Building Insulation

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08/2015

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Abbreviations

ABBREVIATION/ ACRONYM	DESCRIPTION
EE	Energy Efficiency
POET	Performance, Operation, Equipment and Technology
TIASA	Thermal Insulation Association of South Africa
SANS	South African National Standards
U.S. DOE	United States Department of Energy

PURPOSE

The objective of this energy efficiency (EE) report is to provide useful guidance on best available building insulation technology and EE improvements on buildings.

1 INTRODUCTION

Information on building insulation is provided in terms of the performance, operation, equipment and technology (POET) framework. When possible, the information is classified in to groups of South Africa best available technologies and practices and International best available technologies and practices.

The feasibility of using energy efficiency shall be evaluated based on the incremental investment costs incurred to achieve energy and energy cost saving. An easy and quick decision making indicator is the payback period. A maximum payback period should be fixed for each energy efficiency technology or optimal component design. The energy efficiency technology or optimal component design will be recommended if its payback period does not exceed the maximum payback period.

2 Building insulation technology

2.1 Blanket and batt insulation technology

a) **South Africa best available technology/practice** (TIASA, 2010): Blanket and batt insulation is primarily composed of flexible materials prepared from mineral fibers such as fiberglass, rock wool etc. They are usually available in the shape of batts and rolls.
b) **International best available technology/practice** (U.S. DOE, 2002): Same as South Africa **best available technology/practice**.

2.2 Loose fill insulation technology

a) **South Africa best available technology/practice** (TIASA, 2010): Loose fill insulation is either produced as or broken down into—shreds, granules, or nodules. These small particles form fluffy materials that conform to the shape of the spaces in which they are installed. They can easily fill every crack and corner in a building.
b) **International best available technology/practice** (U.S. DOE, 2002): Same as South Africa best available technology/practice.

2.3 Rigid board insulation technology

a) **South Africa best available technology/practice** (TIASA, 2010): Rigid board insulation is made from fibrous materials or plastic foams and is produced in board-like forms and molded pipe coverings. They provide full coverage with few heat loss paths and are often able to provide a better R-value where space is limited.
b) **International best available technology/practice** (U.S. DOE, 2002): Same as South Africa best available technology/practice.

2.4 Spray foam insulation technology

b) **South Africa best available technology/practice** (TIASA, 2010): Spray foam insulation can be applied by a professional using special equipment to meter, mix, and spray the foam into place. Open-celled foam allows water vapor to move through the material more easily while closed-cell foams are able to provide a greater R-value where space is limited.
b) **International best available technology/practice** (U.S. DOE, 2002): Same as South Africa best available technology/practice.

3 Building Insulation Characteristics

3.1 Blanket and batt insulation characteristics

a) **South Africa best available technology/practice:**
- Glass Fiber (Cao X et al., 2015):
  1. High tensile strength, small elongation;
  2. High elasticity, compressive strength and rigidity;
  3. Low water absorption;
  4. Inorganic fibers with good chemical resistance;
  5. Good heat resistance, non-flammable;
  6. Easy to cut and install;
  7. Light weight and cheap

- Polyester Fiber (Pelegrinis, Horoshenkov, & Burnett, 2016):
  1. Non-toxic with no harmful chemicals, safe;
  2. Moisture and insects resistance;
  3. Fire retardation and sound absorbers;
  4. Durability (will not subside or crumble over time);
  5. Easy to cut and install, recycle;

- Rock Wool (Schmidt, Jensen, Clausen, Kamstrup, & Postlethwaite, 2004; Karamanos, Hadiarakou, & Papadopoulos, 2008):
  1. Green, safe and easy to use;
  2. High durability;
  3. Water repellence and sound absorbers;
  4. Fire retardation;
  5. Stable chemical capability, causticity-resistance;
  6. Natural, sustainable and recyclable;

b) **International best available technology/practice:** Same as South Africa best available technology/practice.

3.2 Loose Fill Insulation

c) **South Africa best available technology/practice:**

- Cellulose Fiber (Cellulose Insulation Manufacturers Association of Canada, 2009):
  1. Sound insulation;
  2. Mold and pest control;
  3. Fire retardation;
  4. Vapor barrier;
  5. Non-toxic, safe, green;
  6. Soft, “flow” around obstructions to give a uniform fill;

d) **International best available technology/practice:** Same as South Africa best available technology/practice.

3.3 Rigid Board Insulation

e) **South Africa best available technology/practice:**

- Expanded Polystyrene (Chen et al., 2015):
  1. Long-term stable insulating performance;
  2. Moisture and insects resistance
  3. High compressive strength;
  4. Non-toxic, environmentally safe lifetime durability;
  5. fire retardation;

6. Easy to install, recyclable.
7. Lightweight and cheap;

- Extruded Polystyrene („Polystyrene" - Wikipedia):
  1. Long-term stable insulating performance;
  2. Moisture and insects resistance;
  3. High compressive strength;
  4. Non-toxic, environmentally safe lifetime durability;
  5. Fire retardation;
  6. Lightweight, easy to install, recyclable.

f) **International best available technology/practice:** Same as South Africa best available technology/practice.

3.4 Spray Foam Insulation

a) **South Africa best available technology/practice:**

- Polyurethane Foam (Kakroodi, Khazabi, Maynard, Sain, & Kwon, 2015):
  1. High strength and rigidity;
  2. Moisture, insects and noise resistance;
  3. Block air infiltration;
  4. Seal small cracks to insulate large areas;
  5. Resist settling due to its general stability;
  6. Excellent adhesion and lightweight.

b) **International best available technology/practice:** Same as South Africa best available technology/practice.

Recommendation

a) South Africa best available technology/practice and International best available technology/practice: Blanket and batt insulation shall be used in roofs, ceilings and walls for both residential and commercial projects.

b) South Africa best available technology/practice and International best available technology/practice: Loose fill insulation shall be used in attics, flat or sloped roofs, wall cavities, cathedral ceiling cavities, floors, rim joists and in crawl spaces of single and multi-family dwellings, for both new construction and retrofit applications.

c) South Africa best available technology/practice and International best available technology/practice: Rigid board insulation shall be used in roof, wall, and floor, below grade applications for both residential and commercial projects.

d) South Africa best available technology/practice and International best available technology/practice: Spray foam insulation shall be sprayed onto roof tiles, concrete slabs, into wall cavities, or through holes drilled in into a cavity of a finished wall.

4 Building insulation performance

a) **South Africa best available technology/practice:** The minimum thermal resistance (R-Value) of building insulation (m2K/W) is given in the following table. These building insulation materials are certified by Energy Star.

Category	Equipment Type	Thermal Resistance
Blanket and Batt Insulation	Glass Fiber	3.38 > 2.30
	Polyester Fiber	3.42 > 2.30
	Rock Wool	3.48 > 2.30
Loose Fill Insulation	Cellulose Fiber	3.38 > 2.30
Rigid Board Insulation	Expanded Polystyrene	3.43 > 2.30
	Extruded Polystyrene	3.57 > 2.30
Spray Foam Insulation	Polyurethane Foam	3.40 > 2.30

Table 1: Minimum thermal resistance of building insulation

b) **International best available technology/practice:** Same as South Africa best available technology/practice.

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Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

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