SpaceSUITE

Construction : Structure, materials and thermal behaviour

S. OGAL

VET School (A. Hébert Evreux)

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Co-funded by the European Union

SpaceSUITE

Objectives :

- Identify the components of a building visible from the sky

- Understand the thermal behaviour of the materials

- Link shape, materials and climate to observations

SpaceSUITE

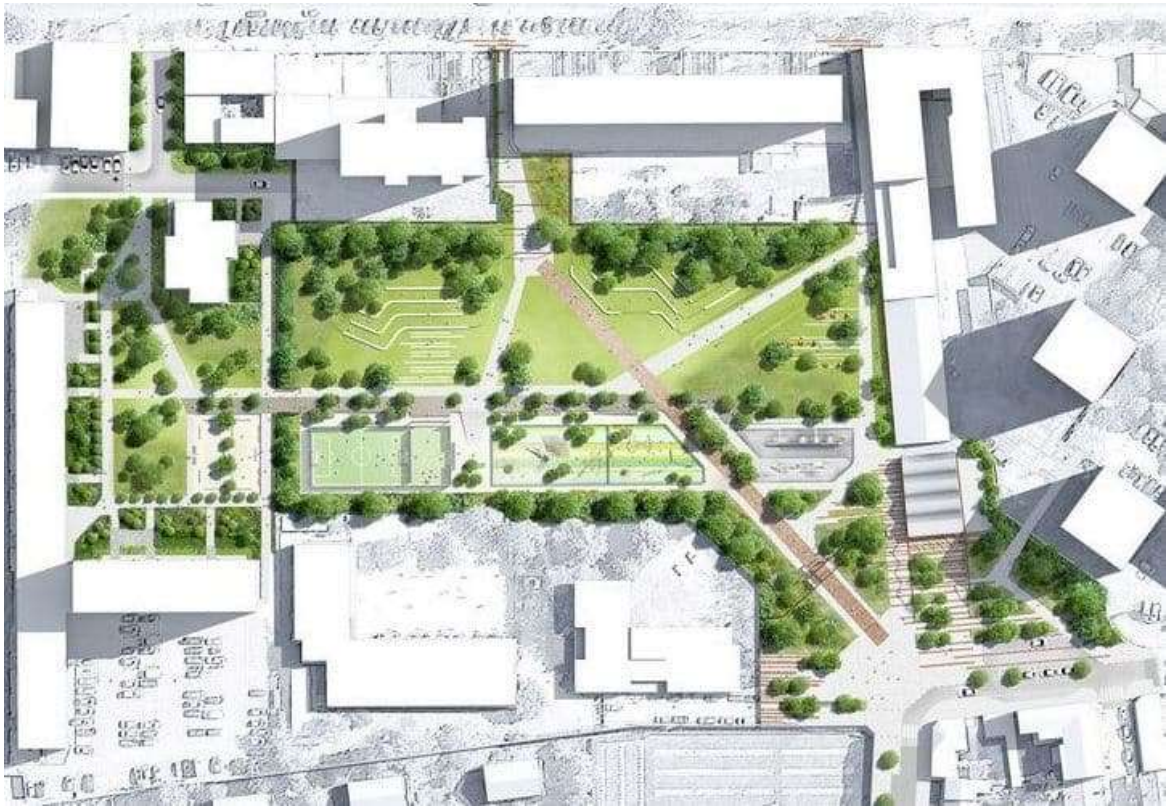
: **Graphical representation / what is observable**

- Urban layouts and roof structures..
- Colors and materials
- Thermal signature

SpaceSUITE

Graphical representation / Site plan

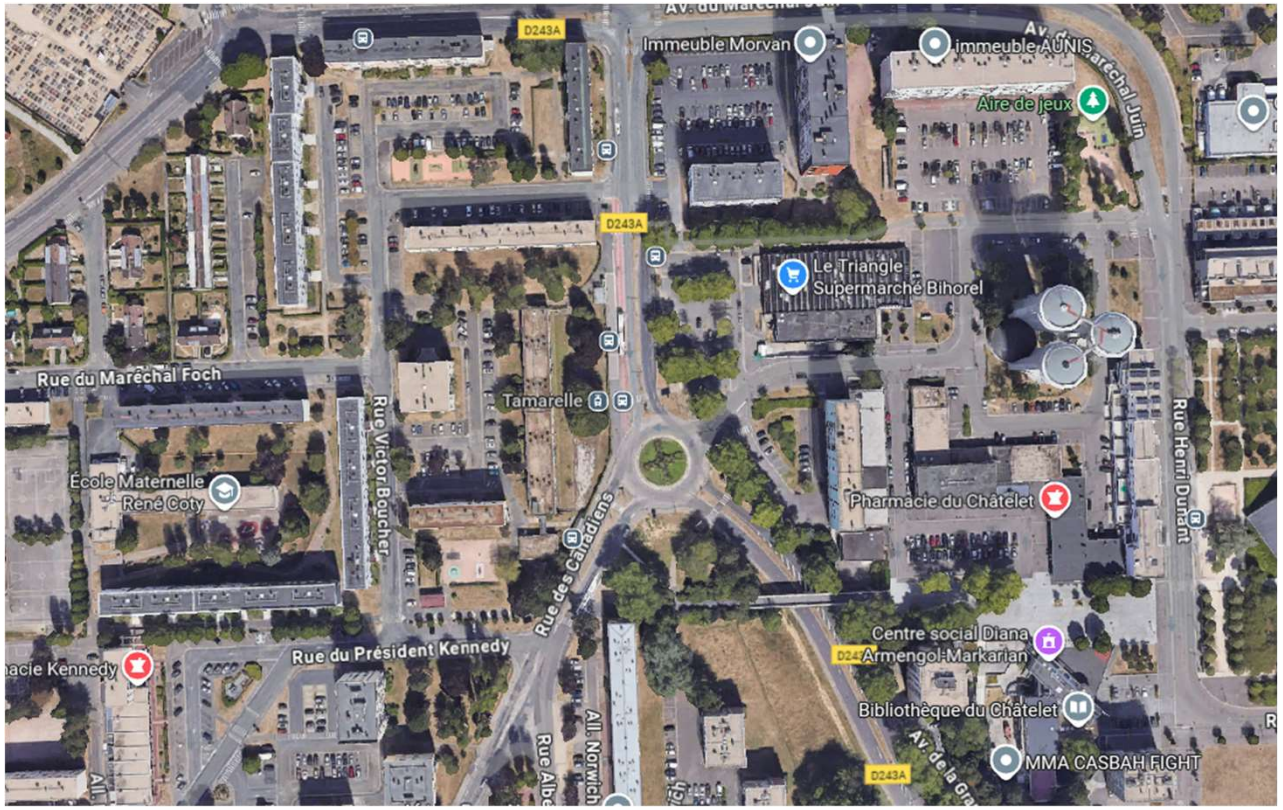
- buildings
- roads
- pedestrian routes
- sports facilities
- vegetation
- shadows
- car parks



SpaceSUITE

Aerial view

- buildings
- roads
- pedestrian routes
- sports facilities
- vegetation
- shadows
- car parks



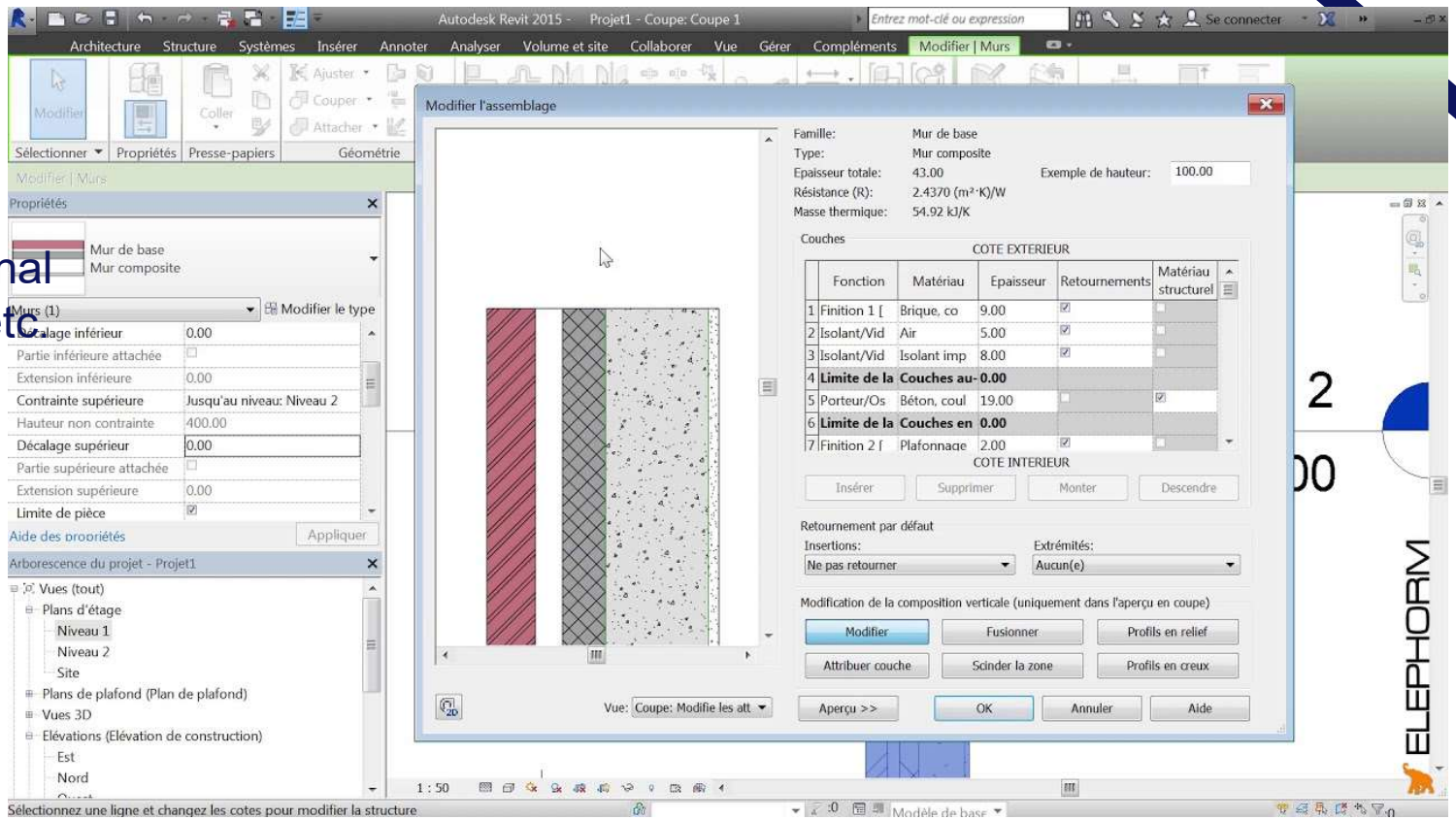
SpaceSUITE

BIM (Building Information Modeling):

Is a collaborative working method based on the creation and management of an intelligent digital model of a building or infrastructure.

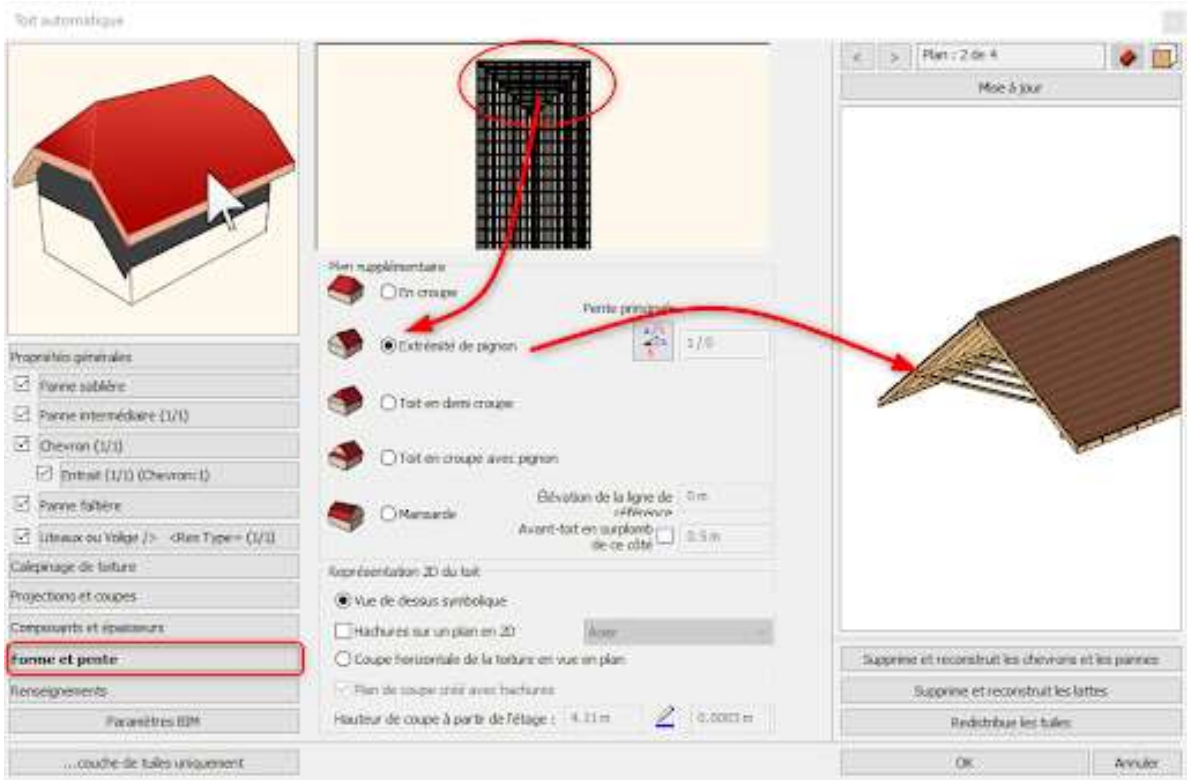
SpaceSUITE

Example of wall or roof information
with thermal and dimensional characteristics, materials, etc.



SpaceSUITE

Example of wall or roof information
with thermal and dimensional characteristics, materials, etc.



SpaceSUITE

The buildings are characterized by :

1) Morphology, function and use

2) Structure and materials

3) Properties and behaviour / environment and climate

SpaceSUITE

Optical and thermal footprint visible from space

SpaceSUITE

Urban morphologies

The following different types of morphologies result in different thermal signatures

- Dense and vertical
- Suburban neighboorhood
- Industrial
- Rural

SpaceSUITE

Dense and vertical : heat accumulation

Each shape influences the thermal signature

SpaceSUITE

Suburban neighborhood, ventilation, green spaces

Each shape influences the thermal signature

SpaceSUITE

Industial, large metal roofs

Each shape influences the thermal signature

SpaceSUITE

: Rural : dominant vegetation

Each shape influences the thermal signature

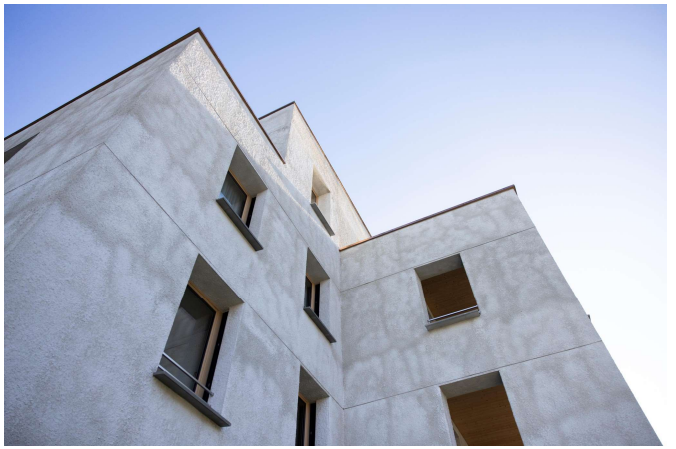
SpaceSUITE

Structure and materials

Classes of materials :

- Heavy minerals : concrete, stone : inertia

- Light materials : wood, metal : conductive or insulating



SpaceSUITE

Insulators : wool and hemp : conductivity

Coverings : tiles, slates : Albedo

SpaceSUITE

Properties and behaviour

The building as a physical system

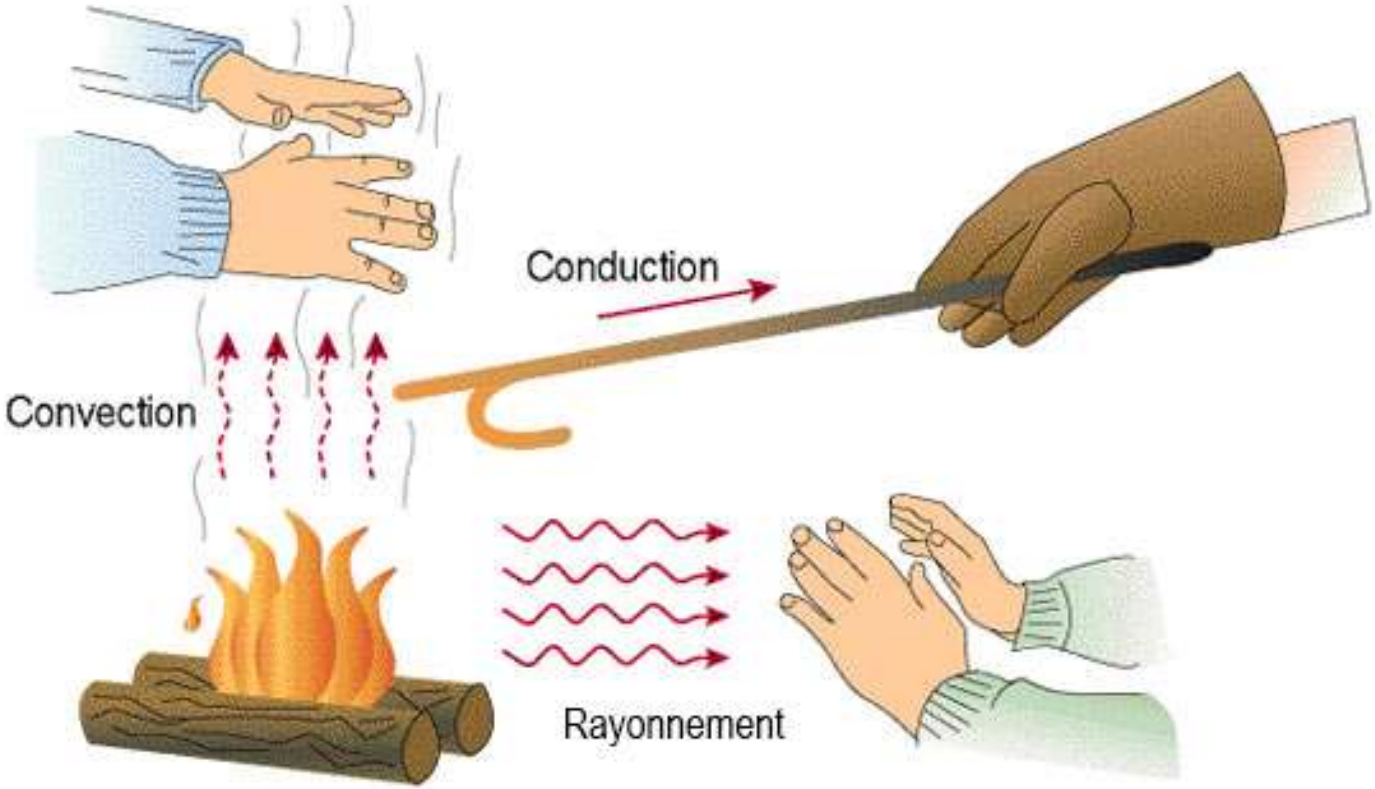
The building is an energy system : It exchanges heat,air, moisture and radiation

Conduction, convection and radiation

Conduction
Convection
Rayonnement

SpaceSUITE

Conduction, convection and radiation



SpaceSUITE

Key thermal properties of materials

- Thermal conductivity
- Thermal resistance
- Thermal inertia
- Albedo (reflectance)
- Emissivity

Impact on inner comfort and satellite signature

SpaceSUITE

Définitions :

Thermal conductivity : ability to allow heat transfer

Thermal resistance : ability to resist heat flow

Thermal inertia : ability of a material to store and release heat

Albedo : fraction of solar energy reflected by a surface

Emissivity : ability of a material to emit heat as infrared radiation

(important for thermal sensors). It varies from 0 (for a perfectly reflective surface) to 1 (for a perfect blackbody)

SpaceSUITE

thermal properties / behavior

Examples : Concrete : heats up slowly, cools down slowly

Wood : natural insulator

Polystyrene : excellent insulator

Metal : rapid heating

Stone : High inertia, bad insulation

SpaceSUITE

The influence of thermal properties of materials

Interaction	Description
Diurnal warming	*Absorption of solar radiation by roofs and facades*
Night cooling	*Release of the heat accumulated during the day*
Albedo effect	*Light colored surfaces reflect solar radiation*
Evapotranspiration	*Cooling through vegetation and soil moisture*
Urban heat islands	*Heat accumulation in dense mineral areas*

SpaceSUITE

Examples of the influence of thermal properties of materials

Phenomenon	Ground observation
Diurnal heating of roofs	*High surface temperature , Indoor comfort reduced*
Urban surfaces Albedo	*White roof versus black*
Vegetation and moisture	*Evapotranspiration, local coolness*

SpaceSUITE

Architectural impact :

Green roofs : Reduce surface temperatures and improve insulation

Reflective materials : Reduce heating in summer (light- colored roofs)

Ventilated façades : Promote inner comfort and and reduce energy losses

Urban layout : Orientation, density and building height influence airflow and shading

SpaceSUITE

Conclusion

The building : energy and visual footprint

Shapes +materials+ colors : thermal behaviour and climate impact

- diurnal warming : heat accumulation
- night cooling : release
- evapotranspiration : cooling
- urban heat islands : higher temperatures

Link between building physics and remote sensing.

Satellite observation and the use of BIM can be very beneficial for building management in order to reduce their impact on climate change

SpaceSUITE

Thank you!

Follow the SpaceSUITE Project on:

@SpaceSUITE_eu

@Spacesuiteproject

@Spacesuite_eu

For more information: www.spacesuite-project.eu

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Co-funded by the European Union