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(on behalf of the American Composites Manufacturers Association)

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"Composite Materials – Strengthening Infrastructure Investment"

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Chairwoman Comstock, Ranking Member Lipinski and members of the Subcommittee on Research and Technology, thank you for the opportunity to testify before you.

My name is Shane Weyant, and I am the President and Chief Executive Officer of Creative Pultrusions in Alum Bank, PA. On behalf of our company and my fellow members of the American Composites Manufacturers Association (ACMA), I appreciate the opportunity to testify before you today.

Creative Pultrusions is one of over 3000 manufacturers of fiber reinforced polymer (FRP) composites in the United States. We have been in business for over 45 years and have seen numerous changes to the industry over the years. One example of composites that many of you are familiar with is found in recreational boating. Salt water destroys traditional metal and wood hulls for boats, but fiberglass remains unscathed after decades of high salinity contact and has come to dominate that sector due to its superb performance. The same material system can be applied for use in numerous other applications where its attributes will benefit consumers and communities through improved performance and lifecycle cost benefits. This capability has been recognized lately by the National Institute of Standards and Technology, which brings us together for this hearing. I participated in their 2017 composites workshop and, as described in more detail later, found it to have tremendous value for the industry, government and hopefully ultimately for the American taxpayer.

Composites are combinations of fiber reinforcements, most commonly glass or carbon among many other materials, and tough engineered polymers. The resulting material combination is

stronger than the constituent materials individually. Composites are formulated to provide characteristics specifically tailored for maximum performance in a host of different applications.

Key Structural Characteristics of Composites

Durable

Why invest in infrastructure that will start decaying the minute it is placed in service? Composite structures typically last twice as long as steel and wood equivalents and require little maintenance. For example, as Congress wrestles with the aftermath of Hurricanes Irma, Maria, and other natural disasters, it is worth noting that most of the first composite utility poles installed in the 1960's are still in service, as compared to wood poles which are frequently destroyed in such storms.

Strong

Per pound, composites are stronger than other materials such as steel, concrete and wood. The two primary components of composites – fibers and resins – contribute to their strength. Fibers carry the load, while resins distribute the weight throughout the composite part as required.

Lightweight

Composites are light in weight compared to most woods and metals. Lighter leads to lower construction costs and fewer installation delays. From utility poles to rebar to bridge decks, composites simplify and speed installation. Lighter components also require less additional supporting materials, further reducing costs.

Resilient

Composites resist damage from weather and harsh chemicals that can eat away at other

materials. They will never rust or rot, making them a good choice for applications that face constant exposure to salt water, toxic chemicals, temperature fluctuations and other severe conditions.

Flexible

A wide range of material combinations can be used in composites, which allows for design flexibility. The materials can be custom tailored to fit unique specifications of each application. Composites can also be easily molded into complicated shapes.

Environmentally Friendly

Composite structures require significantly lower amounts of energy to be produced than traditional construction materials such as steel, aluminum and concrete. In addition, the resulting structure is chemically inert and will not degrade or leach harmful substances into the environment.

Capabilities for Electricity Infrastructure

Events of the last year illustrate the fragility of the electric grid. Demand for power is higher than ever before, while environmental conditions and natural disasters place even higher stress on the system. Electric grid systems that rely on FRP composite utility poles and cross arms find superior performance on every front—durability, strength, flexibility, service life and resistance to natural weather threats. Maintenance-free composites can revitalize and harden the electric grid, making it more reliable and resilient in the face of the types of storms I mentioned earlier thus, reducing outages, and enabling faster service restoration after storms and other natural events.

FRP composite poles are the best choice in environmentally sensitive areas such as coastal areas, wetlands and bogs, because they will not leach toxic preservatives into the environment. Composites are also resistant to rot, termite and ant damage as well as destruction from other pests. In areas prone to wild fires, wood utility poles burn to the ground but the composite poles resist fire and their structural integrity remains intact. An additional key attribute is non-conductivity. This non-conductivity is particularly important when comparing FRP poles to other utility pole materials--wood is potentially conductive, especially when wet; steel is conductive; and concrete is conductive because of its steel reinforcement. The low conductivity of FRP makes them safer for linesmen, especially when speed is essential to restore grid operations.

FRP composite cross arms are another key application. They do not need to be replaced as frequently as wood cross arms, which are more prone to deterioration and mechanical damage. Linemen also have an easier job replacing lighter FRP composite cross arms. Wood cross arms are heavier and may be unwieldy, especially if the lineman is working at the top of a pole. As a result, repairs to wood poles and cross arms may create a workplace hazard risk that is mitigated with lighter and safer composites.

For proof of the potential composites bring to hardening the electric grid, one only needs to look to the Virgin Islands. Hurricanes Irma and Maria brought down all but eight utility poles in the territory – all eight of which were composites. Where all other materials failed, composites were left standing.

Capabilities for Surface Transportation Infrastructure

As the American Society of Civil Engineers notes in their Infrastructure Report Card (www.infrastructurereportcard.com), the state of roads and bridges around the country is woefully inadequate. Traditional materials used to build, repair and maintain our infrastructure are failing to provide the long-term performance and reduced maintenance costs needed to support a 21st century population and economy.

Creative Pultrusions has installed numerous bridge decks and bridge reinforcement components over the last few decades, as have a multitude of other composite manufacturers. Composites bring the advantage of extended service life and superior performance through inherent resistance to corrosion and structural degradation. When traditional materials such as steel reinforced concrete crumble and spall, composites remain undamaged. Composite rebar used to reinforce concrete bridge superstructures is another key application in this market. Composite rebar is cost competitive with standard epoxy coated steel rebar, with the added advantage of complete corrosion resistance. When concrete bridges are seen in crumbling disrepair it is generally due to corrosion of the underlying steel reinforcements that cause the bars to expand and the concrete to crack. Composites avoid this problem and add decades of service life to critical infrastructure.

An additional benefit for composites in the bridge market is the speed of production and installation. Traditionally, bridges take several weeks, and even months, to build onsite. With prefabricated composites, the same bridge can be fabricated offsite and installed in less than a

day, often in just a few hours. This reduction of construction time results in reduced disruption of traffic and commerce that can be critical, especially in rural and remote areas.

Canada has made far greater strides than the United States in deploying composite highway solutions. With harsh winters requiring a lot of salt treatment for roads, a non-corroding solution was needed. Thanks to successful collaboration between the University of Sherbrooke, composites manufacturers, and provincial and federal authorities, composites are now widely used in Canadian bridges and have dramatically reduced the maintenance costs associated with road treatment. This is a partnership that the U.S. should mimic in that it reduces costs of installment, reduces disruptions for drivers, and lowers the lifecycle costs associated with infrastructure.

Capabilities for Water Treatment Systems and Distribution

The recent events in Flint and other locales illustrate a major problem with respect to our water infrastructure. Even in the United States, the delivery of clean drinking water remains a significant problem for federal, state and local agencies. Water and wastewater treatment facilities and water delivery networks in many municipalities are in need of a complete overhaul. Even in systems that are better than others, maintenance costs continue to climb as conventional materials like steel and wood fail to perform adequately in an environment predominated by highly corrosive chemicals.

Composite technologies have the capacity to revolutionize water systems around the country because of their corrosion resistant properties. While composites have been used successfully in

water and waste water applications for decades, they remain under-deployed as many authorities continue to replace aging infrastructure with outdated, and often inferior, technologies. Pultruded grating, baffles, and panel systems fully withstand any degradation from corrosive chemicals. Because of their properties, composite pipes are also used in desalination plants, particularly in drought prone areas.

In addition, a unique process called Cured In-Place Pipe allows for a new composite pipe to be produced onsite within the walls of the failing pipe structure. This system is a transformative change from traditional methods of water distribution rehabilitation, as it can create several hundred feet of new pipe from a single small opening and eliminates the need to tear up roads and curtail traffic and commerce.

Capabilities for Maritime Infrastructure

Because of their anticorrosion properties, composites provide superior performance in wet and high salinity environments. Creative Pultrusions offers a variety of solutions in this sector, as do many other composites manufacturers. Our SuperLoc sheet piling system is one example, designed to rehabilitate deteriorated waterfront structures subjected to harsh marine environments. Advanced ultraviolet additives protect coastal reinforcements from sunlight and heat degradation and are coupled with composites' proven ability to withstand corrosion and structural degradation in fresh and salt water environments. These properties allow for extended service life along with reduced maintenance costs.

Our pipe piling system brings the same property advantages to docks and piers with fender and bearing piles. Unlike wood structures, they are inert to degradation from salt, wood borer, fungi or microbial attack. In addition, they require no external chemical treatment that could ultimately leach and pollute adjacent water sources. A similar product, our fender pile system, was used to rehabilitate the service dock at the Statue of Liberty in the wake of Superstorm Sandy.

Standards and the Opportunity for the Federal Government to Lead

Despite the performance benefits of composites for a host of infrastructure and heavy construction applications, among many other markets, there remain sizeable commercial barriers to realizing the full benefit and utilization of composites. On the one hand, composites are newer than traditional metal and wood products, so it is understandable that market share is comparatively lower. Even still, there are obstacles that can be cleared with the help of sensible government/industry partnership.

Among the most important is the development of standards for composites in infrastructure projects. Our industry has worked hard over the past many years to develop standards that will arm civil engineers, builders, and others with the necessary standards data to help inform them as they make their choice in material. There are a few large companies manufacturing composites, but in general the industry is predominated by small and medium sized companies like mine that do not have the same resources that more entrenched industries have to educate the full breadth of the end-user community. The robust litany of standards and data for traditional materials comes from many decades of work and includes significant investment by the federal government along the way. Much of the fundamental research in traditional materials was

performed and memorialized by the Federal Government and a similar commitment is needed for composites. With the advent of standards driven construction, the need for sanctioned standards is critical as the current public administration environment does not lend itself to rapid adoption of cutting edge civil infrastructure technologies that lack such approved standards.

The federal government can provide a spark to help close the standards gap and has much to gain by investing in this work. Composites can significantly lower the costs and, most importantly, increase the performance of federally funded constructed assets. By being forward looking, we can better leverage scarce taxpayer dollars by lowering the costs of construction and maintenance of the national infrastructure network.

The first step is supporting standards development and the research capabilities of the National Institute of Standards and Technology in this area. I was one of many industry representatives that participated in the NIST composites workshop in 2017. I found this to be an incredibly useful event, and a shining example of positive engagement between industry, academia, and government. The report[1] from this event and the agency's testimony in this hearing lay out the technical challenges to broader composites adoption and the capabilities of NIST to overcome these barriers. I and my fellow members of ACMA strongly support the creation of a program along these lines. Specifically, NIST has a unique ability to aggregate existing standards and design data for composites and validate them broader dissemination and use. In addition, their world class laboratories can lead the way in the development of durability and performance

[1] NIST Special Publication 1218, "Road Mapping Workshop Report on Overcoming Barriers to Adoption of Composites in Sustainable Infrastructure," December 2017, available at: https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1218.pdf

testing for composite infrastructure products. In so doing, this data can support further development of standards for composites in construction. Finally, given NIST's role in standards and research, the agency has a unique convening and knowledge dissemination capacity to assemble stakeholders from industry, academia, and federal and state agencies that, coupled with world class research laboratories, will help ensure that this work is impactful.

Justifying the Investment

NIST can best describe the comprehensive elements of an effective research program. I can say enthusiastically though that this work is necessary and. Our experience with builders and project engineers shows that there is a low diffusion of knowledge about composites as a structural material throughout the design community. Composites are not widely taught in civil engineering courses at universities, and certainly not at high schools and earlier. Once engineers and builders understand the capabilities of composites for structural applications and have used composites in an application, they often become sold on the products and specify them more frequently. Additional research and data that can contribute to standards development will help raise the knowledgebase about composites. Likewise, bringing together the various agencies responsible for infrastructure investment to participate in this effort can help diffuse knowledge to the asset owners and designers.

Engineering work by municipalities, for example, often occurs in silos. For example, successful application of composites in a water treatment system does not automatically mean that the positive outcome will be shared with or understood by the local bridge department. This is not to say that one successful installation should automatically merit wholesale adoption across all asset

sectors by the jurisdiction, but it should necessitate positive knowledge share. Unfortunately, that does not regularly occur.

NIST and the federal agencies responsible for infrastructure spending and construction have an important ability to help raise awareness. Through their direct involvement with asset owners, the federal government can provide knowledge about innovative technologies to facilitate greater consideration of their use when appropriate. To be clear, we do not suggest that it should be within the federal purview to mandate the use of specific materials. We believe all materials, techniques, and designs should stand on their own merit. What we know from experience, however, is that the lack of awareness of and standards for composites means we are underutilized.

Maximizing the Value of Other Federal Investments

It is important to note that successful federal investment in the composites industry comes with precedent. Composites were used in over 150 bridges built under the Innovative Bridge Research and Construction program, a former program of the Federal Highway Administration. The Transportation Research Board is currently conducting a study of the performance of bridges built under that program, with the report due to Congress later this year. This report will serve as an important data set to show how well the technologies work. We are confident that an authoritative study will help demonstrate the readiness of these technologies for broader adoption. A retrospective review of the performance of the composite and several other technologies used in this program also helps assure that less than satisfactory methods are not repeated and lessons learns can be applied to future research. This study will help NIST and

other agencies understand where best to apply resources with respect to research and engagement.

Another federal investment that has proven tremendously successful is the Institute for Advanced Composites Manufacturing and Innovation. IACMI is a part of the Manufacturing USA network managed by the Department of Commerce and pools resources from the Department of Energy, industry, academia and state partners to tackle precompetitive issues to enable adoption of key composite solutions that further the national interest.

Among IACMI's many breakthroughs are composite recycling and reuse. The chemistry of thermoset composites coupled with a lack of previously dedicated research in this area made recycling a critical barrier to broader use of composites. With leadership from ACMA and IACMI and diligent efforts by companies across the composites and recycling industries, an exciting new thermolyzer technology can successfully recycle composites. The success will be further illustrated by a forthcoming major investment in this technology by CHZ Technologies and the construction of a new recycling facility, an investment of more than $70 million creating over a hundred new permanent jobs. This is the first major commercialization of technology developed through IACMI and one of the most successful projects from the Manufacturing USA program to date.

This advancement is worth noting for two reasons – it shows that federal investment in composites pays tremendous dividends and coupled with further structural research by NIST as

described in their report, it will help composites contribute more to the overall sustainability of our infrastructure network.

Conclusion

At a time when Congress is being challenged to support American manufacturing, to rebuild aging infrastructure, and to manage scarce taxpayer funds with more vigilance, I am pleased to cite the benefits of the domestic composite industry. We are not seeking a handout, a mandate, nor favorable treatment. What we know is that we simply need the same kinds of standards and information that many other materials have had created to be made available. To be sure, composites are better understood and more widely used now than ever before. The industry has a track record of successful case studies and innovation. But if we are to truly accelerate the use of composites and garner the benefits from their use, now is the time to support this technology and integrate composites broadly into the decision-making ecosystem.

The demands placed on America's infrastructure have never been greater. To build a network to support a 21st Century population and economy, there needs to be greater availability of 21st Century technologies. Composites will not replace traditional materials overnight, nor should they, but they are a high value tool to add to the toolbox. For a relatively small investment, important research on composite infrastructure technologies can pave the way for the development of more standards and the diffusion of knowledge to stakeholders. This is the first of many steps down the road. Federal and state governments need to modernize their overall approach to infrastructure investment and recognize that greater upfront spending for innovative solutions is worth doing when the reduction of maintenance costs and extension of service life

leads to an exponentially increased return value. Composites can be used successfully in tandem with traditional materials like concrete and metals, given even greater flexibility to engineers to deliver superior performance.

With some smart investment and hard work, we can make bridge, water system and grid failures something for the history books. The ability to build structures that last centuries instead of years is here, we look to Congress to help make it happen.