CONCRETE SLAB FACILITIES

Field pressure studies for understanding depressurization techniques (semi-laboratory scale)

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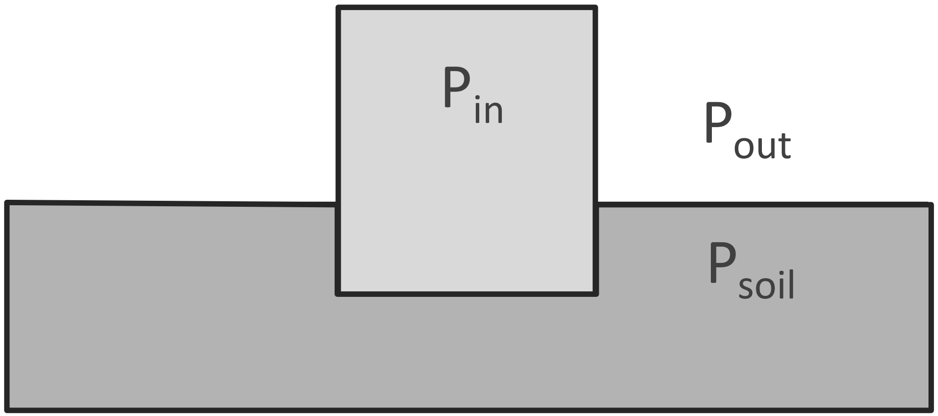
The question - hypothesis

The aim:

Effectiveness of pressure field



- Under normal condition P_{in} < (P_{out} y P_{soil}): 2-5Pa (stack effect)
- If we can reduce P_{soil} under P_{in} → { Advective flux will be inverted. / Also CRn in soil will dilute with fresh air }

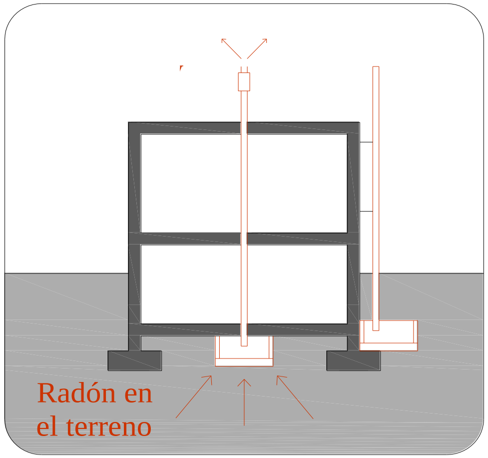
Guaranty value of depression: order -10 Pa

How can we reach those -10 Pa

in all area in contact with the building ???

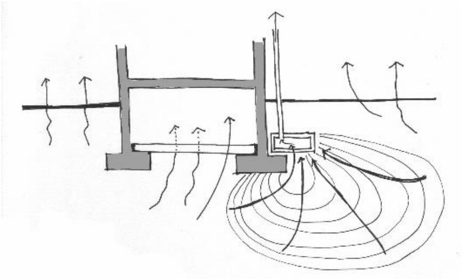
*Designing a depressurization system for the **area to be treated**.*

(Extension of the pressure field):



Parameters

- *Needed to cover the building area (m^2)*
- *Taking into account foundation barrier*
- *Sub slab aggregate permeability*
- *Number of suction points*
- *Power of the mechanical fan*



METHODS

A) Constructions of 2 concrete slab on a real soil:

- 2 types of *slab design.*
- *With different sub slab aggregate permeability*
- *With and without gravel bed*
- *The presence of cracks*
- *Different foundation lines configurations*

B) Mounting a monitoring differential pressure sensors system.

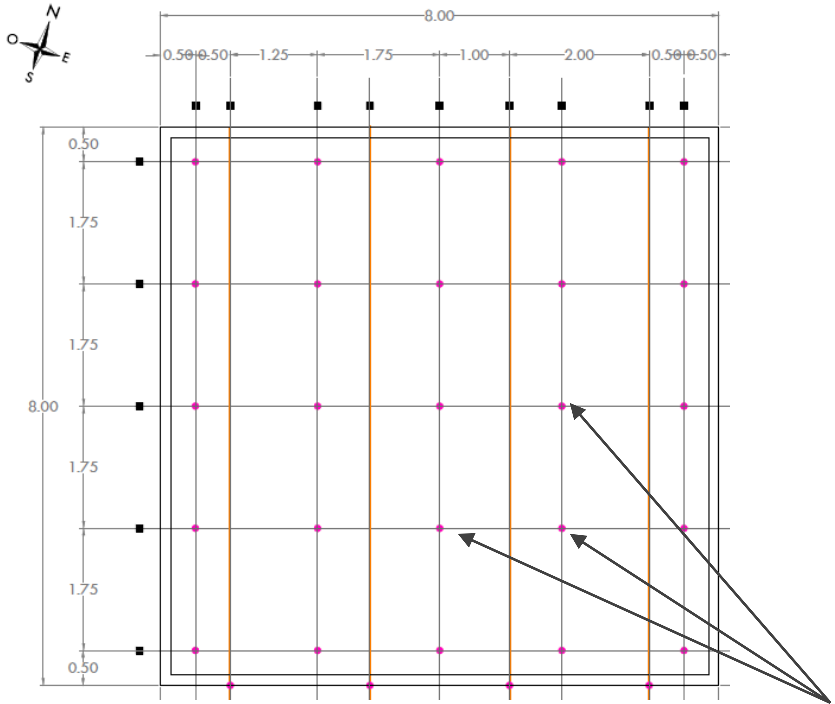
C) Measuring the pressure field with a SDS working

D) Predictive model generation in FEM Software

E) Validating for using as a designing tool

F) Limitations and future works

Concrete slabs

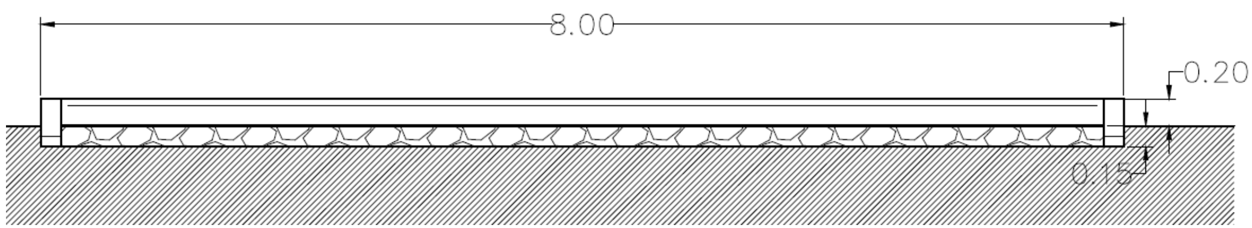


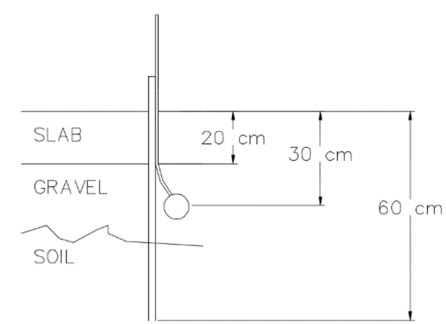
1st Concrete Slab

- *Surface: 64 m² (8 m x 8 m)*
- *20 cm thickness concrete*
- *15 cm gravel bed under slab*
- *Perimeter foundation for avoiding communication between gravel and outside air*

25 Pressure sensors. (5 x 5 mesh)

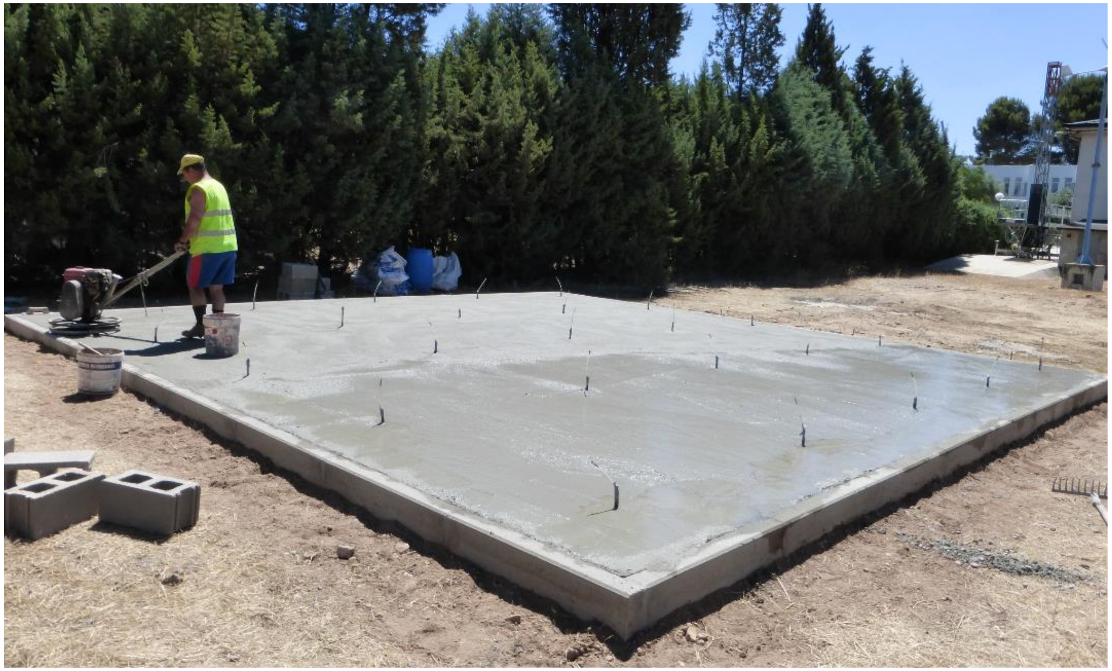
- *Depth 1. In the gravel under the slab (30 cm)*
- *Depth 2. In the soil (60 cm)*

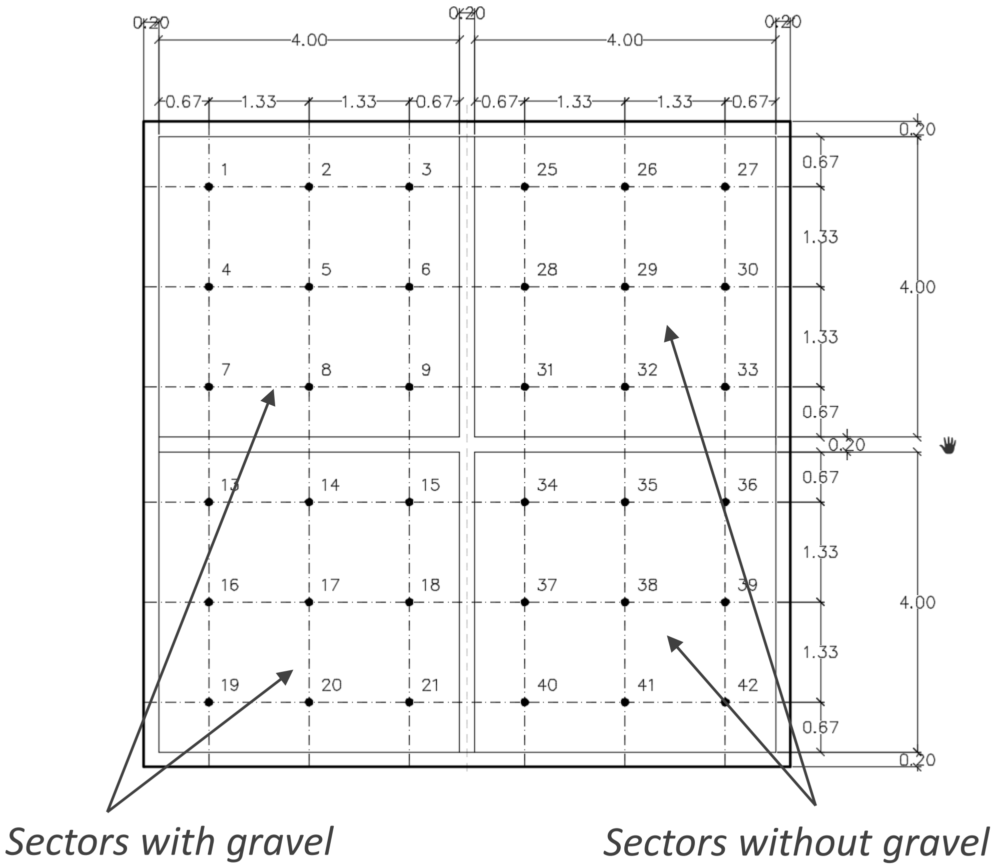




Slab 1

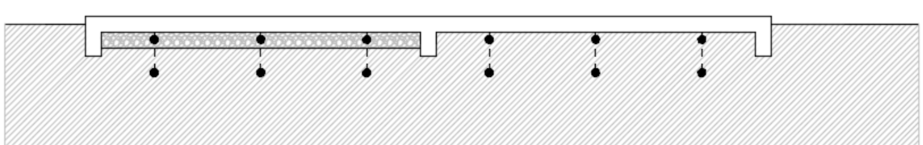
2 insertion devices in each point of the mesh for pressure sensors.





2st Concrete Slab

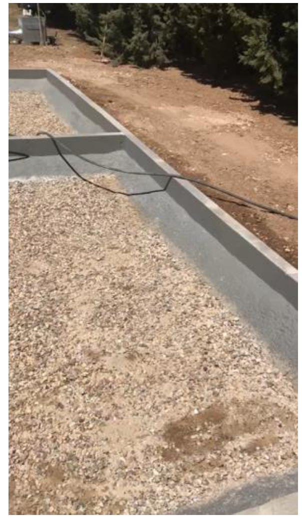
- *Surface: 64 m² (8 m x 8 m). 4 sectors*
  - *2 with gravel bed*
  - *2 without gravel*
- *Perimeter foundation for avoiding communication between gravel and outside air*
- *Central foundation for studying obstacles in field pressure extension*



Sensors (42 nodes in a mesh)

- *Depth 1. Under the slab (30 cm)*
- *Depth 2. In the soil (60 cm)*

Slab 2



Soil studies

3 levels of different material

Depth 0-0.5 m: Vegetal soil with sand

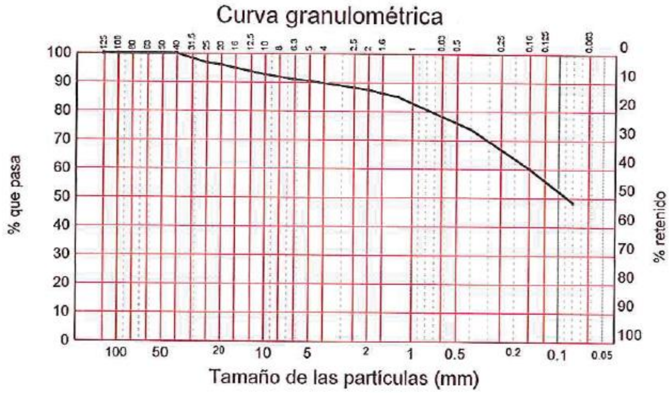
Depth 0.5-1.3 m: small rocks, with clay

Depth 1.3- 1.6 m: Sand, clay and small rocks

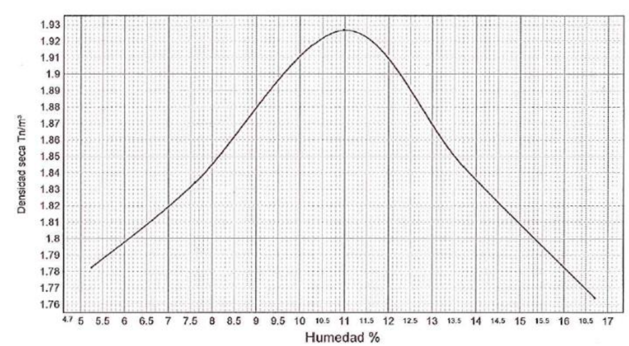
Measuring CRn in soil and Air permeability

(Cantabria University)

Punto Terreno	k (m^2)	Punto Grava	k (m^2)
A'1	$5\cdot10^{-12}$	A1	$6\cdot10^{-12}$
E'1	$1\cdot10^{-12}$	E1	$6\cdot10^{-12}$
A'5	$6\cdot10^{-12}$	A5	$6\cdot10^{-12}$
E'5	$5\cdot10^{-12}$	E5	$5\cdot10^{-12}$
C'3	$3\cdot10^{-12}$	C3	$6\cdot10^{-12}$



Grading curves of the materials of soil



Compaction test

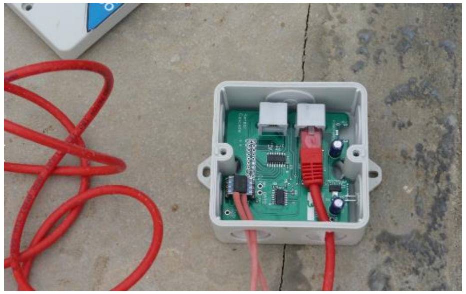
Pressure monitoring system

Needs

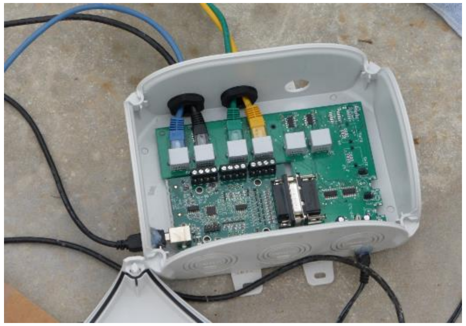
- **Continuous measuring** of pressure induce in soil by a Depressurization System
- MultiSensor System for controlling up to **50 sensor simultaneously (Mesh in Slab)**
- Range of pressure: Expected to reach up tu **500 Pa** in some studies.
- Aquracy: Few Pascal in passive situation. **Around 3-5 Pa.**
- A data logger acquisition system with graphical visualization software.

System mounted

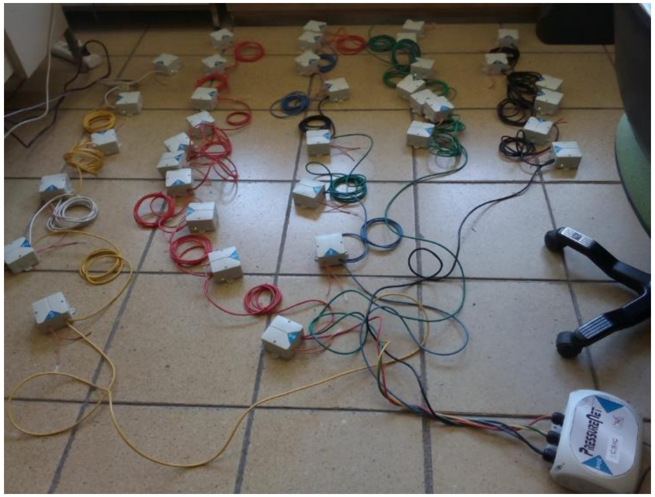
- Sensors: HONEYWELL HSCDRRD006MDSA3. range of ±600Pa with accuracy of 3Pa



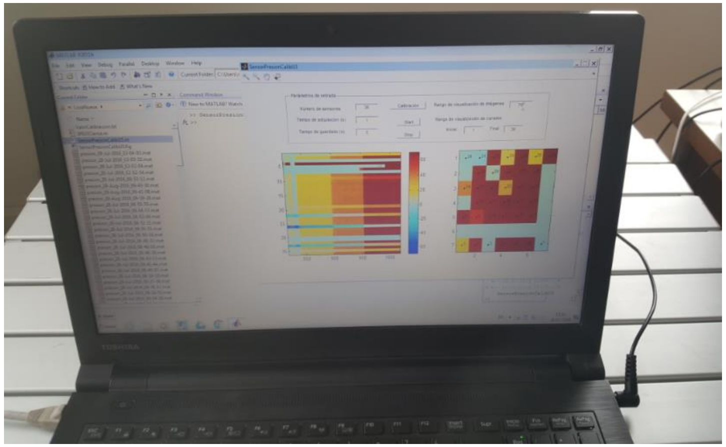
- Multiplexer card with 8 channels and connected to a computer through a LABJACK U3

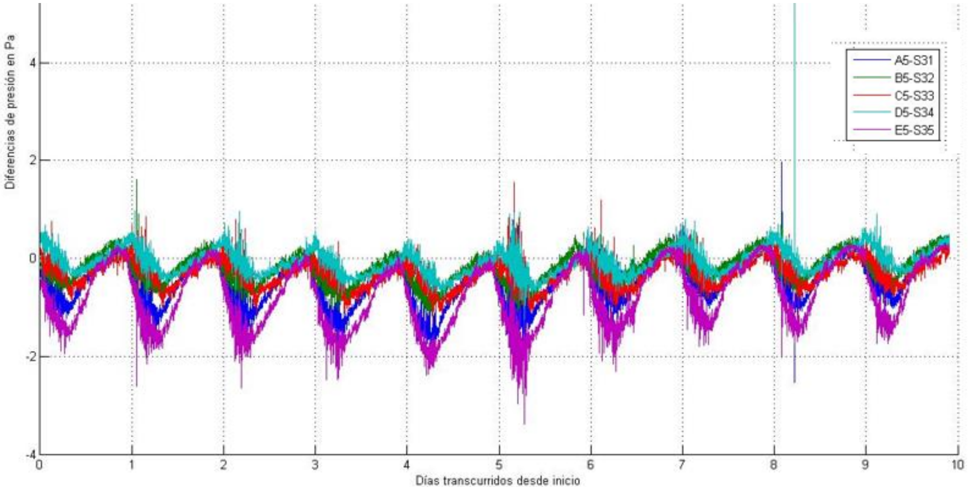


Pressure monitoring system



Software acquisition done by MatLab





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TEST RESULTS,
FEM MODEL AND FUTURE LINES

Test results

Previous work: joints sealing

Before

After

Slab 1

Test 1: corner suction point

59	61	62	63	63
61	62	63	64	65
62	63	65	66	67
63	64	66	71	74
64	64	67	74	102

Test 2: central suction point

55	56	57	57	57
56	57	58	58	58
57	59	63	59	58
58	59	60	60	59
58	58	59	58	59

Test 3: side suction point

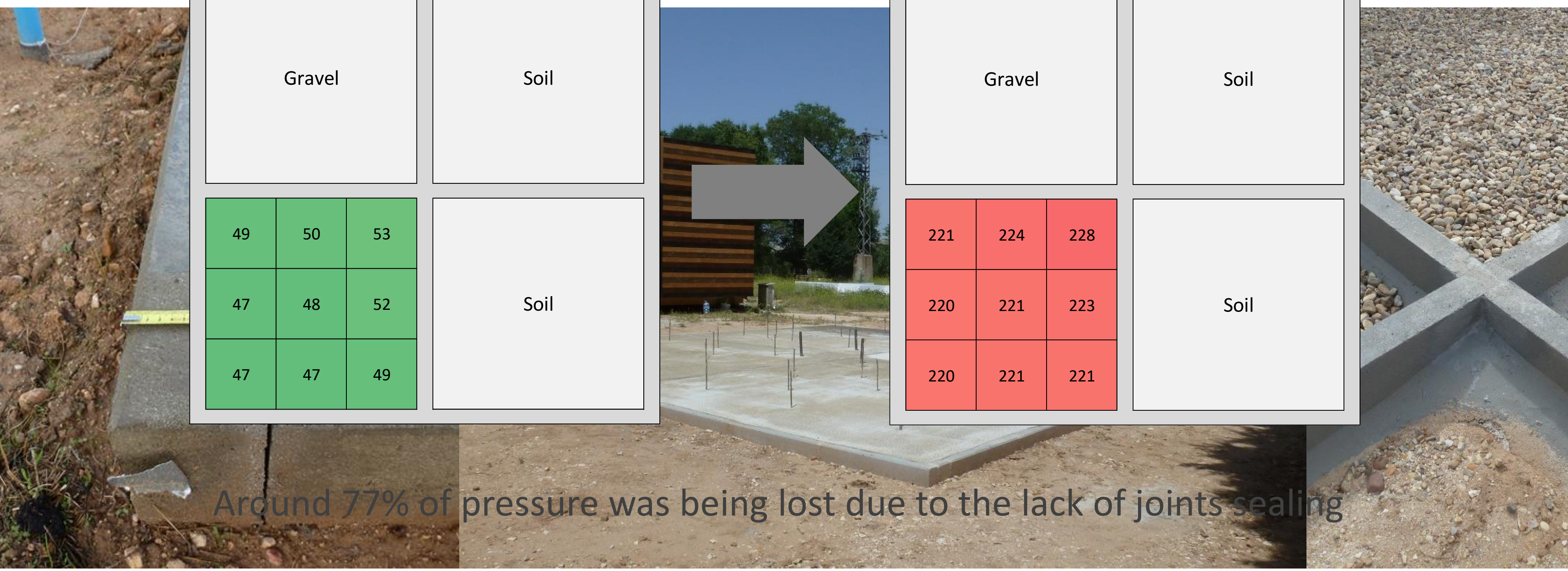
48	49	50	50	49
49	50	50	50	50
50	51	52	51	52
53	53	54	53	53
53	54	64	55	54

Slab 2

Joints Sealing Influence

Differences between gravel and soil despressurisation

Foundation barriers influence



Before joints sealing

Gravel	Soil

49	50	53
47	48	52
47	47	49

Soil

After joints sealing

Gravel	Soil

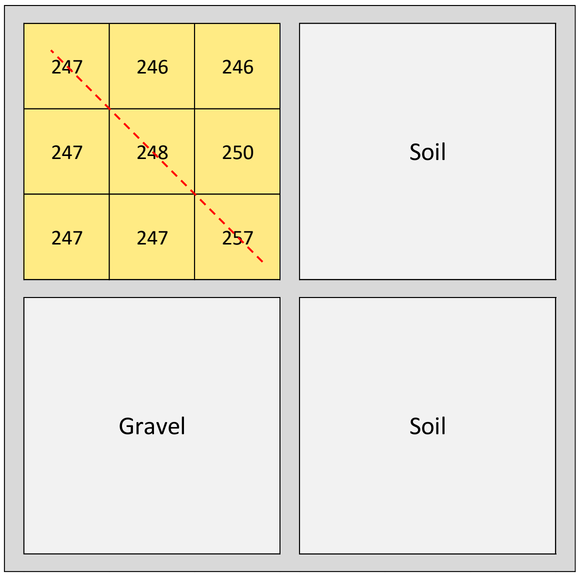
221	224	228
220	221	223
220	221	221

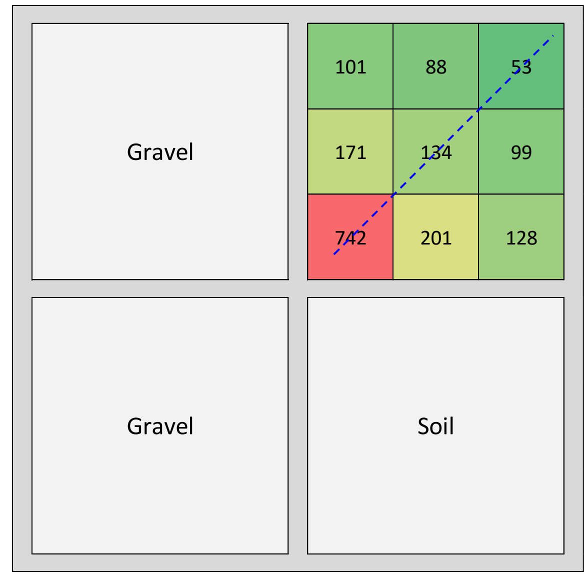
Soil

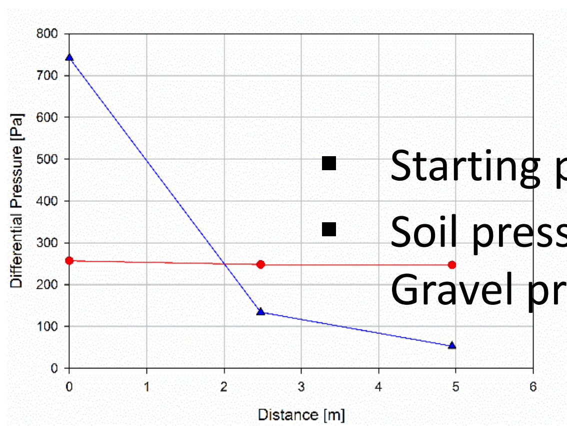
Around 77% of pressure was being lost due to the lack of joints sealing

Slab 2

Differences between gravel and soil despressurisation



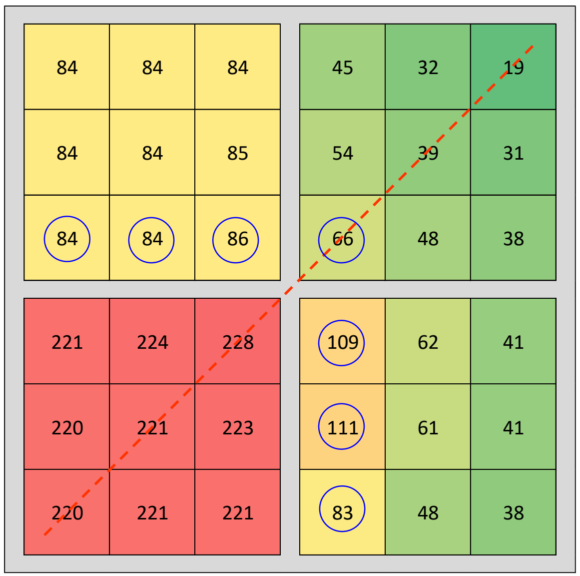


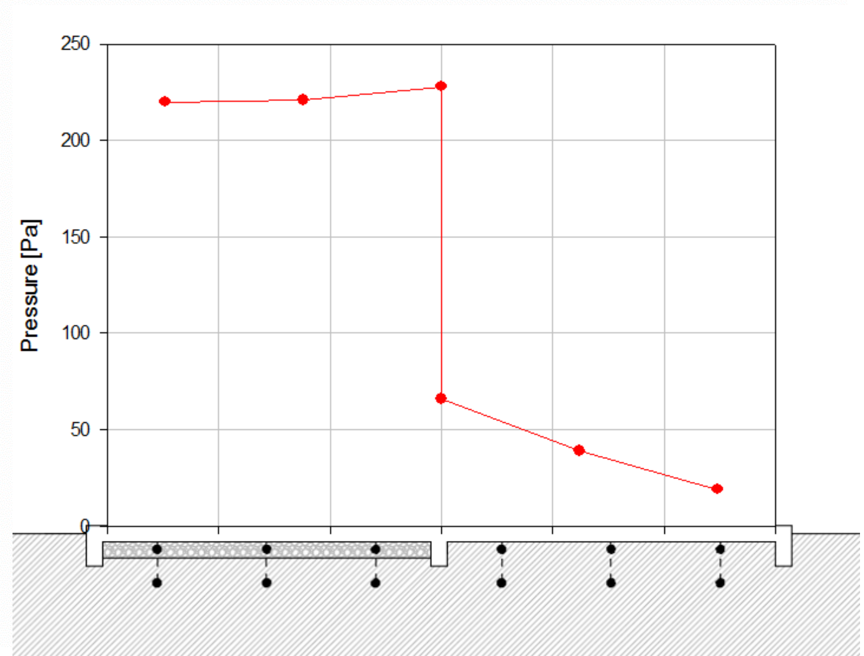


- Starting point: $\Delta P_{Soil} > \Delta P_{Gravel}$
- Soil pressure drop is stronger than Gravel pressure drop (constant)

Slab 2

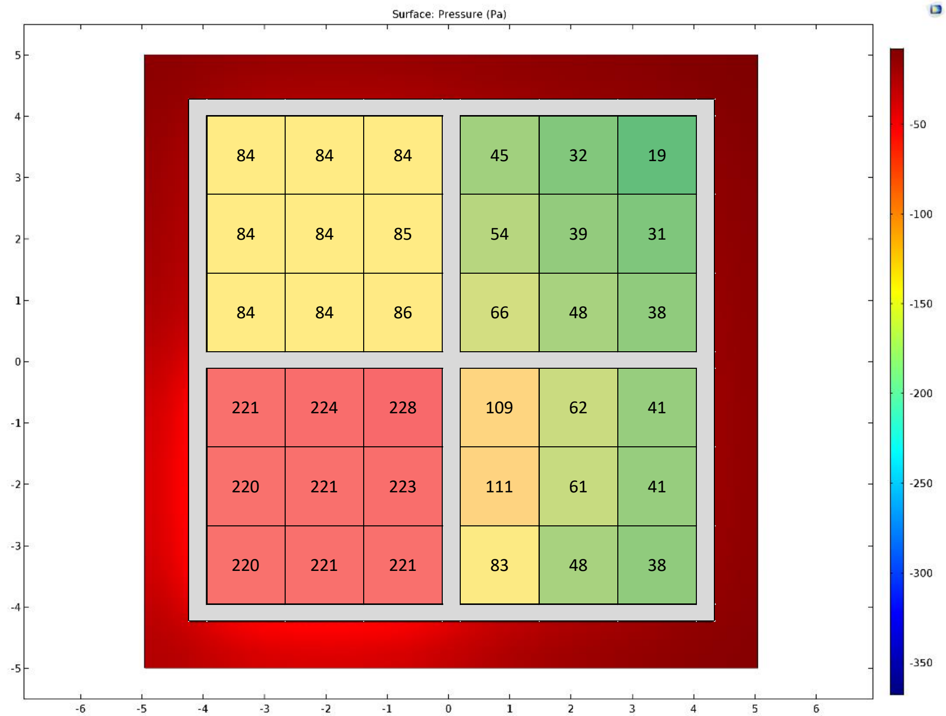
Foundation barriers influence

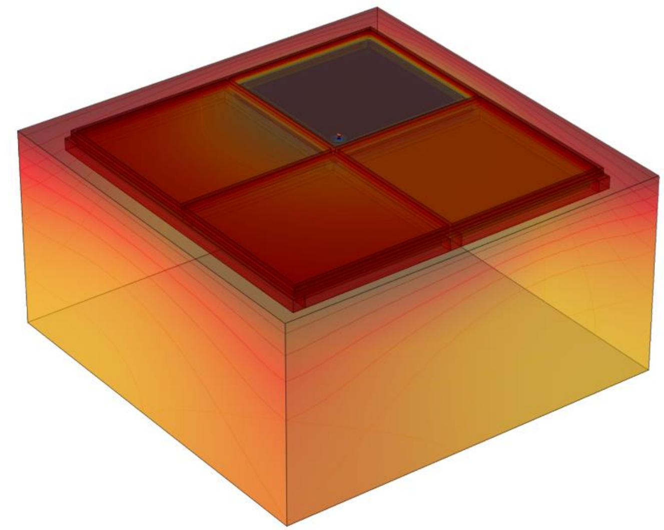




- 50%-70% Foundation pressure drop
- Different soil and gravel pressure distributions

Modelling





Main Parameters

- Soil & Subslab layer permeability
- Vacumm/fan air velocity

Darcy’s and Darcy-Forchheimer law were used to perform this model

Future work

- ***Test different radon mitigation fans***
- ***Check the influence of soil moisture or rainfall***
- ***Validate finite element model (In process)***
- ***Take and advantage of these facilities to train future radon mitigation professionals***

Thank you very much

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