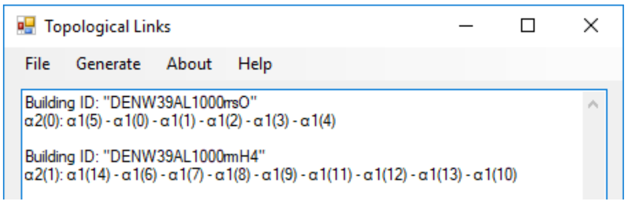

Figure 14. a-2 links for Dataset A

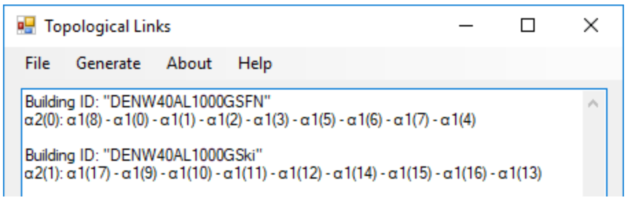

Figure 15. a-2 links for Dataset B

The fourth and final topological link is the a-3 link which is generated only if the 3D buildings are connected. The previously generated a-2 links are used as input to generate the a-3 links. The resulting a-3 links for Dataset A and B are shown in Figure 16 and Figure 17 respectively. Only the connected buildings of Dataset A are able to generate a-3 links wheras the disjointed buildings of Dataset B do not generate any a-3 links. The a-3 links for Dataset A describes that Building 0 (a-2(0)) is connected to Building 1 (a-2(1)) and vice versa.

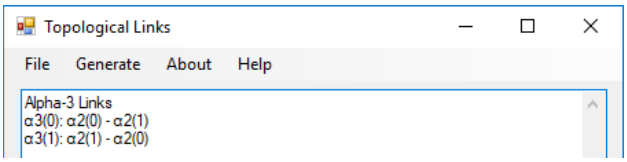

Figure 16. a-3 links for Dataset A

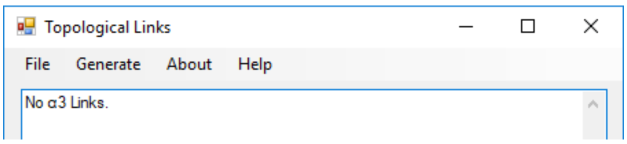

Figure 17. a-3 links result for Dataset B

Originally, the two connected buildings of Dataset A consisted of 15 surfaces and 16 nodes. Each building was represented by 1 a-2 topological link which consisted of the nodes, lines and surfaces that make up the building. The buildings in Dataset B which consisted of 18 surfaces and 20 nodes were also represented by 1 a-2 link per building. Apart from that, the a-3 links were also able to describe the connection between the buildings of Dataset A which could not be referenced in CityGML due to being connected via an "invisible" face. Therefore, the topological links are a simple yet compact way of preseving the topological information and is able to describe how surfaces are connected in the building.

4. CONCLUSION

Topological information for buildings in CityGML are preserved using XLinks mechanism which references surfaces that share a common surface. This is a simple yet sound foundation for maintaining topological integrity within a 3D model. However, analyses that require connectivity information necessitates a comprehensive preservation of topological properties. This paper demonstrated the use of cell complexes topological links to preserve topological properties of buildings in CityGML. Two datasets were used which consisted of two connected buildings and two disjointed buildings. Four links which are a-0 (connects points to form 1D line), a-1 (connects lines to form 2D surface), a-2 (connects surfaces to form 3D volume) and a-3 (represents connections between 3D volumes) were generated. The decrease in number of links from a-0 (57 links) to a-2 (2 links) for Dataset A and a similar decrease for Dataset B shows that the cell complexes topological links is a simple and compact way of preserving topological properties. Additionally, the topological links also describe how the geometries are connected which allows navigation through the connections. Future studies can be carried out regarding the implementation or integration of topological data structures within CityGML and explore other methods of preserving topological information for buildings in CityGML.

ACKNOWLEDGEMENTS

This work is supported by the UTM Research University Grant, Vot Q.J.130000.2527.15H49 and Vot Q.J.130000.2527.11H78. The CityGML datasets used in this study were obtained freely from Nordrhein-Westfalen Open Data. The CityGML viewer used in this study is the FZK Viewer developed by Karlsruhe Institute of Technology.

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Revised May 2018