AD FALCON API Manual

Infinite Elements for Far-Field Truncation (Coupled Consolidation)

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Contents

1 Infinite Elements for Far-Field Truncation (Coupled Consolidation)

1.1 Problem Description

This example demonstrates **mapped infinite elements** for truncating an unbounded domain in a plane strain **coupled consolidation** analysis (solid + pore water, i.e. `PLCoupled`).

Purpose: show how a small near-field mesh augmented with infinite elements reproduces the settlement field of a much larger truncated domain, and how **excess pore-water pressure** dissipates during the consolidation period.

What is compared (same loading and material in all cases): - A **2×2 m** domain with **infinite elements** on the left/right/bottom (small near-field model) - A **2×2 m** domain with **fixed truncation boundaries** (small truncated) - A **4×4 m** domain with **fixed truncation boundaries** (medium truncated) - An **8×8 m** domain with **fixed truncation boundaries** (large truncated reference)

1.2 Model Setup

1.2.1 Analysis Type

```
% AnalysisType
PLCoupled
%%%
```

1.2.2 Material Properties

Linear elastic skeleton with constant saturated permeability:

```
% Materials
Mat1
@Mech: Elastic YoungsModulus 1.0e5 PoissonRatio 0.3
@Perm: Constant k_sat 1.0e-11
@PhaseChar: Solid rhos 2650.0
@PhaseChar: Liquid rhow 0.997 K_l 2.25e6 l_vicosity 1.0e-6
%%%
```

1.2.3 Step Definition (Consolidation)

A multi-step consolidation schedule is used to span multiple decades of time:

```
% Step Definitions
@Step 1:
```

```
  @@NumberSteps: 20
  @@StepTime: 1.0
  @@SimMode: Consolidation
...
@Step 6:
  @@NumberSteps: 20
  @@StepTime: 100000
  @@SimMode: Consolidation
%%%
```

For time-series postprocessing, this example writes results **every sub-step**:

```
@@OutputControlType: ByStep
@@OutputControlValue: 1
@@OutputTypes: Displacement EffStress PW EXPW VoidRatio
```


1.2.4 Stress Boundary (Loading)

A uniform pressure is applied over a strip of width $2a$ centered on the top surface.

1.3 Infinite Element Configuration

Infinite elements are attached to the left, right, and bottom boundaries of the **small** domain:

```
% Infinite Elements
@Boundary Left
  @@Type: TRI6
  @@Topology: Strip
  @@Material: Mat1
  @@Nodes: ...
  @@ExteriorPoint: ...
  @@InteriorPoint: ...
  @@RayLength: ...
  @@ApplyInfinityBC: Yes
  @@ApplyInfinityBCPW: Yes
  @@PW: 0.0
%%%
```

Notes: - `@@Topology: Strip` generates QUAD8 infinite elements with **parallel rays**, suitable for straight boundaries representing half-spaces. - `@@DisX/@@DisY` are optional; if omitted for strip topology the solver uses a default **roller-style** infinity BC (dominant normal component only) to avoid over-constraining the far field.

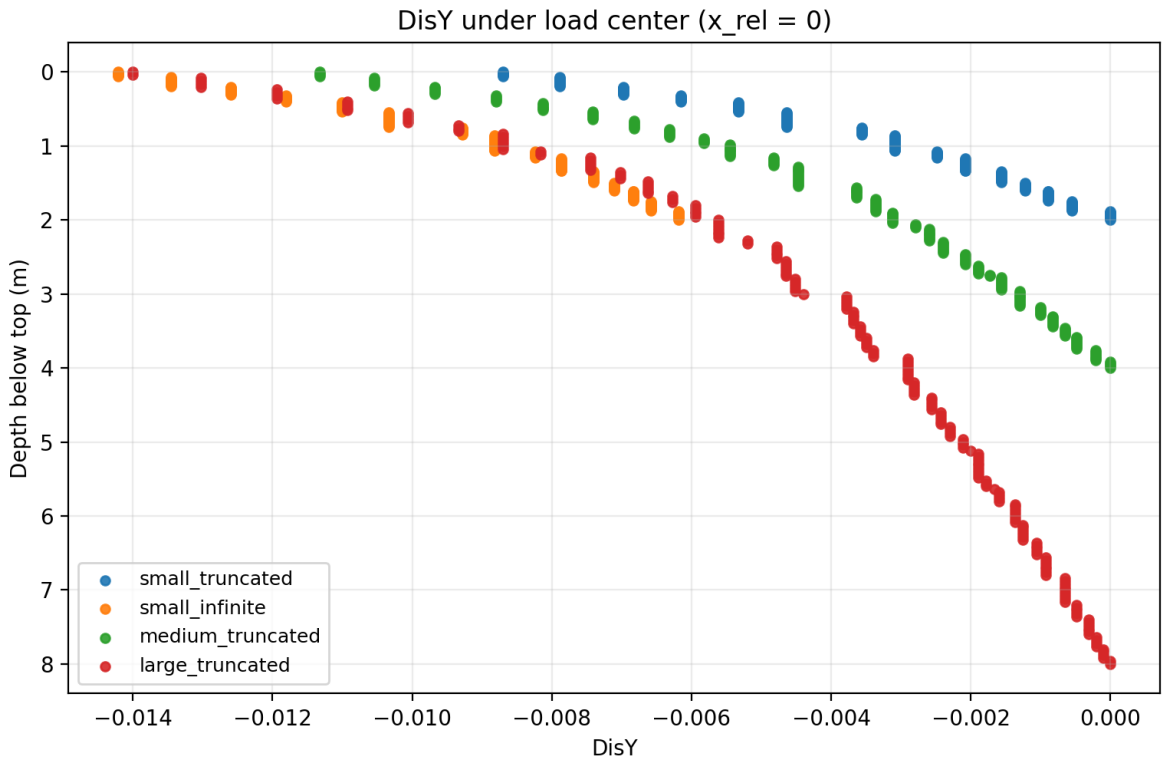

Figure 1: Settlement at load center

1.4 Results

1.4.1 Settlement Profile at Load Center

1.4.2 Settlement Profile at Footing Edges

1.4.3 Displacement vs. Horizontal Position at Depth

1.4.4 Excess Pore-Water Pressure Dissipation

The plots below show **excess pore-water pressure** at representative points beneath the loaded area: - `x_rel = 0` (under the load center) - `x_rel = +1` (under a footing edge) - depths 0.2 m, 0.5 m, and 1.0 m below the top surface

1.4.5 Displacement Evolution During Consolidation

Using the same points as above:

1.5 Input Files

- Small domain with infinite elements
- Small truncated domain
- Medium truncated domain

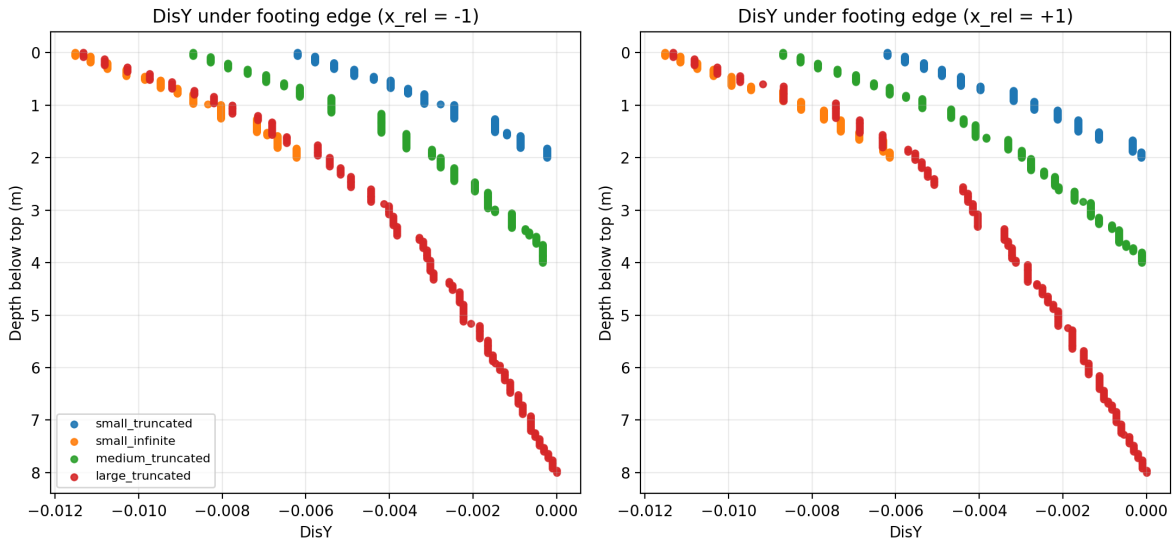

Figure 2: Settlement at footing edges

- Large truncated domain (reference)

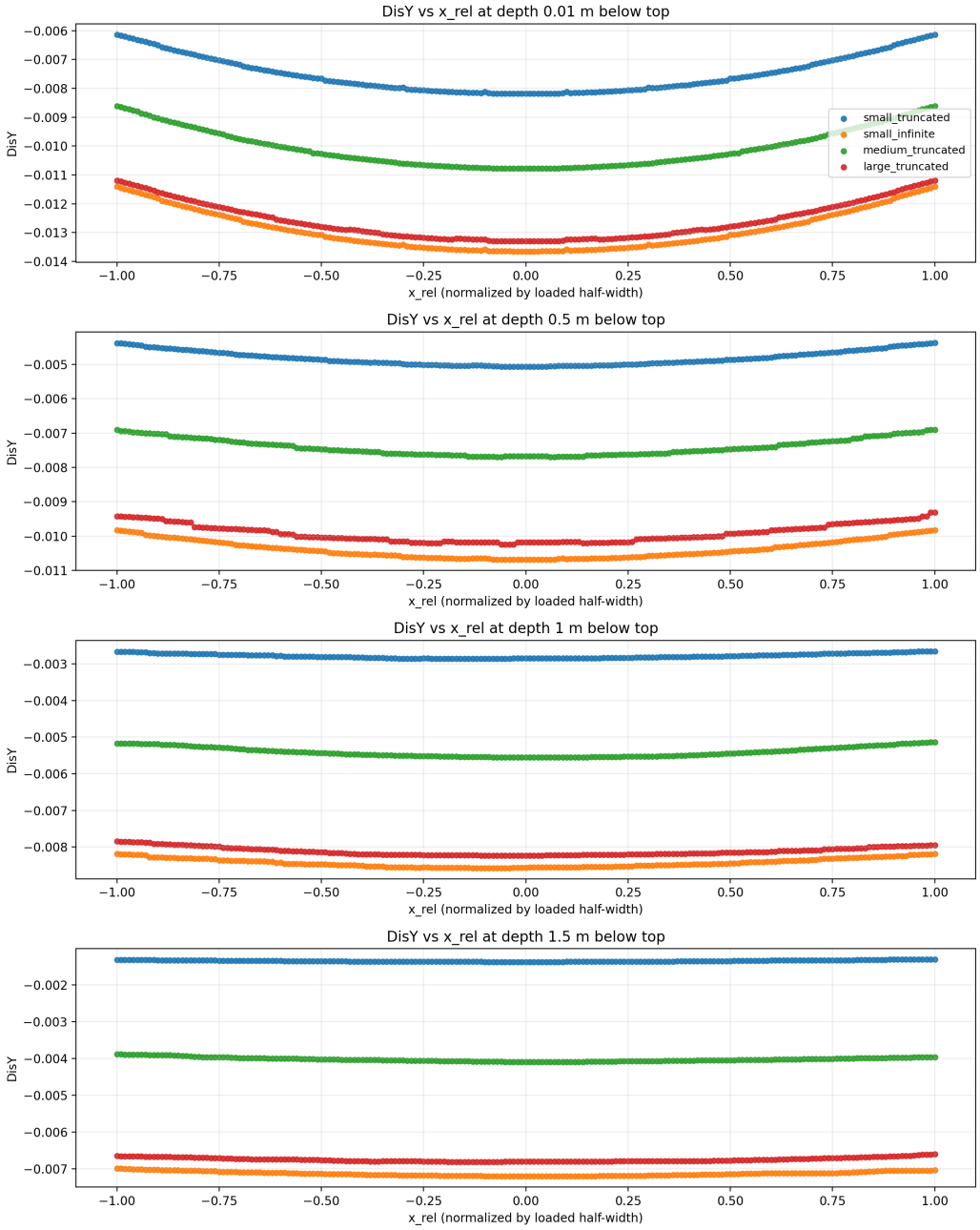

Figure 3: Displacement at various depths

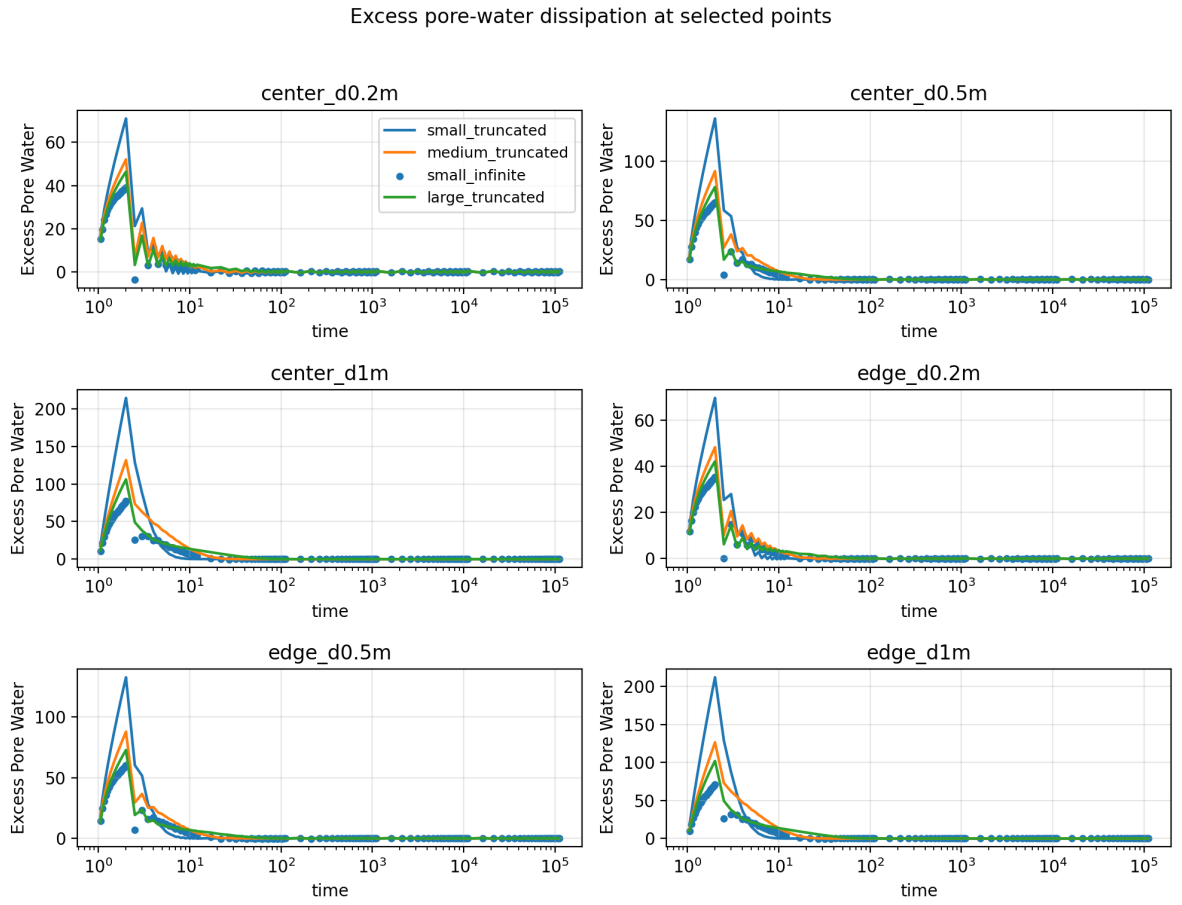

Figure 4: Excess pore-water dissipation

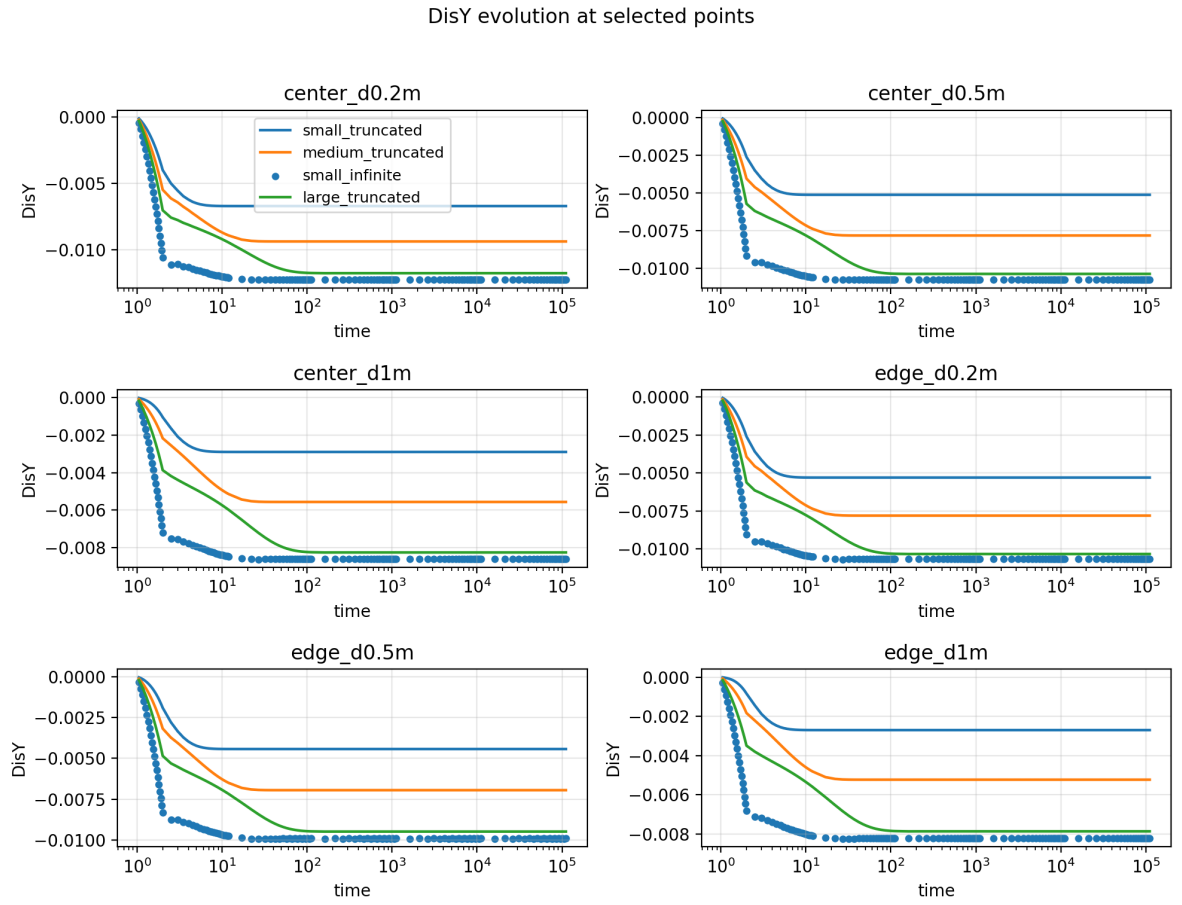

Figure 5: DisY evolution