Universidad de los Andes
Facultad de Ingeniería

Effect of Set Up Parameters of Landmine Blast over Transferred Energy to a Rigid Body: Experimental and Computational Study

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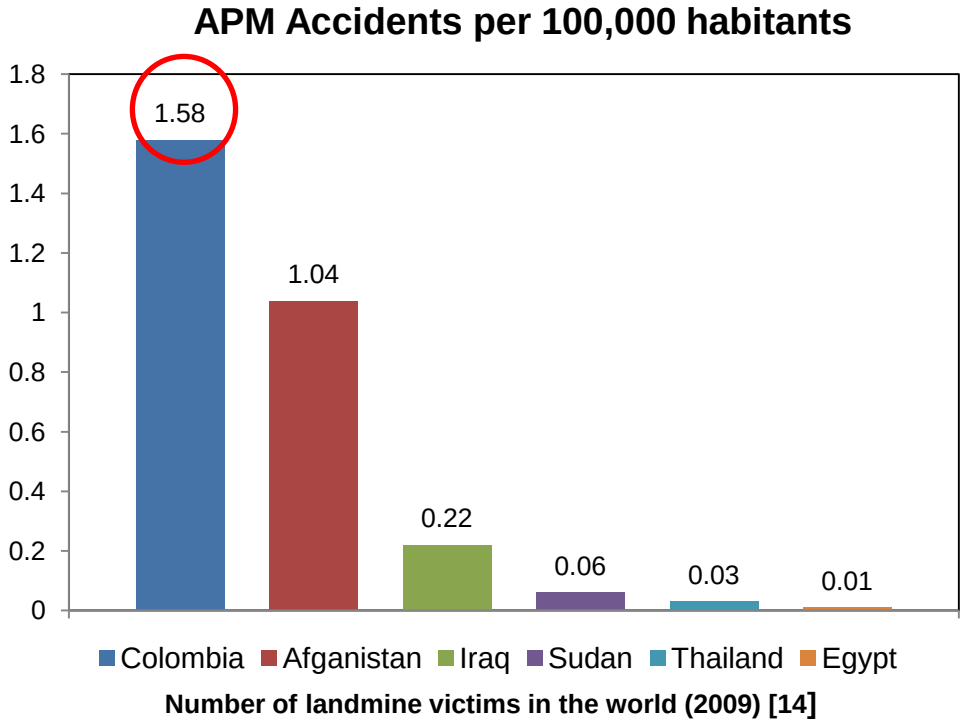
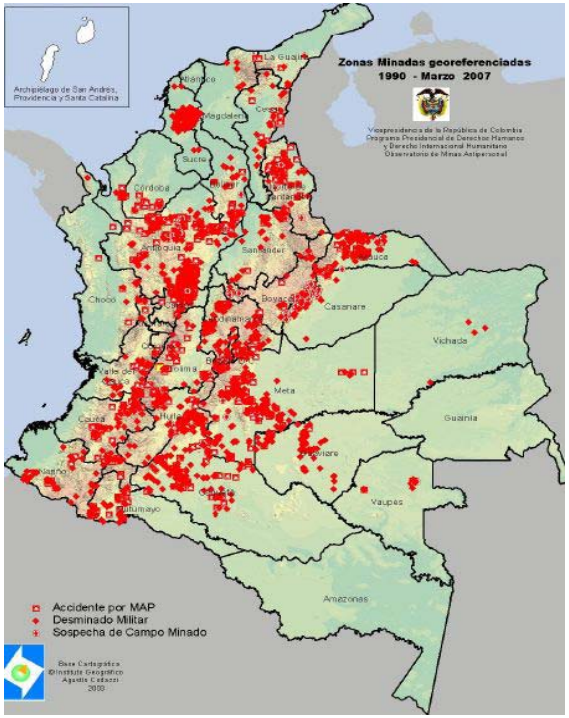
INTRODUCTION





- In Colombia, Antipersonnel mines (APM) are still planted by illegal armed groups
- Colombia presents one of the highest number of landmine victims in the world.

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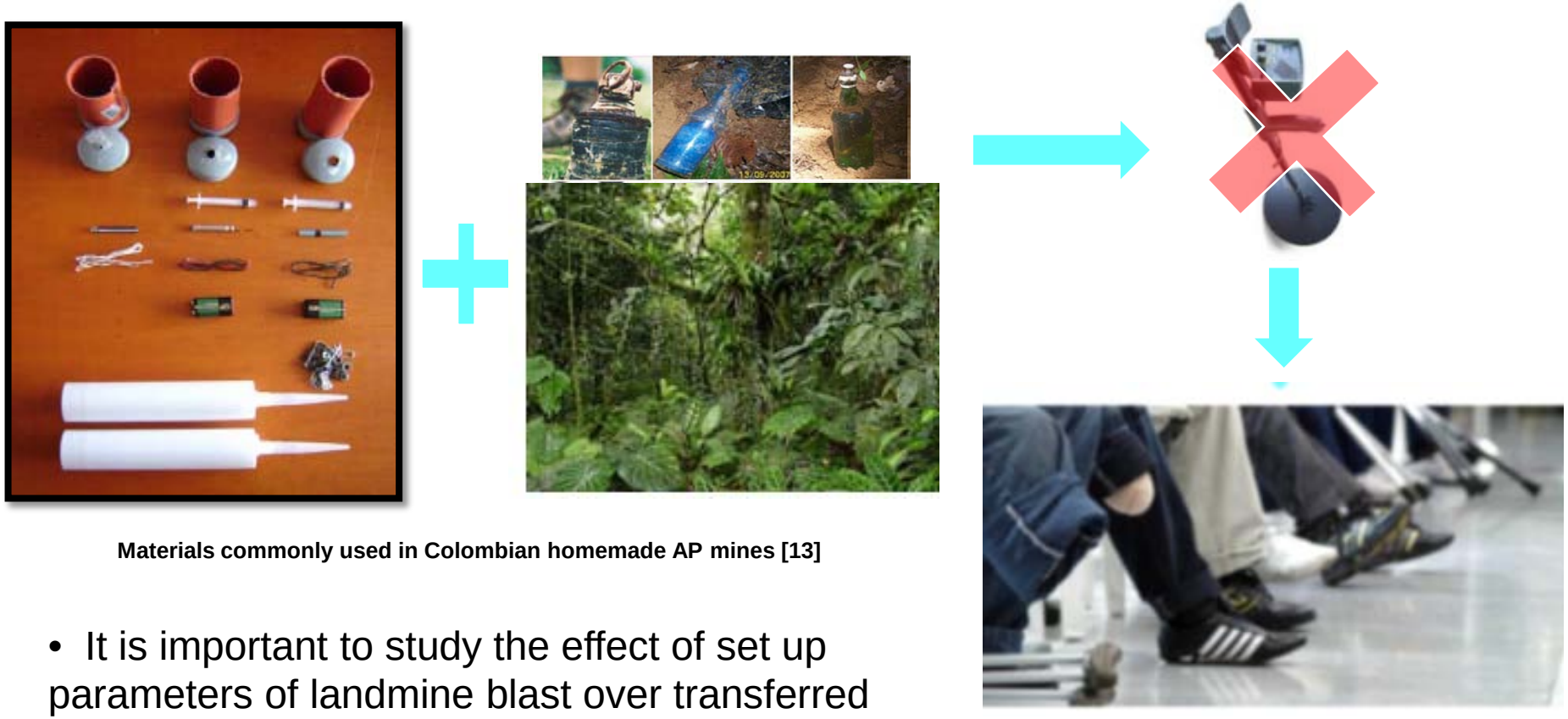
INTRODUCTION



Materials commonly used in Colombian homemade AP mines [13]

- It is important to study the effect of set up parameters of landmine blast over transferred energy to a body.

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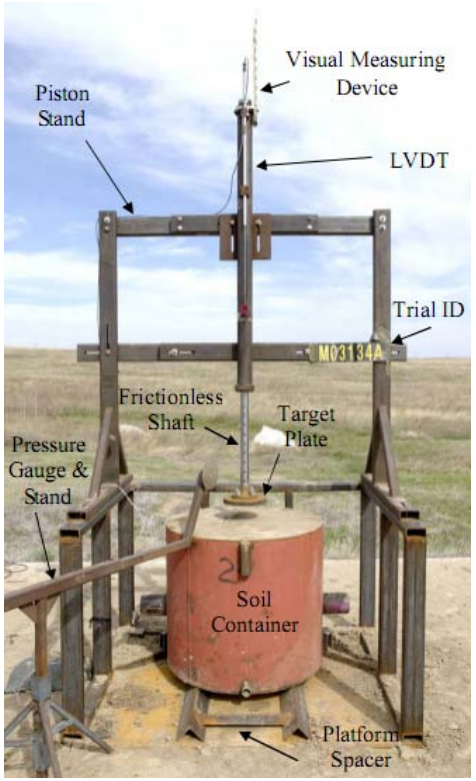
INTRODUCTION

Understanding the explosion dynamics: Experimental and Numerical Studies

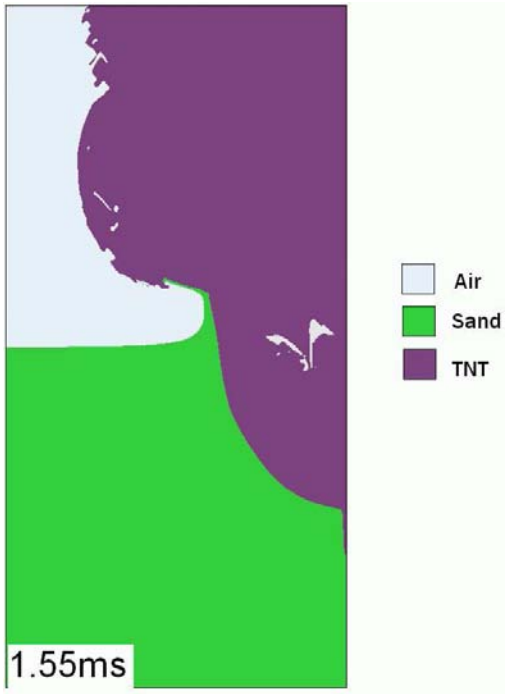
- Some studies have used
  - **Sand**
  - **Prairie soil**

- Transmitted energy is affected by:

  ✓ **Moisture content**
  ✓ **Compaction level**



Hlady Setup [10]



Fiserova-Hameed Simulations [4]

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RESEARCH OBJECTIVE

The aim of this work is to study the dependence of some parameters, such as the mass of the explosive, reaction mass, depth of burial and standoff distance in energy transferred to a rigid objective using a specific soil.

The parametric study involves:

- Development and Calibration of a computational model for a specific soil (using AUTODYN).

- To study the effect of setup parameters during experimental work.

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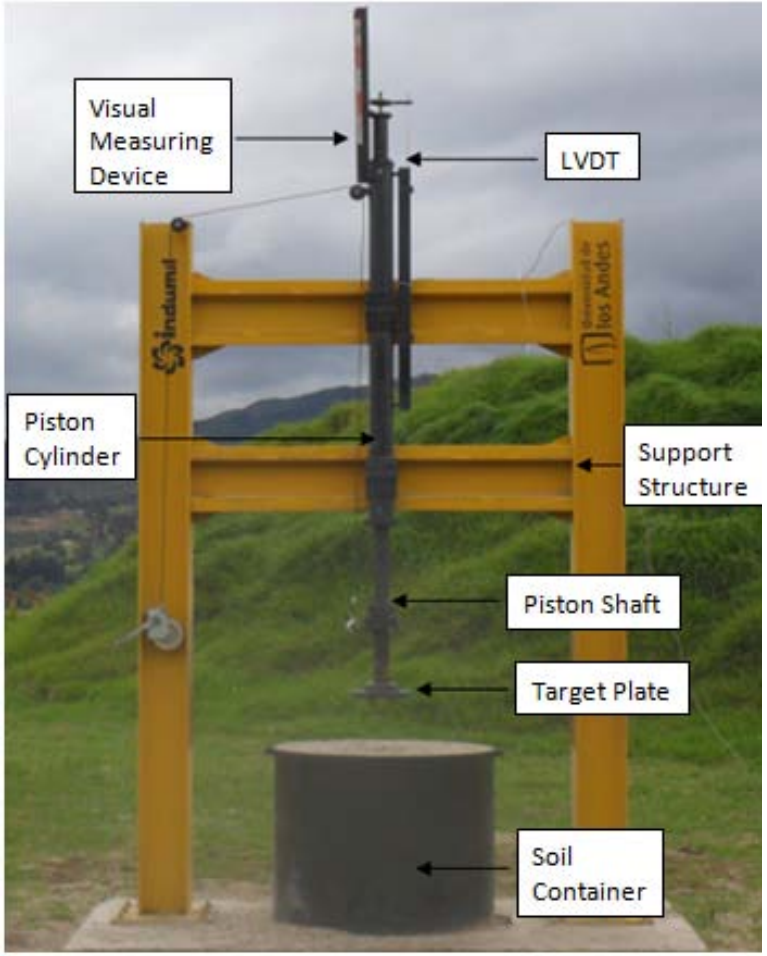
EXPERIMENTAL PROCEDURE

Equipment used



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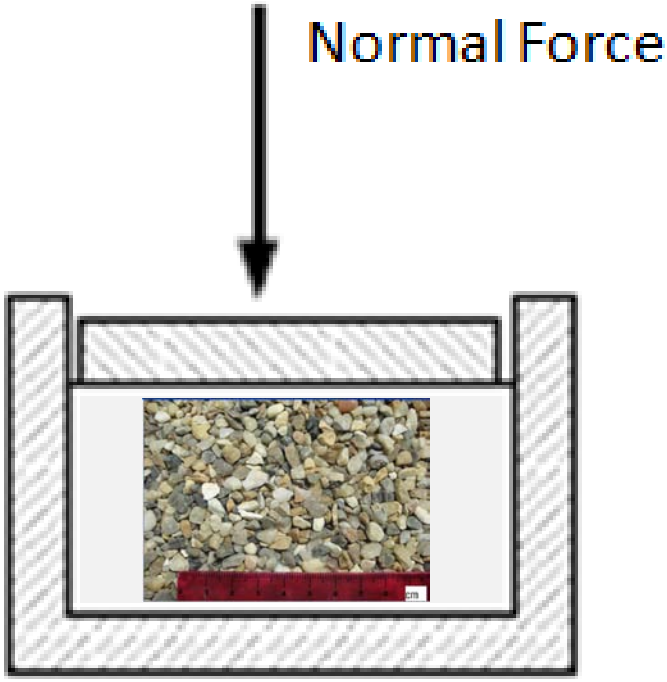
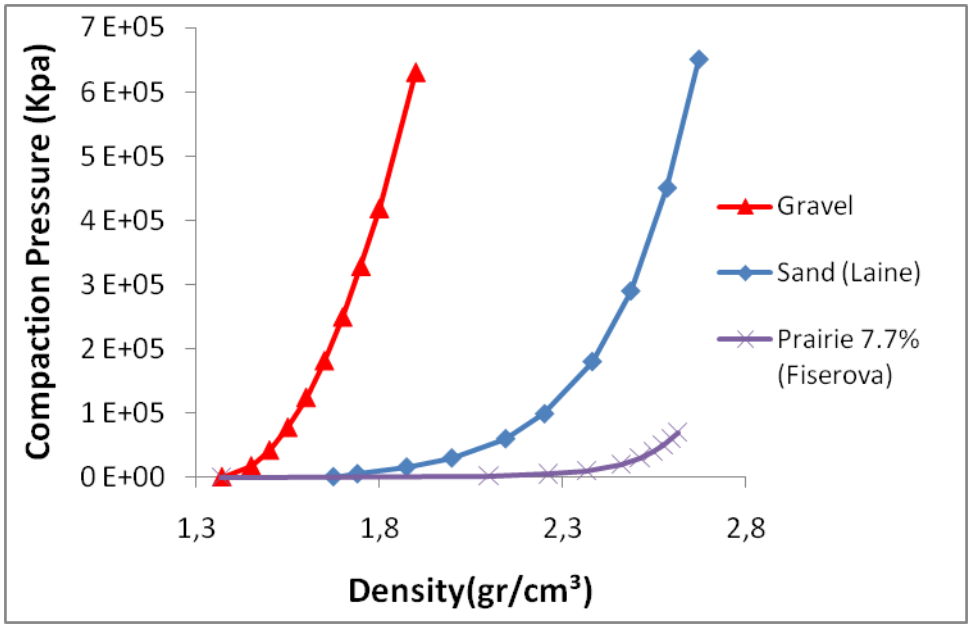
EXPERIMENTAL PROCEDURE

Soil

- It seems that the behavior of gravel has not been studied experimentally or computationally before.
- Gravel characteristics: Low compaction level and maximum moisture absorption of 1.6%.





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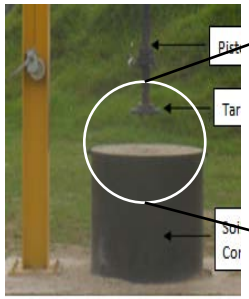
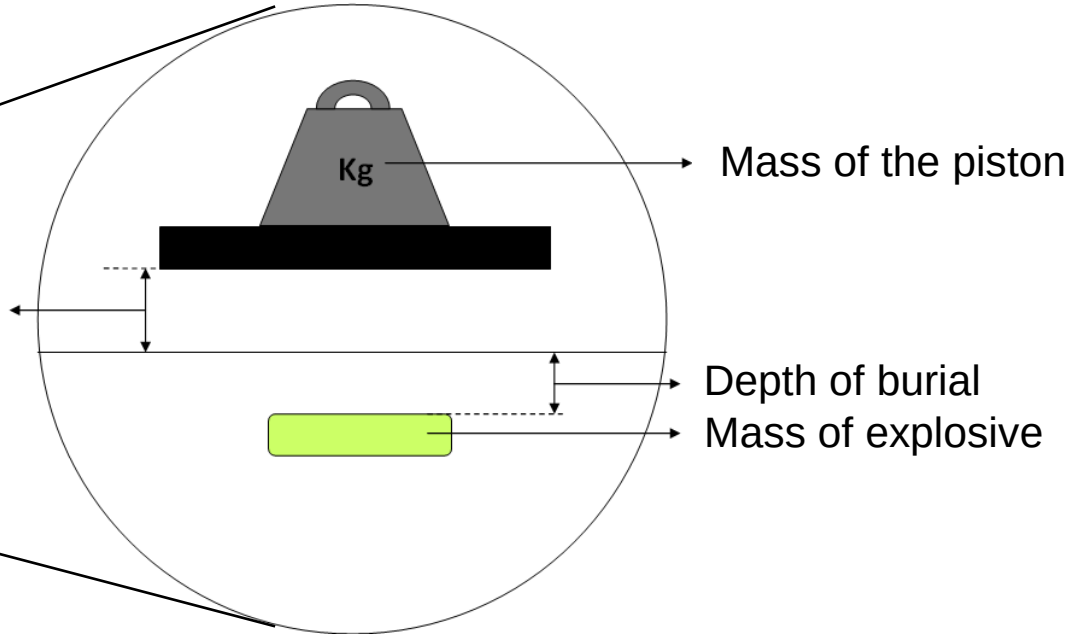
EXPERIMENTAL PROCEDURE: Experimental Matrix

Evaluated Parameter	Explosive mass	Piston mass	Depth of burial	Standoff distance
Explosive mass	m, 1.4*m & 2*m	M	0	3*SD
Piston mass	1.4*m	M, 1.1*M, 1.2*M & 1.4*M	0	3*SD
Depth of burial	1.4*m	1.4*M	0, OB, 2*OB & 3*OB	3*SD
Standoff distance	1.4*m	1.4*M	0	0, SD & 3*SD

Test Parameters



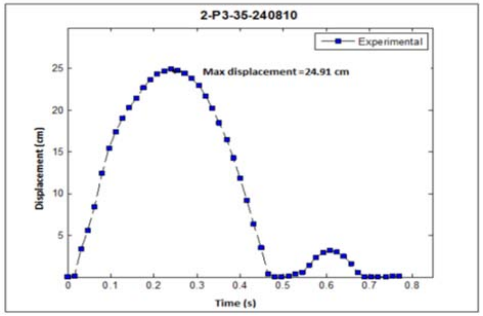
standoff distance



TESTING PROTOCOL

Soil Preparation → Experimental Set up → Measurement Preparation

Detonation



Data acquisition

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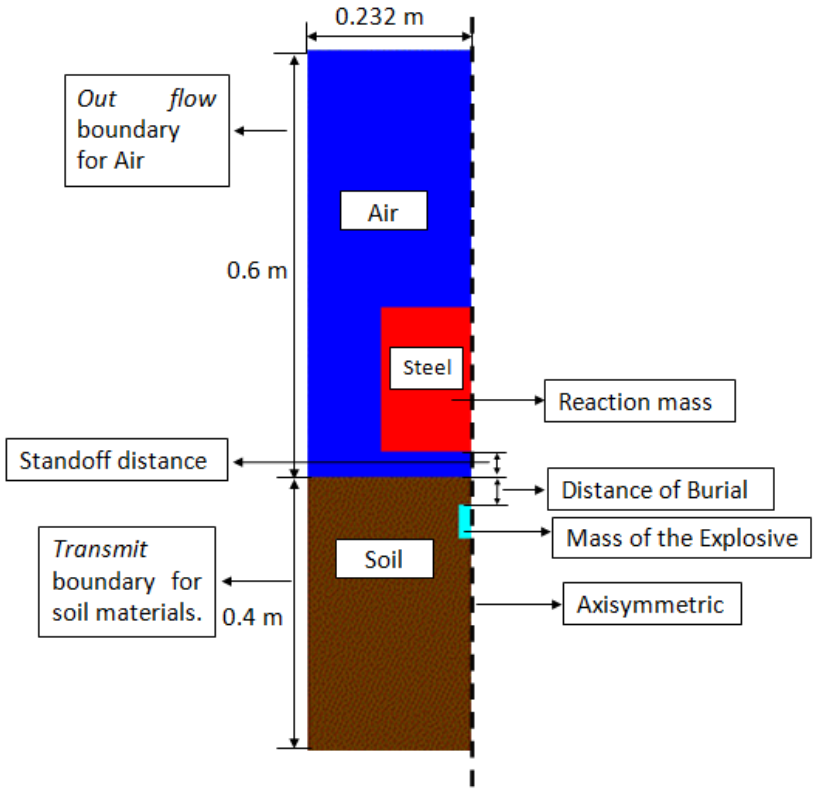
COMPUTATIONAL SIMULATIONS IN AUTODYN

Settings

	Value	Observations
Symmetry	2D	Axisymmetric
Materials	Air	Models: Ideal Gas, JWL, Shock, PJC, Compaction, Granular and Hydro Tensile limit.
	TNT	
	Stainless Steel	
	Sand/Gravel	
Initial Conditions	Atmospheric pressure	101.325 KPa
Boundaries Conditions	Flow out	
	Transmit	
Parts	Space	Contains Air, Gravel and TNT (Euler).
	Piston	Contains the steel (Lagrange).
Mesh size	4x4 mm (Euler)	The calibration were based on comparison between previous experimental and computational works
	8x8 mm (Lagrange)	
Simulation time	5 ms (virtual time)	45 min (PC time)



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RESULTS

Gravel soil after detonation

- There was a relatively small dispersion in the experimentation. The reading of the LVDT and the camera agreed.

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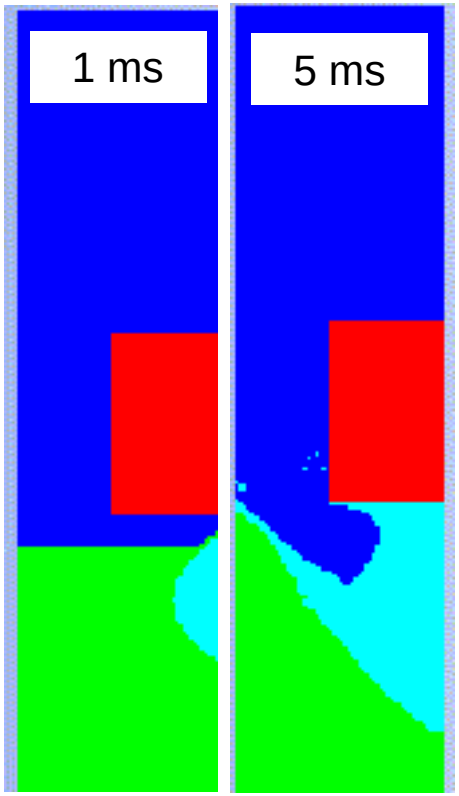
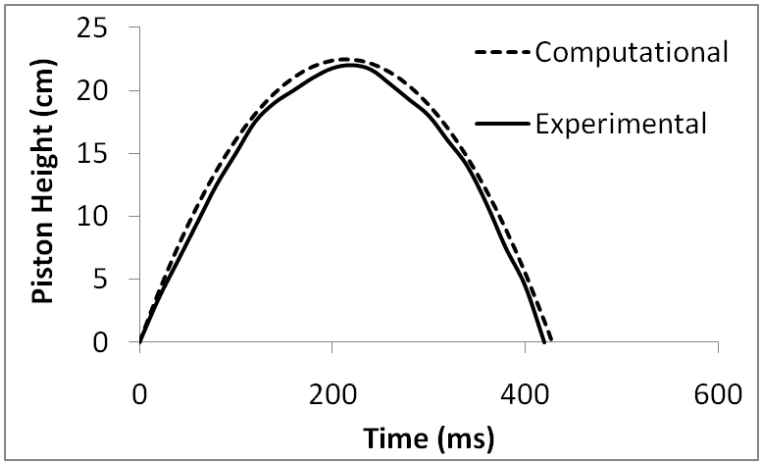
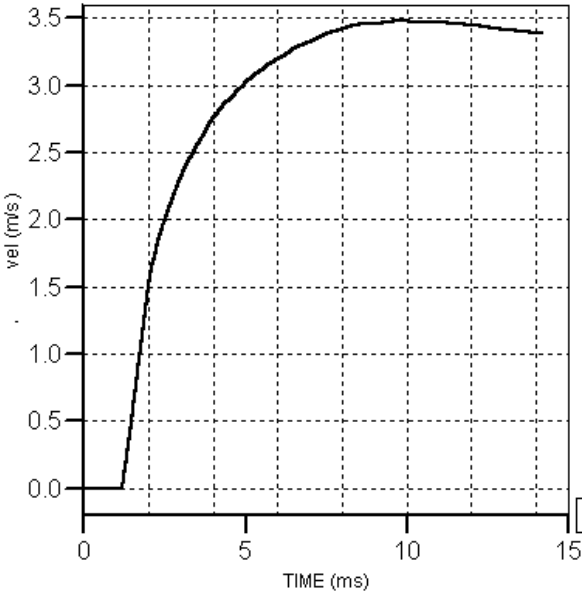
RESULTS







- There was consistency between computational and experimental results.

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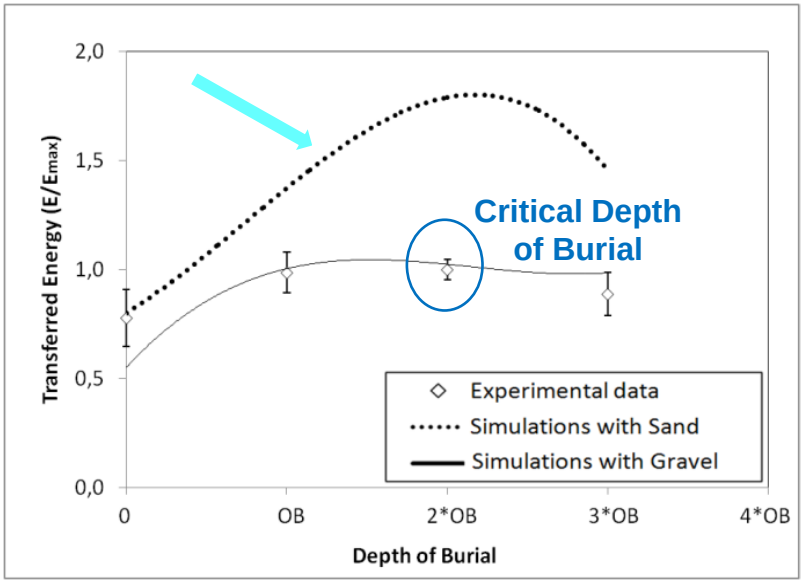
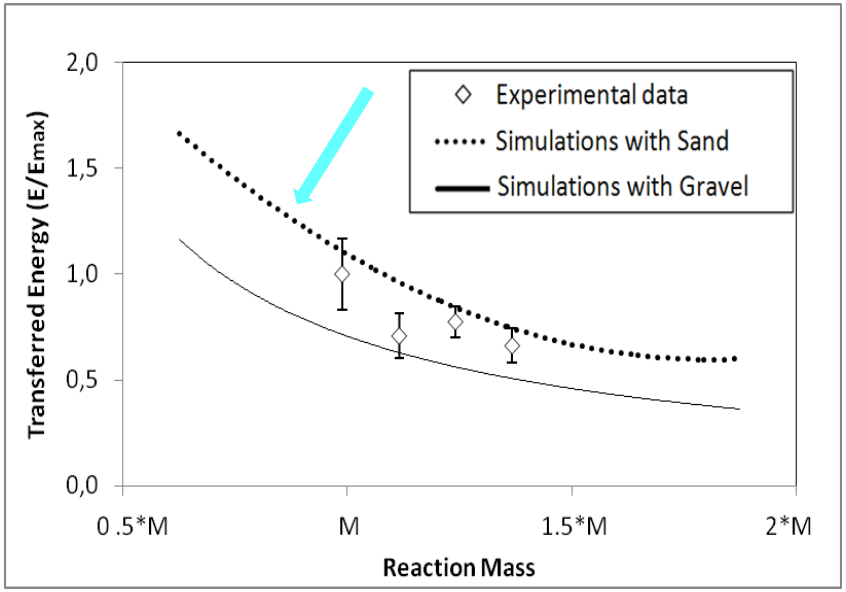
RESULTS

Results of effects of some parameters in mine blast

Depth of Burial effect



Piston mass effect



- The critical Depth of Burial that maximizes the transferred energy to the piston is close to 2*OB.
- The less the reaction mass, the more transferred energy is.

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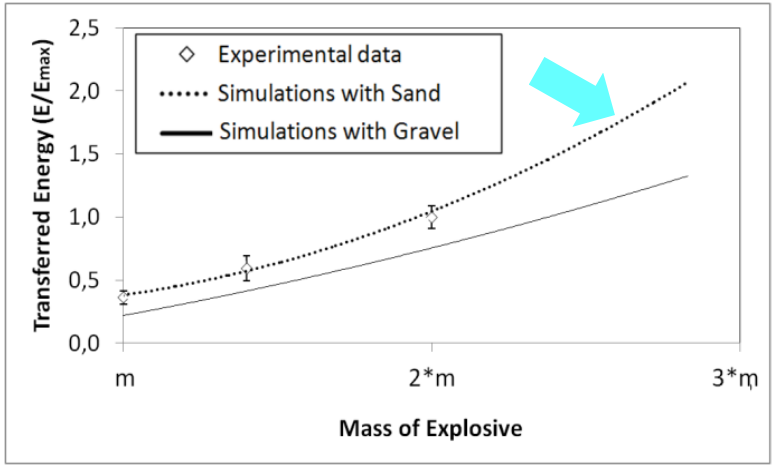
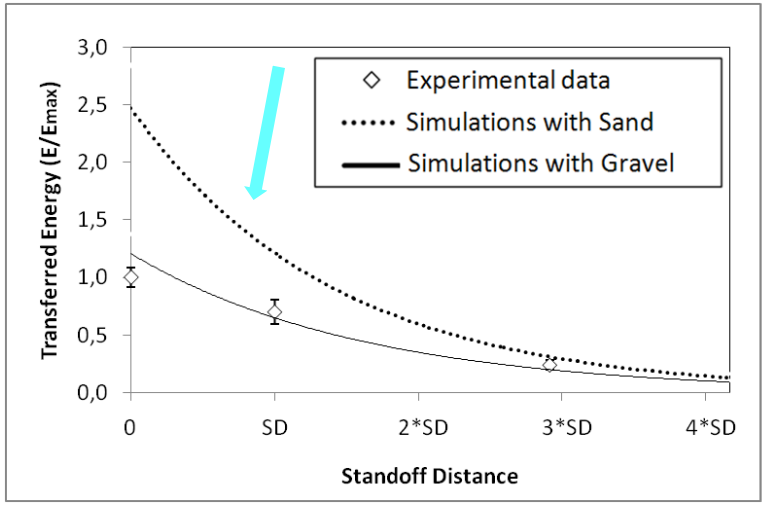
RESULTS

Results of effects of some parameters in mine blast

Mass of Explosive



Standoff effect



- Energy increases as the explosive mass increases.
- Transferred energy decreases when standoff distance increases. In this particular case, the energy decreases 14 times in average for an increment of standoff distance from 0 to 4*SD.

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CONCLUSIONS

- Gravel soil was successfully used in this work and it is possible to use it for future works due to its relatively easy handling.

- It was concluded that the gravel model (developed in this work) described the experimental data tendency successfully.

- It was observed (computationally) that transferred energy from sand is higher than gravel soil.

- Finally, standoff distance is the most influential parameter over the transferred energy, followed by the amount of explosive mass, reaction mass and depth of burial of mine.

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