

PAGAN, UPRM
DHS COASTAL RESILIENCE CENTER
EDUCATION PROJECT
YEAR 5 PROGRESS REPORT
July 1, 2019 – June 30, 2020 (Updated 12/15/2020)

I. INTRODUCTION

Project Title: Education for Improving Resilience of Coastal Infrastructure

Principal Investigator Name/Institution: Ismael Pagán-Trinidad (PI), Ricardo R. López (July 2019-dic. 2019, Co-PI, Retired Dec. 2019); Carla López del Puerto (Co-PI); Raúl Zapata (Co-PI).

Other Partners/Institutions:

ERDC-US Army Corp of Engineers, PR Emergency Management Agency, FEMA, PR Department of Natural Resources, Association of Professional Engineers of PR, UPRM partners (Marine Science Department, Sea Grant Program, CariCOOS NOAA project, Transportation Technology Transfer Center, Civil Infrastructure Research Center); NOAA (National Weather Service), INESI (Instituto Nacional de Energía y Sostenibilidad Isleña = “National Institute on Energy and Island Sustainability”), CRB (Community Resilient Building). Senior Personnel: Dr. Carla Lopez del Puerto, Dept. Of civil Engineering and Surveying, UPRM.

ERDC-US Army Corp of Engineers; US Army Corp of Engineering PR District Office; PR Emergency Management Agency; FEMA; RAND Corporation – HSOAC Project; 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-Dr. Miguel Canals; 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 and Jorge Rivera Santos - 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; Beatriz Camacho, Geotechnical Engineering; Ameesha Mehta-Sampath, EPA, Healthy Buildings.

Short Project Description (“elevator speech”):

This project helps 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 coastal infrastructure systems. 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 alternative available at the state of practice or state of art to cope with risks and vulnerabilities. The project will help motivate students and faculty which will create pipelines of students and professionals into CRI careers and practice.

II. PROJECT NARRATIVE:

1. 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. **Students** (Roles: trainees, undergraduate and graduate research): Students participated 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.
- b. **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.
- c. **Professional Engineers and Planners** – Industry (Role – trainers and trainees, partners and sponsors): Participated as audience, certificate of participation and recipients of continuing education certifications. They also participate as trainers in expertise areas of interest.
- d. **PR Emergency Management Agency Staff - FEMA** (Roles - trainees, collaborators, partners): Provided training and tools through a partnership with administrators for coordinating 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.

- e. **Partnership with RAND Corporation - Contactor to FEMA** (Role- sponsor, trainers, and trainees): A research service partnership (Project DR4339PR -Expert Analysis of FEMA Cost Estimate Development Process and Validation for FEMA-4339-DR-PR was established in 2018 (2018-2019: \$0.5M) and extended to 2020 (added \$0.5M 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 . The partnership was established through the initiative of the CRC. CRC PI's as a PI's of this project and Point of Contact, were instrumental in establishing the relationship and recruited a team of faculties and students to continuously work on various scope of works on reconstruction projects in public infrastructure, namely: buildings, water/waste water, dams, power and energy, transportation, communications, and cost estimates and validations, and others. This initiative operates through periodic meetings, communications and meetings between officials from both parties. Six professors and seven students have been involved in this research project which complements.
- f. **Partnership with EPA** (Role: mentors, sponsors, trainers, and partners). *“As Chairman/Professor of the DHS Coastal Resilience Center of Excellence-UPRM Partner Department of Civil Engineering & Surveying at UPR-Mayagüez (Partnership developed in Year 4) ; Ismael is a key partner of the EPA-led PR Healthy Buildings Workshop (Homes/Public Housing/Schools/Public Buildings) Long-Term Recovery Initiative.”* - citation from the 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, 212-637-3719 This partnership was established through a reference from the CRC personnel at DHS in Year 4. In Year 5 the partnership evolved. Various initiatives have been developed in this direction, namely: 1) “New Test Method for Community Mapping of Radon in PR”; EPA Project Leaders; The specific objectives from UPRM with this project are to: (1) provide assistance to EPA in deploying and retrieving radon monitoring devices; (2) provide technical assistance in testing and monitoring air samples in the identified municipalities; and (3) train and empower community leaders. A total of 9 undergraduate students (both from Civil and Chemical Engineering Departments) have joined this effort under the lead of Dr. Pedro Tarafa, who will be the On-site Technical Leader. \$25,000 (January 2020 – Projected end August 2020).
- g. **Partnership The American Society of Agricultural and Biological Engineers (ASABE)**- (Roles: Participants, Invited Speakers, Students, Faculty, professionals) CRC collaborates with the organization of a one-day conference as part of the five-day International Symposium on Soil Erosion Research under a Changing Climate (A decadal ASABE Soil Erosion Research Symposium) at UPRM- Department of Civil Engineering and Surveying. (postponed January 2022)
- h. **RISE-UP Program-A Collaborative Undergraduate STEM Program in Resilient and Sustainable Infrastructure sponsored by National Science Foundation** (Role: Collaboration, support, partnership in educational activities): RISE-UP is an interdisciplinary program that includes undergraduate students pursuing Civil Engineering, Surveying, Electrical Engineering and Environmental Design (Architecture) degrees at

three University of Puerto Rico Campuses (Mayagüez, Rio Piedras and Ponce). RISE-UP student participants have participated as audience in workshops and field trips.

- i. **Municipality and state government** - engineers, planners, technicians, administrators, others (Role: trainees, collaborators): Participated as audience and certificate recipients. Share their problems and priorities. Coordinated field trips and inspections.
- j. **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.
- k. **Partnership with the Añasco River Watershed Management Working Group:** (Roles: Collaboration, training , sponsorship) A basin wide stakeholder’s team has been formed focusing of basin wide resilient attention to the Añasco River basin flooding and environmental problems. This imitative 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.
- l. **Collaboration Initiative with The Nuclear Alternative Project (NAP)**-(Roles: partners for seismic, geotechnical and water resources studies). 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.
- m. **NIST Intergovernmental Personnel Act with NIST** (Roles: Dr. Aponte-Bermudez has brought significant expertise in wind and structural engineering to the NIST team studying Hurricane Maria's impacts on Puerto Rico. Dr. Aponte-Bermudez contributed 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 has continued his collaboration with NIST for the ongoing evaluation of structural condition of the infrastructure of Puerto Rico.)
- n. **Oregon State University** (Dr. Dan Cox): We planned to supply two UPRM students for 2020 SUMREX opportunities. Unfortunately, this could not be executed for the COVID-19 pandemic and the Puerto Rico lock down public policies.

3. Unanticipated Problems:

Year five has presented significant challenges that we faced, evaluated, managed and adapted to. They are described in the following:

- (1) **Seismic Sequences in Puerto Rico:** From December 28 until present time Puerto Rico has experienced sequences of seismic activities including a major earthquake and several aftershocks with significant magnitudes and ground acceleration. The PI was appointed by the Chancellor to lead a team to perform Rapid Visual Inspections in order to certify the suitability of the building to be occupied and be able to return to classes and research

at the university. A team of 25 Faculties, professional Engineers and students were led to inspect over 100 buildings in campus. Although classes began with one week delay, the PI continued working almost exclusively on the assignment until February.

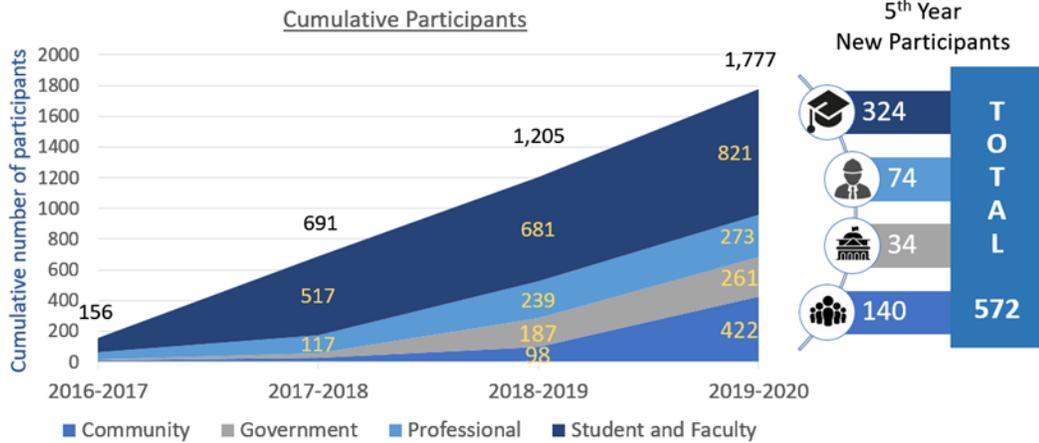
- (2) COVID-19 Pandemic: By early March, less than a month after the first phase of the seismic assignment, the Governor of Puerto Rico, the President of the University and the UPRM Chancellor declared a lock down which closed the university for the rest of the semester. All in-person activities that were planned at the university were cancelled or switched to distance activities assisted by technologies. This included all CRC planned activities which some were reprogrammed for next semester or until allowed. Others were switched to webinars. Various activities initiated to focus on lessons learned and learning experiences, including a Special Project with 11 undergraduate and graduate students, had to be postponed to be finished by Summer for the inability to go back to develop detailed seismic building inspection of the most critical case studies that were assigned to evaluate UPRM buildings.
- (3) An initiative that was negotiated to support the Governor's initiative to evaluate the suitability of returning to normal operation of schools and correctional facilities, has been postponed until the Lock Down is over.
- (4) Two SUMREX opportunities that were announced for two UPRM candidates to participate with Dr. Dan Cox SUMREX Program, as we have done in the past, were canceled.
- (5) The traditional UPRM- ERDC Educational and Research Internship Program that seeks opportunities in resilient infrastructure topics for undergraduate and graduate students was also cancelled, reducing significantly the opportunities and accessibility of excellent prequalified candidate to be assigned to exiting summer experiences in resilient topics with US ARMY Corp of Engineers (ERDC).
- (6) The Co-PI who worked effectively for 4.5 years, retired in December. The CRC team was reorganized during this semester.

4. Students and recent graduates:

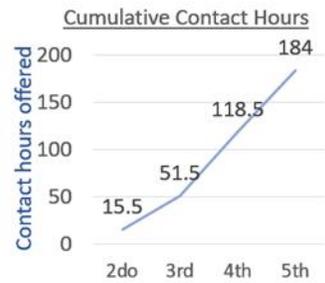
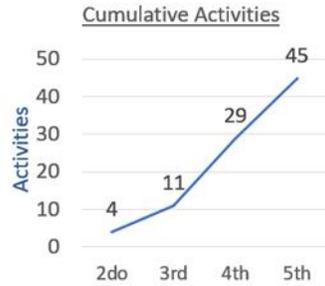
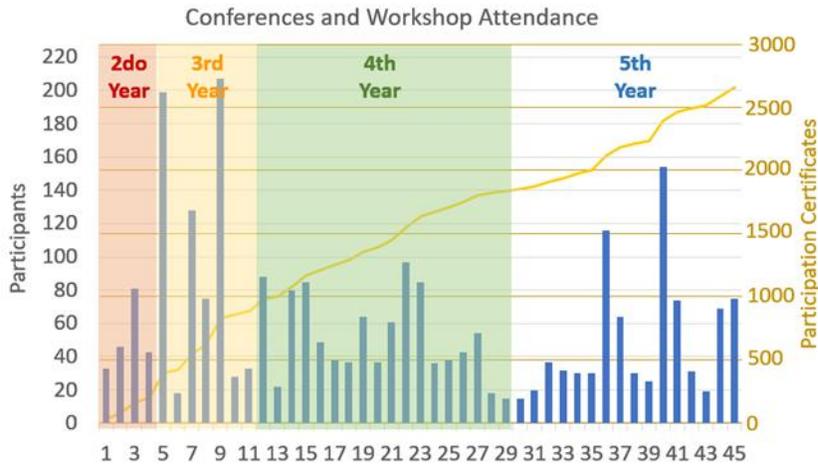
- a) Number of undergraduates, graduates, working professionals: 572
- b) Percentage minority students: over 95% of participants are Hispanics (Puerto Rico)
- c) Number of students graduated: 51
- d) Number of former students employed in resilience-related fields: 5
- e) Number of former students who went on to enroll in graduate-level programs: 4

5. Project Impact:

Number of participants: 1,777
Total contact hours of participation: 8,784



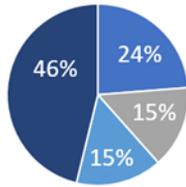
Conferences and Workshop: 45
Contact Hours Offered: 184
Participation Certificates: 2,659



Community, private sector, government and academic participation.

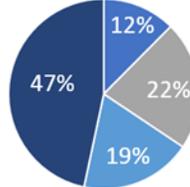
311 Achievement Program Certificates and 105 Instructor Recognitions

Participants per sector



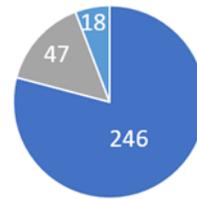
- Community
- Government
- Professional
- Student and Faculty

Total contact hours per sector



- Community
- Government
- Professional
- Student and Faculty

Achievement Program



- Active Participation Achievement
- Meritorious Participation Achievement
- Outstanding Participation Achievement

**UPRM - Coastal Resilience Center
Stats - May 31, 2020**

UPRM - Coastal Resilience Center Participants				
Number of participants:	1,777	Instructor Recognitions:	105	
Total contact hours of participation:	8,784			
Segregation by sector:				
	Community	Government	Professional	Student and Faculty
Number of participants:	422	261	273	821
Total contact hours of participation:	1092.5	1,927.5	1,665.0	4,099
UPRM - Coastal Resilience Center Activities				
Number of activities:	45			
Contact hours offered:	184			
Segregation by year:				
	2do	3rd	4th	5th
Number of activities:	4	11	29	45
Contact hours offered:	15.5	51.5	118.5	184
UPRM - Coastal Resilience Center Achievement Program:				
Achievement	Participants			
Active Participation Achievement	246			
Meritorious Participation Achievement	47			
Outstanding Participation Achievement	18			
Segregation by sector:				
	Community	Government	Professional	Student and Faculty
Active Participation Achievement	19	77	67	83
Meritorious Participation Achievement	1	18	4	24
Outstanding Participation Achievement	0	5	1	12
Segregation by year:				
	2016-2017	2017-2018	2018-2019	2019-2020
Active Participation Achievement	66	28	100	52
Meritorious Participation Achievement	0	7	21	19
Outstanding Participation Achievement	0	1	11	6

**UPRM - Coastal Resilience Center
Stats - May 31, 2020**

UPRM - Coastal Resilience Center Participants

Number of participants:	1,777	Instructor Recognitions:	105
Total contact hours of participation:	8,784		

Segregation by sector:

	Community	Government	Professional	Student and Faculty
Number of participants:	422	261	273	821
Total contact hours of participation:	1092.5	1,927.5	1,665.0	4,099

UPRM - Coastal Resilience Center Activities

Number of activities:	45
Contact hours offered:	184

Segregation by year:

	2do	3rd	4th	5th
Number of activities:	4	11	29	45
Contact hours offered:	15.5	51.5	118.5	184

UPRM - Coastal Resilience Center Achievement Program:

Achievement	Participants
Active Participation Achievement	246
Meritorious Participation Achievement	47
Outstanding Participation Achievement	18

Segregation by sector:

	Community	Government	Professional	Student and Faculty
Active Participation Achievement	19	77	67	83
Meritorious Participation Achievement	1	18	4	24
Outstanding Participation Achievement	0	5	1	12

Segregation by year:

	2016-2017	2017-2018	2018-2019	2019-2020
Active Participation Achievement	66	28	100	52
Meritorious Participation Achievement	0	7	21	19
Outstanding Participation Achievement	0	1	11	6

6. Institutionalization:

- i. Certificate on Resilient Infrastructure: Various modules have been developed for offering as part of the initiatives to institutionalize the Certificate:
 - (a) **“Introduction to the Structural Seismic Design of Reinforced Concrete Structures (in Spanish) & FEMA Rapid Visual Screening of Buildings for Seismic Resistance”** – Dr. Ricardo López, Retired Faculty;
 - (b) INCI 4138- Water Resources Engineering modules were incorporated in the CRC project and has updated - Dr. Raúl Zapata, adapted a required CE core course to incorporate resilience content.
 - (c) **“Soil Hazards, Landslides and Erosion”** – Alexander Molano- CRC Graduate Student,
 - (d) **“Orientación - Carreras de Ingeniería Civil y Agrimensura; Riesgos y Desastres Naturales; Terremotos y Huracanes”**- Juan Rodríguez, CRC Ph.D. Student;
 - (e) **A First Course on Coastal Resilient Structures, The course is divided into four modules.** Dr. Alí Saffar) The first module reviews the fundamentals of probability theory as it relates to extreme low probability coastal events; x2) The second module discusses the principles of the reliability based design. Safety indices are augmented to account for the conditional nature of coastal hazards. x3) The sensitivity analysis is the focus of the third module. The necessary steps in defining uncertainties and the use of decision trees and fault trees are discussed. x4) The fourth module teaches the fundamentals of the fragility analysis. The risk assessment toolkits are developed as part of this module.
 - (f) **Multihazard Mitigation: Resilient Alternatives – Events, Risks, and Hazards-** Dr. Raúl Zapata is developing a module on the relationship of the four needed natural elements of life air, water, soil and energy (fire) to the hazards they present to us. Their interlocking effect they have can also can produce natural hazards which are not single event hazards, because they generate a combined effect that humans need to recognize and deal with them as a multihazards perspective.
- ii. Grant : **RAND Corporation - Contactor to FEMA** (Role- sponsor, trainers, and trainees): A research service partnership (Project DR4339PR -Expert Analysis of FEMA Cost Estimate Development Process and Validation for FEMA-4339-DR-PR was established in 2018 (2018-2019: \$0.5M) and extended to 2020 (added \$0.5M 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 .
- iii. Grant: “New Test Method for Community Mapping of Radon in PR”; EPA Project Leaders; The specific objectives from UPRM with this project are to: (1) provide assistance to EPA in deploying and retrieving radon monitoring devices; (2) provide technical assistance in testing and monitoring air samples in the identified municipalities; and (3) train and empower community leaders. A total of 9 undergraduate students (both from Civil and Chemical Engineering Departments) have joined this effort under the lead of Dr. Pedro Tarafa, who will be the On-site Technical Leader. \$25,000 (January 2020 –Projected end August 2020).

Faculty involvement:

- Instructors: Ricardo López, Ismael Pagán Trinidad, Carla Lopez del Puerto; José Guevara, Alberto Figueroa, Beatriz Camacho, Luis Suárez;
- Module Development: Ali Saffar, Resilient Coastal Structural Design, Reliability and Fragility Curves; Ricardo López: Seismic Rapid Visual Inspections; Carla López del Puerto: Five Dimensional Construction Management; Raúl Zapata- Multihazards; Ismael Pagán Trinidad-Water related multihazards.
- Participants – Over 20 UPRM faculties engaged in the CRC Activities.

f) **Maintenance of project products:**

- i. The Department of Civil Engineering and Surveying through the Civil Infrastructure Research Center (CIRC) has been and will continue to be the host for Resilient Civil Infrastructure Capacity Building (RCICB)

g) **Planning for institutionalization**

- i. The CRC Co-PI's, the Civil Engineering Directors, the Director of the CIRC the Academic Affairs Committee, the faculty, the Deanship.

7. Interactions with research projects:

- Two students participated in at Oregon State University with Dr. Dan Cox (July 2019 SUMREX). The initiative for another SUMREX at Oregon State University for two students had to be canceled due to the national lock down.
- The interaction with Dr. Gavin Smith and the RETALK initiative was interrupted for the Seismic and the COVID-19 lock down for which it was necessary to postpone as some other activities. These initiatives are focused on expanding the collaboration between both institutional and CRC projects.

III. EDUCATION ACTIVITIES AND TRANSITION MILESTONES

1. Year 5 Education Activities and Milestone Achievements:

Education Activities and Milestones: Status as of 6/30/2020			
<u>Education Activities</u>	<u>Proposed Completion Date</u>	<u>% Complete</u>	<u>Explanation of why activity/milestone was not completed</u>
Continue with Second Round of the series of seminars/lectures/short courses (SLSc) in “ Advances in Analyses/Design/Operation/Maintenance/Retrofitting of Resilient Coastal Infrastructure. ” to be selected from the following list of topics. Possible resources will be identified by the end of first year.	One per month (at least	100	

<ol style="list-style-type: none"> 1. Keep Safe: A Guide for Resilient Housing Design in Island Communities (Spanish/English) – Book (Enterprise, 2019) (Participants = 60) 2. Regional PRASA Response to Hurricane Maria & Post-Event Resilient Water Infrastructure Recovery Activities; UPRM-CRC, PRASA Western Region, UPRM-CIRC October 15, 2019 (Participants=116) 3. Basin Wide Initiatives for Improved Coastal Resilience: UPRM-CRC, FEMA, USACE-ERDC, DRNA, November 13-15, 2019. <ol style="list-style-type: none"> a. Uniqueness of Puerto Rico Hydrology: Topography, Rainfall-Runoff, Riverine Flash Floods, Urban Development, Coastal Risks, Sediment Loads - Ismael Pagán Trinidad and Ricardo López-Rodríguez, UPRM CRC b. Consideration for Coastal Communities Key Vulnerabilities: Sea Level Rise, Coastal Flooding, Inland Flooding, Erosion/Sedimentation, and Debris. - Ernesto Díaz, PR Climate Change Council/DNER-Coastal Management Zone c. Integration of Nature Based Solutions: Wetlands, Farm ponds, Stormwater Detention Basins, Terraces, Sediment Detention Basins, Floodplain Restoration, Channel Bank Stabilization, Buffer Strips, Saturated Buffers, Bioreactors and Scalable Low Impact Development – Environmental Lab, ERDC-USACE d. Green infrastructure myth busting: Dealing with site constraints, Cost, Utilities and Performance – Environmental Lab. ERDC-USACE e. Engineering with Nature – NNBF – Environmental Lab, ERDC-USACE f. USACE Jacksonville District Perspectives; Projects: Río Guayanilla, Río Guanajibo, Río Portugués, Río Bucaná, and Río Puerto Nuevo, PR District Office-USACE g. Small-Scale Rainfall Variability in Western Puerto Rico and its Implications on Agricultural Water Management - Eric Harmsen, UPRM 4. Transforming University Engagement In Pre- and Post-Disaster Environments: Lessons from Puerto Rico; PANEL; University Partnership R&D, <u>Education & Engagement</u>: Tapping the Potential of Universities to Develop the Next Generation of Disaster Professionals, Knowledge Creation, Campus Resilience Building and Community Service, presented at the University of Albany, N.Y.; RISE CONFERENCE 2019, Ismael Pagán 			
--	--	--	--

<p>Trinidad and Ricardo R. López Rodríguez, November 18-20, 2019.</p> <p>5. Observations on the Impact of Hurricane María in PR presented at the University of Albany, N.Y. ; RISE 2019 National Conference; Panel: Infrastructure Challenges Facing our Islanded Communities; Ricardo R. López Rodríguez and Ismael Pagán Trinidad, November 18-20,2020</p> <p>6. UPRM -CRC Response to Seismic Sequence in PR Major shot down: Earthquake (6.4M) and aftershocks (5.9M, 5.8M); Chancellor commissioned PI's/CE Department to support recovery process ; In-charge: Inspecting/Certifying/Orienting/Assessing University infrastructure; Team: 13 faculties; 12 students; 10-16 hr/day; Jan 8-Jan 20; About 100 university facilities; many community facilities (Good Samaritan work); Buildings were gradually reoccupied – only one week delay in classes;</p> <p>7. Five faculties were appointed to study the earthquake impact on university buildings and to develop Best Seismic Resistant Practice for Buildings</p> <p>8. IIC Student Chapter & CRC: Engineering Students Field Visit to Perform Rapid Visual Inspections to Earthquake Zone, 2020 Southwest Puerto Rico Earthquake Sequence Damage, Sat, march 7, 2020 (31 students, 9 professionals).</p> <p>9. Introduction to Seismic Analysis of Structures with SAP2000 - Luis E. Suárez, UPRM, March 10, 2020.</p> <p>10. Introduction to Seismic Analysis of Structures with SAP2000 - Luis E. Suárez, UPRM, March 12, 2020</p> <p>11. Coastal Flood Exposure Mapper Webinar - NOAA Office for Coastal Management, May 21, 2020.</p> <p>12. Introducción al Diseño Sísmico de Estructuras de Concreto Reforzado & FEMA Rapid Visual Screening of Buildings for Seismic Resistances, Webinar, Ricardo Lopez, June 11, 2020 (in Schedule)</p> <p>13. Coastal Resiliency Building, Mainstreaming Adaptation (Capstone Course) - Ernesto Díaz, PR Climate Change Council/DNER-Coastal Management Zone, 8/22/2019.</p> <p>14. Planning and Scheduling a Design and Construction Project - Ismael Pagán Trinidad and Carla López del Puerto, UPRM CRC. Sept 24, 2019.</p>			
<p>Internships:</p> <p>1. SUMREX (July 2019) Two students participated at Oregon State University, sponsored by Dr, Dan Cox (carried over from June 2019) Ihan Jarek Acevedo “Measuring Run-up on a Laboratory-Scale Beach Dune using LiDAR”; Ihan-Jarek T. Acevedo González University of Puerto Rico at</p>	<p>May, 2020</p>	<p>100</p>	

<p>Mayagüez Dr. Meagan Wengrove, O.H. Hinsdale Wave Research Laboratory; Oregon State University, REU</p> <ul style="list-style-type: none"> • NSF PIRE Program Follow Up: “Effects of Storm Surge Barriers on Estuary Ecosystems: A Comparison between Eastern Scheldt and Galveston Bay”, Poster presented in September as a result of her continued research work during Summer 2019 (July) Sofia Rivera, with JSU and TAMUG, Continued. • Cancelled due COVID-19, 2 Candidates were pending to be sent to OSU-Dr. Dan Cox • ERIP - Coastal and Hydraulic Laboratory - Engineer Research and Development Center, Vicksburg. MS • Seek and make available to students and faculty new internship opportunities at other federal agencies and universities. 			
<p>Repeat workshops to new audience (tentative dates)</p> <ol style="list-style-type: none"> Basin Wide Initiatives for Improved Coastal Resilience: UPRM-CRC, FEMA, USACE-ERDC, DRNA, November 13-15, 2019: Basin Wide Coastal Resilience Workshop Group think: Each watershed will identify eligible subwatersheds to construct and implement built projects, both conventional hard engineered and soft engineered solutions. – X,Y,Z, ERDC-USACE Basin Wide Initiatives for Improved Coastal Resilience Site Visit to Watershed; Río Guayanilla - Ismael Pagán Trinidad, UPRM CRC Workshop: GIS Training for Coastal Resource Professionals UPRM-CRC, NOAA, UPRM-CIRC, Sea Grant, December 10-11, 2019 (Participants=30) NOAA Digital Coast Tools for Coastal Resource Professionals; UPRM-CIRC, NOAA, Sea Grant, UPRM-CRC, December 12, 2019 (Participants=25) Riverine and Coastal Flood Hazards with USGS– Planned for April – Postponed for Fall Semester October 2019. PR Chamber of Commerce’s Healthy Buildings’ Task Force: Developing Workforce Projections; (Short, Mid and Long-term) for Environmental Skilled Trades: Asbestos, Lead, and Mold; Friday, Dec. 13, 2019; Interamerican University Law School, San Juan, PR (By Invitation Only). <ol style="list-style-type: none"> Five-Dimensional Project Management (5DPM) for Coastal Communities Workshop - Carla López del Puerto, UPRM CRC, 7/5/2019. Tsunami AwarenessAWR-217 - Victor Huérfano, Puerto Rico Seismic Network and Christa von Hillebrandt, Caribbean Tsunami Warning Program. July 31, 2019. 	<p>May, 2020</p>	<p>100</p>	

<p>Formal Courses:</p> <ol style="list-style-type: none"> 1) INCI 5996 - (Earthquake Assessment and Evaluation) Experiential Learning course offered - 11 students; Dr. José Guevara, Dr. Felipe Acosta, Dr. Arsenio Cáceres, Dr. Ali Saffar, January –May 2020. 2) INCI 4998 – Undergraduate Research: Sofia Rivera Soto, NSF PIRE Program Follow Up: “Effects of Storm Surge Barriers on Estuary Ecosystems: A Comparison between Eastern Scheldt and Galveston Bay”, Paper and Poster presented in September as a result of her continued research work during Summer 2019 (May-September) with JSU and TAMUG, continued. Prof. Ismael Pagán Trinidad. 3) INCI 8999- Dissertation: “Variation of the nonlinear dynamic response of three-dimensional buildings of reinforced concrete considering the directionality of seismic accelerations” by Juan Rodríguez 4) INCI 6066-MS Thesis: <ul style="list-style-type: none"> • “Structural Effects of Tsunami Loads on Coastal Infrastructure,” by Kevin Cueto (Ricardo Lopez). • “Stochastic Simulation of Tropical Cyclones for Quantification of Uncertainty Associated with Storm Recurrence and Intensity” by Efrain Ramos (Ismael Pagán-Trinidad and Norberto Nadal) • "Transportation Resilience in Western Puerto Rico: Hurricane Maria Case Study" By Alexander Molano Santiago (Benjamín Colucci, Ismael Pagán Trinidad, Ricardo López Rodríguez and Luis Aponte Bermúdez) 5) INCI 6065 (Master Engineering Project): <ul style="list-style-type: none"> • Structural Analysis of Common Coastal Structures found on the West Coast of Puerto Rico using FEMA P-646 by Jorge Romeu (Ricardo López/Dr. José Guevara) • "Assessment of Hurricane Vortex Models for the Development of Wind and Pressure Profiles and Fields", By Nelson Y. Cordero (Ismael Pagan & Norberto Nadal) • "Decision support system for gate operation at Claren Cannon National Wildlife Refuge in Pikes County, Missouri" by Oscar Velez Ramos (Ismael Pagán Trinidad) 6) INCI 4950 – Capstone Course: Integrated Civil Engineering Design Project: The WIRE CENTER; 45 students work in the design of resilient and sustainable mix use urban development project which were subjected to multihazards (earthquakes, flooding, and hurricane winds. And soil instabilities. <p>Appropriate courses (including new ones) in the curriculum sequence will be offered based on demand. One to two courses will be offered per semester based on needs and demands.</p>	<p>Dec. 2019 & May 2020</p>	<p>100</p>	
--	---	------------	--

<p>Curriculum Sequence – Certificate</p> <ul style="list-style-type: none"> • We are developing capacity building trainings and educational modules which will Impact on the formal Civil Engineering curriculum. • This includes incorporating new content into existing courses and providing professional complementary trainings. • Students are issued certificates of participation to recognize their involvement in the program. 	January 2021	95%	<p>Almost completed. The plan was followed.</p> <ul style="list-style-type: none"> • Courses to be impacted were identified. • Educational modules were developed. • Collaboration with other parallel initiatives in these topics were completed • Certificates have been awarded to students • The only thing pending is to issue certificates to participating students. Pending to finish in January
<p>Website: The website will be updated and documentation form the project and CRC will be incorporated.</p>	Dec. 2019	100	
<p>Publications/Documentation/Divulgateion: Continue efforts to facilitate access to public domain literature on state practice and advances in resilience of coastal infrastructure. Efforts will be targeting peer-reviewed forums, preferable at the national level, e.g., ASEE, ASCE Annual conferences.</p>	June, 2019	100	Web Site
<p><u>Education Milestones</u></p>			
<p>Advance the state of knowledge of various constituencies through technology transfer, training, and teaching</p> <p><u>Metric:</u> Number of participants and number of certificate issued</p>	Aug. 2019 – June 2020	100	
<p>Provide alternative learning, motivation and incentives to students through research and experiential work in internships. Introduce students into a pipeline toward HSE advanced graduate education and research careers and jobs</p> <p><u>Metric:</u> Number of students and nature of experiences participating in alternative learning initiatives</p>	Summers 2019 & 2020	100	
<p>Provide state of practice through practical workshops</p>	Dec-19, Jun-20	100	

Incorporate HSE into the continuing education and formal education curriculum	Dec-19, Jun-20	100	
Advance state of knowledge by divulgation and providing access to state-of -practice technology on resilient infrastructure. <u>Metric:</u> Number and nature of initiatives for divulgation	June, 2019	100	
Institutionalize the Curricular Sequence (Certificate) on Infrastructure Resilience <u>Metric:</u> Number and nature of activities support by the Center- See Statistics and list of activities presented previously.	May, 2020	100	

2. Year 5 Transition Activities and Milestone Achievements:

Year 5 Transition Activities and Milestones: Status as of 6/30/2020			
<u>Transition Activity</u>	<u>Proposed Completion Date</u>	<u>% Complete</u>	<u>Explanation of why activity/milestone was not completed</u>
A target of 10 students is expected to begin the first round of certificates. (35 students enrolled in Capstone Course were issued the Certificate)	May 2020	100	
Establish the Civil Infrastructure Research Center (CIRC) at the CE Department as a Technology Transfer and Training Unit for RCI	May 2020	100	
Institutionalize a Local Annual Meeting addressing the advances of “Advances in Analyses / Design / Operation/Maintenance / Retrofitting of Resilient Coastal Infrastructure.” Invitees will include academics, university partners, and local emergency planners.	April 2020	100	
Identify and diversify possible resources to offer SLSc activities (Advances in Resilient Coastal Infrastructure) by the end of first year :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, others); Extreme Climate Adaptation.	Dec. 2019	100	
<u>Internships:</u> Internships are dependent on availability of positions, qualification requirements, and acceptance by particular internship hosts. Our target will be at least three different sites, receive at least 10 applications, and place at least five students. For the uncertainty of not	Summer 2019	100	

<p>depending on ourselves to allocate students for internships and professional practical experiences, we will also consider hosting summer students at UPRM through undergraduate research and special problems in the topics.</p> <ul style="list-style-type: none"> • SUMREX: Coordination with CRC Research PIs to identify and diversity positions to allocate students with available partner PIs • Seek new opportunities at the Coastal and Hydraulic Laboratory-ERDC, Vicksburg, MS • Seek new opportunities at other federal agencies and universities • Pursue student exchange programs with NCSU, UNC, OSU, and others 			
<p>Repeat workshops to new audience (tentative dates)</p> <ul style="list-style-type: none"> • <u>Basin Wide Initiatives for Improved Coastal Resilience: UPRM-CRC, FEMA, USACE-ERDC, DRNA ,November 13-15, 2019 : Basin Wide Coastal Resilience Workshop</u> Group think: Each watershed will identify eligible subwatersheds to construct and implement built projects, both conventional hard engineered and soft engineered solutions. X,Y,Z ERDC- USACE • <u>Basin Wide Initiatives for Improved Coastal Resilience Site Visit to Watershed; Río Guayanilla - Ismael Pagán Trinidad, UPRM CRC</u> • <u>Workshop: GIS Training for Coastal Resource Professionals UPRM-CRC, NOAA., UPRM-CIRC, Sea Grant, December 10-11, 2019 (Participants=30)</u> • <u>NOAA Digital Coast Tools for Coastal Resource Professionals; UPRM-CIRC, NOAA, Sea Grant, UPRM-CRC, December 12, 2019 (Participants=25)</u> • <u>Riverine and Coastal Flood Hazards with USGS (Walter Silva)– Planned for April – Postponed for Fall Semester October 2019.</u> • <u>PR Chamber of Commerce’s Healthy Buildings’ Task Force: Developing Workforce Projections; (Short, Mid and Long-term) for Environmental Skilled Trades: Asbestos, Lead, and Mold; Friday, Dec. 13, 2019; Interamerican University Law School, San Juan, PR (By Invitation Only).</u> • <u>Five-Dimensional Project Management (5DPM) for Coastal Communities Workshop - Carla López del Puerto, UPRM CRC, 7/5/2019.</u> • <u>Tsunami AwarenessAWR-217 - Victor Huérfano, Puerto Rico Seismic Network and Christa von Hillebrandt, Caribbean Tsunami Warning Program. July 31, 2019.</u> • 	<p>May 2020</p>	<p>100</p>	
<p>Curriculum Sequence - Certificate and Formal Courses Offering</p> <ul style="list-style-type: none"> • Increase students in the curriculum sequence • Certificate program will continue to be promoted and announced 	<ul style="list-style-type: none"> • Jan 2021 	<ul style="list-style-type: none"> • 95% 	<ul style="list-style-type: none"> • Almost finished. The plan was being followed. • 1. Certificates: Issuing certificates to participating students will be

<ul style="list-style-type: none"> • Completion of first round of certificates. • Theses, undergraduate research, special problems and other appropriate course will offered based on demand to be included in the curricular sequence. 			<p>finished be the end of January.</p> <ul style="list-style-type: none"> • • Module development: • a. Water Resources Engineering (INCI4138) course: "This module was incorporated and presented to the 26 students in the course. The natural hazards directly related to water such as hurricanes, storm surge, floods, heavy rainfall as well as droughts periods are frequently associated to the class material. The risk assessment to have more resilient infrastructure during the construction process as well as during the service life of the water infrastructure is also presented. propose alternative for future study. • b. "Planning and Accounting for Adverse Weather" (3 contact hours) • A module titled "Planning and Accounting for Adverse Weather" was developed based on ACE® International Recommended Practice No. 84R-13. Construction
---	--	--	--

			<p>projects, particularly those in coastal communities, are exposed to adverse weather events which impact the project schedule. The module developed discusses weather-related terms and definitions, identifies methodologies for adverse weather planning, and provides recommendations for managing actual weather documentation.</p> <ul style="list-style-type: none"> • During Fall 2020, 4 graduate students and 1 undergraduate student enrolled in INCI 6070 completed the module. • c. Other modules will continue to be developed based on the structure already developed.
<p>Publications/Documentation/Divulgence: Continue efforts to divulge public domain literature on state practice and advances in resilience of coastal infrastructure. The website will be updated and documentation from the Project and CRC will be incorporated. These publications could be peer reviewed or from other reputable accessible sources.</p>	June 2020	100	
<p><u>Transition Milestone</u></p>			
<p>Curricular Alternatives in Civil Engineering/Surveying: Expand and diversify the students' participation in the certificate curricular sequence to the RCI specialty by offering a variety of learning alternatives. Seek more courses and alternative learning opportunities for students.</p> <p><u>Metric:</u> Number and nature of impacts on the curriculum</p>	June 2020	100	

<p>Technology Transfer and Capacity Building: Maintain the technology transfer mechanisms on RCI to professionals and civil engineering/surveying students through training or access to the state of practice literature and educational resources.</p> <p><u>Metric:</u> Number and nature of initiatives</p>	June 2020	100	
<p>Enhance Students Options and Opportunities to Access Jobs in HSE: 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. Seek and follow up on job opportunities from federal, state and local government. Post and distribute job opportunities among participating students and the student's community either in Civil Engineering or other disciplines in Campus.</p> <p><u>Metric:</u> Number of job opportunities, job fairs, HLS companies visiting campus</p>	June 2020	100	
<p>Engage Faculty Leaders: 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. Attract and collaborate with faculty from other disciplines like Social Sciences, Marine Science, and other engineering disciplines to motivate and support their engagement in RCI initiatives.</p> <p><u>Metric:</u> Number faculty has engaged in RCI leadership and type of initiative</p>	May 2020	100	

3. Annual Courses and Enrollments

Annual Courses and Enrollments

<u>Courses Developed and Taught by University of Puerto Rico Mayaguez under Project Education for Improving Resiliency of Coastal Infrastructure</u>						
<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>YR 5</u>
<u>INCI6997</u>	<u>Course Title: "Rehabilitation of Coastal Structures (under development)"- Guevara</u>					
<u>INCI5995</u>	[Dual codes for graduate and undergraduate]					
<u>Status: Developed (D), Revised (R), and or Taught (T)</u>		-	<u>D</u>	<u>T</u>	-	-
<u>Offering: Elective (E), Concentration (C), Minor (M)</u>		<u>0</u>	<u>E</u>	<u>E</u>	-	-
<u>Enrollment</u>		<u>0</u>	<u>0</u>	<u>7</u>	-	-
<u>INCI6XXX</u>	<u>Course Title: "Resilience and Reliability of Coastal Infrastructures (under development)"- Saffar</u>	<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>	<u>YR 5</u>
<u>INCI5XXX</u>						
<u>Status: Developed (D), Revised (R), and or Taught (T)</u>		-	<u>D</u>	<u>R</u>	<u>R</u>	<u>R</u>
<u>Offering: Elective (E), Concentration (C), Minor (M)</u>		-	<u>E</u>	<u>E</u>	-	-

<u>Enrollment</u>		-	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
<u>INCI6995</u>						
<u>Course Title: “CE Special Problems” (Graduate)</u>		<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>	<u>YR 5</u>
<u>Status: Developed (D), Revised (R), and or Taught (T)</u>						
“A Novel Boussinesq -Type Numerical Wave Model Development” – IPT		<u>T</u>	<u>T</u>	-	-	-
“Stochastic Simulation of Tropical Cyclones for the Quantification of Uncertainty Associated with Storm Recurrence and Intensity: Phase II” – IPT		<u>T</u>	<u>T</u>	-	-	-
“Analysis of a Ring Levee Breach Using Adaptive Hydraulic” – IPT		<u>T</u>	<u>T</u>	-	-	-
“US Army Improved Ribbon Bridge” – IPT		-	<u>T</u>	-	-	-
Feasibility of Using the Weather Research and Forecasting Model (WRF) as forcing to the Advanced Circulation Model (ADCIRC) – IPT		-	<u>T</u>	-	-	-
“Assessment of Existing Tropical Cyclone Vortex Models for the Development of Wind and Pressure Profiles and Fields”		-	-	<u>T</u>	-	-
"Vulnerability of Rubble Mound Structures"		-	-	-	<u>T</u>	-
<u>Offering: Elective (E), Concentration (C), Minor (M)</u>		<u>E/C</u>	<u>E/C</u>	<u>C</u>	<u>C</u>	-
<u>Enrollment</u>		<u>3</u>	<u>5</u>	<u>1</u>	<u>1</u>	-
<u>INCI5996</u>						
<u>Course Title: “Special Problems (Undergraduate Project)”</u>		<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>	<u>YR 5</u>
<u>Status: Developed (D), Revised (R), and or Taught (T)</u>						
“Impact of Projected Sea Water Rise on Coastal Infrastructures” - IPT		<u>T</u>	-	-	-	-
“Ship Simulation Study”- IPT		-	<u>T</u>	-	-	-
“Utilities and Building Inventory For Resiliency Analyses at the Mayagüez Municipality Coastal Zone” - Dr. Ricardo Ramos		-	<u>T</u>	-	-	-
"Design and Analysis of Pavements in Coastal Environments"-BCR		-	-	<u>T</u>	-	-
Assessment of Hurricane Vortex Models and Boundary Layer Models for the Development of Wind and Pressure Profiles and Fields - IPT		-	-	-	<u>T</u>	-
“Inspection and Rehabilitation of Earthquake-Affected Structures” - Dr. José Guevara		-	-	-	-	<u>T</u>
<u>Offering: Elective (E), Concentration (C), Minor (M)</u>		<u>E</u>	<u>E</u>	<u>E</u>	<u>E</u>	<u>E</u>
<u>Enrollment</u>		<u>1</u>	<u>4</u>	<u>1</u>	<u>1</u>	<u>11</u>
<u>INCI6066</u>						
<u>Course Title: Master of Science Thesis</u>		<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>	<u>YR 5</u>
<u>Status: Developed (D), Revised (R), and or Taught (T)</u>						
“Structural Effects of Tsunami Loads on Coastal Infrastructure,” by Kevin Cueto (Ricardo Lopez)		-	<u>D</u>	<u>T</u>	<u>T</u>	<u>T</u>

	“Computation of Gradually Varied Flow in Channel Networks with Hydraulic Structures” by Felix Santiago (Walter Silva)	-	<u>D</u>	<u>T</u>	-	-
	“Cost analysis of the alternatives to mitigate damage to the infrastructure in Rincon” by Francisco Villafañe (Luis Aponte)	-	<u>T</u>	<u>T</u>	-	-
	“Stochastic Simulation of Tropical Cyclones for Quantification of Uncertainty Associated with Storm Recurrence and Intensity” by Efrain Ramos (Ismael Pagán-Trinidad and Norberto Nadal)	<u>D</u>	<u>T</u>	<u>T</u>	<u>T</u>	<u>T</u>
	"Transportation Resilience in Western Puerto Rico: Hurricane Maria Case Study" By Alexander Molano Santiago (Benjamín Colucci, Ismael Pagán Trinidad, Ricardo López Rodríguez and Luis Aponte Bermúdez)	-	-	-	<u>D</u>	<u>T</u>
<u>Offering: Elective (E), Concentration (C), Minor (M)</u>		-	<u>C</u>	<u>C</u>	<u>C</u>	<u>C</u>
<u>Enrollment</u>		<u>1</u>	<u>4</u>	<u>4</u>	<u>3</u>	<u>3</u>
<u>INCI6065</u>	<u>Course Title: <i>Master of Engineering Project</i></u>	<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>	<u>YR 5</u>
	<u>Status: Developed (D), Revised (R), and or Taught (T)</u>					
	Structural Analysis of Common Coastal Structures found on the West Coast of Puerto Rico using FEMA P-646 by Jorge Romeu (Ricardo López)	-	<u>D</u>	<u>T</u>	<u>T</u>	<u>T</u>
	"Assessment of Hurricane Vortex Models for the Development of Wind and Pressure Profiles and Fields", By Nelson Y. Cordero (IPT & Norberto Nadal)	-	-	-	<u>D</u>	<u>T</u>
	"Decision support system for gate operation at Claren cannon national wildlife refuge in Pikes County, Missouri" by Oscar Velez Ramos (IPT)	-	-	-	<u>T</u>	<u>T</u>
<u>Offering: Elective (E), Concentration (C), Minor (M)</u>		-	<u>C</u>	<u>C</u>	<u>C</u>	<u>C</u>
<u>Enrollment</u>		-	<u>1</u>	<u>1</u>	<u>3</u>	<u>3</u>
<u>INCI8999</u>	<u>Course Title: <i>PhD Dissertation</i></u>	<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>	<u>YR 5</u>
	<u>Status: Developed (D), Revised (R), and or Taught (T)</u>					
	“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	-	<u>T</u>	<u>T</u>	<u>T</u>	-
	“Variation of the nonlinear dynamic response of three-dimensional buildings of reinforced concrete considering the directionality of seismic accelerations” by Juan Rodríguez	-	<u>D</u>	<u>T</u>	<u>T</u>	<u>T</u>
	“Dynamic Identification and Nonlinear Modeling for the Structural Health Assessment of Aged Coastal Infrastructure in Puerto Rico” by Angel Alicea	<u>D</u>	<u>T</u>	<u>T</u>	<u>T</u>	-
<u>Offering: Elective (E), Concentration (C), Minor (M)</u>		-	<u>C</u>	<u>C</u>	<u>C</u>	<u>C</u>
<u>Enrollment</u>		<u>1</u>	<u>3</u>	<u>3</u>	<u>3</u>	<u>1</u>
<u>INCI4950</u>		<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>	<u>YR 5</u>

	<u>Course Title: Civil Engineering Integrated Design Project - Capstone Course</u>					
<u>Status: Developed (D), Revised (R), and or Taught (T)</u>		-	<u>T</u>	<u>T</u>	<u>T</u>	<u>T</u>
<u>Offering: Elective (E), Concentration (C), Minor (M)</u>		-	<u>C</u>	<u>C</u>	<u>C</u>	<u>C</u>
<u>Enrollment</u>		-	<u>45</u>	<u>43</u>	<u>65</u>	<u>45</u>
<u>CIMA8999</u>	<u>Course Title: Marine Science PhD Dissertation</u>	<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>	<u>YR 5</u>
<u>Status: Developed (D), Revised (R), and or Taught (T)</u>		-	<u>D</u>	<u>D</u>	<u>D</u>	-
<u>Offering: Elective (E), Concentration (C), Minor (M)</u>		-	<u>C</u>	<u>C</u>	<u>C</u>	-
<u>Enrollment</u>		-	<u>1</u>	<u>1</u>	<u>1</u>	-
<u>CIMA6999</u>	<u>Course Title: Marine Science Master Thesis</u>	<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>	<u>YR 5</u>
<u>Status: Developed (D), Revised (R), and or Taught (T)</u>		-	<u>D</u>	<u>D</u>	-	-
<u>Offering: Elective (E), Concentration (C), Minor (M)</u>		-	<u>C</u>	<u>C</u>	-	-
<u>Enrollment</u>		-	<u>1</u>	<u>1</u>	-	-
<u>INCI4998</u>	<u>Course Title: Civil Engineering Undergraduate Research</u>	<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>	<u>YR 1</u>
<u>Status: Developed (D), Revised (R), and or Taught (T)</u>		-	<u>T</u>	<u>T</u>	<u>T</u>	<u>T</u>
<u>Offering: Elective (E), Concentration (C), Minor (M)</u>		-	<u>C</u>	<u>C</u>	<u>E</u>	<u>E</u>
<u>Enrollment</u>		-	<u>1</u>	<u>1</u>	<u>17</u>	<u>6</u>
-	<u>Course Title:</u>	<u>YR 1</u>	<u>YR 2</u>	<u>YR 3</u>	<u>YR 4</u>	<u>YR 5</u>
<u>Status: Developed (D), Revised (R), and or Taught (T)</u>		-	-	-	-	-
<u>Offering: Elective (E), Concentration (C), Minor (M)</u>		-	-	-	-	-
<u>Enrollment</u>		<u>0</u>	<u>0</u>	<u>0</u>	-	-
-	-	-	-	-	-	-
-	-	<u>Annual Enrollment:</u>	<u>6</u>	<u>65</u>	<u>63</u>	<u>94</u>
						<u>67</u>

IV. PUBLICATIONS AND METRICS

1. Publications:

a) Publications

- “Complexity Mapping for Resilient and Sustainable Infrastructure”; Manuscript Published as: López del Puerto, C., Suárez, L. Gransberg, D.D., and Montañez, J., “Complexity Mapping for Resilient and Sustainable Infrastructure, Proceedings, VII Conferencia Internacional de Ciencia y Tecnología de la Ingeniería, IESTEC-2019, Panama City, Panama, October, 2019. Peer reviewed.
- KEEP SAFE A GUIDE FOR RESILIENT HOUSING DESIGN IN ISLAND COMMUNITIES, All rights reserved. © Published by 2019 Enterprise Community Partners, Inc. Disclaimer: The PI’s participated in the book

development as Advisors, Workshop leaders, Reporters and Invited participants of the book presentation.

- Effects of Storm Surge Barriers on Estuary Ecosystems: A Comparison between Eastern Scheldt and Galveston Bay, Sofía N. Rivera Soto; University of Puerto Rico at Mayagüez, Mayagüez, P.R., sofia.rivera6@upr.edu; Dr. Samuel Brody; Texas A&M at Galveston, Galveston, Texas, brodys@tamug.edu; Dr. Yoonjeong Lee; Texas A&M at Galveston, Galveston, Texas, yoonee@tamu.edu; Prof. Ismael Pagán Trinidad; University of Puerto Rico at Mayagüez, Mayagüez, P.R., ismael.pagan@upr.edu. A Final Technical Paper submitted as part of the requirement of her participation in the NSF PIRE Program. 2019 Summer Research Internship Program Partnership for International Research and Education – The Netherlands Texas A&M at Galveston, Jackson State University and University of Puerto Rico at Mayagüez. September 2019.
- Measuring Run-up on a Laboratory-Scale Beach Dune using LiDAR, Ihan-Jarek T. Acevedo González University of Puerto Rico at Mayagüez Dr. Meagan Wengrove, O.H. Hinsdale Wave Research Laboratory, Oregon State University, REU, Summer 2019. (Report presented as part of his Summer Internship at OSU)
- Erosion Analysis of Dune Types for a Typical East Coast Beach under Hurricane Conditions using Bathymetric and LiDAR Measurements. Authors: Robert Lewis^{1,2}, Jeremy Smith³, Meagan Wengrove¹; 1O.H. Hinsdale Wave Laboratory, Oregon State University, Corvallis, OR 97331; 2Department of Civil Engineering, University of Puerto Rico-Mayagüez, Mayagüez, PR. 00682; 3Department of Civil and Environmental Engineering, Stanford University, Stanford, CA94305, December 2019. (Report presented as part of his Summer Internship at OSU)

b) Theses/Dissertations

- A Decision Support System for Gate Operations at Clarence Cannon National Wildlife Refuge (CCNWR) in Pike County, MO., Oscar A. Vélez Ramos, A project report submitted in partial fulfillment of the requirements for the degree of MASTER OF ENGINEERING in CIVIL ENGINEERING UNIVERSITY OF PUERTO RICO, MAYAGÜEZ CAMPUS. May 2020. Advisors: Ismael Pagán Trinidad, UPRM and Norberto Nadal, ERDC. Co-Advisors. UPRM-CHL ERDC Collaboration.
- STOCHASTIC SIMULATION OF TROPICAL CYCLONES FOR QUANTIFICATION OF UNCERTAINTY ASSOCIATED WITH STORM RECURRENCE AND INTENSITY; Efraín Ramos-Santiago; A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in CIVIL ENGINEERING, UNIVERSITY OF PUERTO RICO, MAYAGÜEZ CAMPUS, July 2019. Advisors: Ismael Pagán Trinidad, UPRM and Norberto Nadal, ERDC. Co-Advisors. UPRM-CHL ERDC Collaboration.
- ASSESSMENT OF HURRICANE VORTEX MODELS FOR THE DEVELOPMENT OF WIND AND PRESSURE PROFILES AND FIELDS, Nelson Y. Cordero-Mercado; Master's Progress Project Report Draft expected to be presented in Summer 2020 pending final submittal in partial fulfillment of the

requirements for the degree of MASTER OF ENGINEERING in CIVIL
ENGINEERING UNIVERSITY OF PUERTO RICO, MAYAGÜEZ CAMPUS, May
2020.

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)	<u>Year 5</u> (7/1/19— 6/30/20)
HS-related internships (number)	10	16	9	9	11
Undergraduates provided tuition/fee support (number)		1	2 - ERDC	5	5
Undergraduate students provided stipends (number)		2	1	9	10
Graduate students provided tuition/fee support (number)	5	9	5	7	3
Graduate students provided stipends (number)	6	9	4	7	4
Undergraduates who received HS-related degrees (number)		N/A	2	3	5
Graduate students who received HS-related degrees (number)		N/A	2	1	2
Certificates awarded (number)		245	800	893	821
Graduates who obtained HS-related employment (number)		2	1	1	6
Lectures/presentations/seminars at Center partners (number)		1	2	2	0
DHS MSI Summer Research Teams hosted (number)		N/A	N/A	N/A	N/A
Journal articles submitted (number) *- ASEE, ASCE, ITE	1	0	4	3*	1
Journal articles published (number) *- ASEE, ASCE, ITE	1	0	4	3*	1
Conference presentations made (number) **-All kind of conferences, Seminars, and panels	2	31	23	62	41
Other presentations, interviews, etc. (number)	2	8	5	6	5
Trademarks/copyrights filed (number)		0	0	0	0
Requests for assistance/advice from DHS agencies (number)				10	2
Requests for assistance/advice from other Federal agencies or state/local governments (number)	5		4	9	10
Dollar amount of external funding	\$95,760	\$58,000	\$110,534	\$550K	\$796k *** RAND, ERDC, Southern Command, EPA
Total milestones for reporting period (number)		2	7	9	12
Accomplished fully (number)	2	2	7	9	11
Accomplished partially (number)		N/A	N/A	N/A	1
Not accomplished (number)		N/A	N/A	N/A	0