The Center for Packaging and Unit Load Design

CPULD News

Quarterly Newsletter

Recent IKEA Certification of the Corrugated Packaging Lab Benefits Students!

By Eduardo Molina

The Center for Packaging and Unit Load Design is pleased to announce that its Corrugated Packaging Materials Lab has received the IKEA certification that it's been working towards for years. Eduardo Molina was hired in January, 2018 as an instructor, to help facilitate this, and he quickly became been a great asset in completing the certification process as well as taking over the daily management of the Corrugated Packaging Materials Lab. Everyone involved is excited about the increased industry interest, projects, and funding that will follow from this new certification.

A group of undergraduate interns are already currently in training and will soon be ready to join our highly skilled faculty in researching and testing IKEA suppliers' corrugated board materials in the newly renovated and certified lab.

Over the summer months of 2018, the Corrugated Packaging Materials Laboratory, located inside the Brooks Center at Virginia Tech, was renovated.

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Check out the Center's New Website!

A year-long process finally culminated in the Center's new website going live over this past summer. Our focus with the redesign was on drawing in new industry partners and interesting more students in our educational programs.

www.unitload.vt.edu

A Big Thank You to **Lightning Technologies!**

The Center's industry partner, Lightning Technologies, has helped us in moving towards our research goals by donating funds that have made the Center's new package tracking sensor studies possible!

(Learn more on page 3)

Membership Meeting Notes

During the Center for Packaging and Unit Load Design's annual membership meeting on September 12th, the students gave presentations regarding the research completed over the last year. Most of these research projects were done specifically at industry members' requests and usually designed to satisfy questions or issues that have arisen in their supply chains. These leading companies are working with us to be at the...

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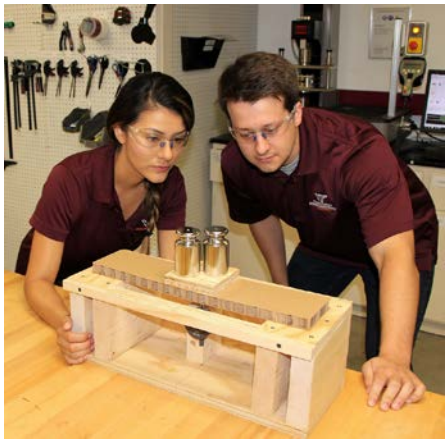

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Corrugated Packaging Lab...

... As part of these renovations, the lab was repainted to match the new Virginia Tech brand and an updated system for organization and cleaning was implemented. The driving force behind this transformation was the certification of the laboratory as an official IKEA testing center for corrugated board packaging materials. This new IKEA certification will benefit our students, and our Center, by attracting more funding which will lead to many new projects and educational opportunities.

A key part of the renovations was the optimization of processes through the employment of the LEAN philosophy to all of the lab's operations. With the help of Jack Cook and Jhonny Fuentes, two undergraduate summer interns from the Packaging Systems and Design program, the laboratory now follows the 5S methodology for a visual workplace.

The interns helped outline the methods and processes needed for sustaining a full lean transformation in day-to-day lab operations. As part of this, a Kanban system was put in place to control the daily workflow, testing projects, simplifying scheduling, and progress tracking. The lab's overall operations will run more smoothly and efficiently due to the organizational processes implemented by this lean renovation which was completed with goal of receiving the IKEA certification.

The IKEA certification was finally obtained after a rigorous, yearlong process of validating all of our testing procedures and the internal processes of the lab. We also hosted IKEA's engineers from China and other locations as they toured and inspected our laboratory's equipment and facilities. We are currently the only testing laboratory in North America that is certified to approve corrugated fiberboard producers to sell to IKEA. In short, this means that any packaging supplier wishing to do business with IKEA must receive approval of their corrugated board products through our lab and its testing processes. This new recognition will allow the Corrugated Packaging Materials Lab to stand out and become a reference for testing services in the United States and abroad.

The Corrugated Packaging Materials Lab consists of state-of- the-art equipment for use in classes, research, and testing projects. The Lab's focus centers on our students; they will be able to gain hands-on experience in the testing and research of corrugated products that can be used in real-life situations. Currently, as part of the revamped operations, a group of undergraduate interns from the Packaging degree are being trained to conduct these real-world testing processes in the near future. Working in the renovated lab will provide them with valuable experiences - both in working with the corrugated industry and in real-world expertise inside a testing laboratory.

The new IKEA certification will further the experiential learning opportunities in our department as a whole.

Lightning Technologies Donation Makes Tracking Sensor Studies Possible!

The new school year is now here, and the Center for Packaging and Unit Load Design is eager to begin utilizing the $50,000 donation that their industry partner, Lightning Technologies, has recently made to the Center. Lightning Technologies is known for their innovative pallet design called the Lightning-GARD, and the funds they donated have been earmarked for the purchase of a variety of sensors which can be used in conjunction with their pallet and others. Dr. Laszlo Horvath, the director of the center, will be making the most of the Lightning Technologies donation by ensuring that students get the proper education both on using the sensors and on analyzing the data collected.

These sensors will be able to measure and track a wide array of conditions. From the changing temperatures inside a shipping container, to each tiny vibration that a palletized unit load experiences during travel, these sensors will provide a wealth of new information. And, the data collected will have to potential to change how global packaging and distribution systems work by giving companies new information on which to base their organizational and financial material handling decisions.

These sensors will also provide companies with real-time alerts in case of emergencies during the shipping process. “For example, many foods and medicines go bad quickly if they aren’t kept at a certain temperature,” Horvath said. “If temperature sensors are installed in the truck that’s carrying these shipments, the company will be notified as soon as the temperature changes, so the truck driver can be alerted that something is wrong.”

This fall, students will start learning how to incorporate the new sensors into their distribution packaging research projects. Students will be working with American Woodmark, a local furniture manufacturer, in order to collect real-life data by placing sensors on the company’s furniture shipments. The new information learned through this research could lead to significant industry improvements in the coming years.

The Lightning Technologies sponsored sensor research is the latest laboratory upgrade in a multi-year project to improve the Center’s facilities through lean management techniques and increasingly technological advancements.

“Distribution packaging isn’t currently an area where we use a lot of high-tech sensors, but we want to build a program around smart and connected packaging,” Horvath said. “The sensors aren’t even the most exciting part. We’re developing a cutting-edge program that is at the intersection of business and science, and will help prepare students to make decisions regarding this technology that will benefit their employers.”

Our Interns Are All ISTA Certified Workers!

The Center for Packaging and Unit Load Design is always striving to make sure its laboratory workers are the most knowledgeable around. Our goal is for our current students to graduate as excellent future employees for our industry members. Our lab interns receive training and attend courses both through the university and through industry partners in order to stay current with the knowledge and procedures needed to benefit the packaging and distribution...

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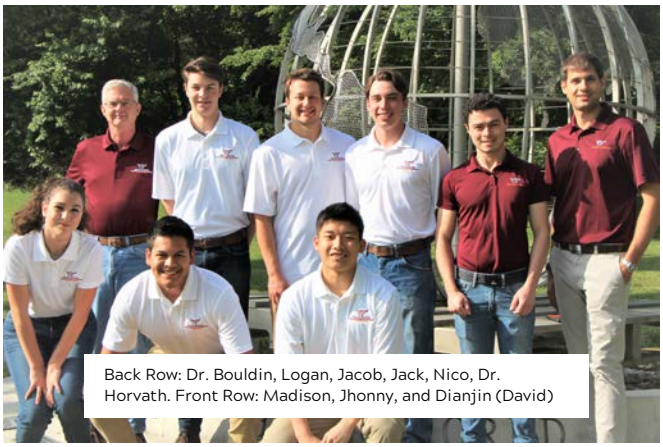

Back Row: Dr. Bouldin, Logan, Jacob, Jack, Nico, Dr. Horvath. Front Row: Madison, Jhonny, and Dianjin (David)

ISTA Certified Workers!

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... industries. The ISTA website states that the "International Safe Transit Association (ISTA) is an organization focused on the specific concerns of transport packaging. ISTA is the leading industry developer of testing protocols and design standards that define how packages should perform to ensure protection of their contents during the ever changing risks of the global distribution environment... Worldwide, ISTA is the most trusted, knowledgeable and respected authority in predictive package-performance testing helping its members develop more effective packaging." One of the ways that ISTA fulfills its main mission is by offering a certification program for packaging and supply chain professionals. This multi-level certification program is designed to show that workers have been through ISTA courses and are knowledgeable in packaging and distribution testing standards. After completing the training individuals receive the title of Certified Packaging Laboratory Professional. These individuals are great assets for their companies in the development of safe, new designs for packaging and other aspects of shipping supply chains.

Usually these certifications are completed by industry professionals but the Center for Packaging and Unit Load Design has decided that all of its undergraduate interns and lab workers will complete the training needed to receive the basic level of certification - called the Technician Level. Our graduate students and lab workers often choose to further their standards trainings and move up to the Technologist Level of certification. So when an industry member brings a question or project to the Center for Packaging and Unit Load Design, they can be sure that it will be researched or completed by individuals who are qualified and now certified to find the answers they need.

Membership Meeting Notes

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... forefront of innovative pallet and package research. We are collaborating in developing new, innovative ways to design pallets and unit loads as well as finding ways to improve the sustainability of the packaging supply chain. Our members had the chance to offer suggestions for the focus of the next year of research projects as well.

Our industry affiliate membership is a three-level program offering industry promotion, discounts on Center services, and access to a wealth of knowledge and world-renowned experts. This is in addition to fostering a close relationship between our membership companies and their potential future employees - companies are regularly connected with our students during research projects, internship opportunities, and networking events.

The Center is very excited about our 2018 growth and the membership program's new momentum. We've gained two new industrial affiliate members this year, ORBIS and PMG - and our previous bronze member, PTM, has decided to become a Gold member this year.

Join these worldwide companies in benefiting from being an Industrial Affiliate Member of the Center for Packaging and Unit Load Design here at Virginia Tech.

GOLD Members:

CHEP A Brambles Company

ptm Advanced Plastic Solutions

National Wooden Pallet & Container Association
Pallets Move the World®

SILVER Members:

white & company PALLET AND PACKAGING SOLUTIONS

LITCO Carry on.

Universal Forest Products

neopal

MONOFLO INTERNATIONAL

BRONZE Members:

PECO PALLET

PMG PALLET MACHINERY GROUP

ORBIS Powered by Menasha Corporation

Nelson

Meet the Interns Working in the Lab!

Jack Lumley is a junior from Johnstown, Pennsylvania. He decided to study in packaging systems and design because of the versatility within the industry and importance it plays in everyday life. His favorite classes this year are "Structures and Properties of Sustainable Biomaterials" because of his interest and love for the outdoors, and his internship course with Dr. Horvath because it provides a good fundamental background for many important professional and industry qualities. Jack's ideal job would be one that he can travel with and eventually help a bigger cause regarding the food and water crisis around the world through packaging. You can catch Jack golfing or enjoying other outdoor activities when he is not on campus doing homework.

Madison Reynolds chose the Packaging program because it allows her "to be creative and still learn basic engineering principles." Her favorite course was the Principles of Packaging because it allowed her to practice her passion for design. She hopes to work for a cosmetic company in CA or NY after graduation, in the packaging design side of their business. Madison is intrigued with the Japanese culture and has been studying the Japanese language for over a year, which she says has opened up her understanding of their society. She hopes her language skills will help her find a career that will allow her to travel to Japan. She was raised in Newport News, VA as an only child and still engages in her favorite hobbies of artwork, cooking and bodyboarding as often as possible.

Logan Tallman had always been interested in technical majors, but once he learned about the packaging program through CPULD, he was drawn to it for the hands on experience he could gain. He has been fascinated by his 'Materials and Processing' and 'Sustainable Packaging Design' courses as they have helped him "develop real world skills." He hopes to put his education to use working in the western US for a world-wide corporation as part of their supply chain management. In that career, he hopes to be challenged while being able to help them cut down on costs and their environmental footprint. When Logan isn't learning warehouse and laboratory skills, his time is spent outdoors with his family, friends, and his dog. Logan also pursues creative endeavors such as painting and music production in his free time.

Dianjin "David" Xu particularly enjoys his pallet and container classes because these courses allow him to practice designing new packaging and figuring out solutions to real-life problems all while developing teamwork skills and learning how to be an industry professional. He believes that working for the Center has helped turn him into "a dedicated worker, a scientific problem solver, and an honest experiment tester." David grew up in Beijing, China where he was surrounded by the flavors of his home. He enjoys sharing this part of his home country by cooking Peking Roast Duck, Kongpao Chicken, Zhajiang noodle, Hotpot, and Baodu for his friends, after a friendly game of basketball. He intends to complete a Masters degree before finding employment with an international company based in China.

~ Research Highlights ~

Investigation of the Effect of Corrugated Boxes on the Distribution of Compression Stresses on the Top Surface of Wooden Pallets

By Page Clayton

This study aims to investigate pallet deflection as a result of different sized packages in a column stacking pattern and the presence of headspace in the box.

Pallets are the foundation of unit loads and supply chains. They provide a way to store and transport products in an efficient manner. Currently, however, the use of "component based" designs for unit loads doesn't consider the interaction between unit load components or how this interaction effects the overall structural integrity of the unit load.

Component based unit load designs also result in the excessive use of raw materials which reduces the sustainability of unit loads, drives costs up, and creates issues for people in the supply chain.

The objective of this study was to investigate the interactions between the unit load components, box size and package head space, especially focusing on the deflection of the pallet as a function of pallet stiffness across multiple common pallet support conditions.

This study aimed to investigate pallet deflection as a result of different sized packages in a column stacking pattern and the presence of headspace in the box. The effect of each of these components on deflection is known as load bridging, in which a redistribution of stress occurs depending on the loads' characteristics within the unit load.

Results showed that, in a column stacked arrangement, smaller boxes caused greater deflection than larger boxes (up to 53 % higher). Data analysis identified that a change in box size causes a decrease in the deflection of a pallet; smaller boxes, with the same load, transfer less pressure to the supports (31% less) and cause more deflection (53% more) than large boxes, especially on lower stiffness pallets. The presence, or lack, of headspace in a box didn't have any significant impact on deflection.

This study confirmed that supported pallet components do, in fact, carry more of the weight of the load and that the boxes' sizes do affect deflection. The experiments from this study confirm that the compressive pressure across the top of the pallet surface redistributes itself towards the supports of pallets when the sizes of the corrugated boxes increase. As more of the compressive forces redistribute across the top of the pallet to the supports, the deflection along the free span decreases.

These quantitative results can help to further understand the load bridging effect and allow us to make adjustments based on the current safety factors. Therefore, to increase the sustainability of pallets and to conserve resources, it is recommended that pallets are always designed with product packaging designs in mind.

Research funded by The Pallet Foundation of the NWPCA and by the U.S. Forest Service.

THE PALLET FOUNDATION, INC.

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

~ Research Highlights ~

The Evaluation of the Ability of Commercially Available Wood Adhesives to Exchange Pallet Nails for Block Pool Pallets

By Gloria Alvarez

This study investigated the tensile and shear strength of a pallet connection secured using commercially available wood adhesives and compared its performance to a pallet connection secured using a common pallet nail.

Currently, the most common pallets are made of wood and are put together with nails or staples. Wood pallets built with nails can provide good strength and durability at a low cost. But, while they are common, and they have a lot of benefits, they are not perfect and can cause issues.

Most failure in wood pallets is at the connections. Nailed connections often fail by the nailhead pulling through the deckboard, the nail withdrawing from the stringer/board while remaining attached to the deckboard, or a combination of these. Nails can also cause splitting in wood, which can lead to the need for repairs. And if they're exposed, nailheads can be dangerous during handling and cause damage to products.

Adhesives could be a potential solution to these problems because they would take away the possibility of metal being exposed, and they would not create a concentrated high stress points like nails do. In a pallet, there are two directions in which the wood aligns, parallel to the grain and perpendicular to the grain. There are also two types of forces experienced, shear and tension. An adhesive would have to be able to bond the wood in both directions while being able to withstand all forces.

The objective of the study was to investigate the tensile and shear strength of pallet connections secured using commercially available wood adhesives and compare their performance to that of a pallet connection secured using a common pallet nail. Using standard ISO 12777-3 this study looks at the effect of these changes and how a pallet connection made with adhesives compares to a connection made with nails.

There are two main testing standards that provide guidelines for pallet testing; ASTM D1185 (2009) is used for domestic pallets, while ISO 8611 (2011) is used for pallets that are expected to be shipped internationally. Both standards are used to evaluate pallet strength under static and dynamic loads. According to current literature research, approximately 77% of pallet damage occurs at the joints; hence, the quality of a pallet is greatly affected by the quality of the joints.

By improving the quality of the joints, be that with fasteners or adhesives, pallet life can be significantly increased. Various studies have been conducted to compare the performance of wooden pallets assembled with nails to pallets assembled with adhesives. An ideal adhesive would have good gap-filling characteristics, be weather and moisture resistant, have low emission of volatile organic compounds (VOCs), be easy to apply, clean, and be disposed of, have a short assembly time, a long pot-life, a low cure temperature, be resilient to creep, relaxation, and impact loading, and be affordable (Mitchell, 1998).

Various impact and static compression tests were conducted on the various types of connections; however, not all combinations of every variable were tested. The results showed some promise for some types of adhesives, but due to confidentiality issues, the actual results of this study are considered proprietary until 2020 at which time they will be published for public perusal.

Research funded by the industry affiliate membership of CPULD.

Personnel Spotlight:

Eduardo Molina joined our team in January, 2018. He is an Instructor in the Packaging Systems and Design degree program and is currently working on his doctoral dissertation. His research focuses on understanding and modelling the effect of load characteristics on pallet deflection. Eduardo also manages the newly renovated Corrugated Packaging Lab at Virginia Tech. This laboratory has the capability of conducting a wide variety of testing on corrugated fiberboard and is the only laboratory in North America certified to conduct testing for IKEA suppliers.

While taking undergraduate classes, Eduardo acquired an interest in Logistics and Supply Chain operations. He started his career in Industrial Production Engineering by working for five years in a supply chain for a global corporation. This position allowed him to obtain knowledge and experience in the practical management of supply chains, including material handling in warehouses and local and international transportation systems.

Having experienced the importance of packaging in logistics operations, he decided to pursue further education at Virginia Tech. So, he went back to college and obtained his Master in Packaging Systems and Design. He has conducted research on the interactions between pallets, packages and the material handling equipment, specifically the effects of the stacking patterns of packages on pallet performance. He has used this new knowledge to collaborate in improving pallet designs, reducing costs, and increasing sustainability.

Eduardo moved to Blacksburg from Costa Rica where he now lives with his wife, Diana. They enjoy the many outdoor activities in the region, as well as playing sports when the weather permits.

Pallet Design Short Course - May 7th-9th, 2019

Pallet design is an integral part of the material handling system. Wood pallet suppliers, sales professionals, professionals responsible for pallet purchases, packaging engineers and pallet specifiers will all benefit from an understanding of how to design pallets that will last longer and perform better.

This intensive three-day short course will teach techniques that pallet designers can use to save money when designing pallets by considering the interactions between all of the components of the material handling system. The course will use a state-of-the-art pallet design software called “Pallet Design System” (PDS) to better demonstrate the steps that go into the pallet design process. You will also be taken on a tour of a working, state of the art, pallet testing laboratory!

Unit Load Design Short Course - August 13th-15th, 2019

Unit Load Design is a revolutionary, systems design approach that significantly reduces the cost of distributing products to consumers by understanding how pallets, packaged products, and handling equipment, mechanically interact. Unit Load Design is a new and valuable service that pallet, packaging, and handling equipment suppliers can offer their customers.

This intensive three-day short course will teach techniques that pallet and packaging designers can use to save money on corrugated board and plastic packaging materials when designing pallets and packages by considering the interactions between all of the components of unit loads. The course will use a state-of-the-art unit load design software called “Best Load” to better demonstrate the steps of unit load design process. You will also be taken on a tour of a working, state of the art, packaging and pallet testing laboratory!

Calendar of Upcoming Center Events:

November 17th-25th: Thanksgiving Holiday Break

December 5th: University Courses End

December 18th - January 2nd: CPULD is closed for Winter Break.

May 7th-9th, 2019 (schedule may change): Wood Pallet Design and Performance Short Course

August 13th-15th, 2019 (schedule may change): Unit Load Design and Performance Short Course

Contact Our Team:

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New research projects
Quotes for new testing projects
Distribution Packaging Projects
Unit load Design Projects

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