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Travel to Europe (FREEDAM project) + SHJ recent developments

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Presentation by Shahab Ramhormozian at
QuakeCoRE Flagship 4 meeting



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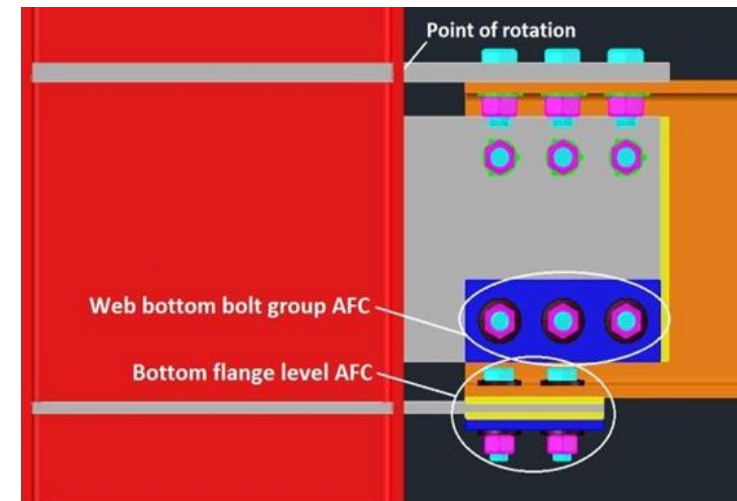
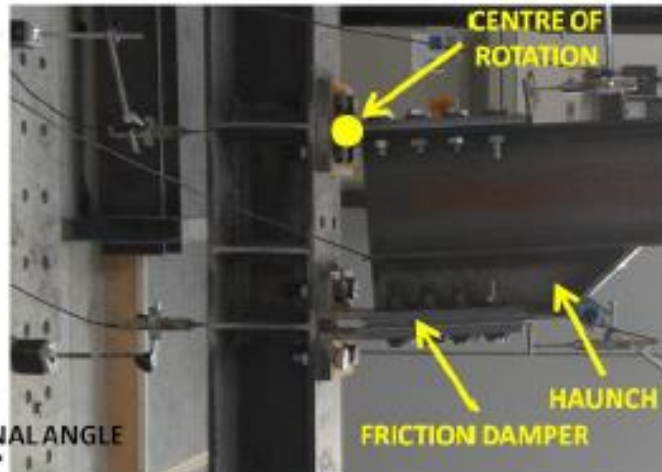
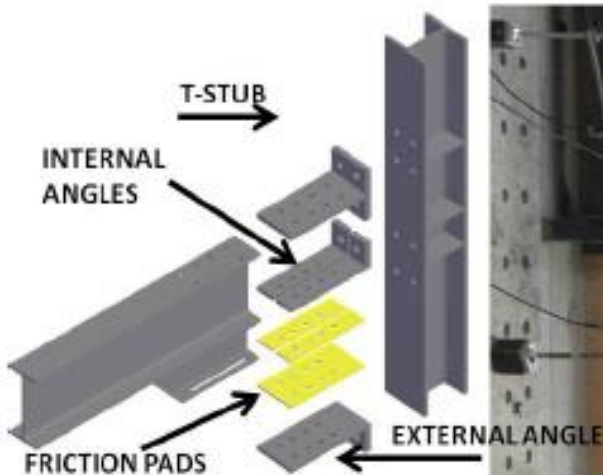


Scope of Talk

- FREEDAM beam column connection test at the University of Salerno and the university of Coimbra
- Key points on the travel + potentials for collaboration with University of Salerno (Italy) and University of Coimbra (Portugal)
- Recent developments in the SHJ

FREE from DAMage (FREEDAM) project

- Funded by European Commission (RFCS (Research Fund for Coal and Steel)) ≈ €2.5 million
- Being undertaken by the universities from Italy, Belgium, and Portugal + two companies
- Inspired by the SHJ research



Key points of the travel



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- Observing FREEDAM experiments at UNISA and UC
- Lectures on the SHJ at UNISA and UC + attending the Eurocode committee meeting on connections
- Established contact people in Europe following Eurocode meeting
- UNISA and UC are interested in collaboration. This may happen in three stages:
 1. *Joint publication*
 2. *Research collaborating without financial involvement*
 3. *Research collaboration with financial involvement at both sides*

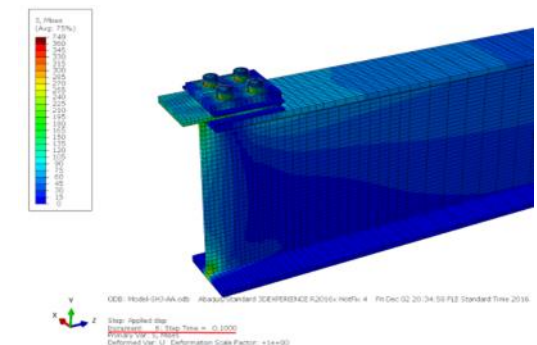
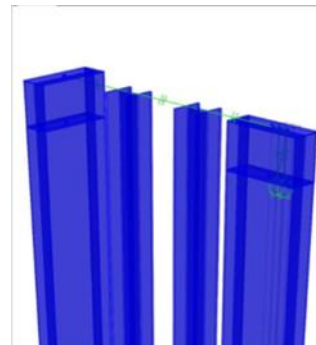
Recent Undertaken research on the SHJ

Analytical: based on first principals;

Experimental: using customized high precision tools to reach the highest level of accuracy and completeness in the experiments;

- *More than 50 AFSHJ real scale component level dynamic tests with and without Belleville springs on two AFSHJ test setups*
- *More than 200 bolt tightening and direct tensioning tests with and without Belleville springs.*

Numerical: using ABAQUS and SAP2000 softwares



Established findings (to be published in Journals in 2017/18:



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- Establishing the **optimum use of the Belleville springs**. This removes the **concerns about the post-earthquake elastic strength loss, damaging prying effects, and the variations of the bolt tensions during sliding**.
- Establishing the **optimum level of installed bolt tension in the AFSHJ**.
- Developing a turn-of-nut-based **methodology to tighten the HSFG bolts with BeSs in the bolt's elastic range**. This removes the **concerns about the delivered installed clamping force in the friction sliders**.
- Establishing the **optimum surface preparation/roughness level** for the AFC plies sliding surfaces. This also removes the **CoF variability concerns about the friction sliders**.
- Proposing **required changes on current NZS3404 recommended method of bolt tightening**. This removes the **concerns about the reliability of the HSFG bolts delivered installed tension**.
- Developing a dynamic SDOF SHJ model to investigate the effect of dynamic loading frequency, mass, and wind down on the **static and dynamic self-centering capability** at component level.
- Experimentally investigating the shim-less AFC, AFC with TiN coated shims, and AFC with abrasion resistant cleat and shims.

FEM modelling of the SHJ AFC with and without BeSs to numerically investigate the effect of BeSs, optimum bolt tension, effect of number of bolt rows, effect of prying actions, effect of plies thickness reduction.

Developing the **AFC bolt model** to design the AFC.

- This is based on the first principals, will explain in details the behaviour of the AFC, and gives the modified design procedure.

Developing a **simplified but accurate MDOF building model of the SHJ** to research the SHJ **dynamic self-centring capability** using SAP2000 considering the several parameters such as column base rotational stiffness, type of the friction damper, the additional linear elastic spring between the column and beam, and stepping column base.

Pre and post earthquake **system identification of the Te Puni Village SHJ building** using SHM data.



Many thanks!