

A dense field of white feathers, likely from a bird, filling the entire frame. The feathers are soft and downy, with some showing a slight yellowish tint. At the top center, there is a bright, circular light source, possibly a reflection on a surface, which creates a strong highlight and casts a soft glow over the feathers below it.

MATERIALS

SECOND YEAR TECHNICAL STUDIES

EMA HANA KACAR

FACADE CRITERIUM: **LIGHTEST**

In order to manufacture an efficient facade, the following criteria must be fulfilled:

- good thermal insulation
- wind/water resistant
- transmitting light
- obstructing view of the interior

When designing the facade, I drew inspiration from nature. More specifically, the insulation qualities of birds and their whole physical structure - their bones are hollow in order to be light enough to fly, their outer layer of feathers (vaned feathers) are covered with a wax texture that makes them water resistant, and their inner layer of feathers (down feathers) are soft and fluffy, acting as thermal insulators.

While the down feathers would be ideal for the thermal insulation layer of the facade, the vaned feathers are not necessary just to achieve water resistancy - a lighter, more durable material can be used, such as a thin layer of plastic. The whole structure must be held together by a thin frame made of a light but sturdy material, in this case 3mm balsa wood sticks.

THERMAL INSULATION

To make this facade thermally efficient in a neutral climate (take London climate for instance - mild winters, mild summers, 601mm precipitation per year), I looked at the facade construction of a typical London house. Usually constructed by tiling bricks and bonding them with mortar, the heat conduction quotient of a brick is 40.7 kW. Therefore, the feather facade should have an equal or greater thermal conduction quotient in order to be thermally efficient.

Following from that:

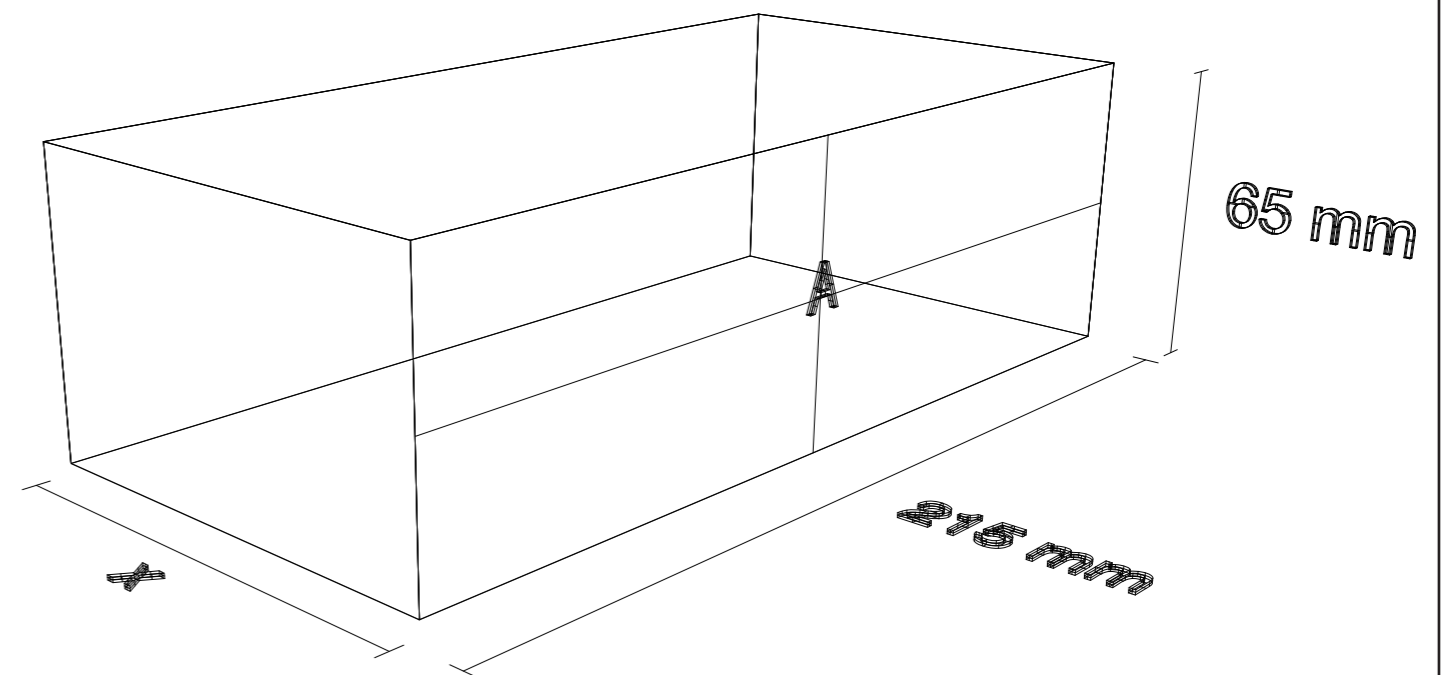
FOURIER'S LAW OF HEAT CONDUCTION

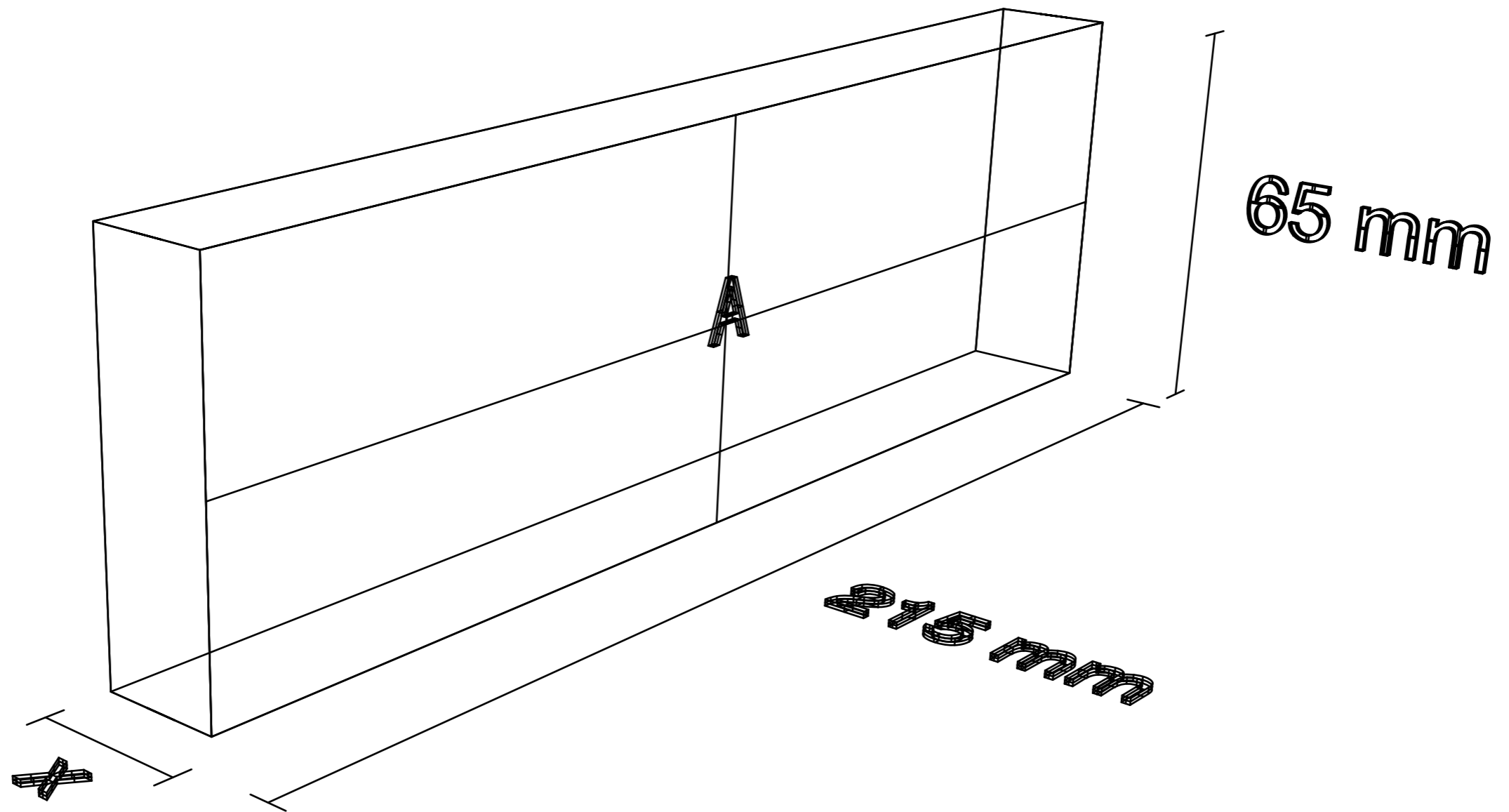
$$R_o = x / A \cdot k$$

$$R_{\text{brick}} = 0.1025 \text{ m} / (0.013975 \text{ m}^2 \cdot 0.18 \text{ W/mK}) = 40.7 \text{ K/W}$$

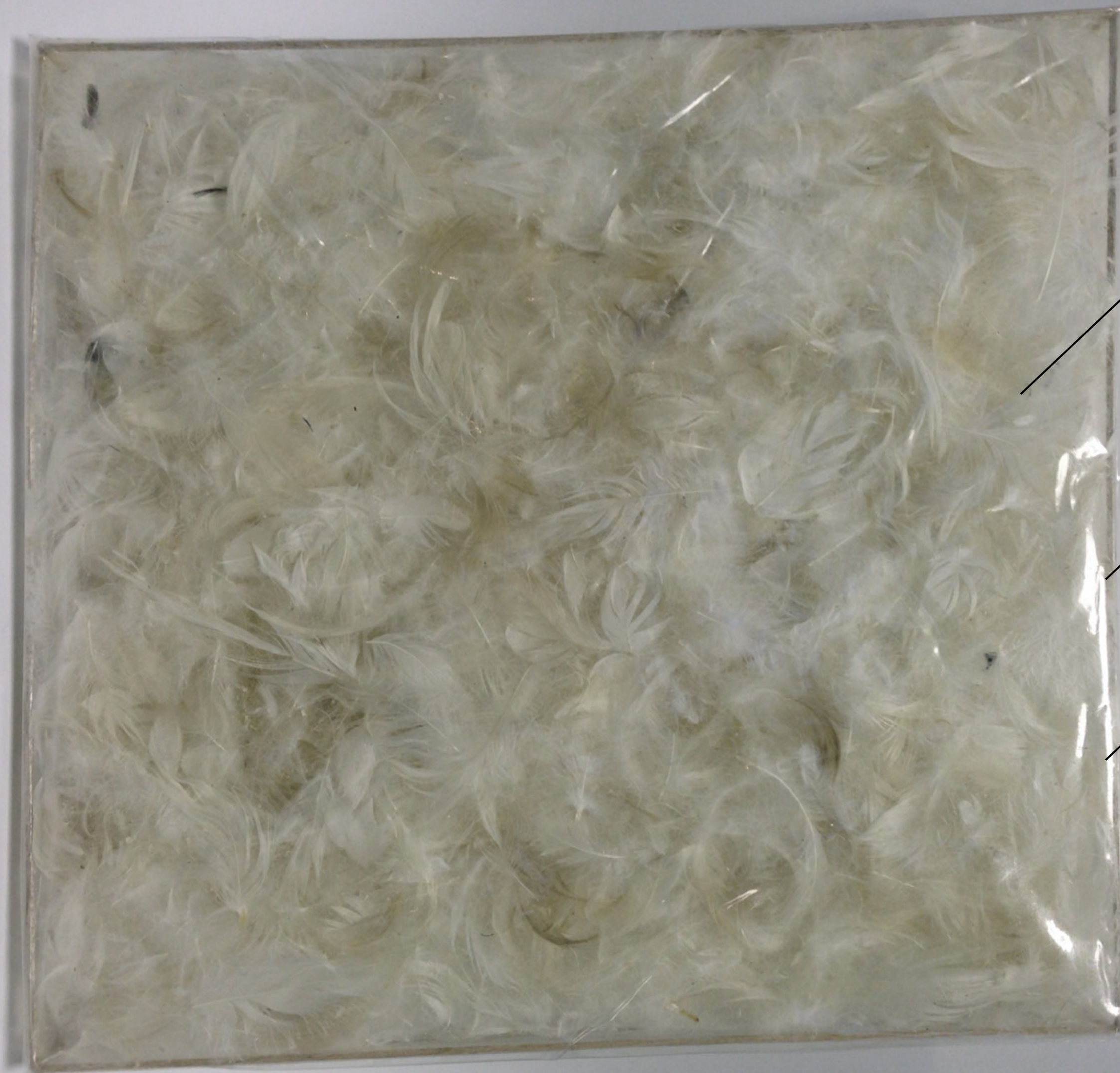
$$R_{\text{brick}} = R_{\text{feather}} = 40.7 \text{ K/W}$$

$$x_{\text{feather}} = R_{\text{feather}} \cdot A \cdot K_{\text{feather}} = 40.7 \text{ K/W} \cdot 0.013975 \text{ m}^2 \cdot 0.034 \text{ W/mK} = 0.01933 \text{ m} = \boxed{19.33 \text{ mm}}$$





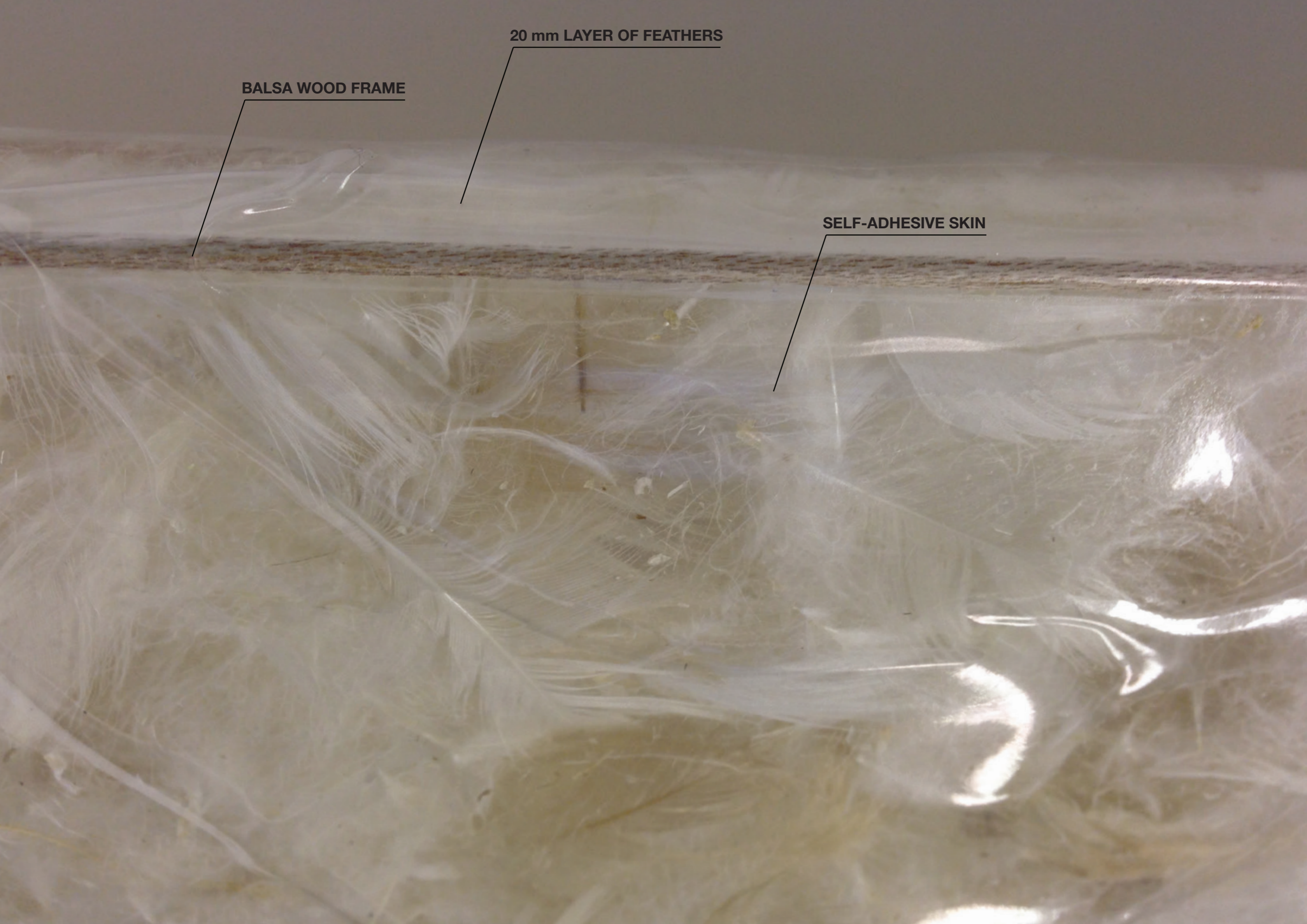
Following from that, the 'feather brick' must be only 19.33mm thick ($x=19.33$) in order to be equally thermally efficient as a standard brick used in typical London facades.



GOOSE FEATHERS

BALSA WOOD FRAME

THIN SELF-ADHESIVE
PLASTIC



BALSA WOOD FRAME

20 mm LAYER OF FEATHERS

SELF-ADHESIVE SKIN



TRANSLUCENT TO LIGHT, YET OBSTRUCTING VIEWS OF THE INTERIOR