**Reviewer #5:**

In this manuscript, the authors study rock deformation in twin tunnels with a transverse gallery, considering plasticity and time-dependent constitutive models. After reviewing the manuscript, I believe the following questions should be addressed in the revised version:

**\*1) The title could be changed to "Evaluation of Rock Deformation in Twin Tunnels with a Transverse Gallery, Considering Plasticity and Time-Dependent Constitutive Models."**

Thank you for your suggestion regarding the title. We agree that the proposed title better reflects the focus and scope of the study. We have also decided, at the suggestion of another reviewer, to make it explicit in the title that the article deals with a three-dimensional finite element model. Therefore, we have revised the title to: *"*Evaluation of rock deformation in twin circular tunnels with a transverse gallery through a three-dimensional finite element framework considering plasticity and time-dependent constitutive models.”

**\*2) Is the twin tunnel mentioned in Section 5 an actual case study? If so, the geotechnical properties, as well as details regarding the size, excavation method, and lithological units of the study area, should be provided.**

The twin tunnel mentioned in Section 5 is not a case study, but a typical configuration used to validate and demonstrate the application of the developed numerical model. The geometrical properties, material parameters, and boundary conditions were defined based on data from the literature and some assumptions (referred to Section 2). There are no specific twin tunnels with geotechnical data, excavation methods, or lithological unit details, as the study aims to explore generic scenarios of interaction between twin tunnels and a transverse gallery.

To make it clearer, this point has been incorporated into Section 5: "Spatial and Time Discretization of the Domain", after introducing the model geometry and conditions, before Table 1 with geometrical parameters, with the following text:

"The twin tunnel configuration is a typical setup designed to validate and illustrate the applicability of the proposed numerical model. The geometric parameters and boundary conditions are common to twin tunnels configurations and the material properties were based on real data from the literature (see section 7.1), however they do not correspond to a specific twin tunnel case study."

**\*3) Which software was used for simulating the tunnel?**

The software used was ANSYS, but it is important to note that the constitutive models (for the rock mass and lining) were developed and implemented within it using the UPF/USERMAT feature. The software doesn't have these advanced models. This information is in the text of the article:

The last paragraph in Section 1:

“[…] At the tunnel structure level, the constitutive modeling ~~and related~~ as well as the related numerical integration schemes are developed and implemented within a specific UPF/USERMAT procedure of ANSYS standard software (ANSYS 2018). The finite element modeling developed in this paper can be viewed as specifically devised tool for addressing the three-dimensional interaction induced by the construction process of closely-spaced twin tunnels with transverse gallery junction. […]”

For the rock mass, in the last sentence of the first paragraph in Section 3:

“[…] Detailed description of the model, including application and validation in the context of single tunnel structures may be found in Quevedo et al. 2022b. Finite element implementation of this model in the USERMAT procedure of ANSYS software is also described in Quevedo 2021.”

And for the lining, in the last sentence of the first paragraph in Section 4:

“[…] Full details regarding model definition and related finite element implementation may be found in Quevedo 2017 and Quevedo et al. 2022a.”

However, to make it clearer the last paragraph in Section 1 will be changed to:

“[…] The simulations presented in this paper were conducted using the ANSYS software suite, a widely used finite element analysis tool. However, to address the specific requirements of the research, these constitutive models were developed and implemented within ANSYS through a specific UPF/USERMAT procedure. At the tunnel structure level, the finite element modeling developed in this paper can be viewed as a specifically devised tool for addressing the three-dimensional interaction induced by the construction process of closely-spaced twin tunnels with transverse gallery junction. […]”

**4) How was the numerical model calibrated?**

Ver com o Samir. Acredito que calibração é feita quando se tem algum estudo de caso, não?

**\*5) How were the results of the numerical simulation verified?**

The results obtained from numerical models were verified by comparing them with analytical and numerical solutions available in the literature for similar configurations without transverse gallery. For example, comparisons were made with the analytical stress solutions for twin tunnels under plane strain conditions proposed by Guo et al. (2021) and Ma et al. (2020). These comparisons demonstrated the ability of the model to capture the key interaction effects and deformation mechanisms.

To make it clearer, at the beginning of the reading, it will be added to the last paragraph in Section 1:

“[…] After presenting the assumptions and details of the computational model (constitutive models, spatial and time discretization) Section 6 presents preliminary simulations and the validation of the twin tunnel problem through comparisons between 3D F.E. numerical results and analytical solutions in elasticity and plasticity under plain strain conditions. The last part of the paper provides several numerical simulations that illustrate the ability of this computational model to deal with twin tunnel transverse gallery and to provide preliminary insight into the interactions involved.”

**6) The support systems of the tunnels and gallery should be clearly presented in a specified table.**

The details of the support systems for the tunnels and gallery, including parameters such as thickness, and installation process, are already presented in Table 1 of the manuscript.

**7) The boundary conditions, assigned material properties, and model size should be illustrated in the text.**

The boundary conditions are detailed in Section 5 and illustrated in Figure 5, including the geostatic initial stresses (Equation 11) and symmetry conditions. The model size is described in third paragraph of Section 5, with domain dimensions and mesh details shown in Figure 5 and Table 1. Assigned material properties are provided in Section 7.1 and summarized in Table 2, covering both rock mass and lining parameters.

**\*8) How were the normal and shear stiffness between the initial and secondary support systems considered in the model?**

The concrete lining is modeled as a continuous structure with constant thickness, without distinguishing between primary and secondary support systems. The interaction between the support and rock mass was modeled assuming perfect bonding, eliminating the need to explicitly consider normal and shear stiffness. This simplification is valid for scenarios with good material connection. For interfaces with potential sliding or separation, advanced interface models with specific parameters could be applied.

To make it clearer, this answer can be emphasized in Section 2: "Fundamental Assumptions":

We changed the eight item:

"Perfect bonding is assumed at the interface between concrete lining and the rock mass."

to:

"The lining was modeled as a continuous structure with a constant thickness, assuming perfect bonding with the rock mass and without distinguishing between primary and secondary supports."

and change the sixth item:

"The simulation excavation processes are carried out assuming a constant tunnel advancement rate (i.e., constant excavation speed), together with a constant thickness of concrete lining."

to:

"The simulation excavation processes are carried out assuming a constant tunnel advancement rate (i.e., constant excavation speed)."