The manuscript presents an interesting theoretical assessment of the effect of a highly permeable layer in a low permeable soil on drainage efficiency. I understand from the manuscript that the first part shows how t90 decreases with the presence of an permeable layer. The second part describes a simplified approach to calculate drainage efficiency. I recommend major revisions, mainly with regards to the second part, as detailed in the comments below.

Dear Reviewer,

we are grateful for your comments and suggestions that give us the opportunity to improve and clarify some aspects of the paper.

In the following, a reply to every point is reported.

C1 - METHODOLOGY AND DERIVATION OF EQUATIONS

C1.1 - I appreciate the page limit on a technical note, but some of the equations are not clear. - How is the term t90 in equation 3 obtained from either equation 2? Is there a closed form solution or is this obtained through optimisation of the numerical solution?

The value of t_{90} has been obtained by a **numerical integration of** Eq. (1) through the following steps:

- Calculation, as a function of time, of the total heads, *h(t,x,y,z)* thus of the pore pressures u(t,x,y,z), which turn from the value u_0 to the value u_∞ (Fig. C1a in the Discussion);
- Representation of obtained results in a dimensionless form, through the efficiency E(t,x,y,z) at any point of the domain, and calculation of the average value of the efficiency, $\bar{E}(t,\Gamma)$, along the basal plane of trenches assumed as being the failure surface, Γ;
- Determination of the time t_{90}, as the instant at which is $\bar{E}(t,\Gamma)=0{,}9$ (Fig. C1b in the Discussion).

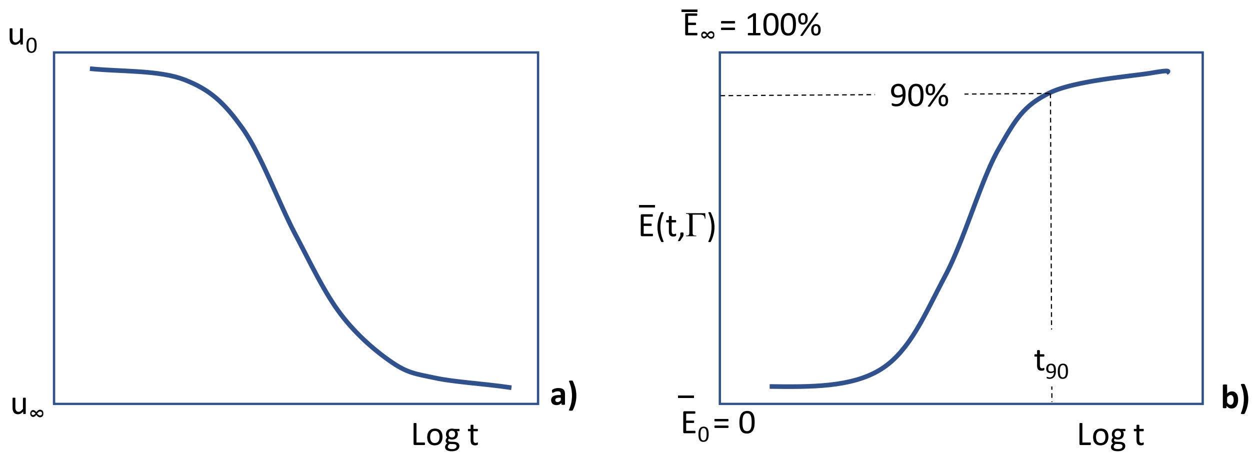

Figure C1. Pore water pressure, u, as a function of logarithmic time, Logt (a); average efficiency along the failure surface Γ, $\bar{E}(t,\Gamma)$, as a function of logarithmic time, Logt (b).

C1.2 - Can you elaborate on how you got equation 4? Is this based on the interpretation of the numerical experiment or is this derived from the governing equation? Is it possible to write equation 4 as a set of differential equations?

Eq. (4) in the submitted paper has been obtained from the interpretation of the results of the numerical integration of Eq. (1). These have been reported in Fig. 2f of the submitted paper, which shows the dependency of s_d/H_0 on K_d/K and H_1/H_0, having fixed H_d/H_0.

Such an equation can be obtained also in a closed form as an algebraic expression through integration of Eq. (1) by some simplifying hypotheses. Under these hypotheses (described later), it may be demonstrated that the conditions for full layer activation are obtained when the spacing, *s*, between trenches, is equal to the value s_d (or minor than it), provided by the following expression:

$$\frac{s_d}{H_0} = 2\frac{H_d}{H_0}\sqrt{\frac{K_d}{K}} \qquad (4a).$$

This may be obtained from Eq. (1) of the submitted paper, written for the layer *d*, assuming $h_t = 0$ (steady state) and $h_{yy}=0$ (the pore pressure distribution along vertical profiles is assumed to be linear). The piezometric surface in the layer *d* is then described by means of the piezometric head, u_d/H_d, at the base of the layer *d*, through the parabolic equation:

$$u_d = ax^2 + bx + c \qquad (5a)$$

in which the abscissa *x=0* corresponds to the lateral face of the trench (Fig. 1a of the submitted paper). The parabolic surface represented by Eq. (5a) separates the upper part of the layer *d*, where pore pressures are negative, from the lower one, where pore pressures are positive.

The coefficients *a*, *b* and *c* may be obtained based on the following hydraulic boundary conditions:

- for $x = 0 \rightarrow u_d(0) = \alpha\gamma_w H_d$ (i.e. the ordinate of surface (5a) at the trench face is a fraction, *α*, of the highest value H_d),

assuming *s'=s-b*, for $x = \frac{s'}{2} \rightarrow u_d\left(\frac{s'}{2}\right) = \gamma_w H_d$ (this is just the condition for full layer activation: the ordinate of surface (5a) is the highest one) and $\frac{\partial u_d}{\partial x} = 0$, for symmetry.

From previous conditions, it follows:

$$x = 0 \rightarrow c = \alpha\gamma_w H_d$$

$$x = \frac{s'}{2} \rightarrow u_d\left(\frac{s'}{2}\right) = a\frac{s'^2}{4} + b\frac{s'}{2} + \alpha\gamma_w H_d = \gamma_w H_d \qquad (6a)$$

$$x = \frac{s'}{2} \rightarrow \left(\frac{\partial u_d}{\partial x}\right)_{x=\frac{s'}{2}} = as' + b = 0 \rightarrow a = -\frac{b}{s'}$$

By entering the values of *a* and *c* in Eq. (6a), it may be obtained:

$$u_d\left(\frac{s'}{2}\right) = -\frac{b}{s'}\frac{s'^2}{4} + b\frac{s'}{2} + \alpha\gamma_w H_d = \gamma_w H_d \rightarrow b\frac{s'}{4} = \gamma_w H_d(1-\alpha) \rightarrow b = 4\gamma_w \frac{H_d}{s'}(1-\alpha)$$

It is then easy to calculate the horizontal gradient i_x and the flow rate Q_x, though the trench face in the layer *d*:

$$(i_x)_{x=0} = \frac{1}{\gamma_w}\left(\frac{\partial u_d}{\partial x}\right)_{x=0} = \frac{1}{\gamma_w} b = 4\frac{H_d}{s'}(1-\alpha);$$

$$Q_x = K_d \alpha H_d (i_x)_{x=0} = 4K_d \frac{H_d^2}{s'}(1-\alpha)\alpha.$$

The highest value of Q_x is obtained for α=1/2:

$$(Q_x)_{max} = Q_x\left(\alpha = \frac{1}{2}\right) = K_d \frac{H_d^2}{s'}.$$

The vertical flow rates, Q_y^s and Q_y^i, through the uppermost and the lowermost boundaries of layer *d* depend on the gradients i_y^s e i_y^i. The numerical analyses discussed above show that i_y^s is around 1 and, on the average, i_y^i is equal to 0.5.

Therefore:

$$Q_y^s = K\frac{s'}{2}i_y^s;\ Q_y^i = K\frac{s'}{2}i_y^i \rightarrow \Delta Q_y = Q_y^s - Q_y^i = K\frac{s'}{2}\left(1 - i_y^i\right).$$

Finally, from the equilibrium condition of the fluid mass it is:

$$(Q_x)_{max} = \Delta Q_y \rightarrow K_d \frac{H_d^2}{s'} = K\frac{s'}{2}\left(1 - i_y^i\right) \rightarrow \left(\frac{s'}{H_d}\right)^2 = 2\frac{K_d}{K\left(1 - i_y^i\right)} \qquad (7a).$$

Eq. (4a) is obtained from Eq. (7a), assuming s'~s and $i_y^i = 0.50$.

The Authors didn't believe useful to report such a detailed series of expressions into the paper, which lead to Eq. (7a), that is valid only in the case of h_{yy}=0 into the permeable layer and for reasonable but arbitrary values of the gradient i_y^i. Moreover, Eq. (4a) does not express the dependency of s_d/H_0 on H_1/H_0 , which has been evidenced by the results of the numerical analysis, because the average value of i_y^i (0.5) has been assumed (while i_y^i depends also on H_1/H_0).

C1.3 - How do you calculate pore pressures in equations 5-8? From line 145 it appears these are not based on the FEM calculation. Is there a closed-form solution?

Pore pressure (and efficiency) in Eq. 5-8 (indicated with *) have been taken from well known dimensionless plots present in the literature for the design of draining trenches in homogeneous soils referring to a simplified geometric scheme accounting for the presence of the permeable layer.

C2 - DISCUSSION OF LIMITATIONS OF SIMPLIFIED APPROACH

The simplified approach is only valid if the drainage layer is fully activated. Can you add a discussion on how to determine if this condition is satisfied?

The Reviewer is right: the simplified approach can be used only when the drainage layer is fully active. To check this condition, Fig. 2f of the submitted paper may be used. Being known the depth of permeable layer (H_1) and its hydraulic conductivity (K_d), the spacing between trenches should be lower than the one provided by the curves in Fig. 2f, this in order to activate the drainage layer all over its length. However, the Author will add in the text some considerations about the use of the simplified approach, suggesting, in particular, to adopt the observational method by installing some piezometers in the permeable layer. These aspects are illustrated at point C3.

C3 - DISCUSSION ON REAL-WORLD APPLICABILITY AND FIELD TESTING

I would recommend a section discussing how this theoretical finding could be corroborated in a field experiment (especially the concept of fully activated drainage layer).

The technical note ends with the following sentence (Lines 163-165) "*Considering the variability and the unpredictability of many natural situations, proper investigations, including the observational method, to check the validity of such an assumption are then warmly recommended*".

The "observational method" is a managed monitoring process of the response of an engineering work aimed at checking the validity of the design and addressing to proper modifications due to unexpected or neglected factors. Regarding drainage trenches, the installation of piezometers is highly recommended to check in real-time the efficiency of the drainage system (especially during the critical rainy season). The piezometers should be installed both in proximity of the slip surface (near and far from the trenches) and in the permeable layer.

Such or similar considerations will be added in section 4.

C4 – CHANGE TITLE

I suggest to make the title more specific, for instance 'The effect of a permeable layer in a low permeable soil on soil stabilisation by drainage trenches'

Following your suggestion, we decided to modify the title in "The beneficial role of a natural permeable layer on slope stabilization by drainage trenches".

C5 – PERVIOUS

Change 'pervious' to the more commonly used word 'permeable'

The word "pervious" will be replaced by "permeable" in the modified version of the text.