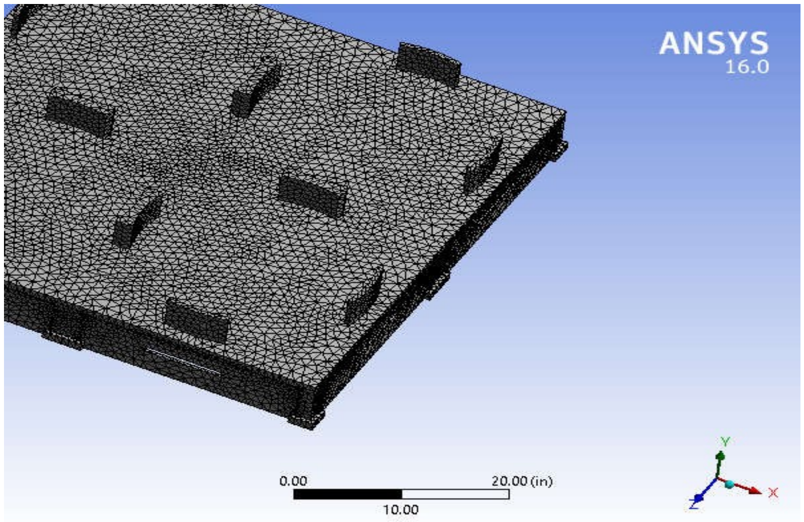
Mesh

TABLE 5 Model (B4) > Mesh

Object Name	*Mesh*
State	Solved
Display	

Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	5.e-002 in
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	108263
Elements	58164
Mesh Metric	None

FIGURE 2
Model (B4) > Mesh > Figure



Static Structural (B5)

TABLE 6 Model (B4) > Analysis

Object Name	*Static Structural (B5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	71.6 °F
Generate Input Only	No

TABLE 7 Model (B4) > Static Structural (B5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s

Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\ Desktop\Plastic_files\dp0\SYS-1\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	Bin

TABLE 8
Model (B4) > Static Structural (B5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	6 Faces	1 Face

Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. lbf (ramped)
Y Component		-1000. lbf (ramped)
Z Component		0. lbf (ramped)

FIGURE 3
Model (B4) > Static Structural (B5) > Fixed Support > Figure

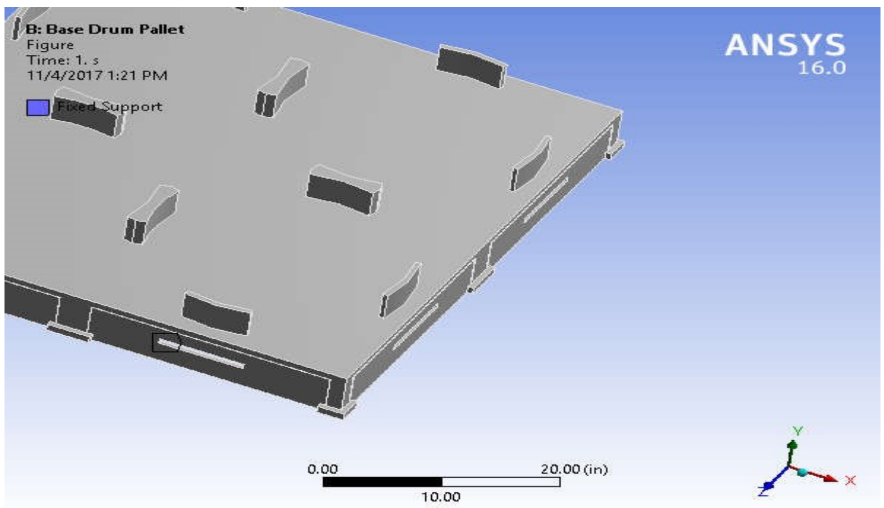
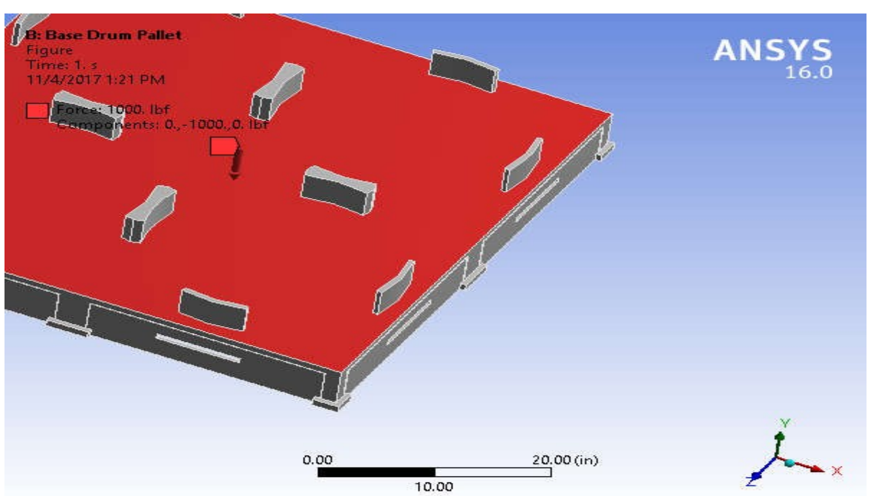


FIGURE 5
Model (B4) > Static Structural (B5) > Force > Figure



Solution (B6)

TABLE 9 Model (B4) > Static Structural (B5) > Solution

Object Name	*Solution (B6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10 Model (B4) > Static Structural (B5) > Solution (B6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11 Model (B4) > Static Structural (B5) > Solution (B6) > Results

Object Name	*Equivalent Stress*	*Equivalent Elastic Strain*	*Total Deformation*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			

Type	Equivalent (von-Mises) Stress	Equivalent Elastic Strain	Total Deformation
By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Integration Point Results			
Display Option	Averaged		
Average Across Bodies	No		
Results			
Minimum	1.9884e-002 psi	6.8548e-010 in/in	0. in
Maximum	263.27 psi	1.3837e-005 in/in	1.5461e-004 in
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		

TABLE 12

Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Stress

Time [s]	Minimum [psi]	Maximum [psi]
1.	1.9884e-002	263.27

FIGURE 7

Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Stress > Figure

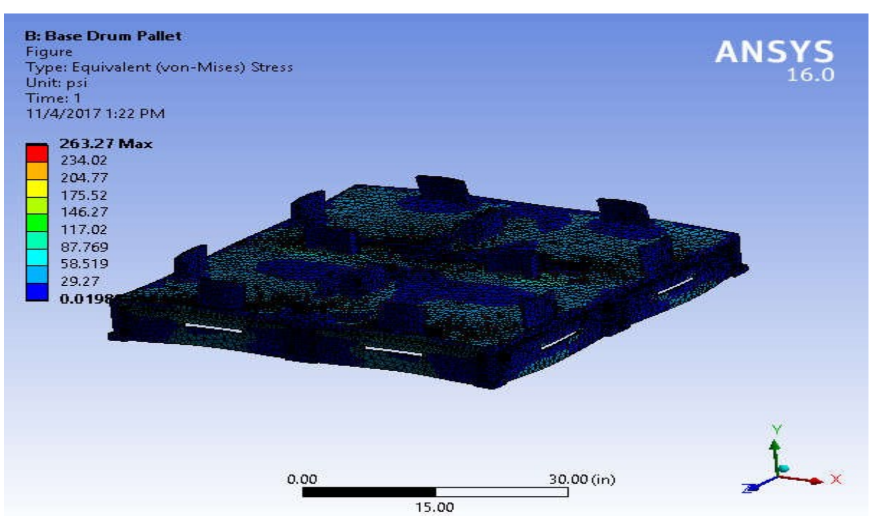


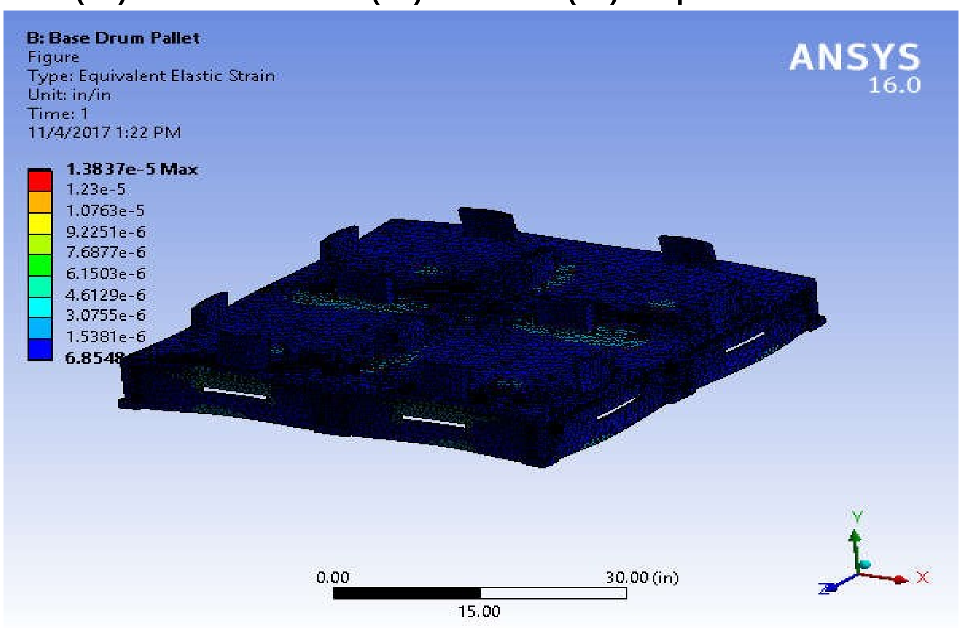
TABLE 13

Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain

Time [s]	Minimum [in/in]	Maximum [in/in]
1.	6.8548e-010	1.3837e-005

FIGURE 9

Model (B4) > Static Structural (B5) > Solution (B6) > Equivalent Elastic Strain >



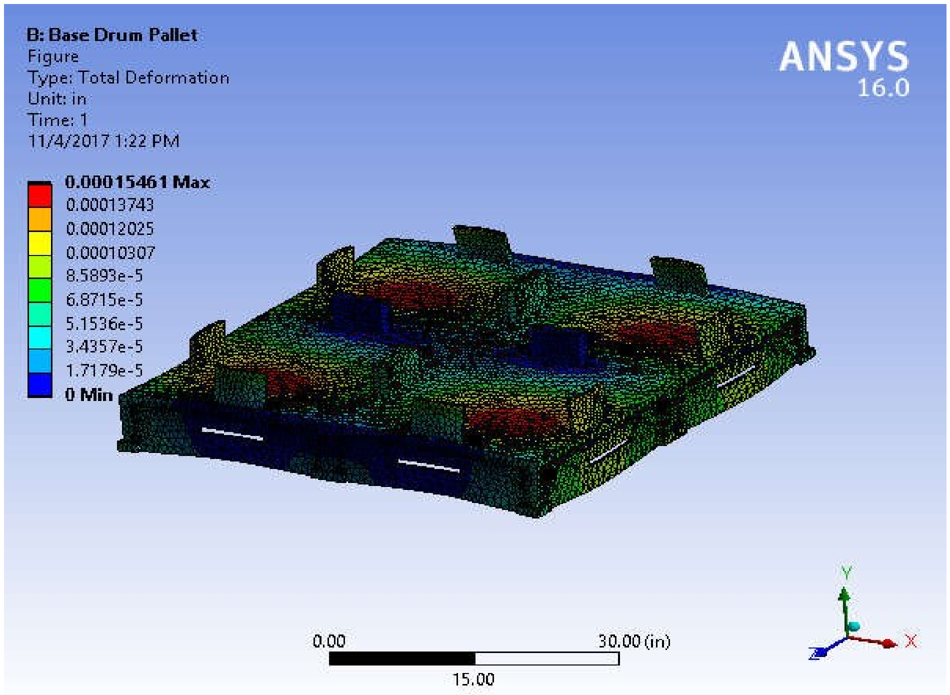
Figure

TABLE 14

Model (B4) > Static Structural (B5) > Solution (B6) > Total Deformation

Time [s]	Minimum [in]	Maximum [in]
1.	0.	1.5461e-004

FIGURE 11



Model (B4) > Static Structural (B5) > Solution (B6) > Total Deformation > Figure

TABLE 15
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Custom Value
Stress Limit	200. psi

TABLE 16
Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last

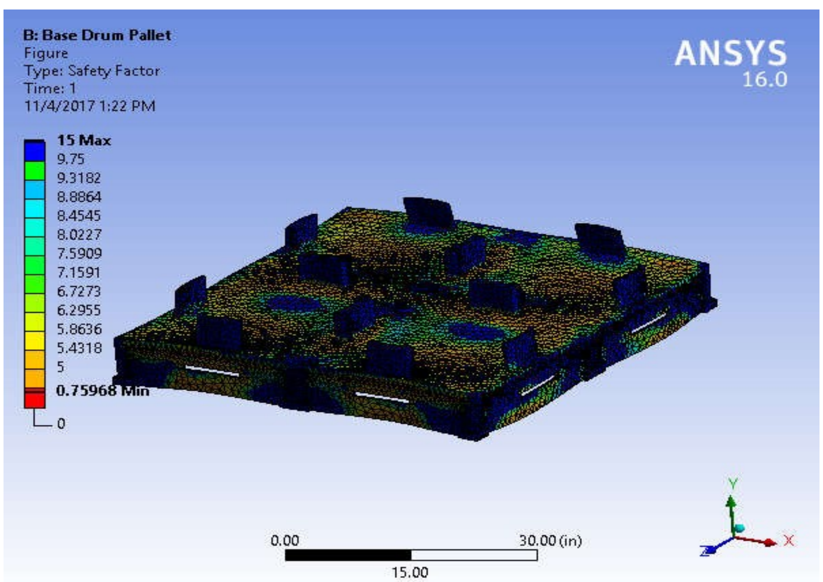
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	0.75968
Information	
Time	1. s
Load Step	1
Substep	1
Iteration Number	1

TABLE 17

Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	0.75968	15.

FIGURE 13



Model (B4) > Static Structural (B5) > Solution (B6) > Stress Tool > Safety Factor > Figure

Material Data

Structural Steel

TABLE 18

Structural Steel > Constants

Density	0.2836 lbm in^-3
Coefficient of Thermal Expansion	6.6667e-006 F^-1
Specific Heat	0.10366 BTU lbm^-1 F^-1
Thermal Conductivity	8.0917e-004 BTU s^-1 in^-1 F^-1
Resistivity	8.5235 ohm cmil in^-1

TABLE 19

Structural Steel > Compressive Ultimate Strength

Compressive Ultimate Strength psi
0

TABLE 20 Structural Steel > Compressive Yield Strength

Compressive Yield Strength psi
36259

TABLE 21

Structural Steel > Tensile Yield Strength

Tensile Yield Strength psi
36259

TABLE 22

Structural Steel > Tensile Ultimate Strength

Tensile Ultimate Strength psi
66717

TABLE 23

Structural Steel > Isotropic Secant Coefficient of Thermal Expansion

Reference Temperature F
71.6

TABLE 24

Structural Steel > Alternating Stress Mean Stress

Alternating Stress psi	Cycles	Mean Stress psi
5.8001e+005	10	0
4.1002e+005	20	0
2.7499e+005	50	0
2.0494e+005	100	0
1.5505e+005	200	0
63962	2000	0
38000	10000	0
31038	20000	0
20015	1.e+005	0
16534	2.e+005	0
12502	1.e+006	0

TABLE 25

Structural Steel > Strain-Life Parameters

Strength Coefficient psi	Strength Exponent	Ductility Coefficient	Ductility Exponent	Cyclic Strength Coefficient psi	Cyclic Strain Hardening Exponent
1.3343e+005	-0.106	0.213	-0.47	1.4504e+005	0.2

TABLE 26

Structural Steel > Isotropic Elasticity

Temperature F	Young's Modulus psi	Poisson's Ratio	Bulk Modulus psi	Shear Modulus psi
	2.9008e+007	0.3	2.4173e+007	1.1157e+007

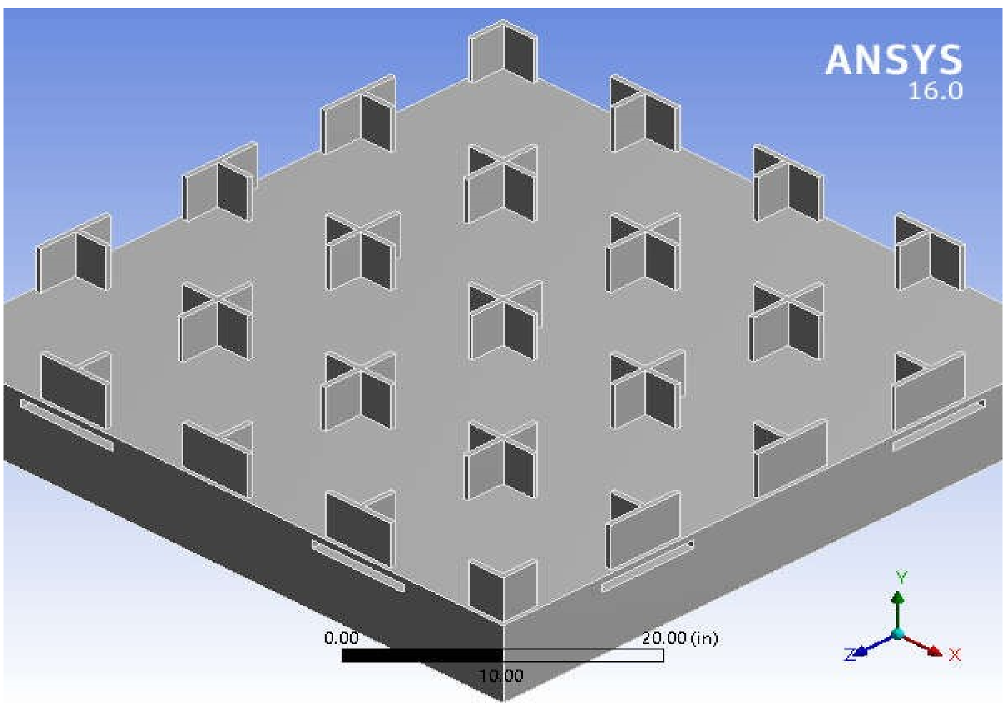
TABLE 27

Structural Steel > Isotropic Relative Permeability

Relative Permeability
10000

Project

First Saved	Saturday, November 4, 2017
Last Saved	Saturday, November 4, 2017
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	U.S. Customary (in, lbm, lbf, s, V, A) Degrees rad/s Fahrenheit
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Fahrenheit

Model (C4)

Geometry

TABLE 2
Model (C4) > Geometry

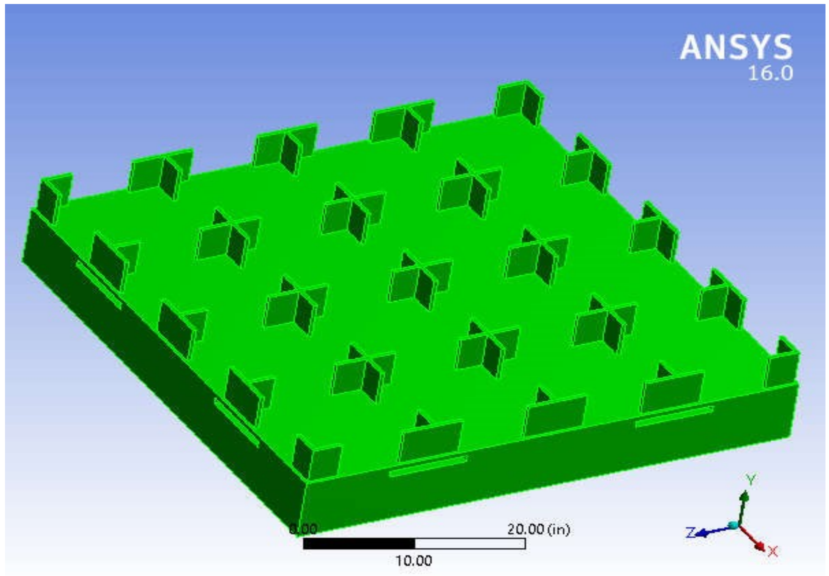
Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users \Desktop\New folder\Top Box Pallet.SLDPRT
Type	SolidWorks
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	51. in
Length Y	11. in
Length Z	51. in
Properties	
Volume	4905. in^3
Mass	168.34 lbm
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	135782
Elements	72087
Mesh Metric	None
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	No
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\ AppData\Local\Temp
Analysis Type	3-D
Mixed Import Resolution	None
Decompose Disjoint Geometry	Yes

Enclosure and Symmetry Processing	Yes

TABLE 3
Model (C4) > Geometry > Parts

Object Name	*Top Box Pallet*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Polyethylene
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	51. in
Length Y	11. in
Length Z	51. in
Properties	
Volume	4905. in^3
Mass	168.34 lbm
Centroid X	-1.9572e-015 in
Centroid Y	-1.0038 in
Centroid Z	2.4873e-003 in
Moment of Inertia Ip1	40286 lbm·in^2
Moment of Inertia Ip2	79990 lbm·in^2
Moment of Inertia Ip3	40368 lbm·in^2
Statistics	
Nodes	135782
Elements	72087
Mesh Metric	None

FIGURE 1
Model (C4) > Geometry > Top Box Pallet > Figure



Coordinate Systems

TABLE 4
Model (C4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. in
Origin Y	0. in
Origin Z	0. in
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

Mesh

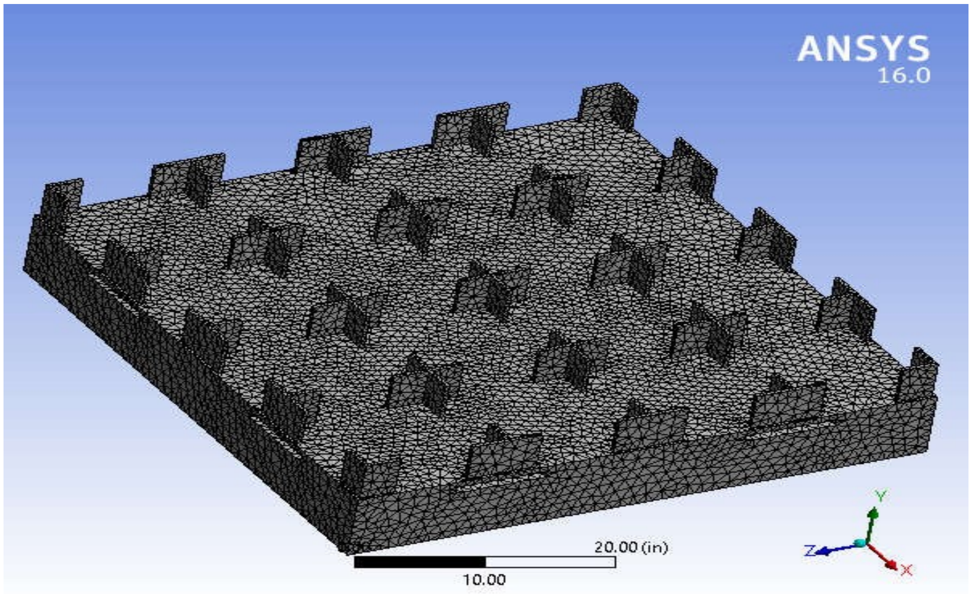
TABLE 5
Model (C4) > Mesh

Object Name	*Mesh*
State	Solved
Display	

Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	0.40 in
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	135782
Elements	72087
Mesh Metric	None

FIGURE 2
Model (C4) > Mesh > Figure

Static Structural (C5)



Static Structural (C5)

TABLE 6
Model (C4) > Analysis

Object Name	*Static Structural (C5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	71.6 °F
Generate Input Only	No

TABLE 7
Model (C4) > Static Structural (C5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled

Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\ Desktop\Plastic_files\dp0\SYS-2\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	Bin

TABLE 8
Model (C4) > Static Structural (C5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		

Type	Fixed Support	Force
Suppressed	No	
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. lbf (ramped)
Y Component		-1000. lbf (ramped)
Z Component		0. lbf (ramped)

FIGURE 3
Model (C4) > Static Structural (C5) > Fixed Support > Figure

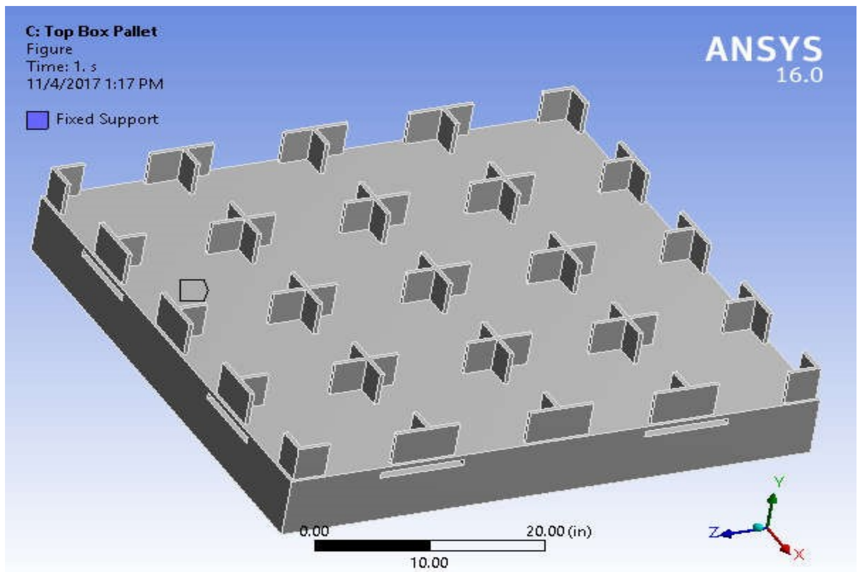
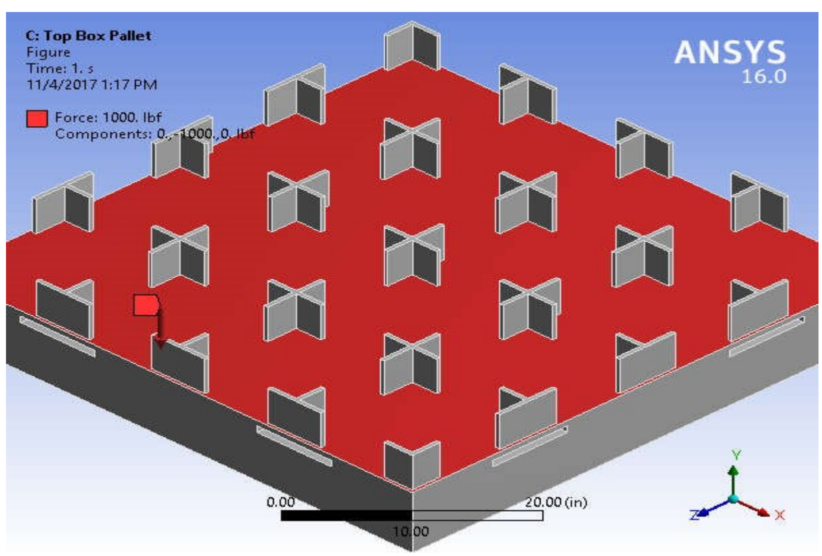


FIGURE 5
Model (C4) > Static Structural (C5) > Force > Figure



Solution (C6)

TABLE 9
Model (C4) > Static Structural (C5) > Solution

Object Name	*Solution (C6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10
Model (C4) > Static Structural (C5) > Solution (C6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11
Model (C4) > Static Structural (C5) > Solution (C6) > Results

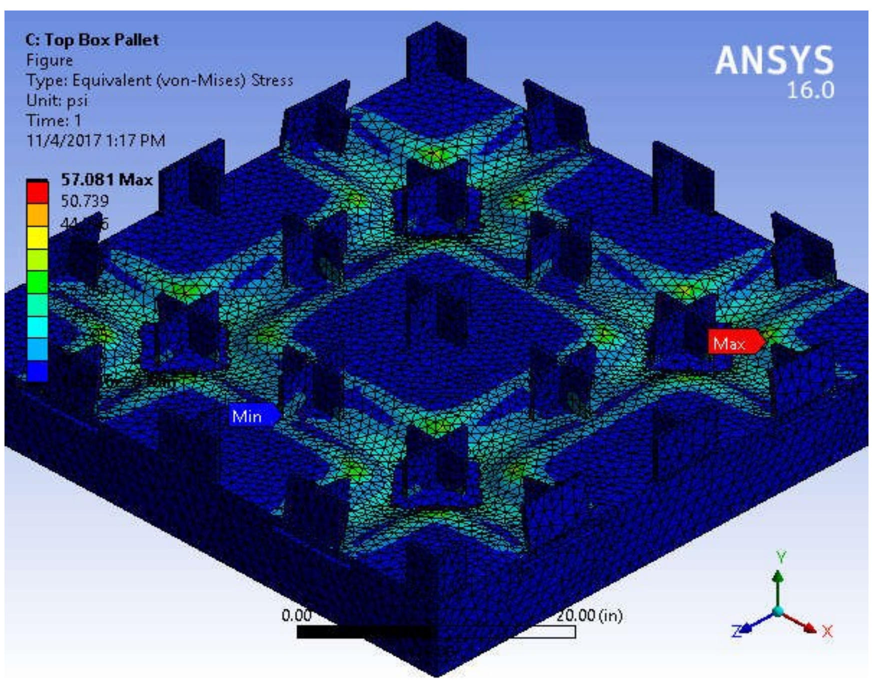
Object Name	*Equivalent Stress*	*Equivalent Elastic Strain*	*Total Deformation*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Equivalent (von-Mises) Stress	Equivalent Elastic Strain	Total Deformation
By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			

Suppressed	No		
Integration Point Results			
Display Option	Averaged		
Average Across Bodies	No		
Results			
Minimum	1.8516e-006 psi	2.1894e-011 in/in	0. in
Maximum	57.081 psi	3.6642e-004 in/in	2.9791e-003 in
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		

TABLE 12
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Stress

Time [s]	Minimum [psi]	Maximum [psi]
1.	1.8516e-006	57.081

FIGURE 7



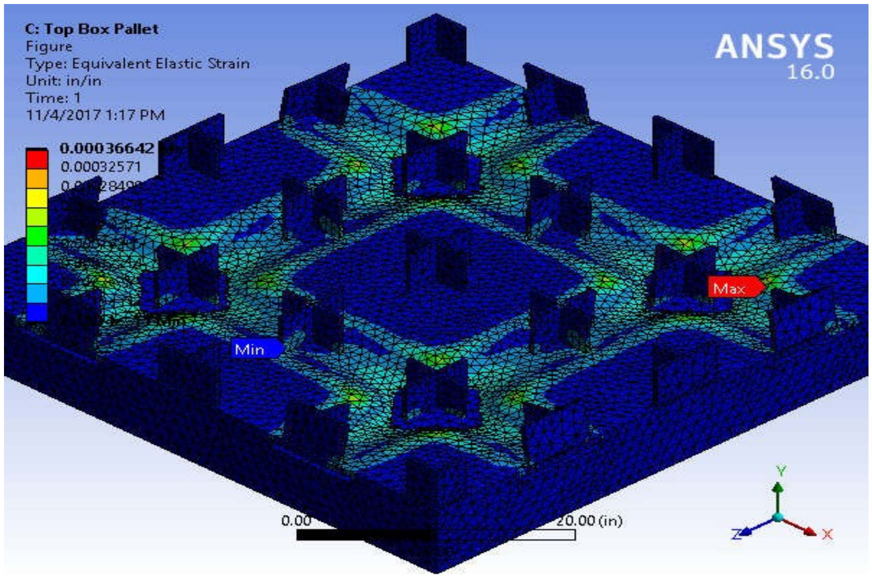
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Stress > Figure

TABLE 13
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Elastic Strain

Time [s]	Minimum [in/in]	Maximum [in/in]

1.	2.1894e-011	3.6642e-004

FIGURE 9
Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Elastic Strain >



Figure

TABLE 14
Model (C4) > Static Structural (C5) > Solution (C6) > Total Deformation

Time [s]	Minimum [in]	Maximum [in]
1.	0.	2.9791e-003

FIGURE 11
Model (C4) > Static Structural (C5) > Solution (C6) > Total Deformation > Figure

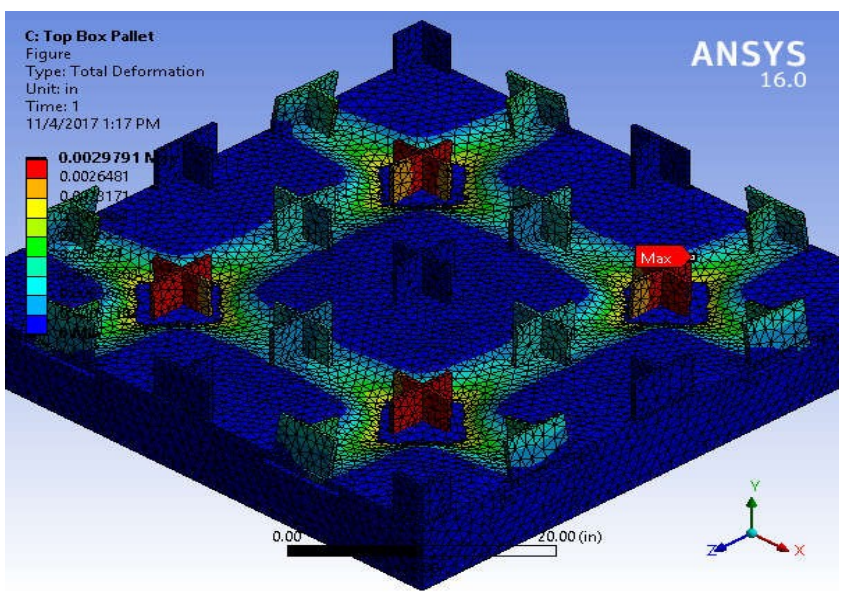


TABLE 15
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Custom Value
Stress Limit	200. psi

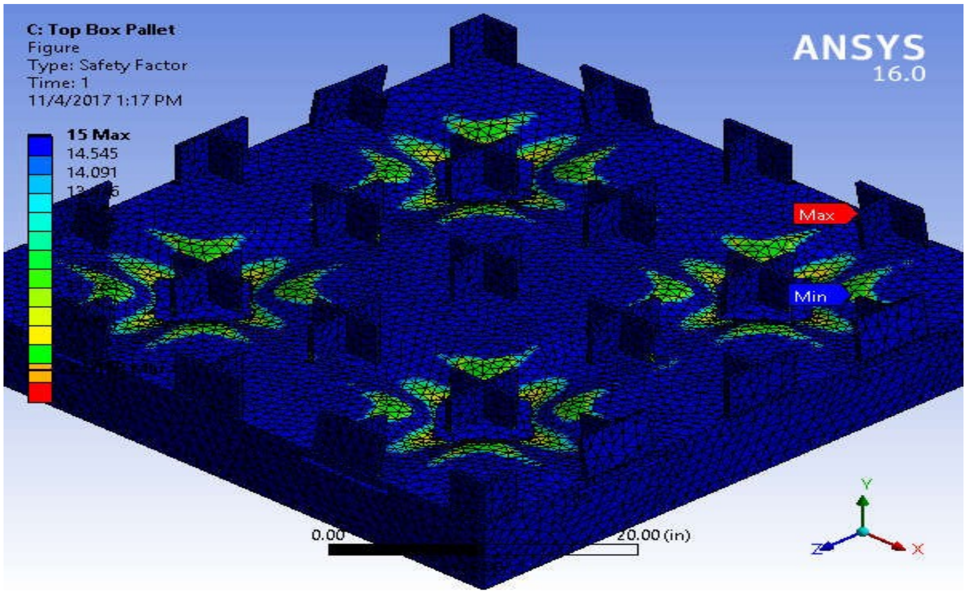
TABLE 16
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	3.5038
Information	
Time	1. s
Load Step	1
Substep	1
Iteration Number	1

TABLE 17
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	3.5038	15.

FIGURE 13
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Safety Factor > Figure



Material Data

Polyethylene

TABLE 18
Polyethylene > Constants

Density	3.4321e-002 lbm in^-3
Coefficient of Thermal Expansion	1.2778e-004 F^-1
Specific Heat	7.0698e-002 BTU lbm^-1 F^-1
Thermal Conductivity	3.7449e-006 BTU s^-1 in^-1 F^-1

TABLE 19
Polyethylene > Compressive Ultimate Strength

Compressive Ultimate Strength psi
0

TABLE 20
Polyethylene > Compressive Yield Strength

Compressive Yield Strength psi
0

TABLE 21
Polyethylene > Tensile Yield Strength

Tensile Yield Strength psi
3625.9

TABLE 22
Polyethylene > Tensile Ultimate Strength

Tensile Ultimate Strength psi
4786.2

TABLE 23
Polyethylene > Isotropic Secant Coefficient of Thermal Expansion

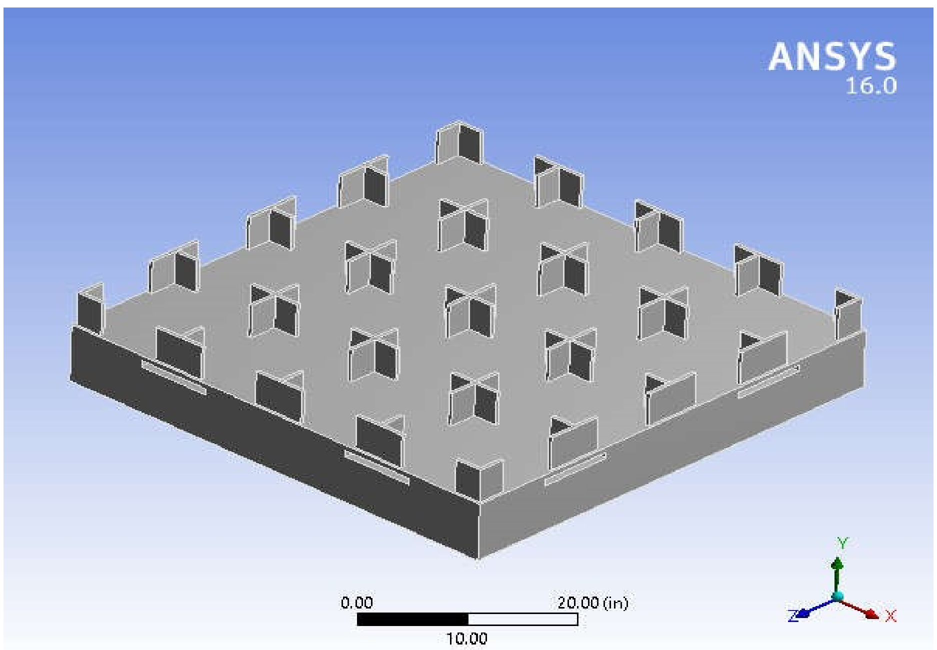
Reference Temperature F
71.6

TABLE 24
Polyethylene > Isotropic Elasticity

Temperature F	Young's Modulus psi	Poisson's Ratio	Bulk Modulus psi	Shear Modulus psi
	1.5954e+005	0.42	3.3238e+005	56177

Project

First Saved	Thursday, November 2, 2017
Last Saved	Thursday, November 2, 2017
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	U.S. Customary (in, lbm, lbf, s, V, A) Degrees rad/s Fahrenheit
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Fahrenheit

Model (C4)

Geometry

TABLE 2
Model (C4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\ Desktop\New folder\Top Box Pallet.SLDPRT
Type	SolidWorks
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	

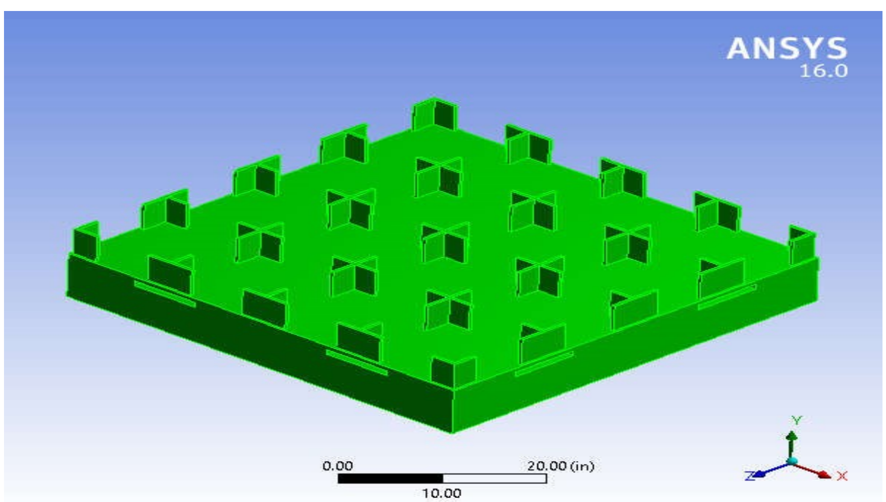
Length X	51. in
Length Y	11. in
Length Z	51. in
Properties	
Volume	4905. in^3
Mass	490.85 lbm
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	135782
Elements	72087
Mesh Metric	None
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	No
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users \AppData\Local\Temp
Analysis Type	3-D
Mixed Import Resolution	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (C4) > Geometry > Parts

Object Name	*Top Box Pallet*
State	Meshed
Graphics Properties	
Visible	Yes

Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Aluminum Alloy
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	51. in
Length Y	11. in
Length Z	51. in
Properties	
Volume	4905. in³
Mass	490.85 lbm
Centroid X	-1.9572e-015 in
Centroid Y	-1.0038 in
Centroid Z	2.4873e-003 in
Moment of Inertia Ip1	1.1747e+005 lbm·in²
Moment of Inertia Ip2	2.3324e+005 lbm·in²
Moment of Inertia Ip3	1.177e+005 lbm·in²
Statistics	
Nodes	135782
Elements	72087
Mesh Metric	None

FIGURE 1
Model (C4) > Geometry > Top Box Pallet > Figure



Coordinate Systems

TABLE 4

Model (C4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. in
Origin Y	0. in
Origin Z	0. in
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

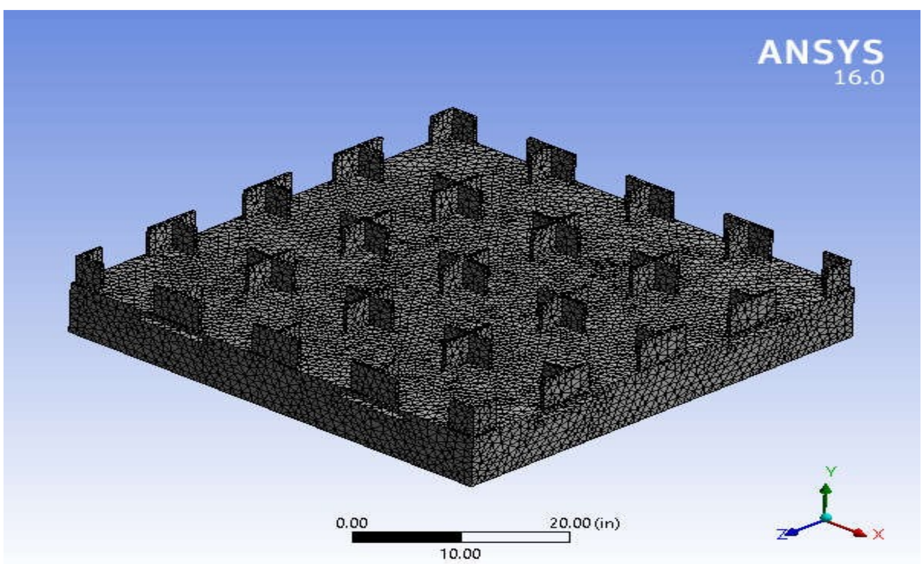
Mesh

TABLE 5 Model (C4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	0.40 in
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272

Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	135782
Elements	72087
Mesh Metric	None

FIGURE 2
Model (C4) > Mesh > Figure



Static Structural (C5)

TABLE 6 Model (C4) > Analysis

Object Name	*Static Structural (C5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	71.6 °F
Generate Input Only	No

TABLE 7
Model (C4) > Static Structural (C5) > Analysis Settings

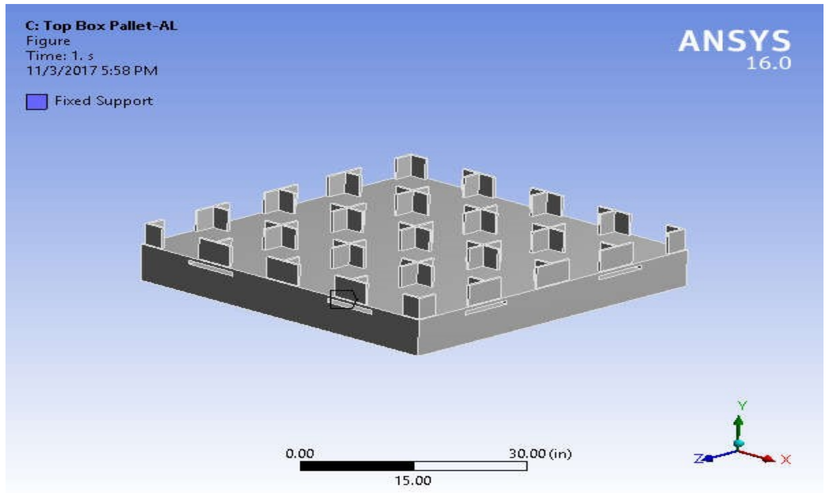
Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes

Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\ Desktop\AL-6061_files\dp0\SYS-2\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	Bin

TABLE 8 Model (C4) > Static Structural (C5) > Loads

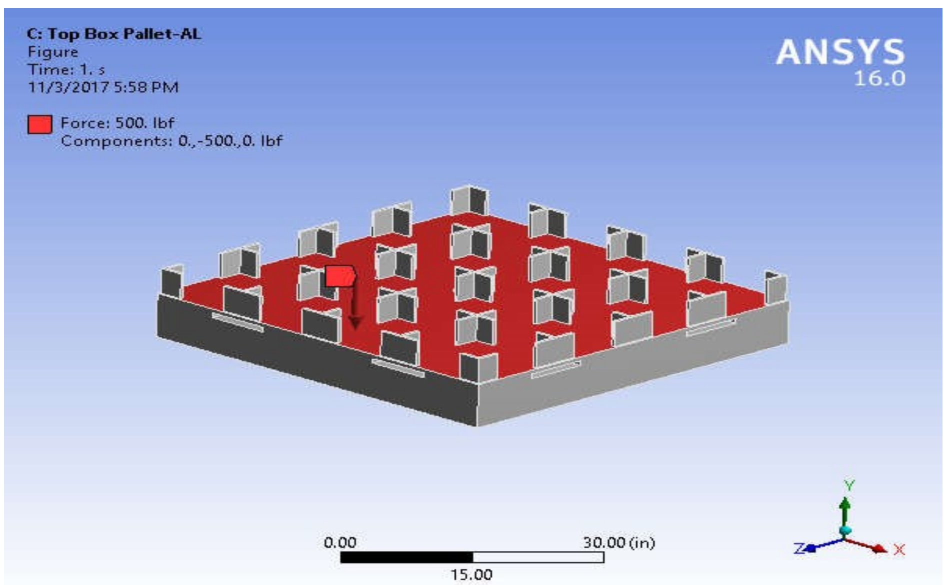
Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. lbf (ramped)
Y Component		-500. lbf (ramped)
Z Component		0. lbf (ramped)

FIGURE 3



Model (C4) > Static Structural (C5) > Fixed Support > Figure

FIGURE 5
Model (C4) > Static Structural (C5) > Force > Figure



Solution (C6)

TABLE 9 Model (C4) > Static Structural (C5) > Solution

Object Name	*Solution (C6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.

Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10 Model (C4) > Static Structural (C5) > Solution (C6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11 Model (C4) > Static Structural (C5) > Solution (C6) > Results

Object Name	*Equivalent Stress*	*Equivalent Elastic Strain*	*Total Deformation*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Equivalent (von-Mises) Stress	Equivalent Elastic Strain	Total Deformation
By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Integration Point Results			
Display Option	Averaged		
Average Across Bodies	No		

Results			
Minimum	8.9948e-006 psi	2.2788e-012 in/in	0. in
Maximum	8.3688 psi	8.1649e-007 in/in	5.5238e-006 in
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		

TABLE 12 Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Stress

Time [s]	Minimum [psi]	Maximum [psi]
1.	8.9948e-006	8.3688

FIGURE 7

Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Stress > Figure

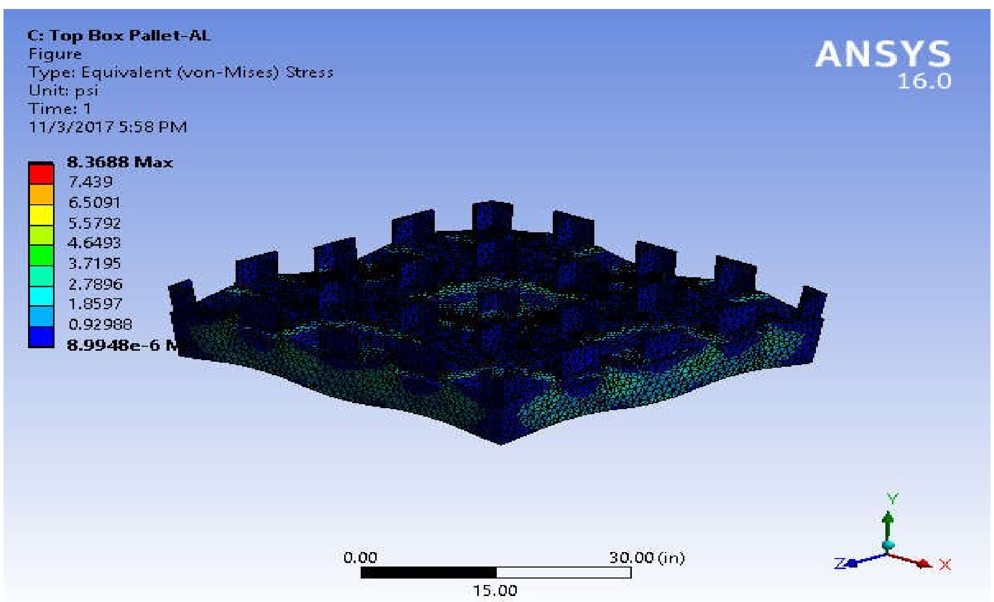


TABLE 13

Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Elastic Strain

Time [s]	Minimum [in/in]	Maximum [in/in]
1.	2.2788e-012	8.1649e-007

FIGURE 9

Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Elastic Strain > Figure

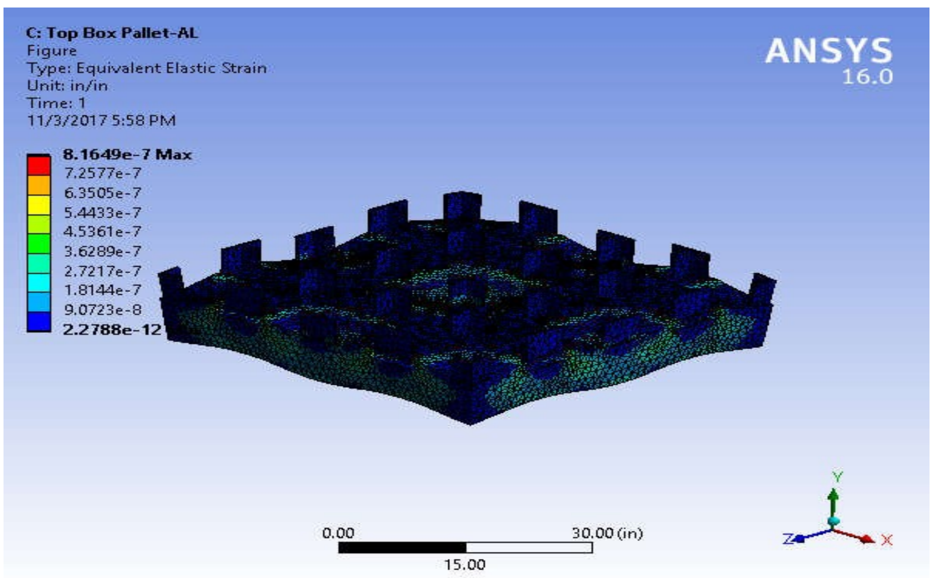


TABLE 14

Model (C4) > Static Structural (C5) > Solution (C6) > Total Deformation

Time [s]	Minimum [in]	Maximum [in]
1.	0.	5.5238e-006

FIGURE 11

Model (C4) > Static Structural (C5) > Solution (C6) > Total Deformation > Figure

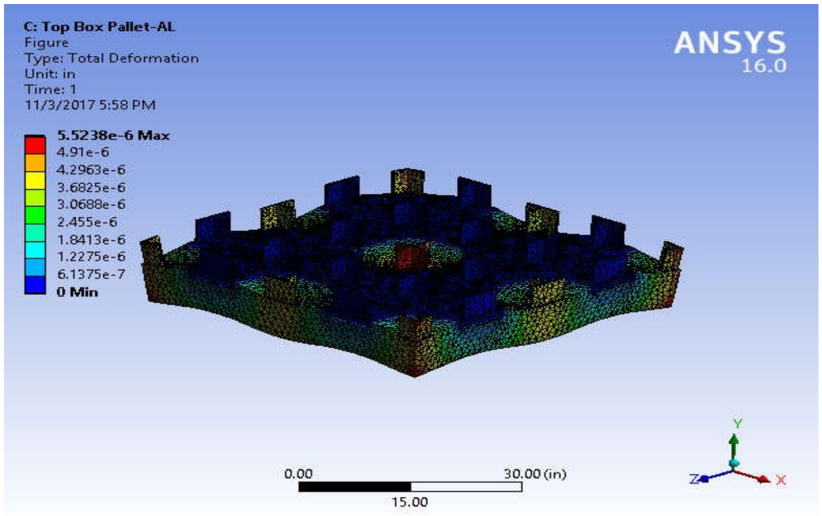


TABLE 15
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Custom Value
Stress Limit	100. psi

TABLE 16
Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	> 10
Information	
Time	1. s
Load Step	1

Substep	1
Iteration Number	1

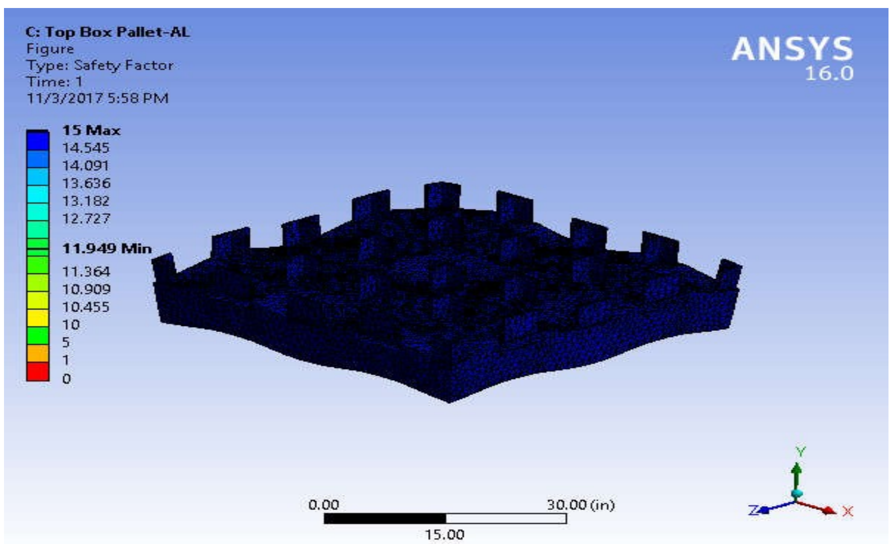
TABLE 17

Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	11.949	15.

FIGURE 13

Model (C4) > Static Structural (C5) > Solution (C6) > Stress Tool > Safety Factor > Figure



Material Data

Aluminum Alloy

TABLE 18

Aluminum Alloy > Constants

Density	0.10007 lbm in^-3
Coefficient of Thermal Expansion	1.2778e-005 F^-1
Specific Heat	0.20899 BTU lbm^-1 F^-1

TABLE 19

Aluminum Alloy > Compressive Ultimate Strength

Compressive Ultimate Strength psi
0

TABLE 20 Aluminum Alloy > Compressive Yield Strength

Compressive Yield Strength psi
40611

TABLE 21

Aluminum Alloy > Tensile Yield Strength

Tensile Yield Strength psi
40611

TABLE 22 Aluminum Alloy > Tensile Ultimate Strength

Tensile Ultimate Strength psi
44962

TABLE 23

Aluminum Alloy > Isotropic Secant Coefficient of Thermal Expansion

Reference Temperature F
71.6

TABLE 24 Aluminum Alloy > Isotropic Thermal Conductivity

Thermal Conductivity BTU s^-1 in^-1 F^-1	Temperature F
1.5247e-003	-148
1.926e-003	32
2.2068e-003	212
2.3406e-003	392

TABLE 25 Aluminum Alloy > Alternating Stress R-Ratio

Alternating Stress psi	Cycles	R-Ratio
40001	1700	-1
34998	5000	-1
29994	34000	-1
25004	1.4e+005	-1
20001	8.e+005	-1

16998	2.4e+006	-1
13000	5.5e+007	-1
12000	1.e+008	-1
24743	50000	-0.5
20247	3.5e+005	-0.5
15751	3.7e+006	-0.5
12750	1.4e+007	-0.5
11251	5.e+007	-0.5
10499	1.e+008	-0.5
21001	50000	0
17506	1.9e+005	0
14997	1.3e+006	0
13500	4.4e+006	0
12499	1.2e+007	0
10499	1.e+008	0
10750	3.e+005	0.5
10250	1.5e+006	0.5
9624.7	1.2e+007	0.5
8999.6	1.e+008	0.5

TABLE 26

Aluminum Alloy > Isotropic Resistivity

Resistivity ohm cmil in^-1	Temperature F
1.2184	32
1.3387	68
1.82	212

TABLE 27

Aluminum Alloy > Isotropic Elasticity

Temperature F	Young's Modulus psi	Poisson's Ratio	Bulk Modulus psi	Shear Modulus psi
	1.0298e+007	0.33	1.0096e+007	3.8713e+006

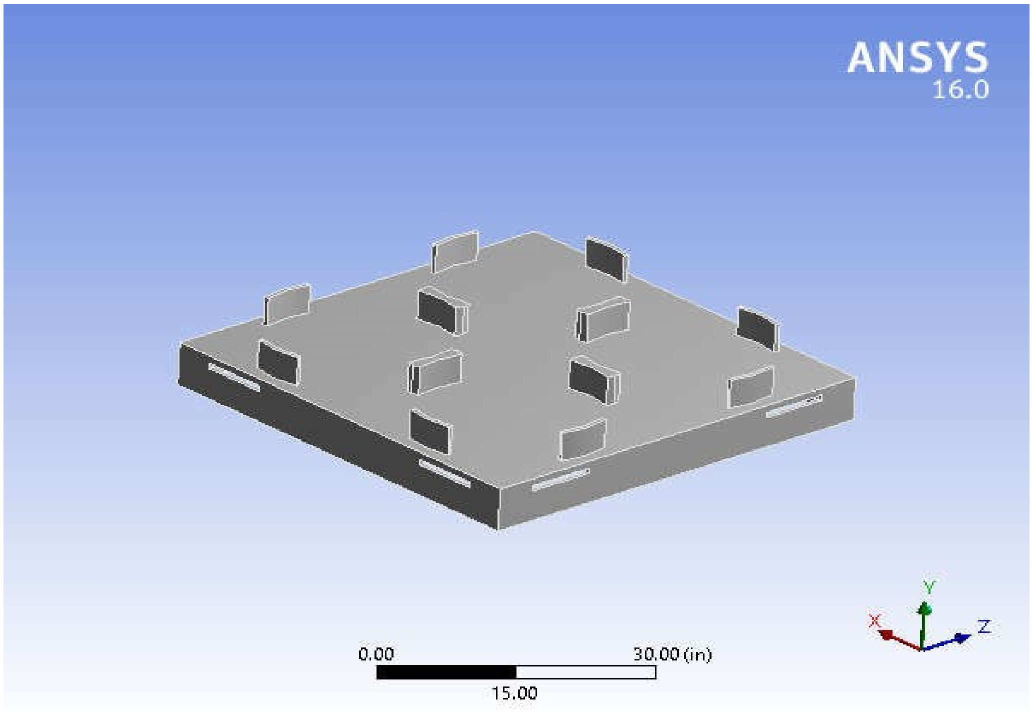
TABLE 28

Aluminum Alloy > Isotropic Relative Permeability

Relative Permeability
1

Project

First Saved	Thursday, November 2, 2017
Last Saved	Friday, November 3, 2017
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

- Stress Tool
- Safety Factor

- **Material Data**o Aluminum Alloy

Units

TABLE 1

Unit System	U.S. Customary (in, lbm, lbf, s, V, A) Degrees rad/s Fahrenheit
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Fahrenheit

Model (D4)

Geometry

TABLE 2
Model (D4) > Geometry

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\CHAITRA\New folder\Top Drum Pallet.SLDPRT
Type	SolidWorks
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	51.3 in
Length Y	10. in
Length Z	51.3 in
Properties	
Volume	3383.4 in³
Mass	338.59 lbm
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	78757
Elements	40948
Mesh Metric	None
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	No

Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\User\AppData\Local\Temp
Analysis Type	3-D
Mixed Import Resolution	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

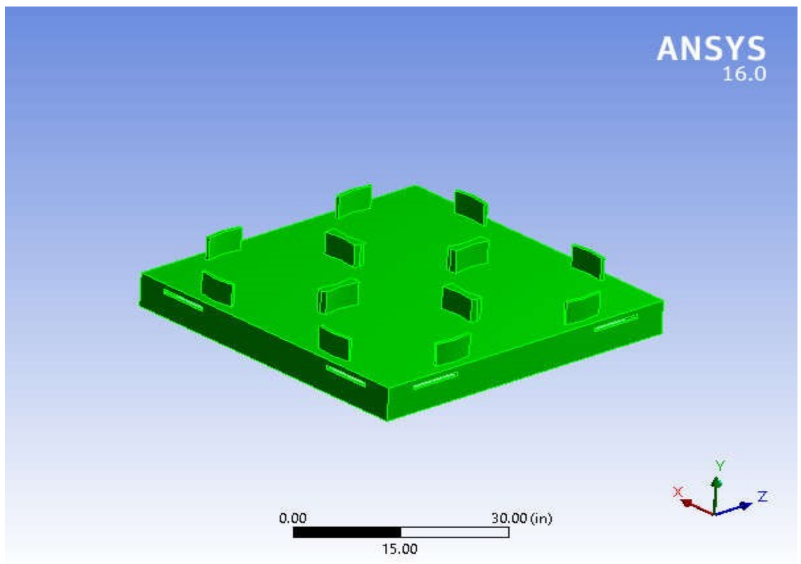
\

TABLE 3
Model (D4) > Geometry > Parts

Object Name	*Top Drum Pallet*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Aluminum Alloy
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	51.3 in
Length Y	10. in
Length Z	51.3 in
Properties	
Volume	3383.4 in^3
Mass	338.59 lbm

Centroid X	2.6405e-004 in
Centroid Y	-0.77893 in
Centroid Z	2.3604e-004 in
Moment of Inertia Ip1	84609 lbm·in²
Moment of Inertia Ip2	1.6773e+005 lbm·in²
Moment of Inertia Ip3	84608 lbm·in²
Statistics	
Nodes	78757
Elements	40948
Mesh Metric	None

FIGURE 1
Model (D4) > Geometry > Top Drum Pallet > Figure



Coordinate Systems

TABLE 4

Model (D4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. in
Origin Y	0. in
Origin Z	0. in
Directional Vectors	

X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

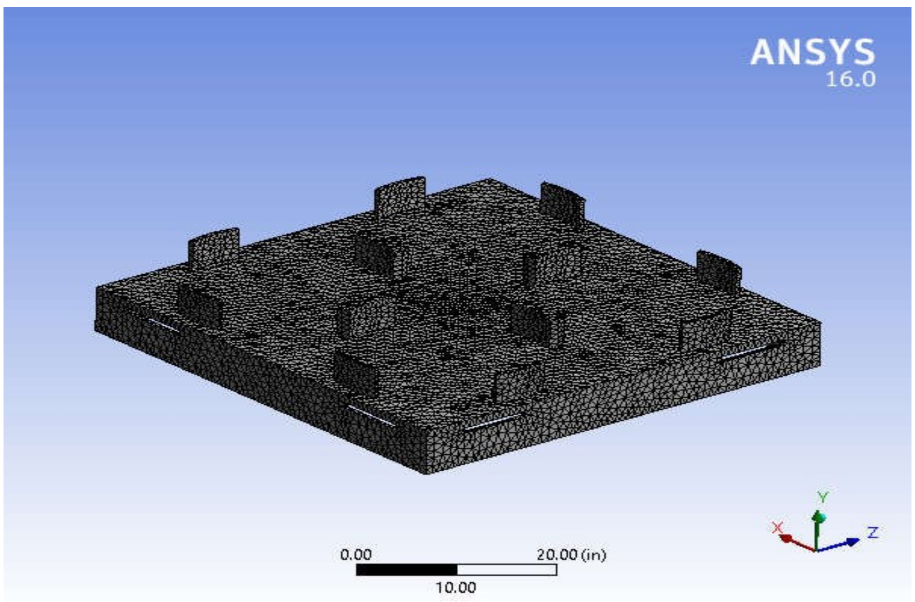
Mesh

TABLE 5 Model (D4) > Mesh

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	0.250 in
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced

Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	78757
Elements	40948
Mesh Metric	None

FIGURE 2
Model (D4) > Mesh > Figure



Static Structural (D5)

TABLE 6 Model (D4) > Analysis

Object Name	*Static Structural (D5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	71.6 °F
Generate Input Only	No

TABLE 7

Model (D4) > Static Structural (D5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off
Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users \Desktop\AL-6061_files\dp0\SYS-3\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	Bin

TABLE 8
Model (D4) > Static Structural (D5) > Loads

Object Name	*Force*	*Fixed Support*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Force	Fixed Support
Define By	Components	
Coordinate System	Global Coordinate System	
X Component	0. lbf (ramped)	
Y Component	-1000. lbf (ramped)	
Z Component	0. lbf (ramped)	
Suppressed	No	

FIGURE 4

Model (D4) > Static Structural (D5) > Force > Figure

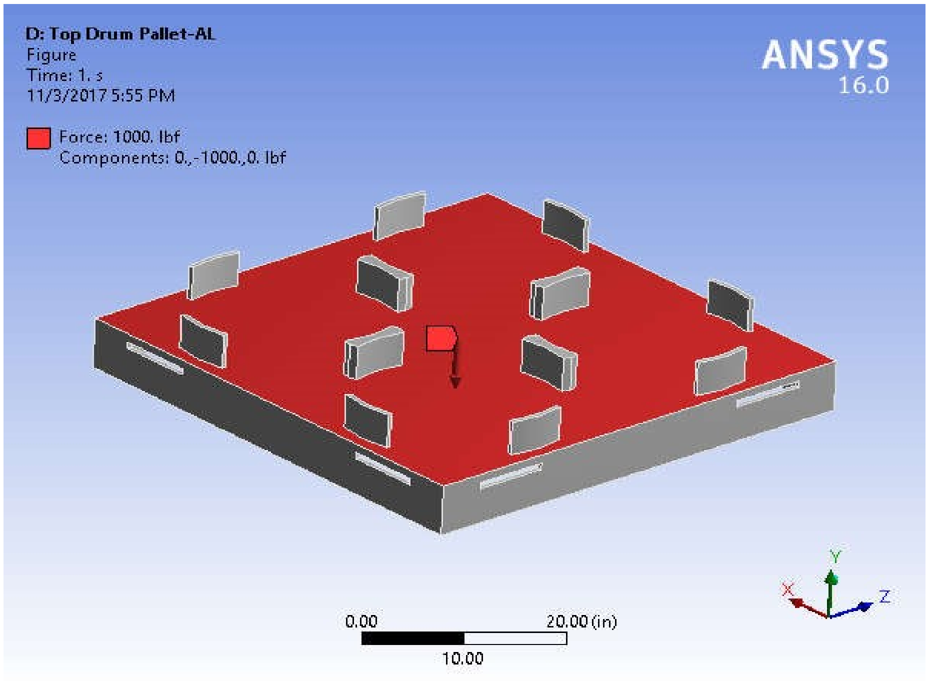
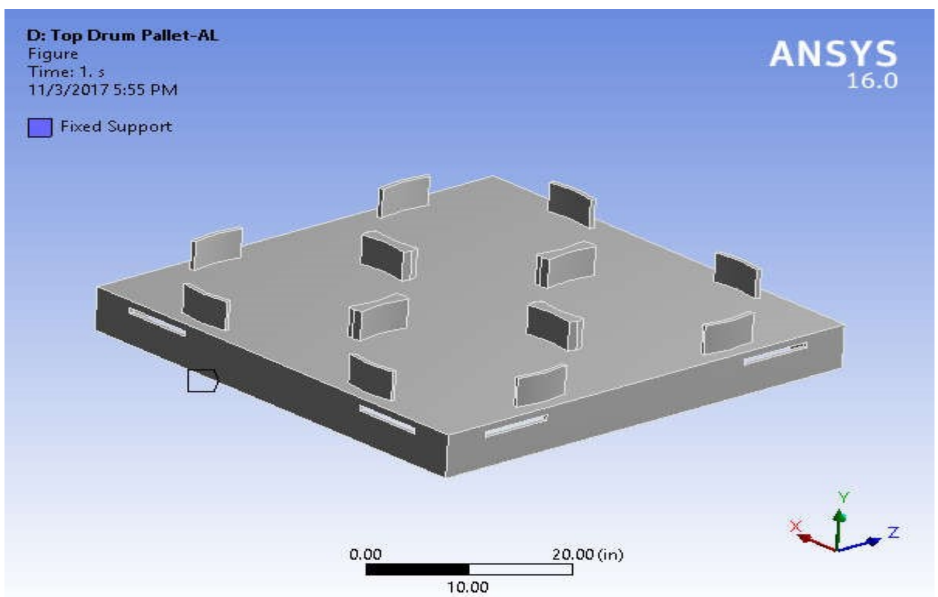


FIGURE 5

Model (D4) > Static Structural (D5) > Fixed Support > Figure



Solution (D6)

TABLE 9 Model (D4) > Static Structural (D5) > Solution

Object Name	*Solution (D6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10

Model (D4) > Static Structural (D5) > Solution (D6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11 Model (D4) > Static Structural (D5) > Solution (D6) > Results

Object Name	*Equivalent Stress*	*Equivalent Elastic Strain*	*Total Deformation*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Equivalent (von-Mises) Stress	Equivalent Elastic Strain	Total Deformation
By	Time		
Display Time	Last		

Calculate Time History	Yes		
Identifier			
Suppressed	No		
Integration Point Results			
Display Option	Averaged		
Average Across Bodies	No		
Results			
Minimum	7.9078e-005 psi	1.5516e-011 in/in	0. in
Maximum	633.6 psi	6.1782e-005 in/in	6.2068e-003 in
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		

TABLE 12

Model (D4) > Static Structural (D5) > Solution (D6) > Equivalent Stress

Time [s]	Minimum [psi]	Maximum [psi]
1.	7.9078e-005	633.6

FIGURE 7

Model (D4) > Static Structural (D5) > Solution (D6) > Equivalent Stress > Figure

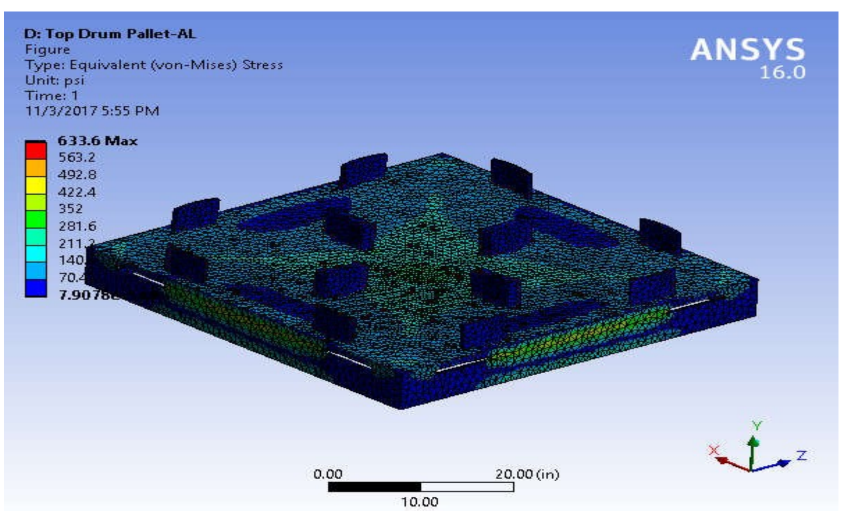


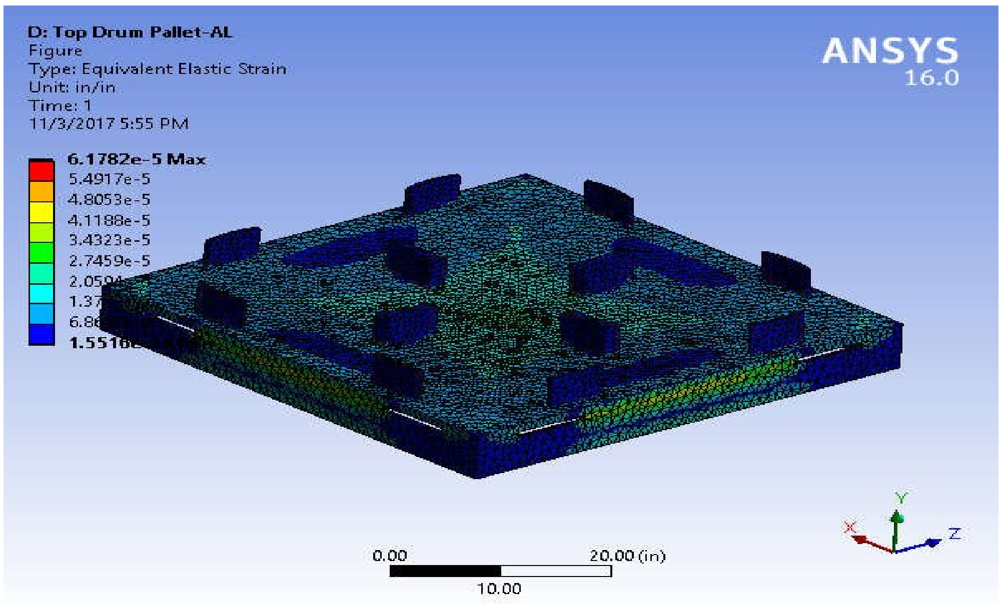
TABLE 13

Model (D4) > Static Structural (D5) > Solution (D6) > Equivalent Elastic Strain

Time [s]	Minimum [in/in]	Maximum [in/in]
1.	1.5516e-011	6.1782e-005

FIGURE 9

Model (D4) > Static Structural (D5) > Solution (D6) > Equivalent Elastic Strain >



Figure

TABLE 14

Model (D4) > Static Structural (D5) > Solution (D6) > Total Deformation

Time [s]	Minimum [in]	Maximum [in]
1.	0.	6.2068e-003

FIGURE 11

Model (D4) > Static Structural (D5) > Solution (D6) > Total Deformation > Figure

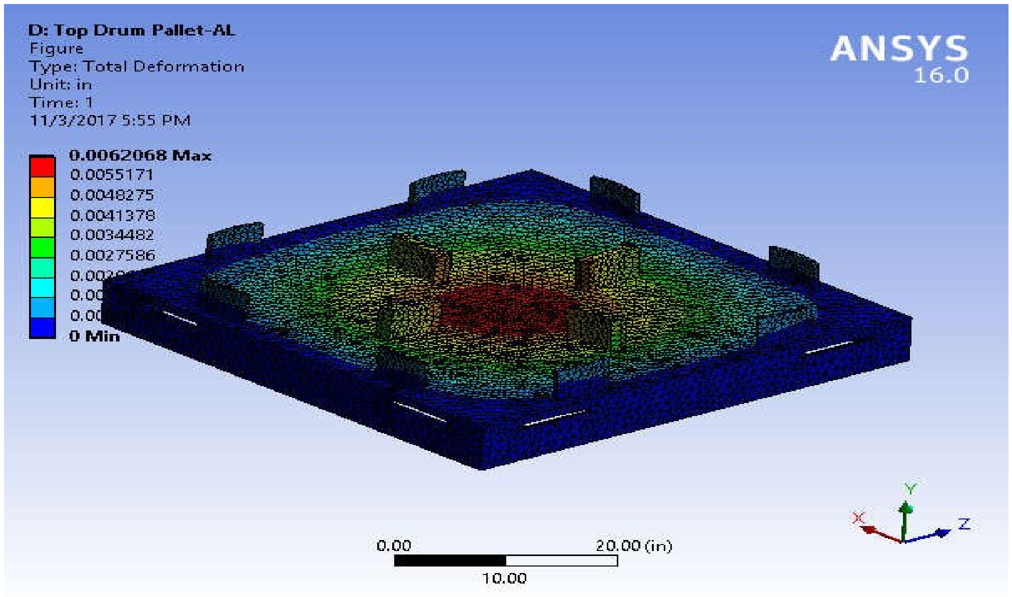


TABLE 15

Model (D4) > Static Structural (D5) > Solution (D6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Custom Value
Stress Limit	200. psi

TABLE 16

Model (D4) > Static Structural (D5) > Solution (D6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	

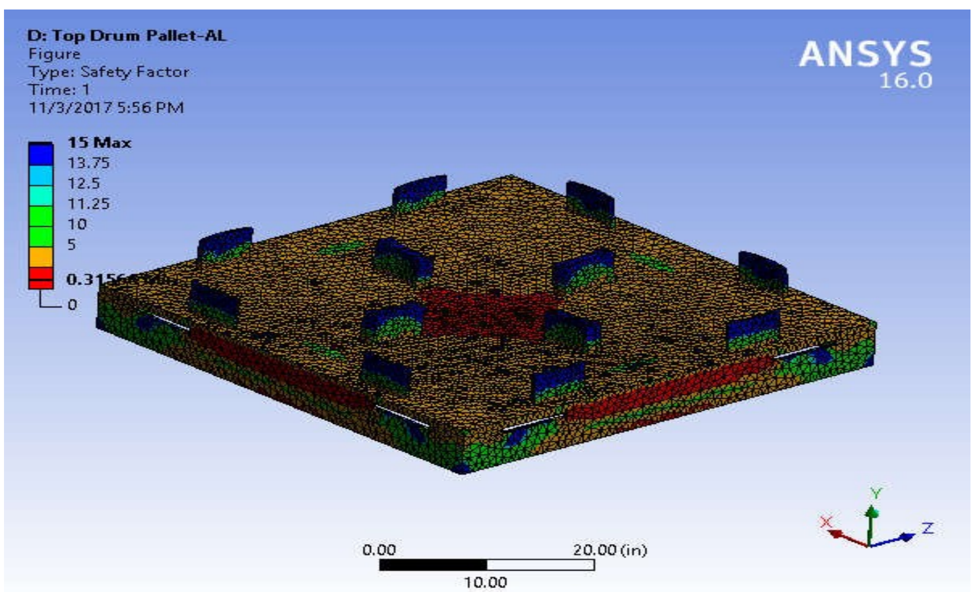
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	0.31566
Information	
Time	1. s
Load Step	1
Substep	1
Iteration Number	1

TABLE 17

Model (D4) > Static Structural (D5) > Solution (D6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	0.31566	15.

FIGURE 13 Model (D4) > Static Structural (D5) > Solution (D6) > Stress



Tool > Safety Factor > Figure

Material Data

Aluminum Alloy

TABLE 18

Aluminum Alloy > Constants

Density	0.10007 lbm in^-3
Coefficient of Thermal Expansion	1.2778e-005 F^-1
Specific Heat	0.20899 BTU lbm^-1 F^-1

TABLE 19

Aluminum Alloy > Compressive Ultimate Strength

Compressive Ultimate Strength psi
0

TABLE 20

Aluminum Alloy > Compressive Yield Strength

Compressive Yield Strength psi
40611

TABLE 21 Aluminum Alloy > Tensile Yield Strength

Tensile Yield Strength psi
40611

TABLE 22 Aluminum Alloy > Tensile Ultimate Strength

Tensile Ultimate Strength psi
44962

TABLE 23

Aluminum Alloy > Isotropic Secant Coefficient of Thermal Expansion

Reference Temperature F
71.6

TABLE 24 Aluminum Alloy > Isotropic Thermal Conductivity

Thermal Conductivity BTU s^-1 in^-1 F^-1	Temperature F
1.5247e-003	-148
1.926e-003	32
2.2068e-003	212
2.3406e-003	392

TABLE 25

Aluminum Alloy > Alternating Stress R-Ratio

Alternating Stress psi	Cycles	R-Ratio
40001	1700	-1
34998	5000	-1
29994	34000	-1
25004	1.4e+005	-1
20001	8.e+005	-1
16998	2.4e+006	-1
13000	5.5e+007	-1
12000	1.e+008	-1
24743	50000	-0.5
20247	3.5e+005	-0.5
15751	3.7e+006	-0.5
12750	1.4e+007	-0.5
11251	5.e+007	-0.5
10499	1.e+008	-0.5
21001	50000	0
17506	1.9e+005	0
14997	1.3e+006	0
13500	4.4e+006	0
12499	1.2e+007	0
10499	1.e+008	0
10750	3.e+005	0.5
10250	1.5e+006	0.5
9624.7	1.2e+007	0.5
8999.6	1.e+008	0.5

TABLE 26

Aluminum Alloy > Isotropic Resistivity

Resistivity ohm cmil in^-1	Temperature F
1.2184	32
1.3387	68
1.82	212

TABLE 27

Aluminum Alloy > Isotropic Elasticity

Temperature F	Young's Modulus psi	Poisson's Ratio	Bulk Modulus psi	Shear Modulus psi
	1.0298e+007	0.33	1.0096e+007	3.8713e+006

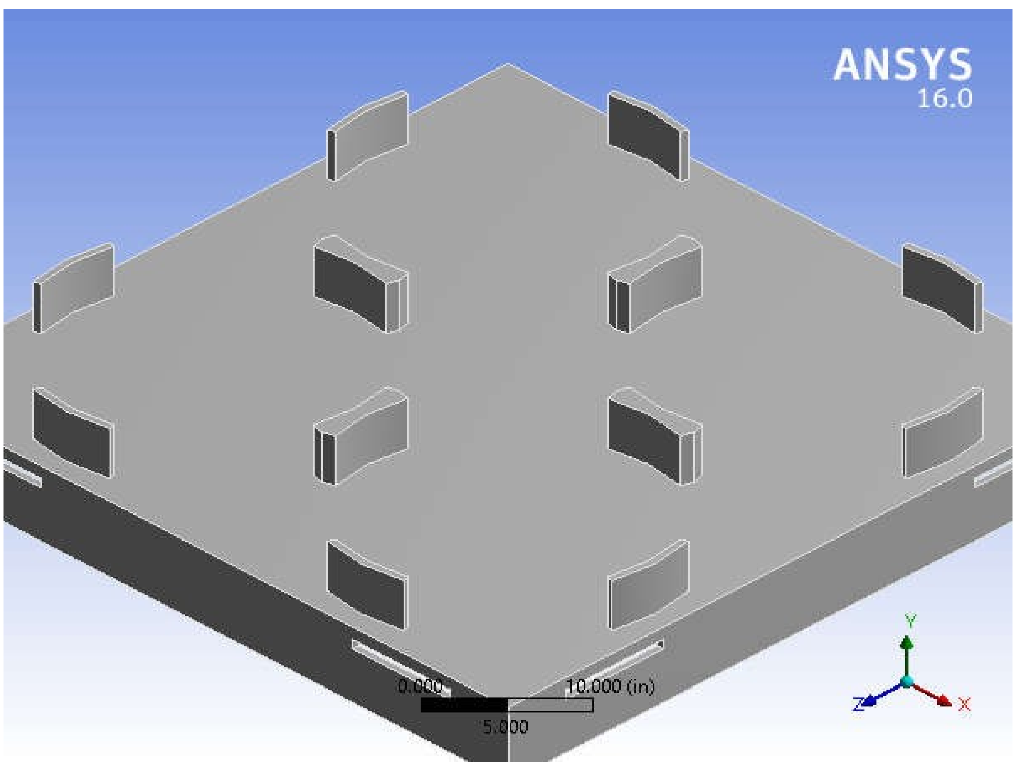
TABLE 28

Aluminum Alloy > Isotropic Relative Permeability

Relative Permeability
1

Project

First Saved	Saturday, November 4, 2017
Last Saved	Saturday, November 4, 2017
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No



Contents

Units

TABLE 1

Unit System	U.S. Customary (in, lbm, lbf, s, V, A) Degrees rad/s Fahrenheit
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Fahrenheit

Model (D4)

Geometry

TABLE 2
Model (D4) > Geometry

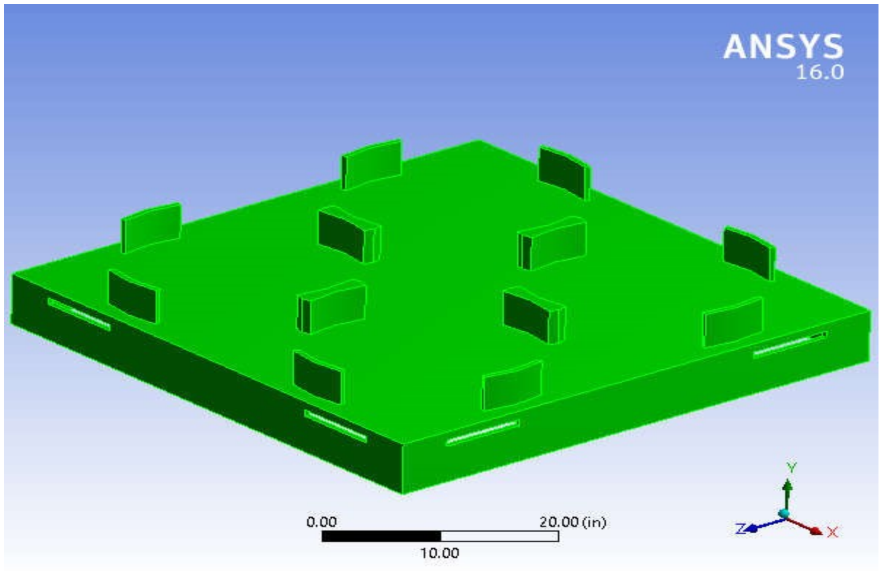
Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users \Desktop\New folder\Top Drum Pallet.SLDPRT
Type	SolidWorks
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color

Bounding Box	
Length X	51.3 in
Length Y	10. in
Length Z	51.3 in
Properties	
Volume	3383.4 in³
Mass	959.54 lbm
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	78757
Elements	40948
Mesh Metric	None
Basic Geometry Options	
Solid Bodies	Yes
Surface Bodies	Yes
Line Bodies	No
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\AppData\Local\Temp
Analysis Type	3-D
Mixed Import Resolution	None
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

TABLE 3
Model (D4) > Geometry > Parts

Object Name	*Top Drum Pallet*
State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Structural Steel
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	51.3 in
Length Y	10. in
Length Z	51.3 in
Properties	
Volume	3383.4 in^3
Mass	959.54 lbm
Centroid X	2.6405e-004 in
Centroid Y	-0.77893 in
Centroid Z	2.3604e-004 in
Moment of Inertia Ip1	2.3978e+005 lbm·in^2
Moment of Inertia Ip2	4.7533e+005 lbm·in^2
Moment of Inertia Ip3	2.3977e+005 lbm·in^2
Statistics	
Nodes	78757
Elements	40948
Mesh Metric	None

FIGURE 1
Model (D4) > Geometry > Top Drum Pallet > Figure



Coordinate Systems

TABLE 4

Model (D4) > Coordinate Systems > Coordinate System

Object Name	*Global Coordinate System*
State	Fully Defined
Definition	
Type	Cartesian
Coordinate System ID	0.
Origin	
Origin X	0. in
Origin Y	0. in
Origin Z	0. in
Directional Vectors	
X Axis Data	[1. 0. 0.]
Y Axis Data	[0. 1. 0.]
Z Axis Data	[0. 0. 1.]

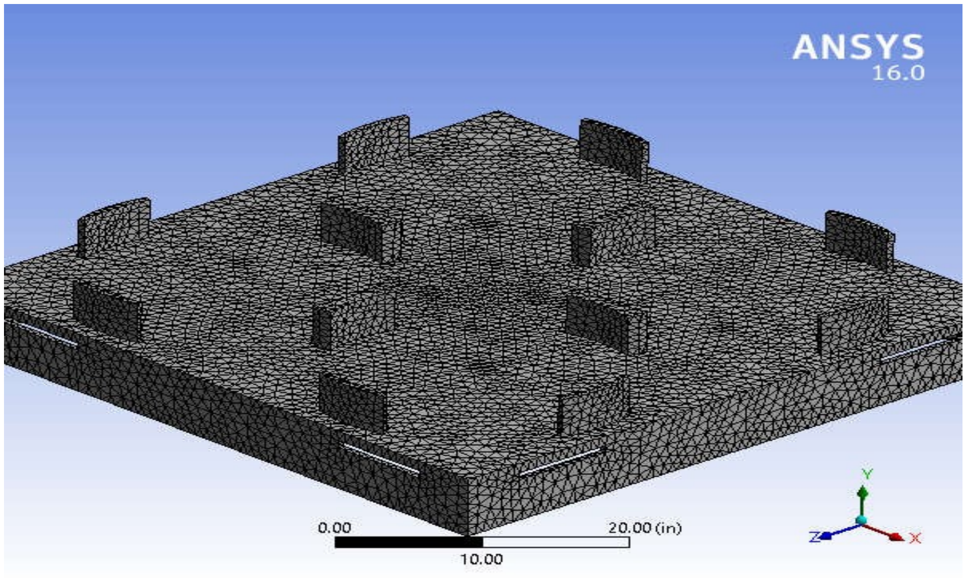
Mesh

TABLE 5 Model (D4) > Mesh

Object Name	*Mesh*
State	Solved
Display	

Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	100
Sizing	
Use Advanced Size Function	Off
Relevance Center	Fine
Element Size	Default
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	0.250 in
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	No
Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	Default (4)
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	78757
Elements	40948
Mesh Metric	None

FIGURE 2
Model (D4) >Mesh > Figure



Static Structural (D5)

TABLE 6 Model (D4) > Analysis

Object Name	*Static Structural (D5)*
State	Solved
Definition	
Physics Type	Structural
Analysis Type	Static Structural
Solver Target	Mechanical APDL
Options	
Environment Temperature	71.6 °F
Generate Input Only	No

TABLE 7 Model (D4) > Static Structural (D5) > Analysis Settings

Object Name	*Analysis Settings*
State	Fully Defined
Step Controls	
Number Of Steps	1.
Current Step Number	1.
Step End Time	1. s
Auto Time Stepping	Program Controlled
Solver Controls	
Solver Type	Program Controlled
Weak Springs	Program Controlled
Solver Pivot Checking	Program Controlled
Large Deflection	Off
Inertia Relief	Off

Restart Controls	
Generate Restart Points	Program Controlled
Retain Files After Full Solve	No
Nonlinear Controls	
Newton-Raphson Option	Program Controlled
Force Convergence	Program Controlled
Moment Convergence	Program Controlled
Displacement Convergence	Program Controlled
Rotation Convergence	Program Controlled
Line Search	Program Controlled
Stabilization	Off
Output Controls	
Stress	Yes
Strain	Yes
Nodal Forces	No
Contact Miscellaneous	No
General Miscellaneous	No
Store Results At	All Time Points
Analysis Data Management	
Solver Files Directory	C:\Users\Desktop\Plastic_files\dp0\SYS-3\MECH\
Future Analysis	None
Scratch Solver Files Directory	
Save MAPDL db	No
Delete Unneeded Files	Yes
Nonlinear Solution	No
Solver Units	Active System
Solver Unit System	Bin

TABLE 8
Model (D4) > Static Structural (D5) > Loads

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. lbf (ramped)
Y Component		-1000. lbf (ramped)
Z Component		0. lbf (ramped)

FIGURE 3
Model (D4) > Static Structural (D5) > Fixed Support > Figure

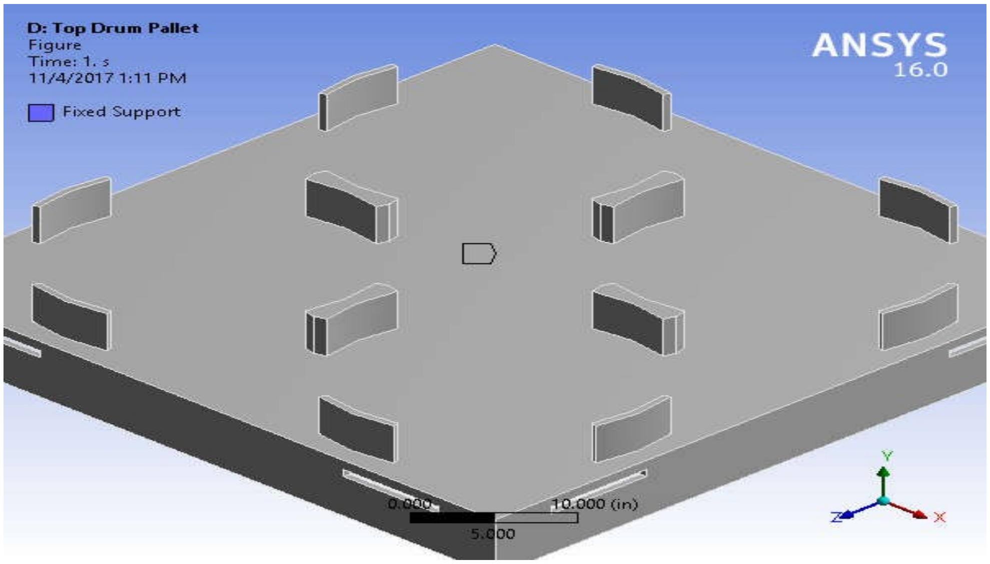
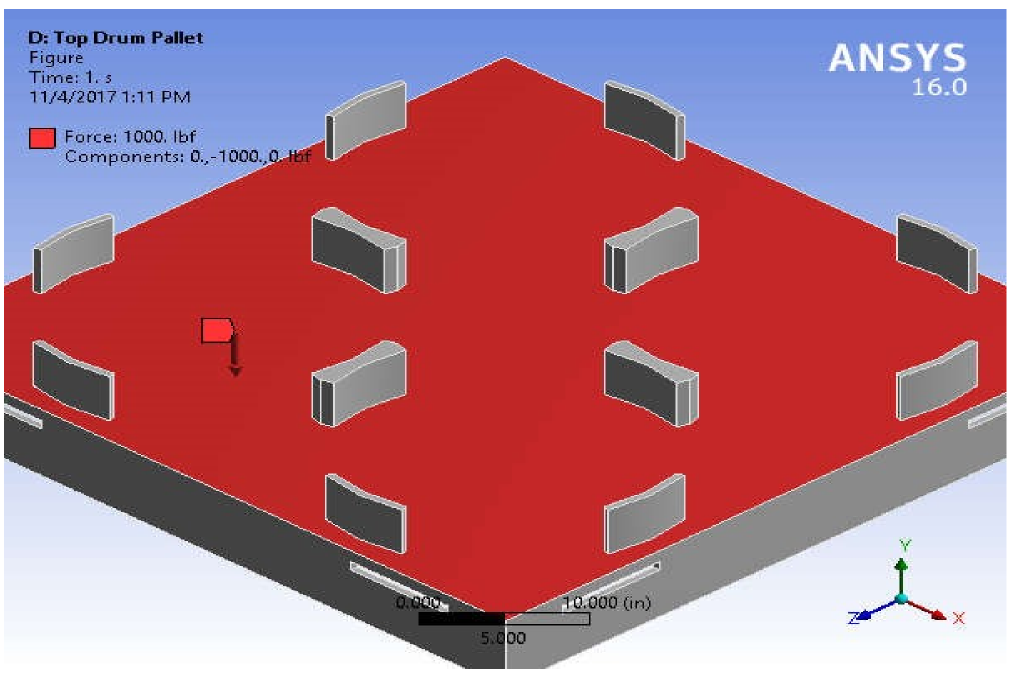


FIGURE 5
Model (D4) > Static Structural (D5) > Force > Figure



Solution (D6)

TABLE 9 Model (D4) > Static Structural (D5) > Solution

Object Name	*Solution (D6)*
State	Solved
Adaptive Mesh Refinement	
Max Refinement Loops	1.
Refinement Depth	2.
Information	
Status	Done
Post Processing	
Calculate Beam Section Results	No

TABLE 10 Model (D4) > Static Structural (D5) > Solution (D6) > Solution Information

Object Name	*Solution Information*
State	Solved
Solution Information	
Solution Output	Solver Output
Newton-Raphson Residuals	0
Update Interval	2.5 s
Display Points	All
FE Connection Visibility	
Activate Visibility	Yes
Display	All FE Connectors
Draw Connections Attached To	All Nodes
Line Color	Connection Type
Visible on Results	No
Line Thickness	Single
Display Type	Lines

TABLE 11 Model (D4) > Static Structural (D5) > Solution (D6) > Results

Object Name	*Equivalent Stress*	*Equivalent Elastic Strain*	*Total Deformation*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		

Definition			
Type	Equivalent (von-Mises) Stress	Equivalent Elastic Strain	Total Deformation
By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Integration Point Results			
Display Option	Averaged		
Average Across Bodies	No		
Results			
Minimum	1.7984e-008 psi	1.0711e-015 in/in	0. in
Maximum	0.65631 psi	3.4688e-008 in/in	2.3456e-007 in
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		

TABLE 12

Model (D4) > Static Structural (D5) > Solution (D6) > Equivalent Stress

Time [s]	Minimum [psi]	Maximum [psi]
1.	1.7984e-008	0.65631

FIGURE 7

Model (D4) > Static Structural (D5) > Solution (D6) > Equivalent Stress > Figure

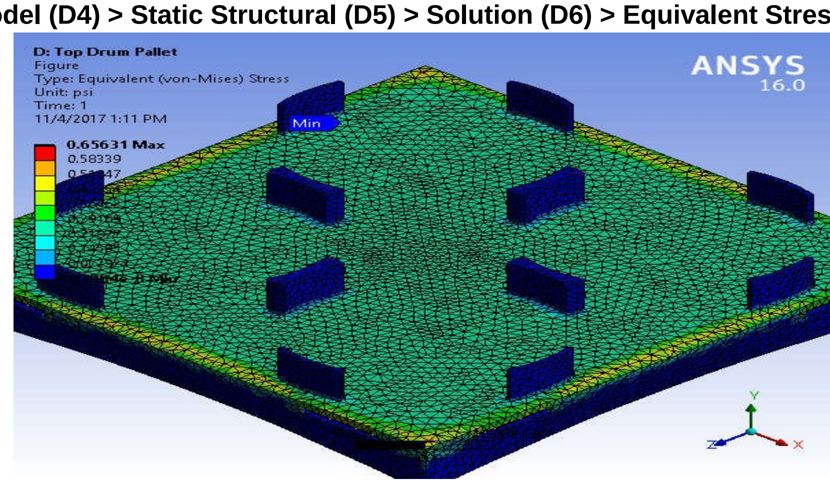


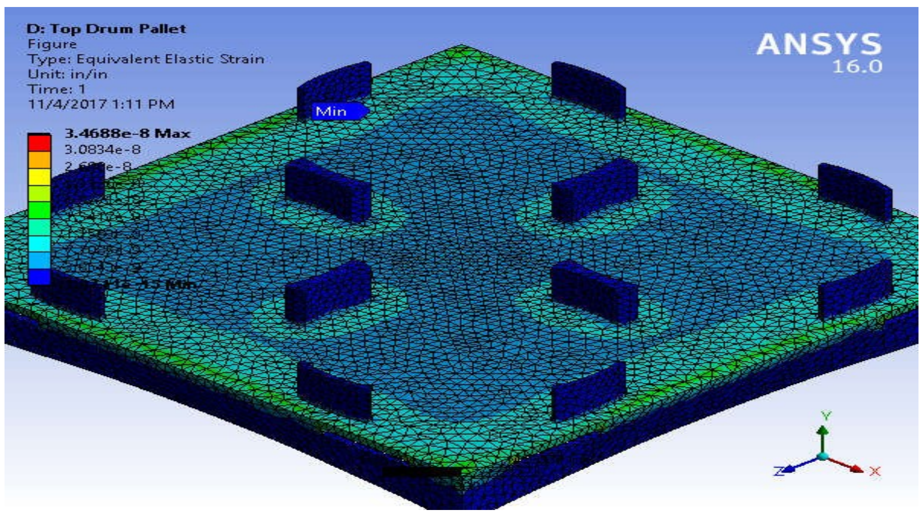
TABLE 13

Model (D4) > Static Structural (D5) > Solution (D6) > Equivalent Elastic Strain

Time [s]	Minimum [in/in]	Maximum [in/in]
1.	1.0711e-015	3.4688e-008

FIGURE 9

Model (D4) > Static Structural (D5) > Solution (D6) > Equivalent Elastic Strain >



Figure

TABLE 14

Model (D4) > Static Structural (D5) > Solution (D6) > Total Deformation

Time [s]	Minimum [in]	Maximum [in]
1.	0.	2.3456e-007

FIGURE 11

Model (D4) > Static Structural (D5) > Solution (D6) > Total Deformation > Figure

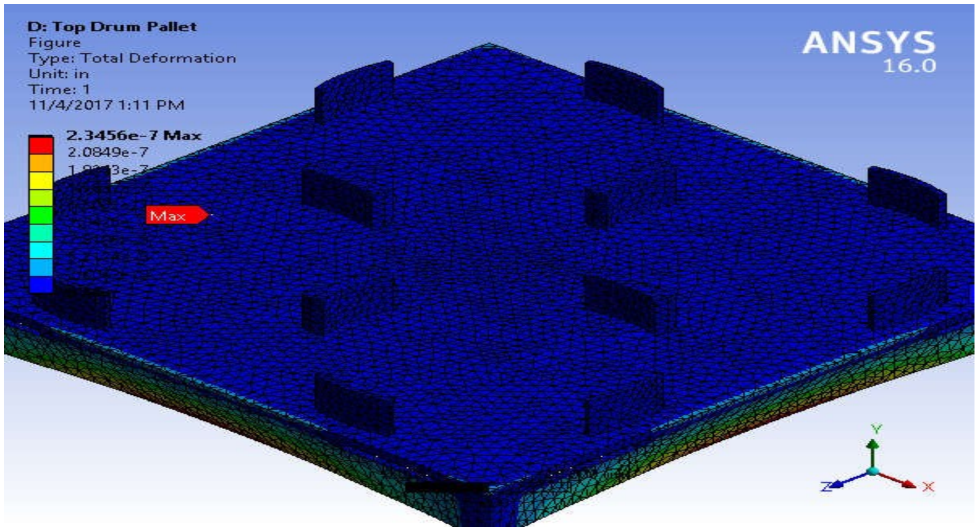


TABLE 15
Model (D4) > Static Structural (D5) > Solution (D6) > Stress Safety Tools

Object Name	*Stress Tool*
State	Solved
Definition	
Theory	Max Equivalent Stress
Stress Limit Type	Custom Value
Stress Limit	9. psi

TABLE 16
Model (D4) > Static Structural (D5) > Solution (D6) > Stress Tool > Results

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No

Results	
Minimum	> 10
Information	
Time	1. s
Load Step	1
Substep	1
Iteration Number	1

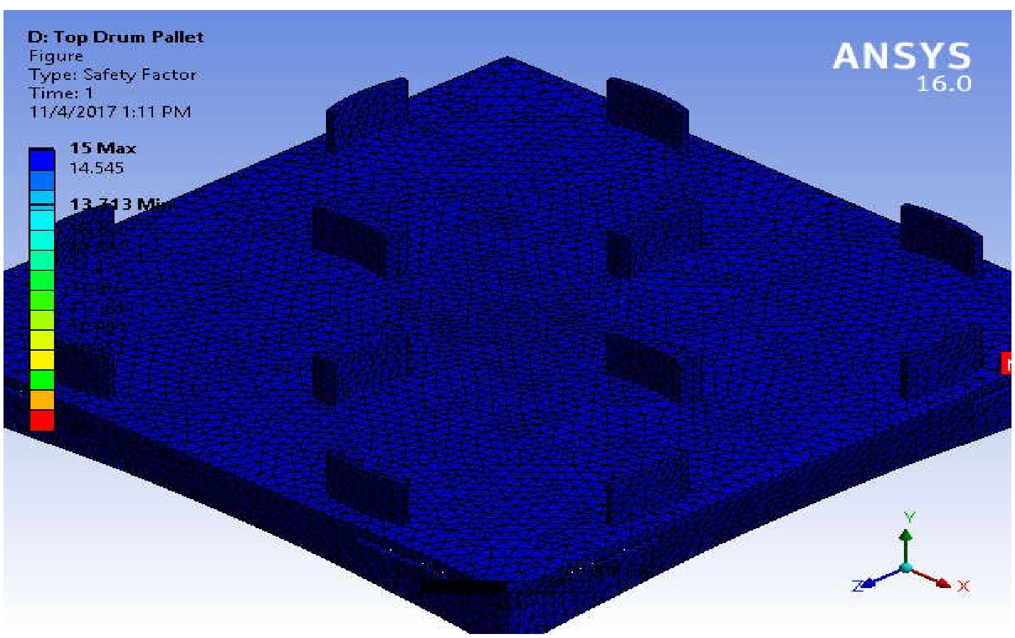
TABLE 17

Model (D4) > Static Structural (D5) > Solution (D6) > Stress Tool > Safety Factor

Time [s]	Minimum	Maximum
1.	13.713	15.

FIGURE 13

Model (D4) > Static Structural (D5) > Solution (D6) > Stress Tool > Safety Factor > Figure



Material Data

Structural Steel

TABLE 18

Structural Steel > Constants

Density	0.2836 lbm in^-3
Coefficient of Thermal Expansion	6.6667e-006 F^-1
Specific Heat	0.10366 BTU lbm^-1 F^-1
Thermal Conductivity	8.0917e-004 BTU s^-1 in^-1 F^-1
Resistivity	8.5235 ohm cmil in^-1

TABLE 19

Structural Steel > Compressive Ultimate Strength

Compressive Ultimate Strength psi
0

TABLE 20 Structural Steel > Compressive Yield Strength

Compressive Yield Strength psi
36259

TABLE 21

Structural Steel > Tensile Yield Strength

Tensile Yield Strength psi
36259

TABLE 22

Structural Steel > Tensile Ultimate Strength

Tensile Ultimate Strength psi
66717

TABLE 23

Structural Steel > Isotropic Secant Coefficient of Thermal Expansion

Reference Temperature F
71.6

TABLE 24

Structural Steel > Alternating Stress Mean Stress

Alternating Stress psi	Cycles	Mean Stress psi
5.8001e+005	10	0
4.1002e+005	20	0
2.7499e+005	50	0
2.0494e+005	100	0
1.5505e+005	200	0
63962	2000	0
38000	10000	0
31038	20000	0
20015	1.e+005	0
16534	2.e+005	0
12502	1.e+006	0

TABLE 25

Structural Steel > Strain-Life Parameters

Strength Coefficient psi	Strength Exponent	Ductility Coefficient	Ductility Exponent	Cyclic Strength Coefficient psi	Cyclic Strain Hardening Exponent
1.3343e+005	-0.106	0.213	-0.47	1.4504e+005	0.2

TABLE 26

Structural Steel > Isotropic Elasticity

Temperature F	Young's Modulus psi	Poisson's Ratio	Bulk Modulus psi	Shear Modulus psi
	2.9008e+007	0.3	2.4173e+007	1.1157e+007

TABLE 27

Structural Steel > Isotropic Relative Permeability

Relative Permeability
10000