

**PAGAN, UPR-M
DHS COASTAL RESILIENCE CENTER
EDUCATION PROJECT
YEAR 4 PROGRESS REPORT
July 1, 2018 – June 30, 2019**

Project Title:

Education for Improving Resilience of Coastal Infrastructure

Principal Investigator Name/Institution:

Ismael Pagán-Trinidad (PI), Ricardo R. López (Co-PI)/ University of Puerto Rico - Mayagüez

Other Partners/Institutions:

ERDC-US Army Corp of Engineers; US Army Corp of Engineering PR District Office; PR Emergency Management Agency; FEMA; RAND Corporation - Dr. Isaac Porche; PR Department of Natural Resources; PR Climate Change Council (PRCCC) – Mr. Ernesto Díaz; Association of Professional Engineers of PR- Eng. Marilú de la Cruz; Aqueduct and Sewer Authority (AAA)- Eng. José Rivera, Eng. Joel Lugo and Eng. Glorimar Cortes; Integrated Añasco River Basin Management Group - Mr. Luis Villanueva; UPRM partners (Marine Science Department, PR Sea Grant Program Ruperto Chaparro; CariCOOS NOAA project; Transportation Technology Transfer Center- Dr. Benjamín Colucci; Civil Infrastructure Research Center); NOAA (National Weather Service); INESI - Dr.Cecilio Ortiz (Instituto Nacional de Energía y Sostenibilidad Isleña - “National Institute on Energy and Island Sustainability”); CRB (Community Resilient Building); Re-Imagina Puerto Rico;

Senior Personnel: Dr. Carla López del Puerto, Dept. of Civil Engineering and Surveying, UPRM; Collaborating Faculty at UPRM: Dr. Luis Aponte, Professor, Wind Engineering; Dr. José Guevara, Professor, Rehabilitation of Coastal Infrastructure; Dra. Alesandra Morales, Geotechnical Engineering; Dr. Walter Silva- Hydraulics; Dr. Ali Saffar, Structural Reliability; Dr. Raúl Zapata, Water resources; Dr. Francisco Maldonado, Construction and Cost Management; Dr. Alberto Figueroa, Resilient Transportation Systems; Dr. José Cedeño, Electrical and Power Systems

Short Project Description (“elevator speech”)

This project will help educate the community by transferring state of practice knowledge to stakeholders (students, faculty, professionals, first responders, and workforce) through formal (curriculum, internships, student projects, undergraduate research) and informal (workshops, seminars, lectures, short courses, webinars) learning experiences. It will serve as a vehicle to engage the community as a whole to understand and learn its members’ roles and responsibilities in providing resilient infrastructure systems to coastal and neighboring communities. The project will help the community understand better various stages in coastal infrastructure hazard prevention, preparedness, response, recovery, and mitigation. The focus will be on understanding the natural phenomenology, the engineering methodologies to address the level of risk the infrastructure is exposed to, the engineering methodologies and technology to analyze and predict the level of resistance and vulnerability the infrastructure and community is exposed to, the sustainable and resilient alternatives available at the state of practice or state of art to cope with communities’ risks and vulnerabilities. The project will help motivate students, faculty,

professionals and the community leaders and will create pipelines of students and professionals into coastal resilient infrastructure (CRI) careers and practice.

1. Introduction and project overview:

The main goal of this project is to develop and offer formal and informal education through courses, workshops, seminars, lectures, and other educational means leading to advance knowledge on the state of practice on the Resiliency of Coastal Infrastructure (RCI) of the built and natural environment. This initiative aims at creating a **Certificate in Resiliency of Coastal Infrastructure**. The focus of the project is to provide students and faculty, professionals and homeland security personnel, and affected citizens with capabilities to assess the effects of natural hazards on coastal infrastructure, the conditions of existing structures, and rehabilitation alternatives to mitigate future damage and potential risks. The educational content will focus on pre-incidents, incidents and post-incidents. New courses and revisions of existing course will be evaluated in Civil Engineering and related disciplines dealing with estimates of causes and effects of coastal flooding, storm surge, ocean waves, tsunami loads, earthquake effects, and strong winds. Courses will be alternatively offered in the form of conferences, workshops, and lectures. Lecturers and experts from CRC, ERDC, FEMA, and other partners will be invited to participate. State of practice technology will be a priority, e.g., FEMA P646 publication for tsunami load estimates. The National Infrastructure Protection Plan and state infrastructure protection programs and plans will be addressed. Results of recent research work by UPRM, ERDC, and other CRC partner investigators regarding flood, wave, earthquake and tsunami, and hurricane wind effects on structures will be incorporated. Being a small and fully developed island, Puerto Rico offers the ideal setting to assess lessons learned of the effect of natural hazards on built and natural infrastructure including housing, commercial, industrial, institutional, transportation, communication systems, and others. Most recent Hurricane Irma and María experiences on the devastation over Puerto Rico will continued to be evaluated and the lessons learned will be incorporated in presentations, curriculum contents, and guidelines. The principal investigators will continue participating in various working teams, forums and meetings addressing building a resilient community in Puerto Rico for the future. At present time the PI's are involved with various initiatives, for example, Resilient Puerto Rico, Imagine Puerto Rico, and others. All communities in Puerto Rico have been left overexposed to major damages and recovery challenges which requires strong capacity building from the engineering perspective.

The Island continues to present more catastrophic settings from overdeveloped and exposed urban and rural communities, more vulnerable zones (flood prone, weak soils and landslides, hurricane wind exposure), highly concentrated and poorly planned urban communities, stressful tradeoff between urban development and natural ecosystems development and conservation, extreme economic development constraints and suboptimal first responders resources (e.g. funding, equipment, capabilities, training, and others) make the Island educational settings most challenging. All this setting will be available for first-hand assessment and evaluation from the educational and research perspective.

Puerto Rico will be in a continuous development process focusing on providing a more resilient community, infrastructure, families, and individual. The project will collect, disseminate and expose new knowledge and lessons learned from our past and expected natural events causing damages to the community.

This program has also the goal to facilitate internships at CRC universities performing research in CRI and in government agencies and industry dealing with coastal hazards. Being a minority serving institution (MSI) with a high women's participation (near one-third in Civil Engineering) it is also our goal to create and capacitate minority Hispanic students, faculty, professionals, and affected citizens to warranty up to date level of competency in Coastal Resilient Infrastructure to this part of the community. Our MSI University has been providing well qualified Hispanic engineers to the mainland United States for many years and will benefit from the opportunity to collaborate with DHS and the community it serves.

2. End users:

- a. **PR Emergency Management Agency Staff - FEMA (Roles - trainees, collaborators, partners):** Provided training and tools through a partnership with administrators for coordinating near two dozen trainings, workshops, meetings and collaboration activities (see list in Section 9. Educational Activities and Milestones) based on their needs and priorities. Provide instructors for trainings, provide facilities, videotaped of activities, and issued Certificates of Participation to FEMA officials were invited and participated in all the activities sponsored by the CRC.
- b. **RAND Corporation -Contactor to FEMA (Role- sponsor, trainers, and trainees):** A research service partnership was established to support RAND officials in the reconstruction efforts of Puerto Rico focusing on providing expert advice and support on cost estimation and validation of permanent reconstruction projects to be sponsored by FEMA public assistance projects. CRC recruited a team of faculties and students to continuously work on various scope of works on reconstruction projects in public infrastructure, namely: buildings, water/wastewater, dams, power and energy, transportation, communications, and others. This initiative is operated through periodic meetings, communications and meetings between officials from both parties.
- c. **Municipality and state government - engineers, planners, technicians, administrators, others (Role: trainees, collaborators):** Participate as audience and certificate recipients. Share their problems and priorities. Coordinated field trips and inspections.
- d. **Professional Engineers and Planners – Industry (Role – trainers and trainees):** Participated as audience, certificate of participation and recipients of continuing education certifications. They also participate as trainers in expertise areas of interest.
- e. **Faculty (Roles - trainers, trainees, researchers):** Course development and supervision, research work-proposals and projects): Faculty continued engaged in resilience of coastal infrastructure either by offering training and courses and engaging in research work (proposals and projects) but also as trainees in trainings and workshops. Various professors engaged course amendments and course development in resilience topics. Some turned into leadership roles in their research teams.
- f. **Students (Roles: trainees, undergraduate and graduate research):** Students participate in formal and informal education. A variety of undergraduate and graduate research and projects addressing local projects associated with civil infrastructure exposed and vulnerable to natural hazards.

- g. **Community leaders and members (Roles: trainees, certificate recipients):** Community leaders and members of communities at risk participate in trainings, workshops and team building where they can share their experiences and needs.
- h. **Partnership with EPA (“As Chairman/Professor of the DHS Coastal Resilience Center of Excellence-UPRM Partner; Department of Civil Engineering & Surveying at UPR-Mayagüez, Ismael is a key partner of the EPA-led PR Healthy Buildings (Homes/Public Housing/Schools/Public Buildings) Long-Term Recovery Initiative.”** - citation from LEED-AP Indoor Air Quality Coordinator - Asthma, Mold, Radon & Radiation, Disaster Recovery HSS-RSF Co-Lead Technology, Transportation and Radiation Branch, Air and Radiation Division, US EPA Region II.
- i. **Partnership with the Añasco River Watershed Management Working Group:** A basin-wide stakeholders team has been formed focusing of basin wide resilient attention to the Añasco River basin flooding and environmental problems. This initiative has been led by the *Community Planning and Capacity Building Recovery Support Function (CPCB RSF) – Aguadilla Office with the participation of many government and community stakeholders.*
- j. **Collaboration Initiative with The Nuclear Alternative Project (NAP) :** The UPRM-CRC Team coordinated to participate in practical research work for evaluating the feasibility of alternative nuclear energy for the Island. A feasibility study is proposed (FEASIBILITY STUDY FOR MICRO AND SMALL MODULAR REACTORS (SMR) FOR PUERTO RICO \$3.1M) by the NAP to the USA Department of Energy to evaluate the economic, safety and societal aspects of deploying micro-reactors and SMRs for Puerto Rico. Puerto Rico aspires to a clean, resilient, zero-carbon emission energy generation portfolio as the basis for a modernized, robust and dynamic economy. Based on the latest draft of the Integrated Resources Plan (IRP), for the near-term, Puerto Rico plans to replace all oil and coal plants with natural gas plants while at the same time reforming regulatory and financing tools to expedite solar and wind projects across the island.
- k. **NIST Intergovernmental Personnel Act with NIST:** Dr. Aponte-Bermúdez will bring significant expertise in wind and structural engineering to the NIST team studying Hurricane Maria's impacts on Puerto Rico. Dr. Aponte-Bermúdez has extensive experience with measurements and modeling of the wind environment in Puerto Rico, as well as documentation of the performance of buildings through post-hurricane damage assessments. Dr. Aponte-Bermúdez's participation in this study will provide a synergy with his ongoing research activities. At the completion of this assignment, Dr. Aponte-Bermúdez will continue in his current position at the University of Puerto Rico at Mayagüez.
- l. **Oregon State University (Dr. Dan Cox) and Rice University:** A Planning Grant was proposed and approved Led by OSU to work on a proposal for adaptation and resilience of coastal infrastructure (CARCI) was approved. Dr. Ricardo López (UPRM) is CO-PI. ORU also collaborates in the SUMREX with a total of 8 students since the CRC project began in 2016. Two team meetings were celebrated at Washington DC (George Mason University) and OSU where a number of partners collaborated in the topic of resilient coastal infrastructure.

3. Unanticipated Problems:

A significant number of students and faculty have been attracted to the CRC project however, due to the proposed budget constraints a limited number of students and faculty could be committed to the project. Some faculty have participated through extended release time whenever possible or by Ad-Hon participation. It turned out that attracting faculty and students to work Ad-Hon is not the best way of building up leadership, work force and long-term resources. Although we have not received any instruction not to transfer funding to support students and faculty, we felt we need to consult and have prior budget revision and authorization from headquarters to move on for last project year. We understand that a more effective engagement of the faculty can be obtained with appropriate funding support.

4. Students and recent graduates:

A total of 8 students registered in graduate courses. A total of 81 students registered in undergraduate courses. All of the courses focused on resilient infrastructure.

INCI 4998/ININ5996 – 16 undergraduate students

INCI 4950 – 65 undergraduate students

INCI 5996 – 1 graduate student

INCI 6995 – 1 graduate student

INCI 6066 – 2 graduate students

INCI 6065 - 1 graduate student

INCI 8999 – 3 graduate students

Other than formal courses, many of the project activities were sponsored conferences and seminars open to students, faculty and the general public. The number and distribution by sector of attendants can be seen in Figure 1 in the following.

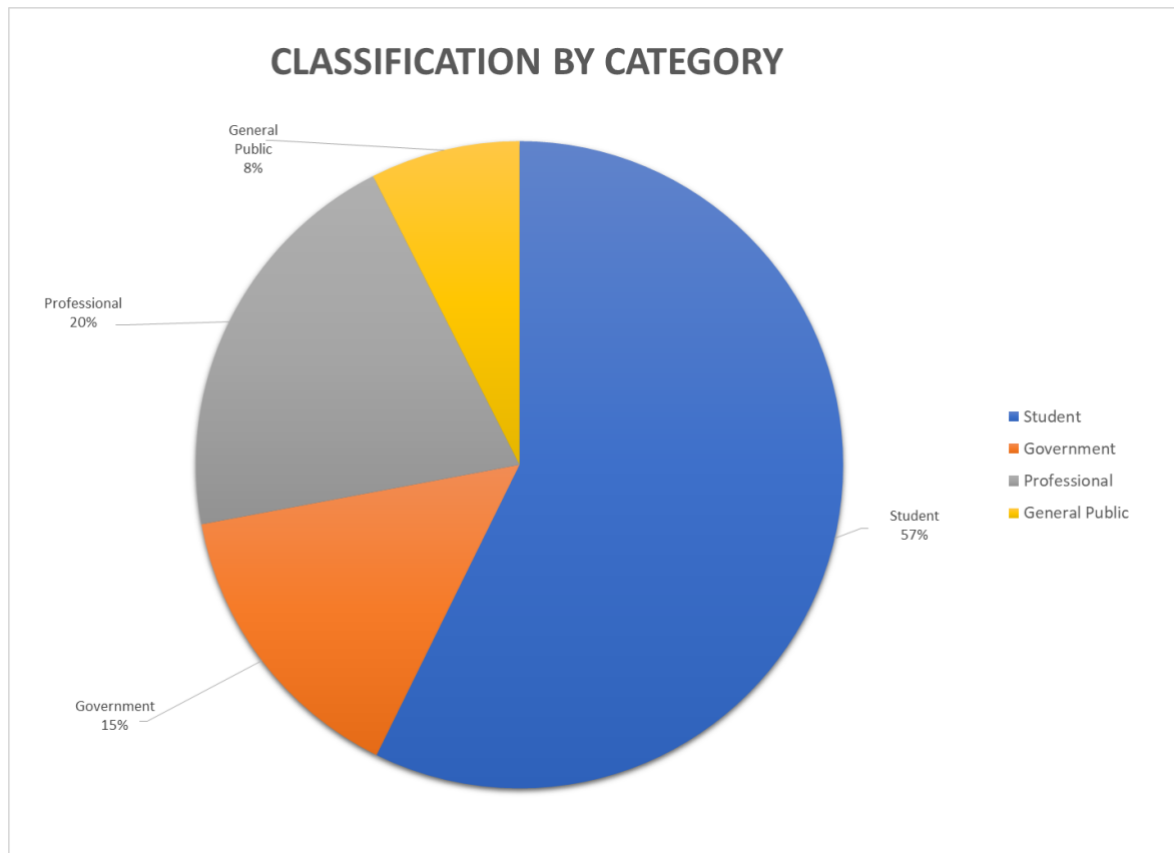


Figure 1 – Attendants by Category

5. Project Impact

The project intensively reached out to students, professors, government officials, design professionals and the general public. Many of the activities were developed in coordination with other departments and organizations to ensure ample diffusion and participation. Within the collaborators are FEMA, NOAA, US Army Corps of Engineers, Department of Natural Resources, Sea Grant, CoHemis, ReImagina, and others. A total of 17 main educational conferences and workshops have were organized during Year 4 with 893 participants (an average of 52 participants per activity) and 108 contact hours (an average of with the representation of different sectors like (Students-57%, Professionals -20%; Government 15%; and General Public-8%). Since 2017 until 2019 a total of 1823 participants attended the project activities with a total of 120 contact-hours.

The invited speakers are well recognized leaders in their fields precisely to make sure the most up to date information is given. The project has become a leader with partners in our state agenda to rebuild Puerto Rico. The project team has acquired the collaboration of students and faculty through developing leadership and reaching out for their own initiatives and sponsorship.

Although it is difficult to measure, there is a significant impact on the attitude, confidence and capacity of the participants from all sectors. It evident in our graduates who have been hired by FEMA and contractors responsible for the emergency management and the permanent

reconstruction of Puerto Rico after Hurricane María. Figure 2 shows the distribution of participants per educational activity.

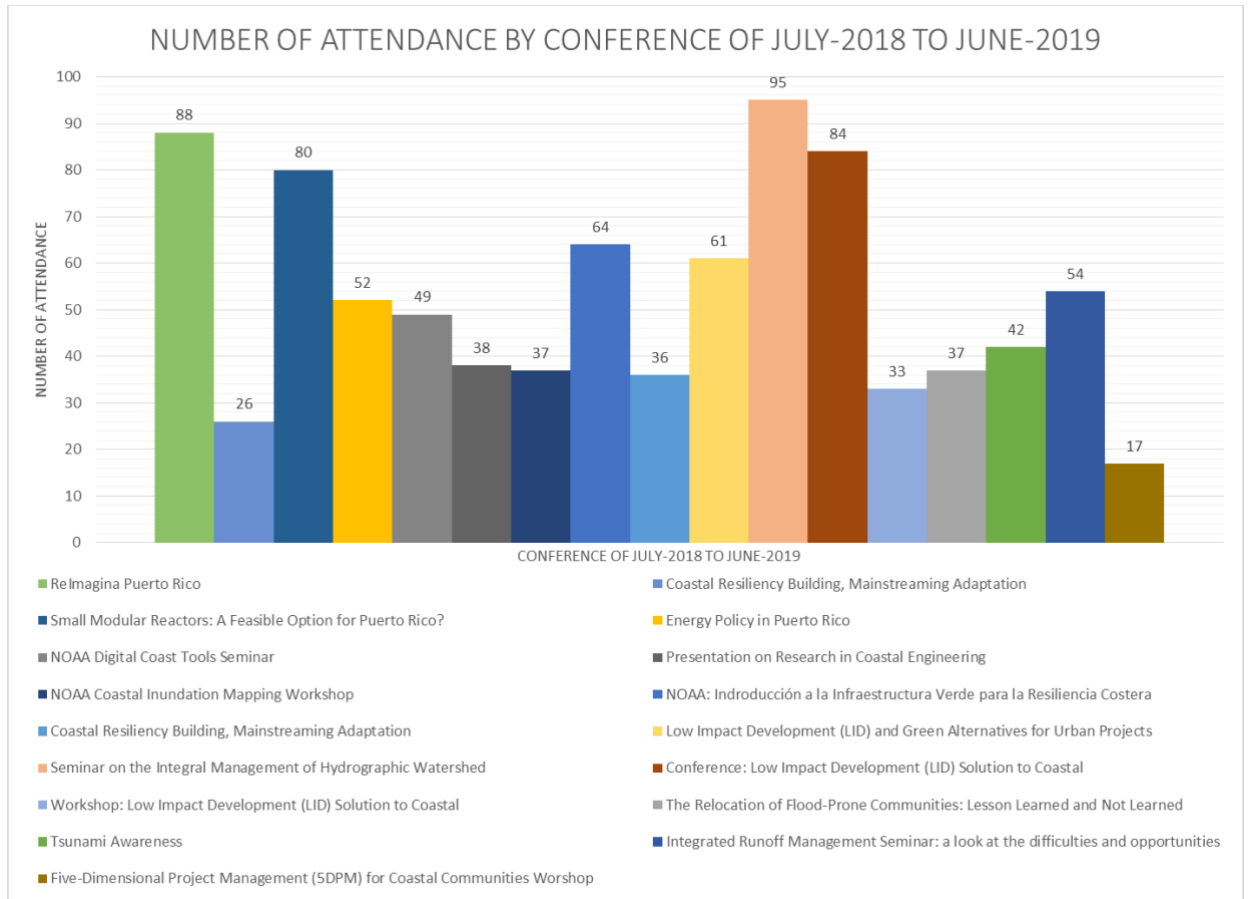


Figure 2: Distribution of Participants per Educational Activity

6. Institutionalization:

The project PI's have been very active searching for additional funding for activities related to the project. Some of the most important activities are:

- Proposal to NSF for an Engineering Research Center together with Oregon State University and Rice University. A Planning Grant for this purpose was approved to OSU with Ricardo López as CoPI. The proposed Center name is CARCI- Center for Adaptation and Resilience of Coastal Infrastructure. A request for a no cost extension of the Planning Grant has been submitted recently.
- Proposal to Rand Corporation to give advice and support on FEMA projects for the reconstruction of Puerto Rico after Hurricane María. An agreement for \$500,000 was approved with the name “Expert Analysis of FEMA Cost Estimate Development Process and Validation for FEMA-4339-DR-PR”. This project started February 2019 and is in progress.

- Continuation of efforts to establish an Education Certificate in Resilient Infrastructure. It is being negotiated with several Departments. Courses have been identified, two new courses have been developed, other potential courses for the certificate have been identified. The initiative has been expanded and it is ongoing to be developed by various departments, namely: Materials Science and Engineering Marine Science, and Civil Engineering. This coordination is much more complex but much more significant than being developed by only one department.
- Participation in NSF Rise-Up Project. Senior Personnel Carla López del Puerto is the PI and Ismael Pagán and Ricardo López are Co-PI's in the NSF project. The project is called "A Collaborative Undergraduate STEM Program in Resilient and Sustainable Infrastructure and started in 2018 with a duration of 5 years.
- The PI's have developed collaboration with other initiatives at UPRM which are focusing on parallel activities with similar goals hosted at the INESI, PR Sea Grant, Materials Science and Engineering, Marine Science outside the department or like NSF RISE-UP project and other faculty initiatives at the department. The resilience mission has been adopted by the College of Engineering and the whole UPRM where the PI's play a leadership role.

For the foreseeable future the main activities of the project will be housed in the Department of Civil Engineering and Surveying, (where Prof. Ismael Pagán Trinidad is the Chairman) through the Civil Infrastructure Research Center (where Dr. Ricardo López is the Center Director) at UPRM.

7. Interactions with research projects:

- a. SUMREX: Civil Engineering undergraduate students Jorge Santiago and Bryan Acevedo attended OSU in Summer 2018 (July 1- August 17).
- b. SUMREX: Civil Engineering undergraduate students Robert Lewis and Ihan- Jarek T. Acevedo González are attending Oregon State University during Summer 2019 (June 2019) Supervisors Dan Cox and Meagan Wengrove.)
- c. UPRM-ERDC 2018 and 2019: Coastal and Hydraulic Laboratory - Engineer Research and Development Center, Vicksburg. MS (One Student Nelson Cordero)
- d. UPRM-ERDC ERPA – Civil Engineering Graduate Nelson Cordero worked under BAA working at ERDC in Vicksburg from Aug 2018 to May 2019.
- e. NSF – PIRE Summer Intern - One student, Sofia N. Rivera-Soto was selected to attend the internship and travel to Netherlands in Summer of 2019. Spent 2 weeks in the Netherlands in May and 10 weeks at UPRM completing her research project during Summer. She continued her work at UPR and the project is due August 30.
- f. ReTalk
 - Research in Coastal Engineering at UPRM, Dr. Dan Cox, and 2 others from Oregon State University, Dr. Jamie Padgett from Rice University, and Drs. Miguel Canals and Sylvia Rodriguez from UPRM gave 6 lectures to students, professors and general public at UPRM, December 6, 2018
 - Profs Ismael Pagán and Ricardo López of UPRM made 2 presentations on Dr. Gavin Smith's courses in UNC and NCSU, February 27, 2019.

- Dr. Gavin Smith visited UPRM and gave the presentation “Relocation of Coastal Communities”, at UPRM, attended by a good mixture of students, professors and general public including officials from local and federal government, on April 26, 2019. He also visited coastal areas affected by Hurricane María.

8. Publications:

Publications/Presentations:

- Pagán Trinidad, Ismael, López-Rodríguez, Ricardo and Ernesto Diaz, “Education and Building Capacity for Improving Resilience of Coastal Infrastructure”, Proceedings, ASEE 126th Annual Conference & Exposition: June 16-19, 2019, Tampa FL, **Peer-reviewed.**
- Hector Colón, (SUMREX student 2017), Paper and Presentation, ASCE Coastal Engineering International Conference, “NUMERICAL MODELLING OF TSUNAMI INUNDATION CONSIDERING THE PRESENCE OF OFFSHORE ISLANDS AND BARRIER REEFS”, Baltimore, MD, July 2018; **Peer-reviewed.**
- Benjamín Colucci, Alberto Figueroa and Alexander Molano, (Graduate student supported by the CRC project), Paper and Presentation, “Impacts and Lessons Learned as a Result of the Passage of Hurricane Maria on the Transportation Infrastructure of the Caribbean Island of Puerto Rico”, UPADI, August 2018.
- Benjamín Colucci, Alberto Figueroa and Alexander Molano,(Graduate student supported by the CRC project), Paper and Presentation, “Lessons Learned for the Puerto Rico Transportation Infrastructure after Hurricane María”, ITE, October 2018.
- Morales-Velez, A. C., and Hughes, K.S., “Comprehensive Hurricane María Mass Wasting Inventory and Improved Frequency Ratio Landslide Hazard Mapping”, Revista Dimension Year 32, Vol 1, 2018. Peer-reviewed
- Aponte Bermúdez, Luis D., “Huracán María,: Sinopsis y Análisis Preliminar del Impacto en la Infraestructura de Puerto Rico”, Revista Dimensión Year 32, Vol 1, 2018. Peer-reviewed.
- Martínez-Cruzado, José A. Huerta-López, Carlos I. Martínez-Pagán, Jaffet, Santana Torres, Erick X. and Hernández-Ramírez, Francisco J., “Destrozos, Recuperación, y Planes en la Red Sísmica de Movimiento Fuerte a Raíz de los Huracanes Irma y María”, Revista Dimensión, Year 32, Vol 1, 2018. Peer-reviewed.
- Acosta, Felipe J, Esquilín-Mangual, Omar, Wood, Stephanie G., Long, Wendy R. and Valdés, Didier, Lessons Learned from the Evaluation of Concrete Pole Failures Following Hurricane María, Revista Dimension Year 32, Vol 1, 2018. **Peer-reviewed.**
- Ismael Pagán-Trinidad and Ricardo R. López, editors, Digital proceedings of Conference “Lessons Learned and Best Practices: Resilience of Coastal Infrastructure” , San Juan, PR, August 2017, [_http://engineering.uprm.edu/inci/?page_id=3522](http://engineering.uprm.edu/inci/?page_id=3522)
- The following two presentations were given by Dr. Ricardo López at the World Engineering Conference on Disaster Risk Reduction. More information at

<http://www.wfeo.org/events/world-engineering-conference-disaster-risk-reduction-wecdr-2016/>

- **Ismael Pagán-Trinidad, Ricardo López-Rodríguez, Agustín Rullán, Oscar Perales-Pérez, John Fernández-Van Cleve**, “THE ROLE OF UNIVERSITIES ON DISASTER RISK REDUCTION IN THE COMMUNITY: UPRM CASE STUDY”, *World Engineering Conference on Disaster Risk Reduction*, Peruvian Association of Professional Engineers, Lima Perú, December 5-6, 2016. Presentation.
- **López-Rodríguez, Ricardo R., Pagán-Trinidad, Ismael**, “Structural Vulnerability to Natural Hazards in Puerto Rico”, *World Engineering Conference on Disaster Risk Reduction*, Peruvian Association of Professional Engineers, Lima Perú, December 5-6, 2016. Presentation.
- **Robert W. Whalin, Ismael Pagán-Trinidad, Evelyn Villanueva and David Pittman**, “A Quarter Century of Resounding Success for a University/Federal Laboratory Partnership”, *Proceedings, 123rd ASEE Annual Conference and Exposition, Vol 1*, presented June 27 2016 in New Orleans, LA. ISBN: 978-1-5108-3480-4. Peer-reviewed
- **Ismael Pagán-Trinidad, Ricardo López-Rodríguez**, “Education, Resilience and the Built Environment: Impacts and Some Lessons Learned on Infrastructure for Improvement of Coastal Infrastructure in PR”, *Symposium: Planning and Resilient Recovery in Puerto Rico*, Graduate School of Planning – University of Puerto Rico – Río Piedras, May 18-19, 2018. Presentation.
- Benjamín Colucci Ríos (Presenter), Alexander Molano Santiago, Ismael Pagán Trinidad and Didier. M Valdés Díaz. *Impact of Extreme Climate in Coastal Transportation Civil Infrastructure in the Caribbean*, *World Engineering Forums* November 26 to December 2, 2017, Rome, Italy. Presentation
- Benjamín Colucci Ríos (Presenter) and Alexander Molano Santiago, *Impact of Hurricane Maria on Puerto Rico’s Transportation Infrastructure: Lessons Learned*, *97th Transportation Research Board Annual Meeting, AHB55 Committee, Work Zone Traffic Control Committee Meeting*, January 9, 2018. Presentation
- Benjamín Colucci Ríos (Presenter) and Alexander Molano Santiago, *Impacto del Huracán María en la infraestructura de transportación de Puerto Rico (Impact of Hurricane María in Puerto Rico’s Transportation Infrastructure)*, 4to *Conversatorio para un Puerto Rico Resiliente*. February 20, 2018, Presentation.
- Benjamín Colucci Ríos (Presenter), Alexander Molano Santiago and Joel F. Alvarado López, *El impacto del Huracán María en la infraestructura de transporte de Puerto Rico: Lecciones aprendidas (The Impact of Hurricane Maria in Puerto Rico’s Transportation Infrastructure: Lessons Learned)*, *Mega Viernes Civil 2018: Resiliencia Aplicada*, College of Engineers and Surveyors of Puerto Rico, San Juan, April 6, 2018. Presentation.
- Benjamín Colucci Ríos (Presenter), Alexander Molano Santiago, Luis Sevillano García, Launelly M. Rosado Rosa and Joel F. Alvarado López, *Transportation Engineering Innovation Spearheading the Economic Development of Puerto Rico after an Extreme Natural Disaster*, *XXX Congress of Engineering and Surveying, COINAR 2018*, San Juan, April 17, 2018. Presentation.

- Re-Imagine Puerto Rico a discussion panel on solutions to rebuild PR, co-sponsored with Resilient Puerto Rico Advisory Commission, 11 speakers including Prof. Ismael Pagán, ample audience participation, UPRM, August 14, 2018, Presentations
- Coastal Resiliency Building, Mainstreaming Adaptation, Ernesto Díaz, Director, Coastal Management Program of Dept. Natural Environment Resources and of PR, offered at Capstone course, UPRM, October 4, 2018, Presentation.
- Digital Coast Tools Applications-1 day Seminar, Sponsor: PR Sea Grant, NOAA, CRC; Two NOAA instructors, UPRM, December 5, 2018, Presentations
- NOAA Coastal Inundation Mapping Workshop, Sponsors Sea Grant, NOAA, CRC; two NOAA instructors, UPRM, December 6-7, 2018, Workshop.
- Research in Coastal Engineering, Sponsors with CARCI NSF planning grant with Dr. Dan Cox, Six speakers including three from Oregon State University, one from Rice University and two from UPR Mayagüez, UPRM, December 6, 2018, Presentations
- NOAA – Introduction to Green Infrastructure for Coastal Resiliency: Co-sponsored with NOAA, PR Sea Grant Program, UPRM-CRC, December 12, 2018, Presentations
- Coastal Resiliency Building and Promoting Adaptation: Ernesto Díaz of Dept Natural Resources and Environment of PR, offered at Capstone course UPRM, January 31, 2019, Presentation.
- Low Impact Development and Green Alternatives for Urban Projects: Sponsors FEMA, CRC; Speaker Ismael Pagán Trinidad, Aguadilla FEMA Headquarters, February 8, 2019, Presentation.
- Seminar on the Integral Management of Hydrographic Watershed: Sponsors with FEMA, UPRM, March 5, 2019, Presentations.
- Small Modular Reactors: A Feasible Option for Puerto Rico?, a panel discussion, co-sponsored with Nuclear Alternative Project, UPRM, October 30, 2018, Presentations
- Public Forum: Energy Policy in Puerto Rico, What is Ongoing, Co-sponsored with INESI, UPRM, November 29, 2018, Presentations.
- Carla López del Puerto, Ismael Pagán Trinidad and Ricardo López, “Hurricane Maria in Puerto Rico: Assessment of the Damages, Reconstruction Efforts and Beyond Recovery” at ASCE Construction Summit in Atlanta, March 7 to 9, 2019, Presentation Panel.
- Ismael Pagán Trinidad and Ricardo López,” Overview of Damage Caused by Hurricane Maria in PR”, at Gavin Smith’s Seminar at NCSU, February 27, 2019, Remote Presentation.
- Ismael Pagán Trinidad and Ricardo López were invited and participated in Coastal Engineering Workshop, sponsored by NSF, held in Arlington, Virginia, November 13 and 14, 2018. Similarly, a second meeting-workshop at OSU in February 4-5, 2019 with the same objective.
- Ismael Pagán Trinidad and Ricardo López, “Improving Resilience of Coastal Infrastructure through Education and Building Capacity”, 2019 NLTAPA Southeast Region Meeting, April 30, 2019 San Juan PR, Presentation

- Ismael Pagán Trinidad and Ricardo López, “Education and Building Capacity for Improving Resilience of Coastal Infrastructure” at ASEE 126th Annual Conference & Exposition: June 16-19, 2019, Tampa FL, Presentation
- Ricardo López and Juan Rodríguez, “Análisis tridimensional no lineal de estructuras de concreto (Non Linear Tridimensional Analysis of Reinforced Concrete Structures)” at CIAPR –Mega Viernes Civil (Island wide meeting of Civil Engineers), April 5 2019, San Juan PR, Presentation.
- Carla López del Puerto (senior personnel) gave short course Complex Project Management for Coastal Communities presented at FEMA headquarters in Aguadilla PR for FEMA personnel on June 27, 2019.

Dissertations and Theses

- Angel Alicea (PhD Dissertation): “Dynamic Identification and Nonlinear Modeling for the Structural Health Assessment of Aged Coastal Infrastructure in Puerto Rico”, PhD dissertation completed in December 2018, Department of Civil Engineering, advisor Ricardo López
- Efrain Ramos (MSCE Thesis): “Stochastic Simulation of Tropical Cyclones for Quantification of Uncertainty associated with Strong Recurrence and Intensity”, July 8, 2019 (already submitted, pending final oral presentation); Dept. of Civil Engineering and Surveying; Advisor Ismael Pagán Trinidad-UPRM; Co-Advisor Norberto Nadal ERDC-UPRM.
- Kevin Cueto (MSCE Thesis): “Modeling considering Computational Fluid Dynamics of hydraulic pressure exerted on coastal structures”, July 8, 2019 (already submitted, pending final oral presentation); Dept. of Civil Engineering and Surveying, Advisor-Ricardo López, UPRM.

9. Year 4 Education Activities and Milestone Achievements:

Education Activities and Milestones: Status as of 6/30/2019

Reporting Period 7/1/2018 – 6/30/2019			
Education Activities	Proposed Completion Date	% Complete	Explanation of why activity/milestone was not completed
Offer series of seminars / lectures / short courses (SLSc) in: Advances in Analyses / Design / Operation / Maintenance / Retrofitting of Resilient Coastal Infrastructure.	Offered from 09/2018 to 06/2019	100	
Internships:			*-Notice that Summer internships run over two fiscal year periods.
a. SUMREX: Civil Engineering undergraduate students Jorge Santiago and Bryan Acevedo attended OSU in Summer 2018 (July 1- August 17).	07/01/2018-08/17/2018	100	
b. SUMREX: Civil Engineering undergraduate students Robert Lewis and Ihan- Jarek T. Acevedo González are attending Oregon State		100	

<p>University during Summer 2019 (June 2019) Supervisors Dan Cox and Meagan Wengrove.)</p> <p>c. UPRM-ERDC 2018 and 2019: Coastal and Hydraulic Laboratory - Engineer Research and Development Center, Vicksburg. MS (One Student Nelson Cordero)</p> <p>d. UPRM-ERDC ERPA – Civil Engineering Graduate Student - Nelson Cordero worked under BAA working at ERDC in Vicksburg from Aug 2018 to May 2019.</p> <p>e. NSF – PIRE Summer Intern - One student, Sofia N. Rivera-Soto was selected to attend the internship and travel to Netherlands in Summer 2019. Spent 2 weeks in the Netherlands in May and 10 weeks at UPRM completing her research project during Summer. She continued her work</p>	<p>06/01/2019 – 06-30-2019</p> <p>06/06/2018 - 08/15/2018 and 06/01/2019 – 06/30/2019</p> <p>15/08/2018 - 31/05/2019</p> <p>12/05/2019-30/06/2019 (will continue until 30/08/2019)</p>	<p>100</p> <p>100</p> <p>100</p>	
<p><u>Workshops/Conferences</u> Rehabilitation of Coastal Infrastructure (José Guevara) - Jan 2019</p> <p>a. Re-Imagine Puerto Rico a discussion panel on solutions to rebuild PR, co-sponsored with Resilient Puerto Rico Advisory Commission, 11 speakers including Prof. Ismael Pagán, ample audience participation, UPRM, August 14, 2018</p> <p>b. Small Modular Reactors: A Feasible Option for Puerto Rico?, a panel discussion, co-sponsored with Nuclear Alternative Project, UPRM, October 30, 2018</p> <p>c. Public Forum: Energy Policy in Puerto Rico, What is Ongoing, Co-sponsored with INESI, UPRM, November 29, 2018.</p> <p>d. Reliability of Resilient Infrastructure - course to be video recorded (Ali Saffar)- Recording modules (Module 1 Dec 2018, Module 2 May 2019, Module 3 Summer 2019)</p> <p>e. Community Resilience Building (Adam Welchel) Dec 2018</p> <p>f. Riverine and Coastal Flood Hazards (Walter Silva) October 2018</p> <p>g. Complex Coastal Construction Projects (Carla López del Puerto) June 2019</p> <p><u>Others - depending on availability of instructors</u></p> <p>h. Coastal Resiliency Building, Mainstreaming</p>	<p>08/2018— 06/2018</p>	<p>100*</p>	<p>*-The objective of Educational Activities was completed well beyond expectations and over 100% of the proposed work. Only two activities were not offered but many others were added. Many more activities were incorporated and some of the planned activities were substituted. Some limited adjustments were done as follows:</p> <p>1. Activity d. began and significant recording was done, however, the quality of the recording is not convincing for the PI's and the author. It has been agreed to re do it. New appropriate digital equipment has been in the process of</p>

<p>Adaptation, Ernesto Diaz, Director, Coastal Management Program of Dept. Natural Environment Resources and of PR, offered at Capstone course, UPRM, October 4, 2018</p> <ul style="list-style-type: none"> i. Digital Coast Tools Applications- 1-day Seminar, Sponsor: PR Sea Grant, NOAA, CRC; Two NOAA instructors, UPRM, December 5, 2018 j. NOAA Coastal Inundation Mapping Workshop, Sponsors Sea Grant, NOAA, CRC; two NOAA instructors, UPRM, December 6-7, 2018 k. Research in Coastal Engineering, Sponsors with CARCI NSF planning grant with Dr. Dan Cox, Six speakers including three from Oregon State University, one from Rice University and two from UPR Mayagüez, UPRM, December 6, 2018 l. NOAA – Introduction to Green Infrastructure for Coastal Resiliency: Co-sponsored with NOAA, PR Sea Grant Program, UPRM-CRC, December 12, 2018 m. Coastal Resiliency Building and Promoting Adaptation: Ernesto Diaz of Dept. Natural Resources and Environment of PR, offered at Capstone course UPRM, January 31, 2019 n. Low Impact Development and Green Alternatives for Urban Projects: Sponsors FEMA, CRC; Speaker Ismael Pagán Trinidad, Aguadilla FEMA Headquarters, February 8, 2019 o. Seminar on the Integral Management of Hydrographic Watershed: Sponsors with FEMA, UPRM, March 5, 2019 ReImagina Stormwater Management Workshop: ‘Comprehensive Stormwater Management Seminar: A look at the difficulties and opportunities’; cosponsored with ReImagina Puerto Rico Initiative; Ten expert speakers on stromwater management issues. Participants from FEMA, Municipal Staff, Academia and Private Sector. June 19, 2019. p. Five-Dimensional Project Management (5DPM) for Coastal Communities Workshop, Speaker-Dr. Carla López del Puerto (UPRM CRC Senior Personnel), offered to FEMA and PR COR3 staff at Aguadilla Branch, June 27, 2019. 			<p>being acquired. This task has been rescheduled for year 5 work plan.</p> <p>2. Activity e. was cancelled pending the possibility of rescheduling for Year 5.</p> <p>3. Activity f. was incorporated with the Re-Imagine Puerto Rico Storm Water Management Workshop from June 19, 2019.</p>
<p><u>Establish or Continue Formal Courses</u></p> <ul style="list-style-type: none"> a. Theses (various ongoing): Kevin Cueto, Jorge Romeu, Angel Alicea, Johnny Rosario, Efrain Ramos, Nelson Cordero, Juan Rodríguez, Oscar Vélez b. Undergraduate Research and Problems: various INCI 4998 (13 students IPT), INCI 6995 (2) , ININ 4996 (1) c. Appropriate courses will be offered based on demand: INCI 4950 Twice (32, 33) 	<p>07/2018— 06/2019</p>	<p>100</p>	
<p><u>Develop and Institutionalize Curriculum Sequence for CRI</u></p>	<p>05/2019</p>	<p>75**</p>	<p>** -Courses have been identified, two new</p>

<p>a. Design a Curriculum Sequence leading to an Educational Certificate in Resilient Infrastructure</p> <p>b. Identify potential courses</p> <p>c. Design new courses as required</p> <p>d. Certificate will be promoted and announced</p> <p>e. Orientations will be programmed</p>			<p>courses have been developed, other potential course for the certificate have been identified. The initiative has been expanded and it is ongoing to be developed by various departments, namely: Materials Science and Engineering Marine Science, and Civil Engineering. This coordination is much more complex but much more significant than being developed by only one department.</p>
<p><u>Website:</u></p> <p>Electronic repository of digital documentation, sites, educational resources, videos, photos, webinars, experiential testimonies, etc. will continue to develop and advertise.</p>	12/2018	80***	<p>***-This initiative is continuous. The site has been developed. It continues to be populated.</p>
<p>Publications in peer review sources by participants as faculty, students, and researchers from UPRM and partner institutions are and will continue to be motivated and supported by the project.</p>	05/2019	100	
Education Milestones			
<p>Advance the state of knowledge of various constituencies through technology transfer, training, and teaching</p> <p><u>Purpose:</u> To provide education and formation of the participants in RCI</p> <p><u>Goal:</u> Build up capacity and better trained professionals and students.</p>	08/2018 – 06/2019	100	
<p>Provide alternative learning, motivation and incentives to students through research and experiential work in interns. Introduce students into a pipeline toward HSE advanced graduate education and research careers and jobs</p> <p><u>Purpose:</u> Attract and orient students into RCI to pursue graduate studies and related carriers; and attract, orient and support students to pursue HSE jobs.</p> <p><u>Goal:</u> Provide work and research experiences to students to become motivated to pursue graduate studies, education and research careers, and HSE jobs.</p>	<p>Summer 2018</p> <p>Summer 2019</p>	100	
<p>Host at least two workshops to increase accessibility and hands on experiences of best available technology to the audience with special emphasis to practitioners, faculty</p>	12/2018, 06/2019	100	

<p>and students. Purpose: Help provide accessibility and hands on experiences of best available technology to the audience with special emphasis to practitioners, faculty and students. Goal: Build up capacity on the best available technologies for professionals involved or motivated to be involved in HSE.</p>			
<p>Strengthen and update the contents of the civil engineering curriculum and faculty expertise on HSE priorities for RCI Goal: Help provide a better educated new generation of civil engineers and professionals in related disciplines.</p>	12/2018 – 06/2019	100	
<p>Facilitate end-users updated and state of practice references, tools, and guideline son RCI. Goal: Better educated and informed professionals, government employees, faculty and students on RCI.</p>	06/2019	100	

10. Year 4 Transition Activities and Milestone Achievements:

Transition Activities and Milestones: Status as of 6/30/2019

Reporting Period 7/1/2018 – 6/30/2019			
Transition Activity	Proposed Completion Date	% Complete	Explanation of why activity/milestone was not completed
<p><u>Curricular Sequence-Certificate</u> (Impact on the curriculum): A curricular sequence is proposed that enhances the informal Certificate implemented the first three years will provide opportunities to incorporate infrastructure resilience into the formal curricular options. Appropriate courses will be identified which will accumulate credits towards obtaining the Certificate.</p>	05/2019	75**	<p>**.-Courses have been identified, two new courses have been developed, other potential courses for the certificate have been identified. The initiative has been expanded and it is ongoing to be developed by various departments, namely: Materials Science and Engineering Marine Science, and Civil Engineering. This coordination is much more complex but much more significant than being developed by only one department.</p>
<p><u>Host a series of seminars/lectures/short courses</u> (SLSc) called “Advances in Analyses /Design/ Operation / Maintenance / Retrofitting of</p>	06/2019	100	

<p>Resilient Coastal Infrastructure” will be designed, institutionalized and managed through the Civil Infrastructure Research Center (CIRC) at the department of Civil Engineering and Surveying.</p> <p>List of priority topics to be selected from include: Water/Wastewater; Transportation (bridges, roads, etc.); Flood/Drainage; Buildings (Housing/Commercial/Industrial/Hospitals/Schools, etc.); Airports/Seaports Pending); Communication/Power; Geotechnical Structures/Landslides/ Liquefaction; Coastal Protection Infrastructure (Partners from ERDC, CRC, others to be invited); Green Protective Infrastructure (Partners from ERDC, CRC,); Extreme Climate Adaptation.</p> <p>It is expected to be offered on the average at least one per month. It will depend on the availability of resources, suitability of the activity for supplying the audience needs and particular enquiries from our constituents.</p>			
<p><u>Alternative Learning Initiatives (ALI):</u> Alternatives to learning other than the one obtained through formal courses required in the curriculum in RCI will be institutionalized and offered through internships, undergraduate research, special projects, professional practice, community service and any other available option.</p> <p>Workshops, conferences, and seminars will also help develop informally a desirable body of knowledge on RCI. Alternative learning mode bring students and practitioners the opportunity of: (a) learning by doing, participate in experiential learning, (b) engage in new state of practice advances in the field of resilience engineering, (c) expand breadth and depth of curriculum contents, (d) be exposed to experts from abroad, (e) and start new journeys either academically or professionally in the resilience agenda of the homeland security enterprise, among others</p>	06/2019	100	
<p><u>Technology Transfer on RCI:</u> Access to the state of practice and experiential infrastructure resilience will be made available through trainings, divulgation, and digital literature at the project site or a family of web links. This web site is intended to be a repository of literature on RCI. Divulgation of knowledge and literature through this project is aimed through various available modes, namely: website, conference presentations, class and reports, class notes, guidelines, theses, and conference proceedings, and journal papers, Publications of new materials in peer reviewed conferences or journal will be sought based on opportunities and availability.</p>	06/2019	80 ****	**** This initiative is continuous. The site has been developed. It continues to be populated.
<p>Transition Milestone</p>			
<p><u>Curricular Alternative Offering in Civil Engineering/Surveying:</u> Formalize the curricular exposure</p>	06/2019	100	

<p>of students through RCI curriculum by offering a variety of learning alternatives. New formal courses will be proposed and existing course will be updated including the resilience of coastal infrastructure and resilience theme (in general) topics. At least three new courses are expected to be submitted for approval during year 4-5 period. Various others continue to be updated to include the RCI topics.</p>			
<p><u>Technology Transfer:</u> Establish a continuous technology transfer mechanisms on RCI to civil engineering/surveying students through training or access to the state of practice literature and educational resources. On the average, one activity per month is expected. Although our target student audience is the junior, senior, and graduate student audience, students from other disciplines will be also welcome. At least 30 students are targeted to be directly exposed to formal or informal technology transfer activities.</p>	06/2019	100	
<p><u>Enhance the Students' Study or Work Options and Opportunities in HSE:</u> Provide civil and surveying students the opportunity to expand their opportunities to study and work in the HSE business and be a part of a pipeline for its national labor force team by means of alternative learning experiences.</p>	06/2019	100	
<p><u>Engage Faculty Leaders:</u> Engage civil engineering and surveying faculty as leaders in the RCI field which help seek new opportunities in resilience of coastal infrastructure education, research and practice</p>	05/2019	100	

11. Tables:

Table 1: Annual Courses and Enrollments

Table 1: Annual Courses and Enrollments

Courses Developed and Taught by <u>University of Puerto Rico Mayaguez</u> under Project Education for Improving Resiliency of Coastal Infrastructure						
<u>Course Number</u>	<u>Course Title</u>	<u>Project Year</u>				
		<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>	
<u>INCI6997</u> <u>INCI5995</u>	<u>Course Title: "Rehabilitation of Coastal Structures (under development)"- Guevara</u> [Dual codes for graduate and undergraduate]					
Status: Developed (D), Revised (R), and or Taught (T)			D	T		
Offering: Elective (E), Concentration (C), Minor (M)		-	E	E		
Enrollment		-	-	7		
<u>INCI6XXX</u> <u>INCI5XXX</u>	<u>Course Title: "Resilience and Reliability of Coastal Infrastructures (under development)"- Saffar</u>	YR 1	YR 2	YR 3	YR 4	
Status: Developed (D), Revised (R), and or Taught (T)			D	R	R	
Offering: Elective (E), Concentration (C), Minor (M)		-	E	E		
Enrollment		-	-	-		

INCI6995	<p><u>Course Title: “CE Special Problems” (Graduate)</u> <u>Status: Developed (D), Revised (R), and or</u> <u> Taught (T)</u></p> <ul style="list-style-type: none"> ● “A Novel Boussinesq -Type Numerical Wave Model Development” – IPT ● “Stochastic Simulation of Tropical Cyclones for the Quantification of Uncertainty Associated with Storm Recurrence and Intensity: Phase II” – IPT ● “Analysis of a Ring Levee Breach Using Adaptive Hydraulic” – IPT ● “US Army Improved Ribbon Bridge” – IPT ● Feasibility of Using the Weather Research and Forecasting Model (WRF) as forcing to the Advanced Circulation Model (ADCIRC) – IPT ● “Assessment of Existing Tropical Cyclone Vortex Models for the Development of Wind and Pressure Profiles and Fields” ● Vulnerability of Rubble Mound Structures 	<u>YR1</u>	<u>YR2</u>	<u>YR3</u>	<u>YR4</u>
		T	T		
		T	T		
			T		
		T	T		
			T		
				T	
					I
	Offering: Elective (E), Concentration (C), Minor (M)	E/C	E/C	C	C
	Enrollment	3	5	1	1
<u>INCI599</u>	<p><u>Course Title: “Special Problems (Undergraduate</u> <u> Project)”</u> <u>Status: Developed (D), Revised (R), and or</u> <u> Taught (T)</u></p> <ul style="list-style-type: none"> ● “Impact of Projected Sea Water Rise on Coastal Infrastructures” - IPT ● “Ship Simulation Study”- IPT ● “Utilities and Building Inventory For Resiliency Analyses at the Mayagüez Municipality Coastal Zone” - Dr. Ricardo Ramos ● Assessment of Hurricane Vortex Models and Boundary Layer Models for the Development of Wind and Pressure Profiles and Fields - IPT 	<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>
<u>6</u>		T			
			T		
			T		
					I
	Offering: Elective (E), Concentration (C), Minor (M)	E	E		E
	Enrollment	1	4		1
INCI6066	Course Title: MS-Thesis	<u>YR1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>

	<p><u>Status: Developed (D), Revised (R), and or Taught (T)</u></p> <ul style="list-style-type: none"> • “Structural Effects of Tsunami Loads on Coastal Infrastructure,” by Kevin Cueto (Ricardo Lopez) • “Computation of Gradually Varied Flow in Channel Networks with Hydraulic Structures” by Felix Santiago (Walter Silva) • “Cost analysis of the alternatives to mitigate damage to the infrastructure in Rincon” by Francisco Villafañe (Luis Aponte) • “Stochastic Simulation of Tropical Cyclones for Quantification of Uncertainty Associated with Storm Recurrence and Intensity” by Efrain Ramos (Ismael Pagán-Trinidad and Norberto Nadal) 		D	T	T
		D	D	T	T
			T	T	
		D	T	T	T
	Offering: Elective (E), Concentration (C), Minor (M)		C	C	C
	Enrollment	1	4	4	2
INCI6065	<p><u>Course Title: Master of Engineering Project</u> <u>Status: Developed (D), Revised (R), and or Taught (T)</u></p> <p>Structural Analysis of Common Coastal Structures found on the West Coast of Puerto Rico using FEMA P-646 by Jorge Romeu (Ricardo López)</p>	<u>YR1</u>	<u>YR2</u>	<u>YR3</u>	<u>YR4</u>
			D	T	T
	Offering: Elective (E), Concentration (C), Minor (M)		C	C	C
	Enrollment		1	1	1
INCI8999	<p><u>Course Title: PhD Dissertation</u> <u>Status: Developed (D), Revised (R), and or Taught (T)</u></p> <ul style="list-style-type: none"> • “Resistencia a Cargas de Tsunami de Estructuras Críticas en el Norte de Puerto Rico” (Resistance to Tsunami Loads of Critical Structures in the North of PR) by Johnny Rosario • “Variation of the nonlinear dynamic response of three-dimensional buildings of reinforced concrete considering the directionality of seismic accelerations” by Juan Rodríguez • “Dynamic Identification and Nonlinear Modeling for the Structural Health Assessment 	<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>
			D	T	I
			D	T	I
		D	T	T	I

	<i>of Aged Coastal Infrastructure in Puerto Rico” by Angel Alicea</i>				
Offering: Elective (E), Concentration (C), Minor (M)			C	C	C
Enrollment			3	3	3
INCI4950	<u>Course Title:</u> <i>Civil Engineering Integrated Design Project - Capstone Course</i>	<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>
Status: Developed (D), Revised (R), and or Taught (T)			T	T	T
Offering: Elective (E), Concentration (C), Minor (M)			C	C	C
Enrollment			45	43	65
CIMA8999	<u>Course Title:</u> <i>Marine Science PhD Dissertation</i>	<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>
Status: Developed (D), Revised (R), and or Taught (T)			D	D	
Offering: Elective (E), Concentration (C), Minor (M)			C	C	
Enrollment			1	1	
CIMA6999	<u>Course Title:</u> <i>Marine Science Master Thesis</i>	<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>
Status: Developed (D), Revised (R), and or Taught (T)			D	D	
Offering: Elective (E), Concentration (C), Minor (M)			C	C	
Enrollment			1	1	
INCI4998	<u>Course Title:</u> <i>Civil Engineering Undergraduate Research</i>	<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>
Status: Developed (D), Revised (R), and or Taught (T)			T	T	T
Offering: Elective (E), Concentration (C), Minor (M)			C	C	E
Enrollment			1	1	16
	<u>Course Title:</u>	<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR</u>
Status: Developed (D), Revised (R), and or Taught (T)					
Offering: Elective (E), Concentration (C), Minor (M)					
Enrollment					

Table 2: Performance Metrics

PAGAN: Performance Metrics:

<u>Metric</u>	<u>Year 1</u> (1/1/16 – 6/30/16)	<u>Year 2</u> (7/1/16 – 6/30/17)	<u>Year 3</u> (7/1/17 – 6/30/18)	<u>Year 4</u> (7/1/18 – 6/30/19)
HS-related internships (number)	10	16	9	9
Undergraduates provided tuition/fee support (number)		1	2 - ERDC	5
Undergraduate students provided stipends (number)		2	1	9
Graduate students provided tuition/fee support (number)	5	9	5	7
Graduate students provided stipends (number)	6	9	4	7
Undergraduates who received HS-related degrees (number)		N/A	2	3
Graduate students who received HS-related degrees (number)		N/A	2	1
Certificates awarded (number)		245	800	893
Graduates who obtained HS-related employment (number)		2	1	1
Lectures/presentations/seminars at Center partners (number)		1	2	2
DHS MSI Summer Research Teams hosted (number)		N/A	N/A	N/A
Journal articles submitted (number) *- ASEE, ASCE, ITE	1	0	4	3*
Journal articles published (number) *- ASEE, ASCE, ITE	1	0	4	3*
Conference presentations made (number) **--All kind of conferences, Seminars, and panels	2	31	23	62
Other presentations, interviews, etc. (number)	2	8	5	6
Trademarks/copyrights filed (number)		0	0	0
Requests for assistance/advice from DHS agencies (number)				10
Requests for assistance/advice from other Federal agencies or state/local governments (number)	5		4	9
Dollar amount of external funding	\$95,760	\$58,000	\$110,534	\$550K
Total milestones for reporting period (number)		2	7	9
Accomplished fully (number)	2	2	7	9
Accomplished partially (number)		N/A	N/A	N/A
Not accomplished (number)		N/A	N/A	N/A