# Comparative field test evaluation of the Impact Insulation Class (IIC) of roofs


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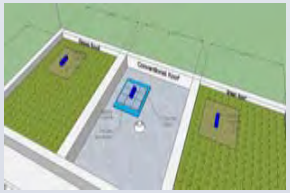
## ABSTRACT


*Most building structures are excellent transmitters of noise and vibration. Noise generated on the roof due to mechanical units, maintenance personnel and amenity uses is usually under estimated. This is of great importance particularly when the roof is supported by a light weight structure. The tests for this project were performed in a conventional light weight roof with 2 ply modified bitumen and two green roofs in the same building. Some additional elements regularly used on roofs were evaluated as well, in order to understand their effect in the impact sound transmission.*


http://www.flickr.com/photos/26786061@N00/2536147455/

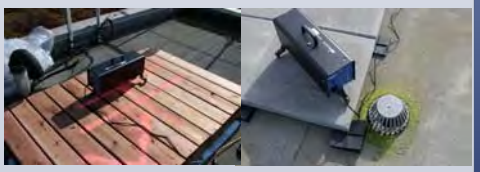
## INTRODUCTION

As urban density is increasing, the use of rooftops to regain exterior private and/or public spaces is also increasing. Rooftop use for outdoor recreational, urban agriculture and restaurant seating are examples of this increment. The impact noise created by users must now be considered.



Sound tests are performed to determine how well roof/ceiling assemblies insulate against noise created by impact and airborne vibration. Where airborne sound transmission loss has been quantified, it is almost unknown if green roofs perform as well as resilient deck to isolate concrete and wood decks and decrease impact noise.

Impact Insulation Class (IIC) that measures the ability of the assembly to isolate impact noise like foot fall or objects being dropped or dragged.

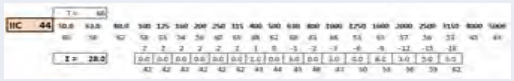


## METHODOLOGY

*The tests were performed at BCIT Green Roof Research Centre on one conventional roof consisting of 2"x12"x16" O.C. wooden deck, insulation and two layers of torch-on modified bitumen, two green roofs -75mm and 150 mm depth- with a fully established sedum communities, in the same edification, as per ASTM standard E1007 "Field Measurement of tapping machine impact sound transmission through floor –ceiling assemblies and associated support structures".*

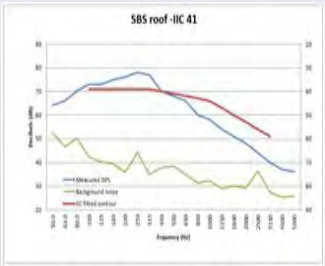
A *standard tapping machine is placed in operation at four prescribed positions on the roof. Sound pressure levels are measured. Four measurements are averaged to get the average sound pressure level in the room.*

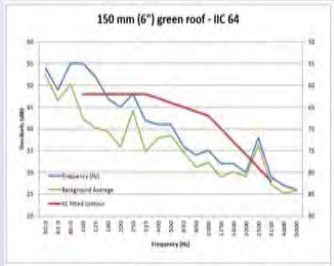
$$D = \sum_{f=100}^{f=3150} if pos\,[L_n(f) + (C(f) + T)]$$

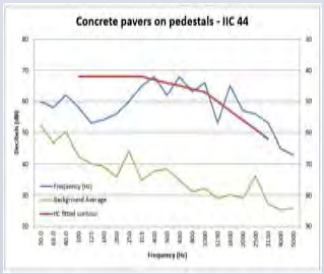



## RESULTS

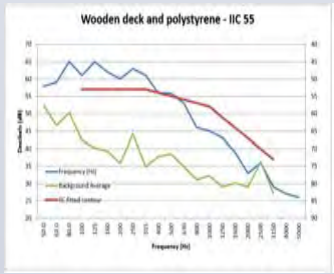
The Impact Insulation Class (IIC) is a single figure rating scheme intended to rate the effectiveness on roof-ceiling assemblies at preventing the transmission of impact sound from the standard tapping machine. The higher the value of the rating, the better the roof performance.



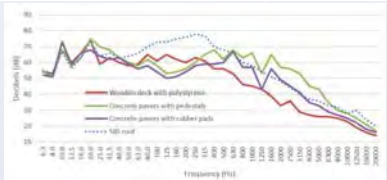



Wooden deck and concrete pavers over conventional roof, show some improvement when using absorbent materials (polystyrene and rubber pads). The plastic pedestals used with the concrete pavers allow for a direct transmission of the impact to the roofing structure and, almost no effect in mitigating the impact sound transmission.

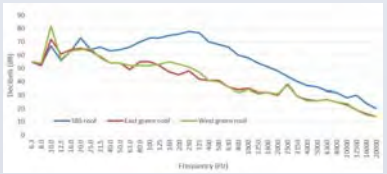
The wooden deck and the concrete pavers generate higher perceptible levels air borne noise when using the tapping machine. For this reason flanking noise would be expected inside the receiving room and lower values for the IIC test would be obtained

## CONCLUSIONS

| SBS roof (reference) | IIC 41 |
|---|---|
| Concrete pavers with plastic pedestals | IIC 44 |
| Concrete pavers with rubber pads | IIC 50 |
| Wooden deck with polystyrene insulation | IIC 55 |
| 75 mm (3") green roof | IIC 64 |
| 150 mm (6") green roof | IIC 64 |



International Building Codes requires a minimum IIC of 45 for field test in new constructions for floor-ceiling assemblies. Under this parameter, the SBS roof over wooden deck and the same roof with concrete pavers and plastic pedestal do not comply with the requirement.



Some acoustical consultants define the following values for the type of quality of floor/ceiling assemblies in new homes:
FIIC 50 for low income or affordable (minimum quality)
FIIC 60 for average or mid-range (medium quality)
FIIC 65 for luxury or high end (high quality)

Under this consideration, bare SBS roofs with concrete pavers fall in the minimum quality category. Wooden deck with polystyrene comply with the medium quality one. **Both green roofs perform as high end/high quality roofs and outperform the other roofs tested.**

## REFERENCES


- Connelly M, Hodgson M, *Experimental investigation of the sound transmission of vegetated roofs*, Applied Acoustics 74 (2013) 1136-1143
- ASTM E1007 - 11e1 Standard "*Test Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures*"
- *Estimation of sound transmission class and impact insulation class ratings for steel framed assemblies*. American Iron & Steel Institute. NRC-CNRC.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