W3C LBD Community Group
Minutes - Call 18/11/2024

Attendees

- Alex Donkers (Eindhoven University of Technology, The Netherlands)
- Maria Laura Leonardi (mlauraleonardi@gmail.com)
- Carlos Ramonell
- Giorgia Marcellino
- Philipp Hagedorn
- Janakiram Karlapudi
- Rebekka Benfer
- Rolando Chacón (rolando.chacon@upc.edu)
- Timothy Rossi
- Zhangcheng Qiang

Please join the W3C LBD CG and subscribe to the internal mailing list:
Linked Building Data Community Group (w3.org)

Presentation slides and other material

https://github.com/w3c-lbd-cg/lbd/blob/gh-pages/presentations/20241011_Presentation_MariaLauraLeonardi.pdf

Date and time

- Monday 18th of November 2024, 15:00-16:30@UTC/ 16:00-17:30@CET/ 07:00-08:30@PST

Moderators

1. Alex Donkers

Agenda

1. Introduction of new members
2. Quick notes:
   a. OGC GeoSPARQL use-cases:
      https://github.com/opengeospatial/ogc-geosparql/issues/523
   b. EC3-CIB W78 2025-LDAC2025 conference in Porto
      https://ec-3.org/conference2025/
      https://linkedbuildingdata.net/ldac2025/
   c. GitHub issue on BOT
      https://github.com/w3c-lbd-cg/bot/issues/119
3. Maria Laura Leonardi: Enhancing Finite Element Modeling of Historic Masonry Structures Through Ontology-Driven BIM Integration
4. Discussion
5. Further topics

Minutes

1. **Introduction of new members**
   a. Timothy Rossi
      i. Company in health in buildings
      ii. Coding on indoor air quality improvements for buildings
      iii. Interested and working on ontologies
   b. Carlos Ramonell
      i. UPC, Barcelona
      ii. Semantic web technologies for Digital Twins on bridges
      iii. Working on ideas that are similar to the ones presented in this presentation
   c. Rolando Chacón rolando.chacon@upc.edu
      i. Associate Prof, UPC
      ii. Digital twins of the built environment
   iii. Bridges, masonry arch bridge
2. **Quick notes**
3. **Maria Laura Leonardi: Enhancing Finite Element Modeling of Historic Masonry Structures Through Ontology-Driven BIM Integration**
   - Currently doing a PhD in the University of Minho and teaching in the BIM A+ master.
a. Historic Masonry Structures
   - Heterogeneous material with a structurally complex nonlinear behavior, typically built in masonry aggregates.
   - Seismic behavior, difficulties during earthquakes.
   - Various methods to understand this seismic behavior, Solid FEM is the one that is able to create a very detailed model of the buildings structural behavior.
b. Challenges in FEM, and solutions presented by Maria Laura
   i. Mechanical properties -> Semantic Web Technologies
   ii. Geometry complexity -> BIM-to-FEM automation
   iii. Computational costs -> FEM parallelisation
   iv. Convergency problems -> Implex algorithm
c. Recent paper on BIM-to-FEM interoperability: Scalable BIM based open workflow for structural analysis of masonry building aggregates (https://doi.org/10.1016/j.compstruc.2024.107321)
d. Limitation in the IFC schema
   i. Lack of methods to represent complex features of the masonry wall
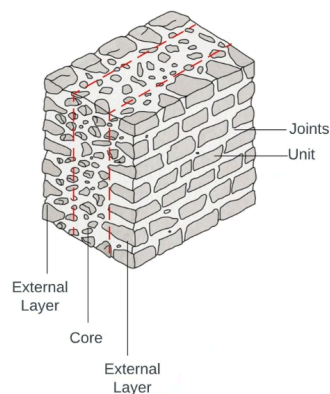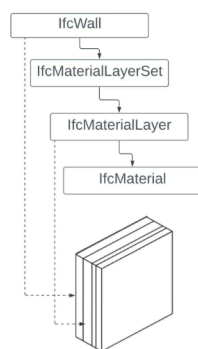
   ii.
   iii. Need to describe with more semantics the heterogeneity of the material and to describe the mechanical properties related to the material.
e. Proposal: a linked data approach
   see also: http://dx.doi.org/10.36253/979-12-215-0289-3.78 which was my first idea.

Current state of the ontology + rules will be published in ITcon jornal: "Leveraging semantic web rule languages to define modeling assumptions for the structural analysis of unreinforced masonry buildings, Leonardi et al. (2024)" -> corrently in production
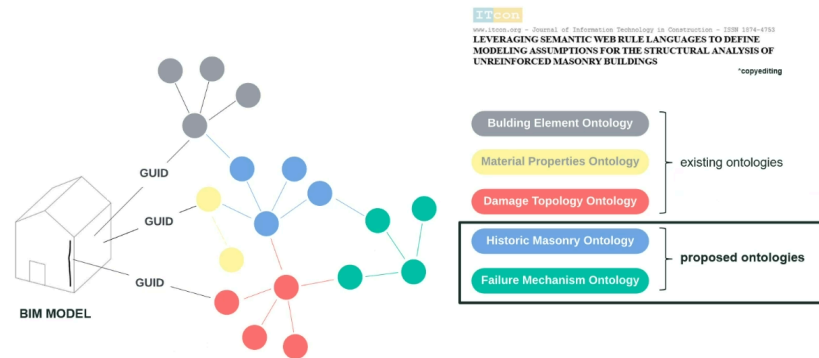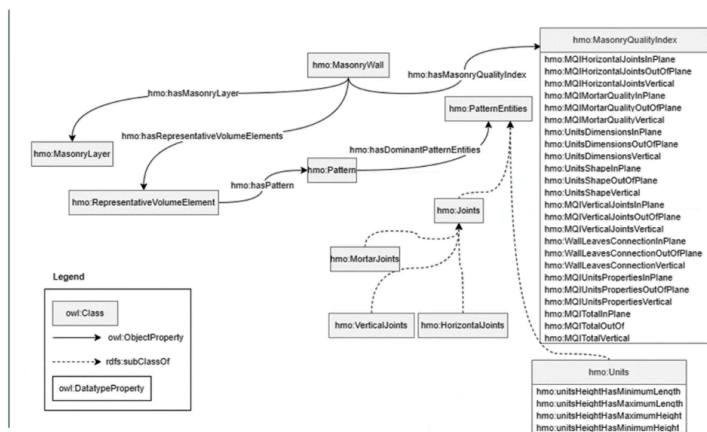

     i.
     ii.   Two extensions, the HMO and FMO ontologies
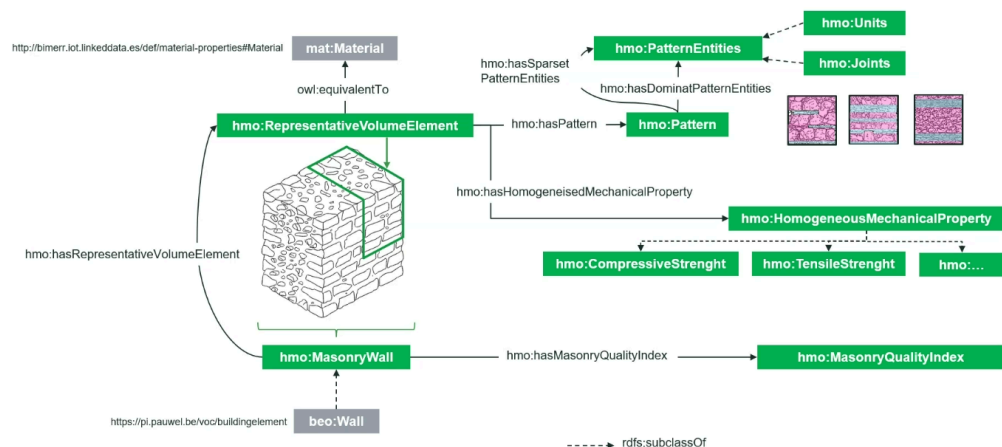f.   Historic Masonry Ontolgy (https://w3id.org/hmo#)

   i.


     ii.
     iii.   hmo:MasonryWall is a subclass of beo:Wall
     iv.   hmo:RepresentativeVolumeElement represents a concept that is often used in FEM. When modeling heterogeneous elements, the RepresentativeVolumeElement is a snippet of the larger element with homogeneous mechanical properties
     v.   hmo:Pattern is used to model different combinations of units and joints in the element.
     vi.   various datatype properties from SAREF are reused (hasValue, isMeasuredIn) to represent values and units

vii. Masonry Quality Index can be measured using the datatype properties in the hmo ontology.

viii. SWRL rules are created to calculate the Masonry Quality Index taking the Abox data as an input.

g. Reasoning

    i. Reasoning is currently tested in a Protégé reasoner.

    ii. Future work is planned to build an application with a viewer, (idea: Three.js) so that the calculations can be visualized.

h. The Failure Mechanism Ontology (https://w3id.org/fmo#)

    i. A second ontology, way smaller.
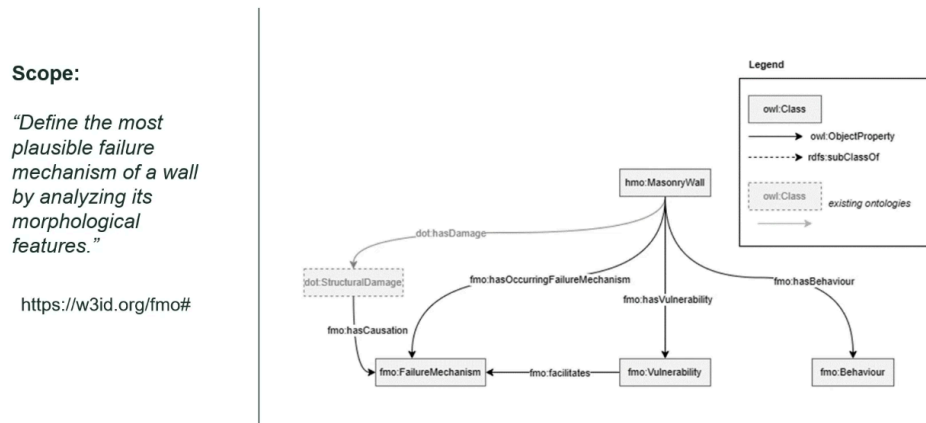
    ii.

iii. Next to the mechanical properties, we need to understand failure mechanisms of walls and how they relate to those mechanical properties.

iv. FMO reuses parts of the Damage Topology Ontology DOT.

v. hmo, dot and fmo can be linked to represent the failure mechanisms causing damages in walls:
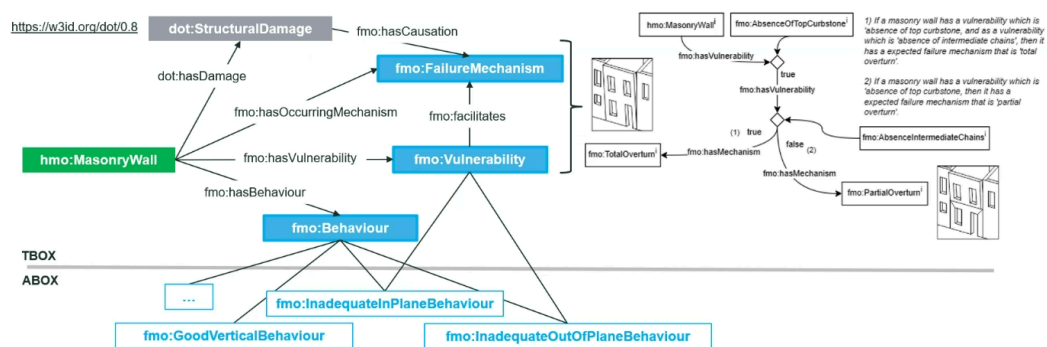
vi.

i. Future work

    i. Framework improvement (complex multimaterial elements

    ii. Javascript

4. Discussion

a. Carlos: How would you use a reasoner outside of Protégé

b. Maria Laura: There should be a tool in Three.js, Comunica. Not sure if it will work. Also not sure where the reasoning should happen (frontend/backend). Also thought of using BonsAI/BlenderBIM to do reasoning in Python.

c. Rolando Chacon: interested in using those ontologies in a masonry arch bridge

d. Maria Laura: What is the scope of the project?

e. Rolando: Scope is to cover all the steps of the bridge construction, including the structural analysis. But also the basics, such as inspection tasks.

f. Maria Laura: Would be nice to do a case study together and see how we can use the ontology in a bridge project.

g. Alex: Why do you build a viewer, who is going to use it and what do you want to visualize?
h. Maria Laura: My idea is that the assessor of a building should have a platform to be able to get information from the beginning of the assessment process to the FEM software.
i. Alex: Could you do future SWRL use cases where you would combine this work with other work (cross-domain SWRL, e.g. with inspection tasks).
j. Maria Laura: yes, this is why I started working with ontologies. I'm very interested in the field of chemistry. I think it would be nice to create SWRL rules that combine multiple ontologies.
k. Alex: Did you try SHACL? e.g. If value X is lower than Y, go and do an inspection.
l. Maria Laura: Maybe this is a nice idea. It's good to meet as many people are working on similar topics. I'm not sure how to apply semantic web technologies in python.
m. Carlos: rdflib basically maps semantic web languages to python so that you can use those classes and properties in the regular python way of working.
n. Alex: And you need this to build software on top of your graphs.
o. Carlos: How do you manage geometry from the IFC to the FEM calculation. Sometimes, how geometry is interpreted by Architects is not valid for FEM calculations.
p. Maria Laura: I use OpenCascade a lot to work with geometry. there's a github library (https://github.com/mlaura1996/OpenBIMtoFEM) with the code that exports IFC to OPS. There's still problems, such as that solid elements are converted to just the shell. Using the sewing function and face_iterator.
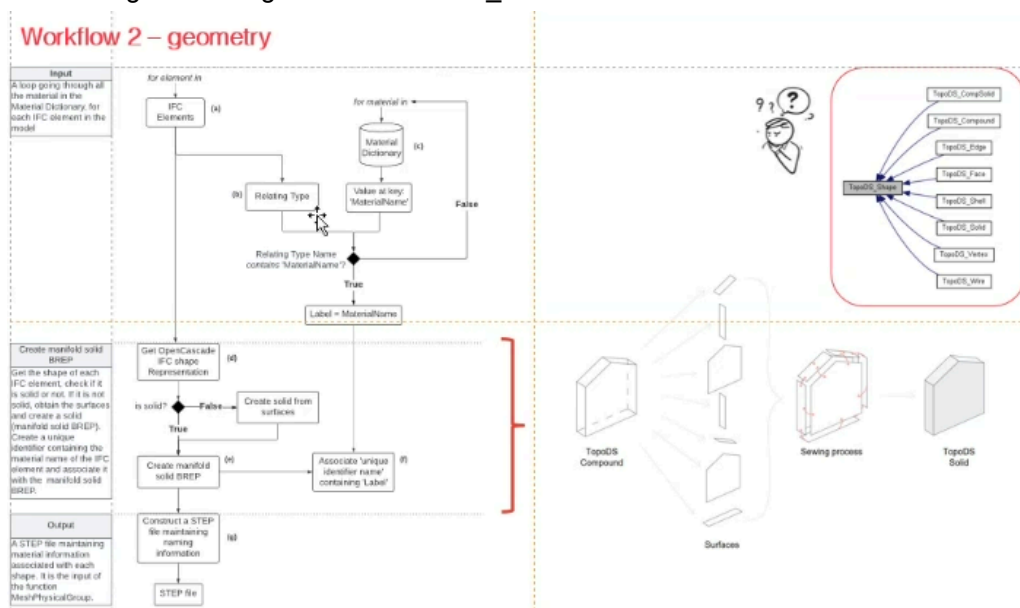
5. **Further topics**

Next Call

- 16/12/2024, Monday, 15:00-16:30@UTC/ 16:00-17:30@CET/ 07:00-08:30@PST

  We are interested in getting suggestions from the community about potential agenda items and **Elevator Pitches** for the following calls. Please send your suggestions to the chairs or to internal-lbd@w3.org, whether you have a short presentation to bootstrap the discussion, and an approximate duration you think the discussion will last.

Previous minutes

https://github.com/w3c-lbd-cg/lbd/tree/gh-pages/minutes