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Extreme Performance Testing Center

Seoul National University

Sponsored by  Ministry of Land, Infrastructure and Transport  KAIA Korea Agency for Infrastructure Technology Advancement



Greetings



Welcome to Extreme Performance Testing Center (EPTC).

EPTC of Seoul National University is a facility that can simulate the extreme loads and environments to evaluate the behavior of SOC infrastructures. Extreme loads such as impact or impulsive load due to a collision of transport, missiles, and natural disasters, and extreme environment under ultimate high and low temperature can be simulated in this testing facility. EPTC equipped with the world-class state-of-the-art research facilities will contribute to public interests such as development of new materials, establishment of analysis theories and design specification, and creation of efficient structural system, thereby improving the performance of civil/building structures under extreme events.

Thank you.

Director
Prof. Jae-Yeol Cho

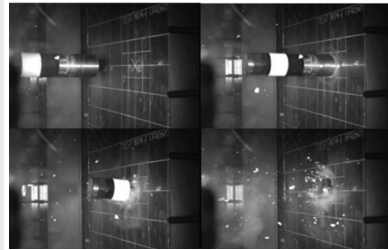
History

- 12/23/2013 Signed the project
(Establishment of Structural Performance Testing Facilities for Extreme Conditions)
- 03/06/2015 Completion of design
- 02/07/2016 Completion of construction work
- 10/22/2018 Termination of the project and Running the EPTC

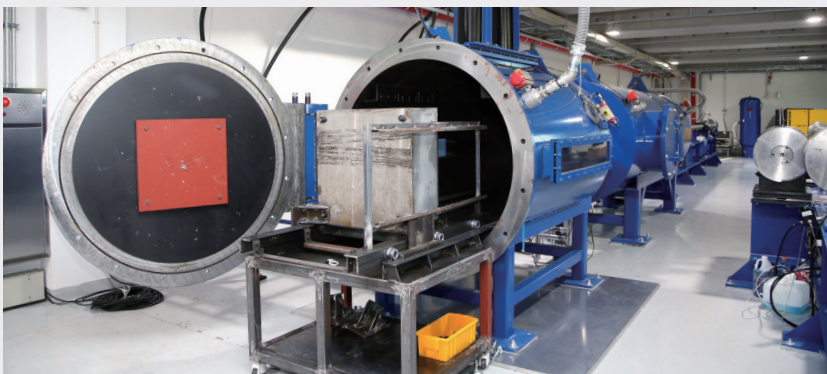
● Middle Velocity Propulsion Impact Machine (Single-stage Gas Gun)



- Performance
 - Diameter of a projectile : ~250mm
 - Size of a target : 2.1m×2.1m (B×H)
 - Mass of a projectile : 10~100kg
 - Velocity of a projectile : 220~470m/s
- Application
 - Simulate aircraft collision to nuclear power plant
 - Simulate missile impact to weapon hangar
 - Assess the protective performance ocean plant, and large vessel, etc.

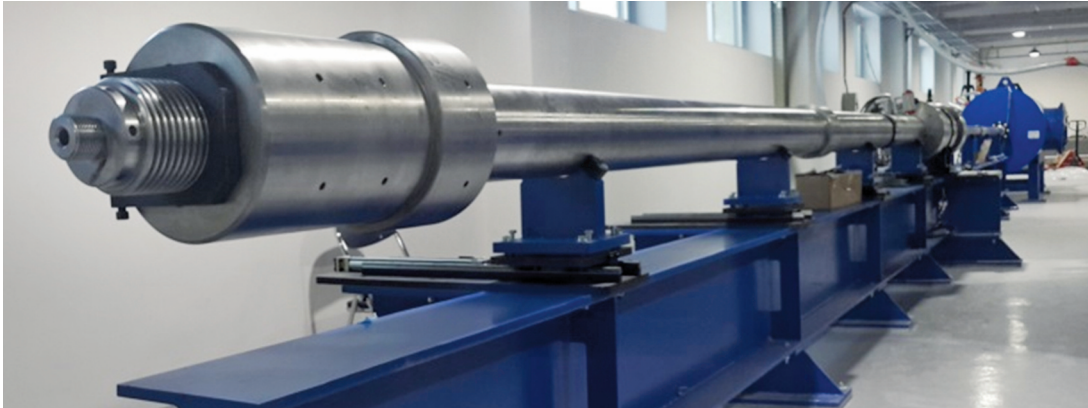


● High Velocity Propulsion Impact Machine (Single-stage Gas Gun)

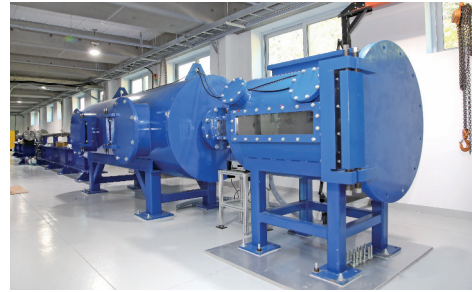


- Performance
 - Diameter of a projectile : ~60mm
 - Size of a target : 0.7m×0.7m (B×H)
 - Mass of a projectile : 0.5~5kg
 - Velocity of a projectile : 0.5~1.2km/s
- Application
 - Verify the performance of materials for long span ridge/skyscraper/plant
 - Verify the performance of bullet & bulletproof equipment
 - Verify the performance of materials for high-speed train/aircraft/vehicle/vessel

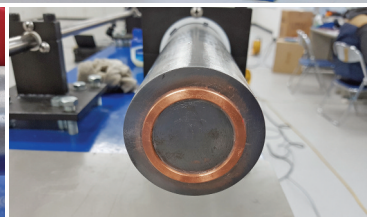
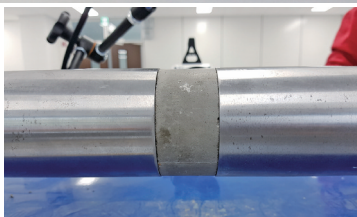
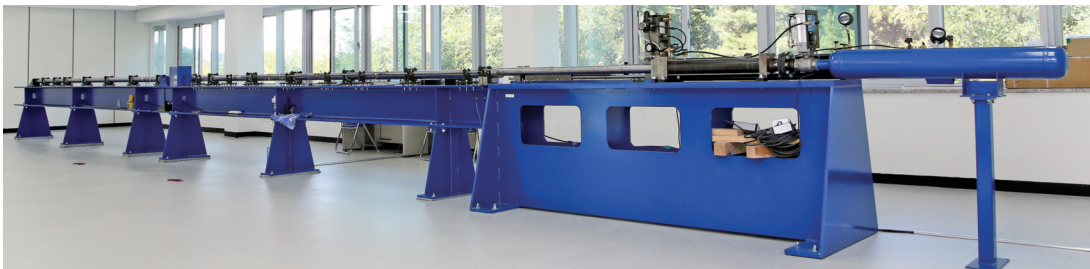
|| Hypervelocity Propulsion Impact Machine (Two-stage Gas Gun)



- || Performance
 - Diameter of a projectile : ~25mm
 - Size of a target : 0.5m×0.5m (B×H)
 - Mass of a projectile : 25~200g
 - Velocity of a projectile : 2.6~7km/s
- || Application
 - Verify the safety of spacecraft and satellite for space debris impact
 - Simulate the geologic formation in planets



|| Split Hopkinson Pressure Bar

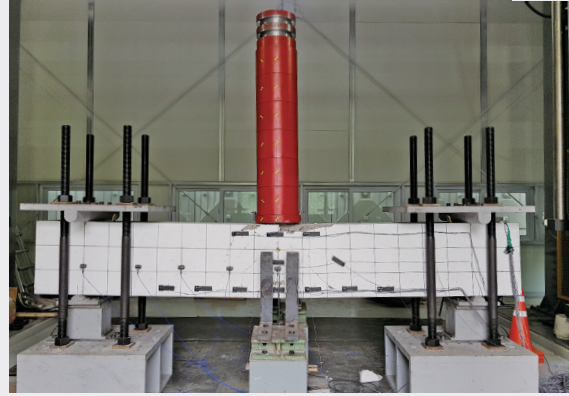


- || Performance
 - Strain rate : $\sim 10^4 \text{ s}^{-1}$ / $\sim 10^3 \text{ s}^{-1}$
 - Diameter of bar components : 19mm / 75mm
 - Impact velocity : $\sim 30 \text{ m/s}$ / $\sim 20 \text{ m/s}$
 - Specimen materials : metal, concrete, ceramics, polymer etc.
- || Application
 - Obtain the stress-strain curve of materials under high strain rate
 - Civil/building engineering field : concrete, UHPC, FRC, steel, etc.
 - Mechanics/aerospace/marine engineering field : aluminum, titanium, alloy, plastic, etc.

Drop Weight Impact Tester



- Performance**
 - Weight : ~3tonf
 - Height : ~15m
 - Strong bed : 4.5m×4.5m
 - Impact velocity : ~17m/s
- Application**
 - Verify protective performance of wall of plant, harbor structure, bridge pier
 - Verify protective performance of vehicle, vessel, aircraft, etc.
 - Mock-up test of impact of heavy weight freight, falling rock, etc.



Extreme Temperature Chamber



- Performance**
 - Temperature range : -60~60℃
 - Capacity of dynamic UTM : 500kN
 - Temperature deviation : ±1℃
 - Stroke of dynamic UTM : 300mm
 - Chamber size : 12m×5m×3m (L×W×H)
 - Frequency of dynamic UTM : 5Hz
 - Humidity control range : 25~90% (at 25~60℃)
 - Temperature control rate : 1℃/min for heating, -0.5℃/min for freezing
- Application**
 - Performance test of members and materials in high/low temperature
 - Verify performance of vehicle, wind power supplier, etc.
 - Verify qualities of materials such as concrete, aluminum, titanium, magnesium, alloy, etc.
 - Development & Verification of construction method in hottest & coldest places
 - Simulate frost heaving due to freeze-thaw of the ground
 - Assess weld-ability on low temperature
 - Assess freezing behavior of pipe lines

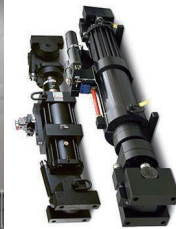
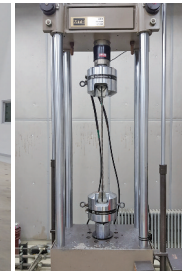
High-speed Hydraulic Loading Machine



- Performance
 - Compression force : 320kN at 5m/s velocity
 - Tension force : 330kN at 10m/s velocity
- Application
 - Compressive, tensile, flexural test at high strain rate in various fields
 - Construction materials for bridge, building, and plant
 - Marine materials for aircraft, vehicle, vessel, etc.

	Material	Specimen Dimension [mm]	Strength [MPa]		Gage Length [mm]	Strain Rate [/s]	Force [kN]	Velocity [m/s]	
			Static	Dynamic					
Comp.	General Concrete	Cylinder (Φ75×150)	40	72	50	100	320	5	
Tension	General Concrete	Dumbbell Shape L×W×T (500×100×50)	5	15	100	100	75	10	
	Fiber Reinforced Concrete		12	40	100	100	200	10	
	Steel Bar (Grade 60)	Φ19	710		150	95	200	9.5	
	Steel Strand (7-wire Strand)	Φ15.2	1,860		100	100	258	10	
			2,160		100	100	300	10	
			2,400		100	100	333	10	
	FRP Bar	GFRP	Φ12	758		100	100	96	10
		CFRP	Φ12	2,068		100	100	234	10
		AFRP	Φ12	1,326		100	100	150	10
	FRP Tendon	Φ10	2,450		100	100	192	10	
	FRP Composites Bar	Φ12	600		50	100	70	5	

Material/Structure Test Facilities



Performance

Equipment / Facility		Performance
Structural Test Facility	Strong Floor	• Size : 13m×33m (W×L)
	Strong Wall	• Size : 13m×8m (W×H)
	Loading Frame	• Capacity : 5,000kN, 5.2m×8m (W×H)
	Overhead Crane	• Capacity : 25ton+10ton Dual
	Main Gate	• Size : 7m×6m (W×H)
UTM	MTS 311	• Load : ±5,000kN (Dynamic) • Stroke : 500mm
	MTS 815	• Compressive load : 2,853kN (Dynamic) • Tensile load : 1,344kN (Dynamic) • Stroke : 100mm
	MTS 810	• Load : ±500kN (Dynamic) • Stroke : 100mm
Actuators	MTS 244.41	• Load : ±500kN (Dynamic) • Stroke : 508mm
	MTS 243.70T	• Compressive load : 1,460kN (Static) • Tensile Load : 960kN (Static) • Stroke : 508mm
	STC 1000	• Load : ±500kN (Static) • Stroke : 60mm

|| Pendulum Impact Tester



- Performance**
 - Impactor weight : 0.8~2.0tonf
 - Height : 5m
 - Impact energy : 39.2~100kJ
- Application**
 - Verify the impact resistant performance of road safety facilities such as crash barrier, column of traffic signs, rigid protective wall, etc.
 - Evaluate the behavior of retaining wall for landslide
 - Simulate ship impact for pier & pile



|| High-speed Camera



- Performance**
 - Model : Phantom V711
 - Max. resolution : 1,024×800pixels at 7,530FPS
 - Max. frame rate : 153,200FPS with 256×128pixels
 - Exposure time : 1μs
 - Model : Photron FASTCAM SA-Z
 - Max. resolution : 1,024×1,024pixels at 20,000FPS
 - Max. frame rate : 300,000FPS with 256×128pixels
 - Exposure time : 0.159μs
- Application**
 - Obtain impact and crash image of projectile and specimen during high speed impact test

|| Flash X-ray System

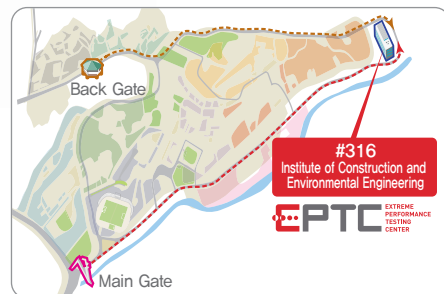
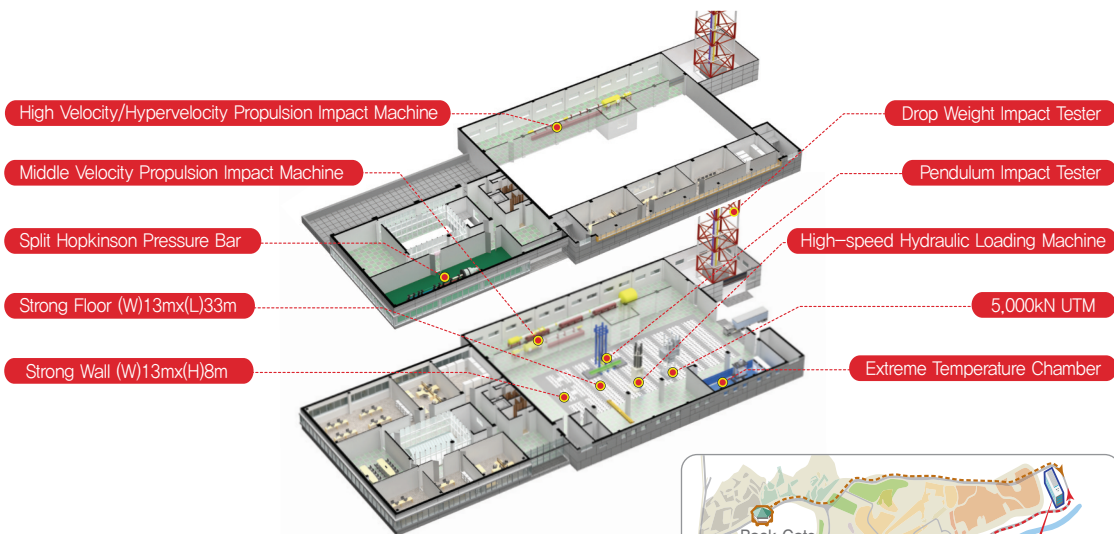


- Performance**
 - 450kV single X-ray tube
 - 2 Pulsers with 4 tube heads
 - 14"×17" image plate
 - Maximum steel penetration : 55mm
 - Limit film-to-source distance : 7.6m
 - Exposure time : 25ns
- Application**
 - Obtain impact and crash image of projectile and specimen during high speed impact test when visible light is limited due to debris, flash, etc.
 - Especially, used to observe explosively formed projectiles, hypervelocity impact, energetic materials, etc.

DAQ System



- Performance
- A/D measuring frequency : 1MHz
 - Minimum time interval : 1 μ s
 - The number of channels : 64channels
 - 16channels : accelerometer
 - 48channels : displacement meter, strain gauge, load cell, etc.
 - Capable of acquiring data at high rates



Contact Address

Director **Prof. Jae-Yeol Cho** (+82-2-880-1522 / jycho@snu.ac.kr)
 Manager **Mr. Kwon-Taek Kim** (+82-2-880-4187 / teagi@snu.ac.kr)