REVIEWER'S FORM
for thesis evaluation

1. Identification of the student

Student:	Maïa Laffineur
Thesis:	Optimization of a computational model for the restoration of the intrados of the Charles Bridge (Prague)
1st Institution:	UPC Barcelona/UNIPD Padova
2nd Institution:	Czech Technical University in Prague
Academic year:	2016/2017

2. Identification of the reviewer

Name:	Vít Šmilauer
Institution:	Czech Technical University in Prague
Position:	Associate professor

3. Fulfillment of thesis goals

excellent ☐ above aver. **X** average ☐ below aver. ☐ weak ☐

"The thesis focuses on the development and discussion of a methodology to model the replacement stage by stage of some damaged stones of the intrados of the Charles Bridge in Prague."

The goals are fulfilled by introducing computational methodology with 2D plane stress simplified model of the arch. Two approaches are fostered, starting with a homogeneous model using a uniform eigenstrain loading to a heterogeneous model introducing mortar as a phase. All approaches are well documented with stress/displacement figures and corresponding flowcharts for assembling mesh, FE model and postprocessing. Figure 4.14a shows that it is possible to restore original stress state with replaced ashlars. Conclusion gives a nice overview of used methods, their limitations and possible extensions.

More elaborated discussion would help explaining several intrinsic aspects to FE model, particularly stress singularity in convex areas around sharp corners, displacement and stress continuity in replaced subdomains.

4. Academic/scientific/technical quality

excellent ☐ above aver. **X** average ☐ below aver. ☐ weak ☐

The thesis has a logical structure, beginning with a review of brief history of the Charles Bridge and continuing to main causes for decay of ashlar masonry. Due to abundant amount of information, description focused only on 14th arch investigation which currently contains 15-20% of ashlars to be replaced as soon as possible. Previous interventions with patching (replacing only surface-damage ashlars) was found inappropriate with low durability.

Chapter 1.3.3 reviews destructive and non-destructive methods and related mechanical properties of sandstone and mortar. Chapter 2 deals with modeling on a general basis. Chapter 3 presents homogeneous models while Chapter 4 introduces heterogeneous approach. The modeling examples start from simple to more complex.

Scientifically, the thesis could formulate boundary value problem between inclusion (new brick) and surrounding prestressed masonry in terms of displacement compatibility and stress equilibrium. This would enable different approaches, such as continuum micromechanics with Eshelby's solution.

5. Formal arrangement of the thesis and level of language

excellent **X** above aver. ☐ average ☐ below aver. ☐ weak ☐

The thesis is well written and arranged. The majority of results is well documented with figures or graphs. The major conclusions in each Chapter are supported and briefly discussed. Occasionally, subject-verb word order is changed.

6. Further comments

1. Figures 1.7-1.11 show substantial ashlars' degradation on 14th arch. I assume that our ancestors faced similar problems of deterioration as we do today. What were historical methods of ashlars' replacement? Whether and how did they introduce prestress in the new parts?
2. Chapter 3 reviews homogeneous model of masonry. This resembles famous Eshelby's solution from 1957 of an ellipsoidal inclusion in linear elastic material, where stress/strain in the inclusion remain constant. Did you verify your FE results with this simple analytical approach?
3. You have calculated average tangential stress -0.5 MPa in the arch. Wood wedges belong to traditional method of prestressing, however, there are serious doubts about their efficiency. Civil engineering today offers new methods, such as use of hydraulic presses, expansive mortars, pressurized injection or precooling. Especially precooling seems to be attractive since such low stresses need a few centigrades difference and the intervention could be minimal. What method would you suggest?

7. Grade: B (very good)

Use the following scale

A (excellent)	B (very good)	C (good)	D (satisfactory)	E (sufficient)	F (fail)

Prague

July 14, 2017

The Reviewer,

Doc. Ing. Vít Šmilauer, Ph.D.