

# Simulation-Based Prediction of Mould Growth Using Coupled Building and Fungal Models

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AIVC webinar - Emerging Risks of Indoor Mould: Assessment Methods, In-Situ Measurements & Predictive Modelling

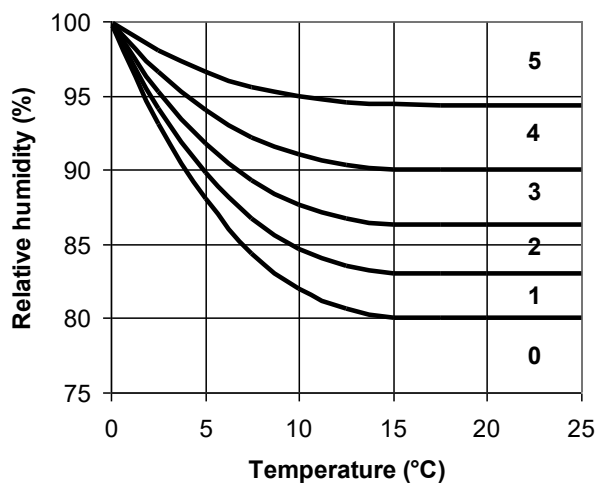
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Mold growth conditions Pine [Hukka 1999]



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# Finish mold growth model

Sensitivity class		Description	Examples
<b>very sensitive</b>	<b>1</b>	untreated wood, which contains high amount of nutrients	Roughly sawn and dimensioned plank (pine, spruce and hardwood), planed pine, birch plywood, untreated porous wood fibre board, cardboard-surfaced gypsum board
<b>sensitive</b>	<b>2</b>	planed timber, materials and films with paper coating, wood-based boards	Planed pine, paper-based bitumized/treated products and films, wood-based glued boards, pine or spruce plywood, bitumized/treated porous fibre board
<b>medium resistant</b>	<b>3</b>	cement or plastic based materials, mineral wool	Mineral wools, plastic-based materials, autoclaved aerated concrete, expanded-clay lightweight concrete, carbonated old concrete, cement-based products, bricks, cement bonded fibreboard, fibreglass-surfaced gypsum board
<b>resistant</b>	<b>4</b>	glass and metal, products containing mould-preventive additive	Glass and metals, alkaline new concrete, products containing mould-preventing additives

Decline factor $C_{\text{decl}}$		Examples
<b>Strong decline</b>	<b>1</b>	
<b>significant decline</b>	<b>0.5</b>	sawn or rough planed pine and spruce, autoclaved aerated concrete
<b>relatively low decline</b>	<b>0.25</b>	planed pine and spruce, glued spruce board, concrete, paper-coated PUR
<b>almost no decline</b>	<b>0.1</b>	lightweight expanded clay aggregate concrete, polyester fibre insulation, EPS, glass wool



<https://research.tuni.fi/buildingphysics/finnish-mould-growth-model/>



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# Mold Index

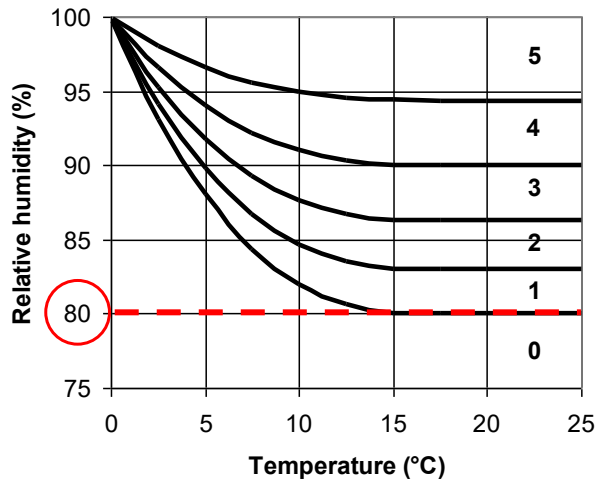
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<b>Very heavy</b>	<b>6</b>	Very heavy and tight growth, coverage around 100%	Visual Microscopic
<b>Plenty</b>	<b>5</b>	Plenty of growth on surface, >50% coverage (visual)	
<b>Visual &lt;50%</b>	<b>4</b>	Visual findings of mold on surface, 10-50% coverage, or, >50% coverage of mold (microscope)	
<b>Visual &lt;10%</b>	<b>3</b>	Visual findings of mold on surface, <10% coverage, or, <50% coverage of mold (microscope)	
<b>Several</b>	<b>2</b>	Several local mold growth colonies on surface (microscope)	
<b>Small amounts</b>	<b>1</b>	Small amounts of mold on surface (microscope), initial stages of local growth	
<b>No growth</b>	<b>0</b>	No growth, spores not activated	



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Mold growth conditions Pine [Hukka 1999]



Avoid mold growth:  $p_i \leq 0.8 \cdot p_{sat}(\theta_{si})$

Vapor pressure indoor  $p_i = p_e + \frac{R_v T_i}{\dot{V}} G_p$

$$\theta_{si} = \theta_e + f_{0,2}(\theta_i - \theta_e)$$

↑ Ventilation -  $\dot{V}$

↑ Indoor temperature -  $\theta_i$

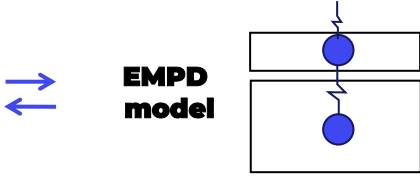
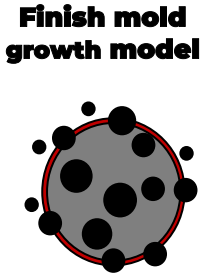
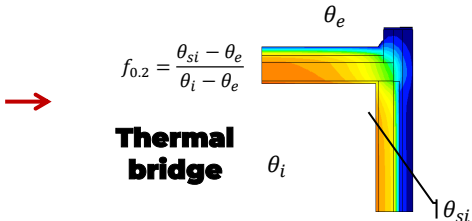
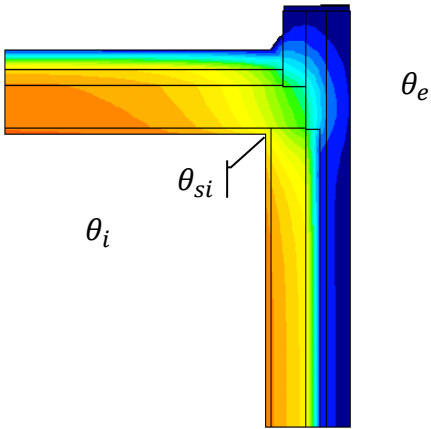
↑ Temperature factor (avoid thermal bridges) -  $f_{0,2}$



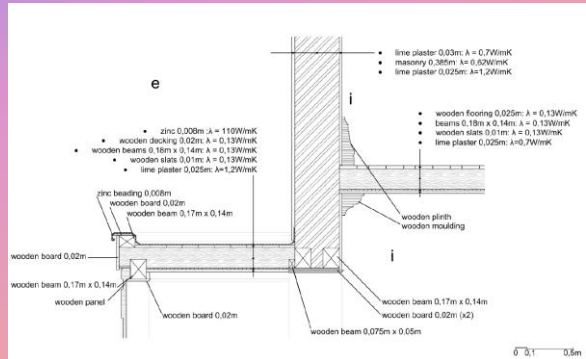
# Avoiding surface mold growth by design

$$f_{0.2} = \frac{\theta_{si} - \theta_e}{\theta_i - \theta_e} > 0,7$$

**\*for typical indoor conditions Belgium (up to Belgian internal climate class III)**



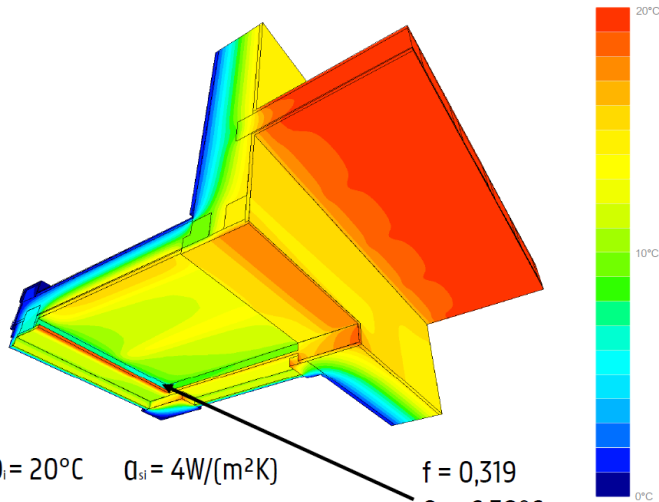
# Application: Heritage bay-window



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**f = 0,319**

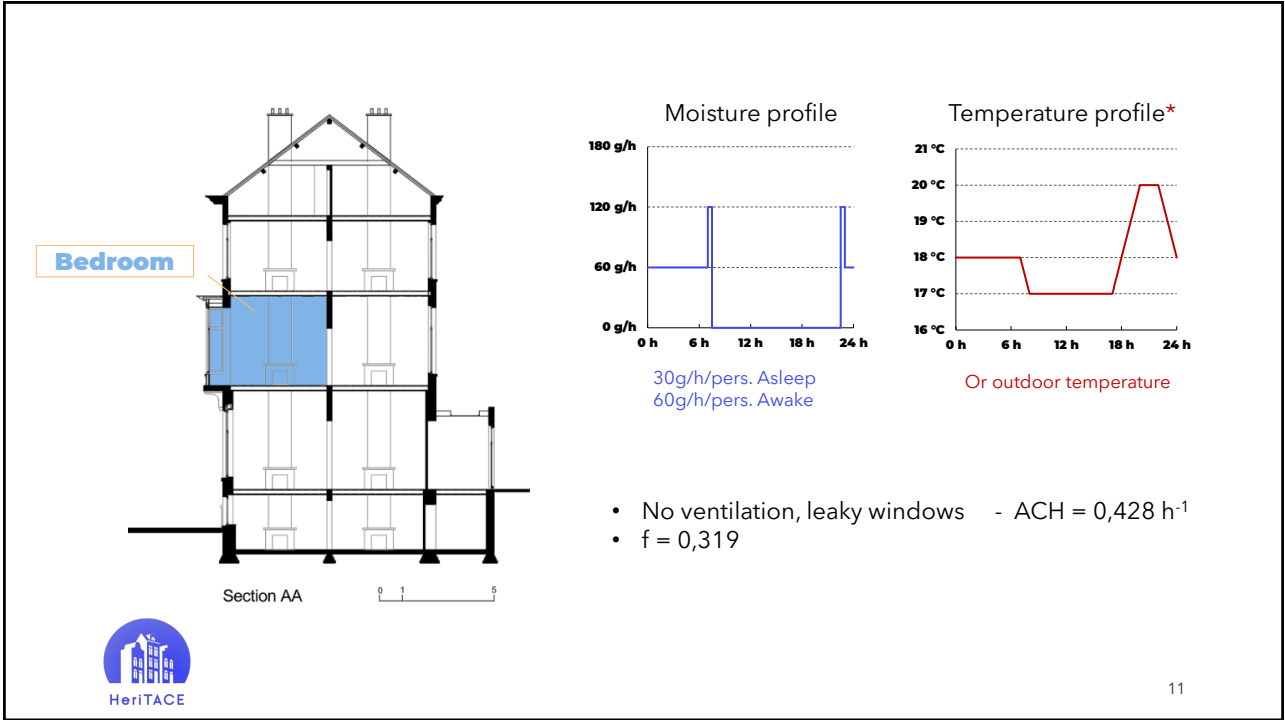


Author simulation - Baptiste Dewil

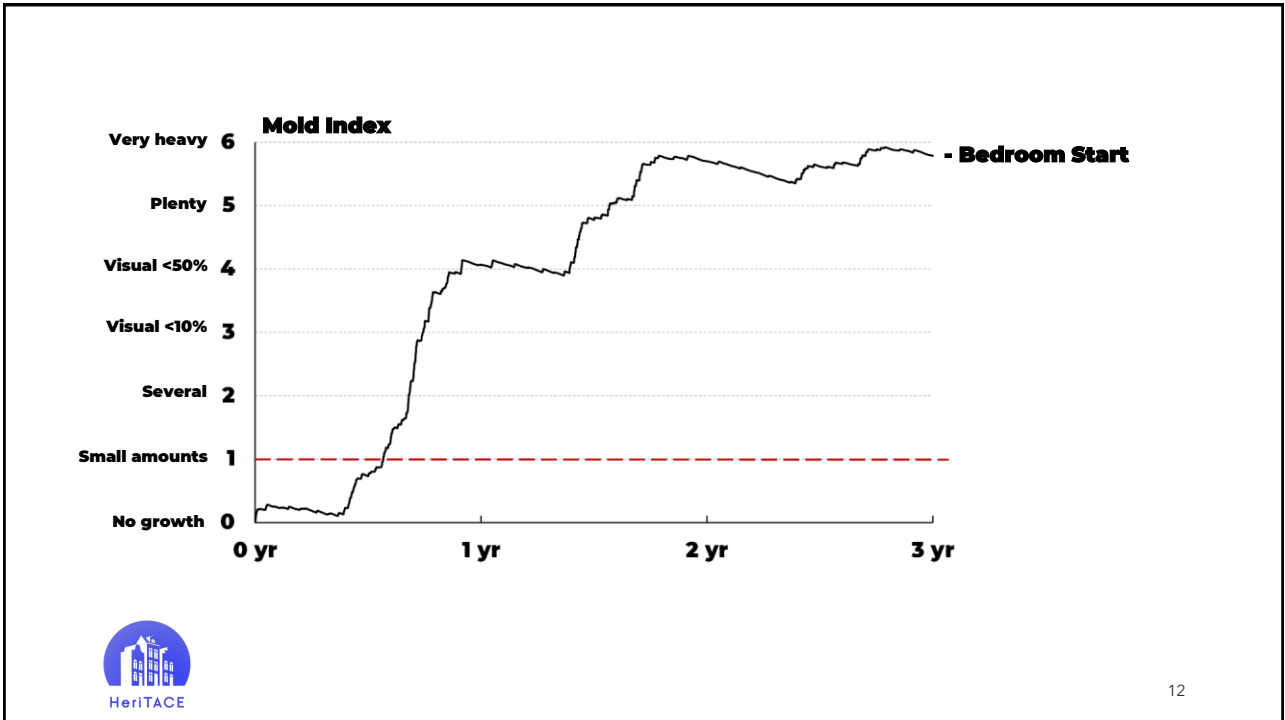


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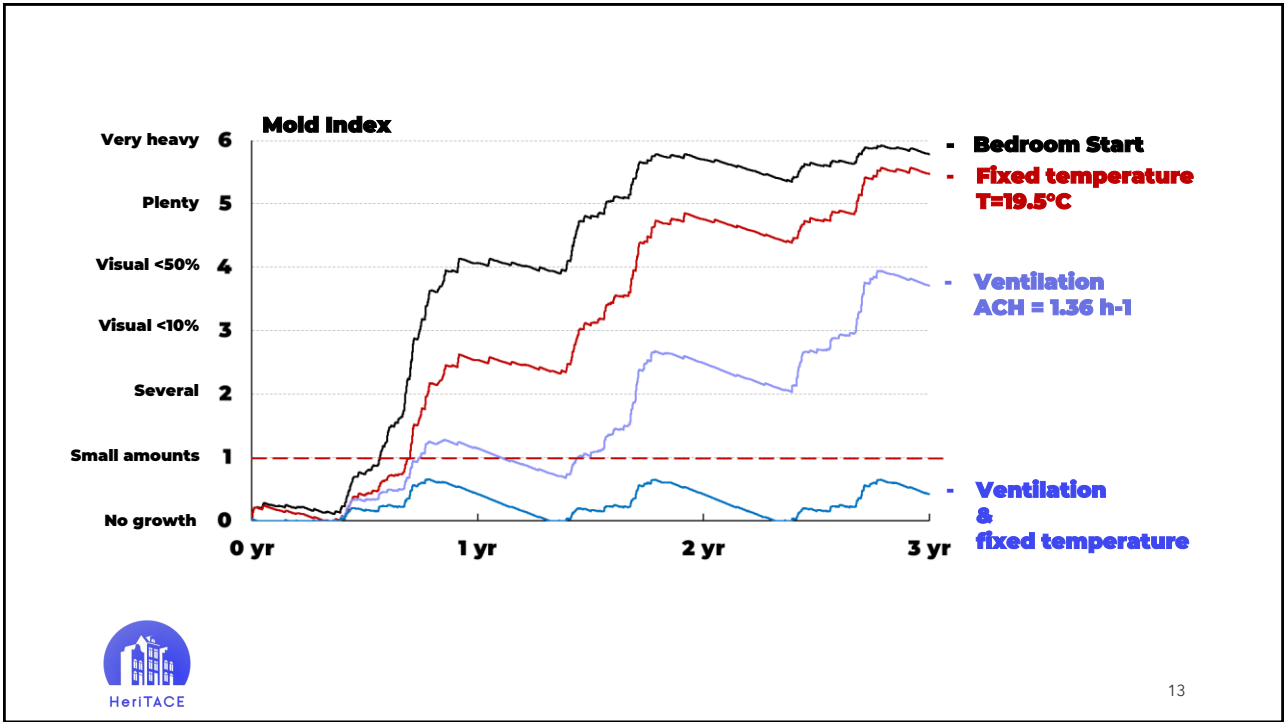
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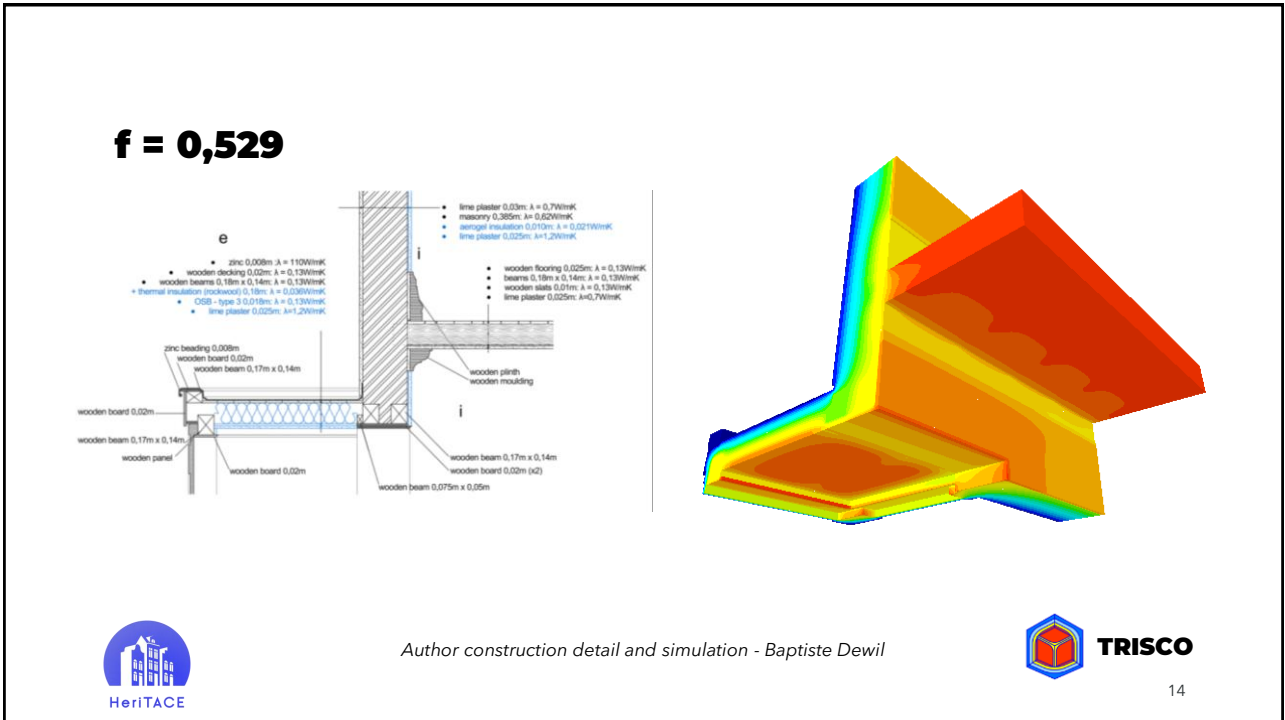
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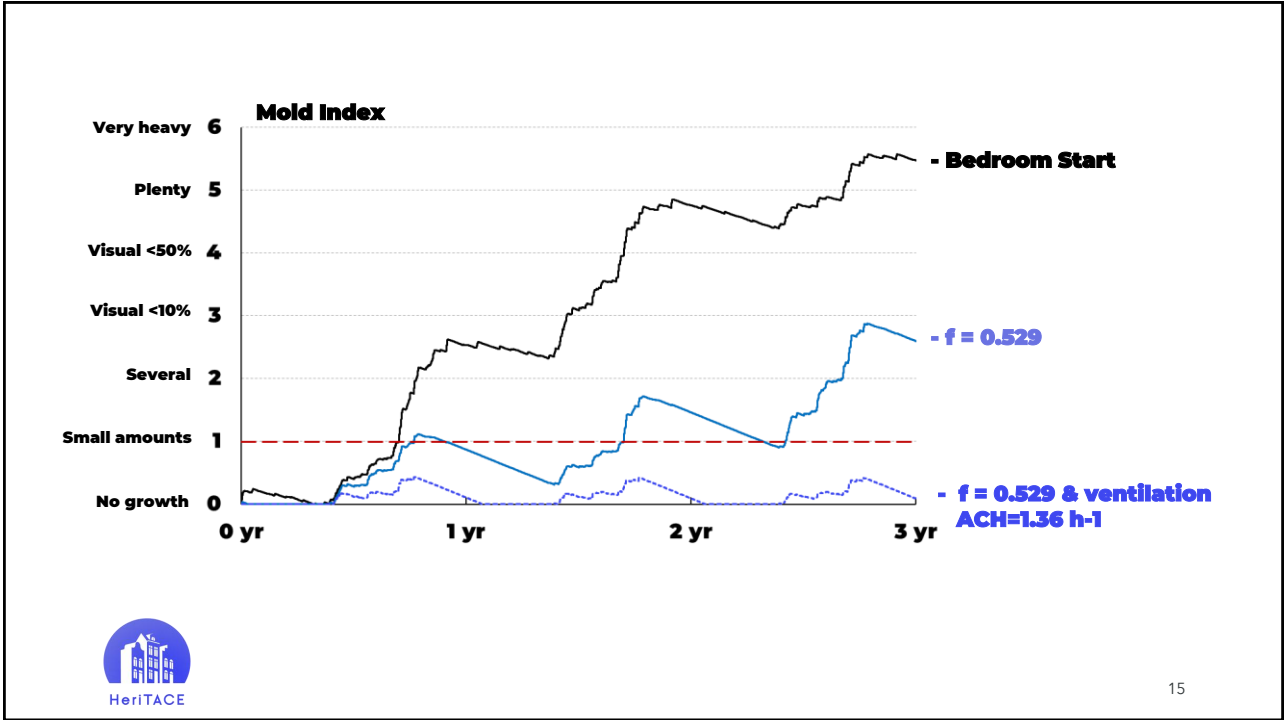
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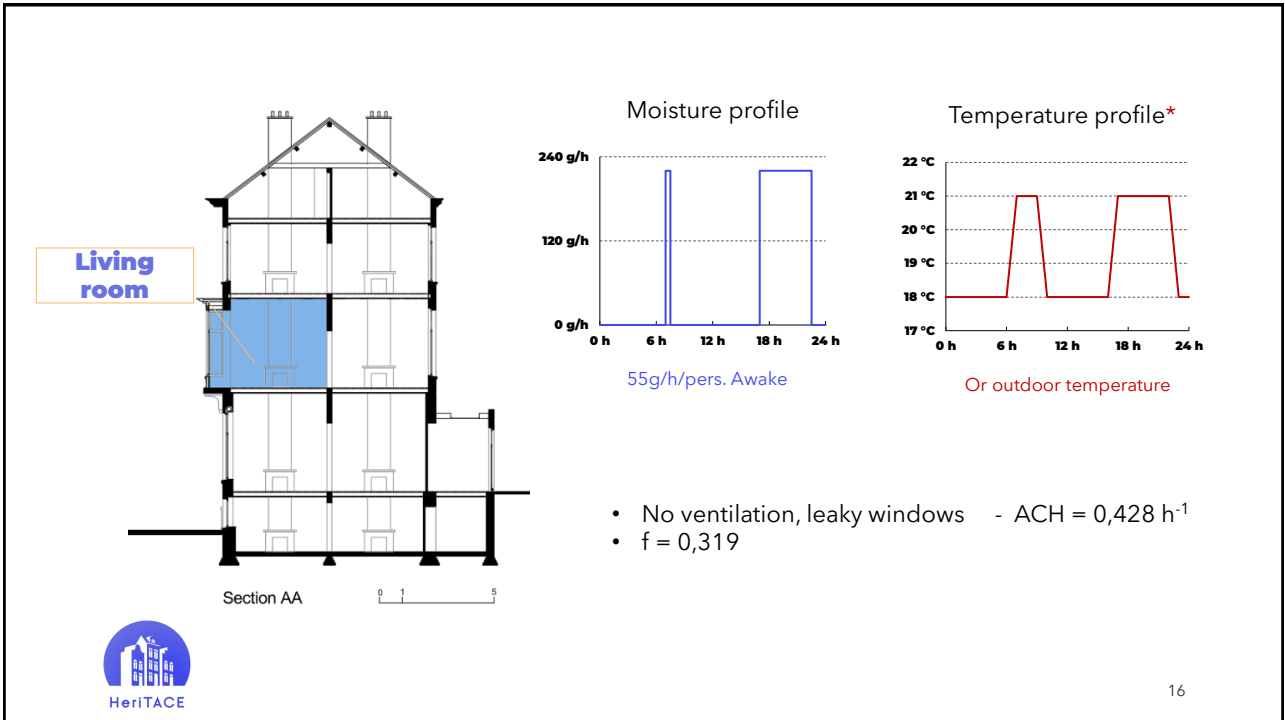
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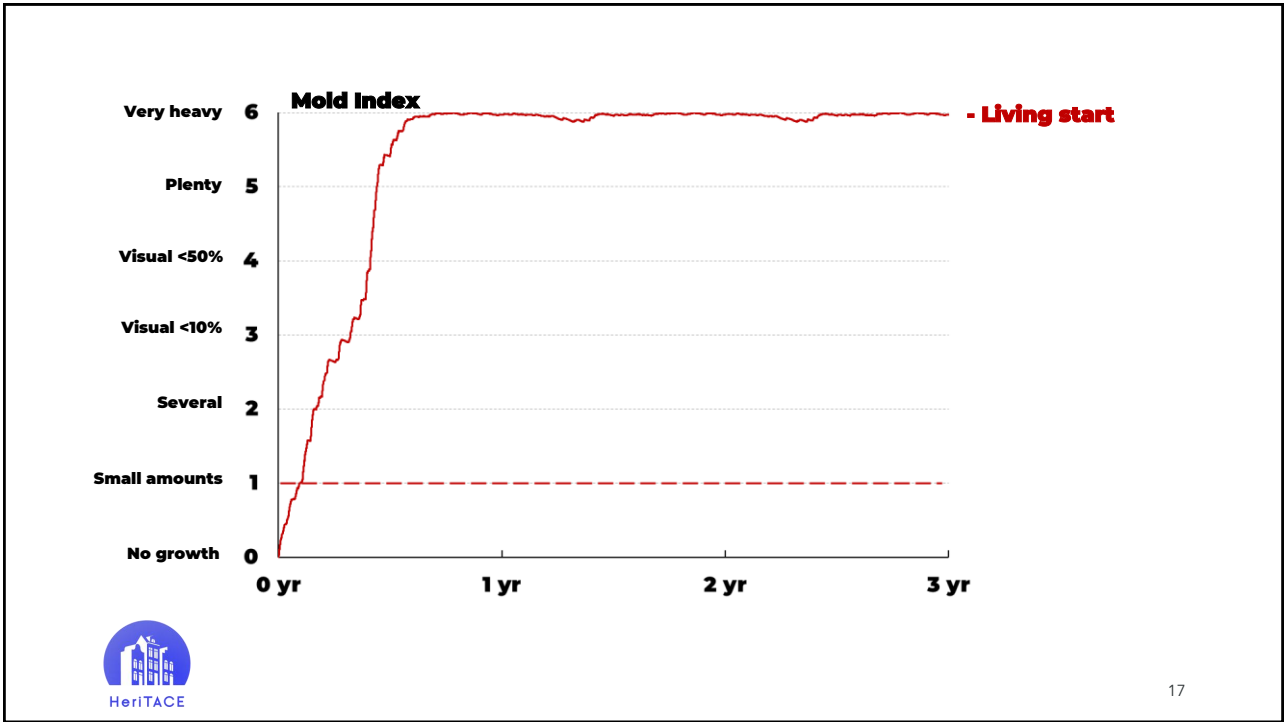
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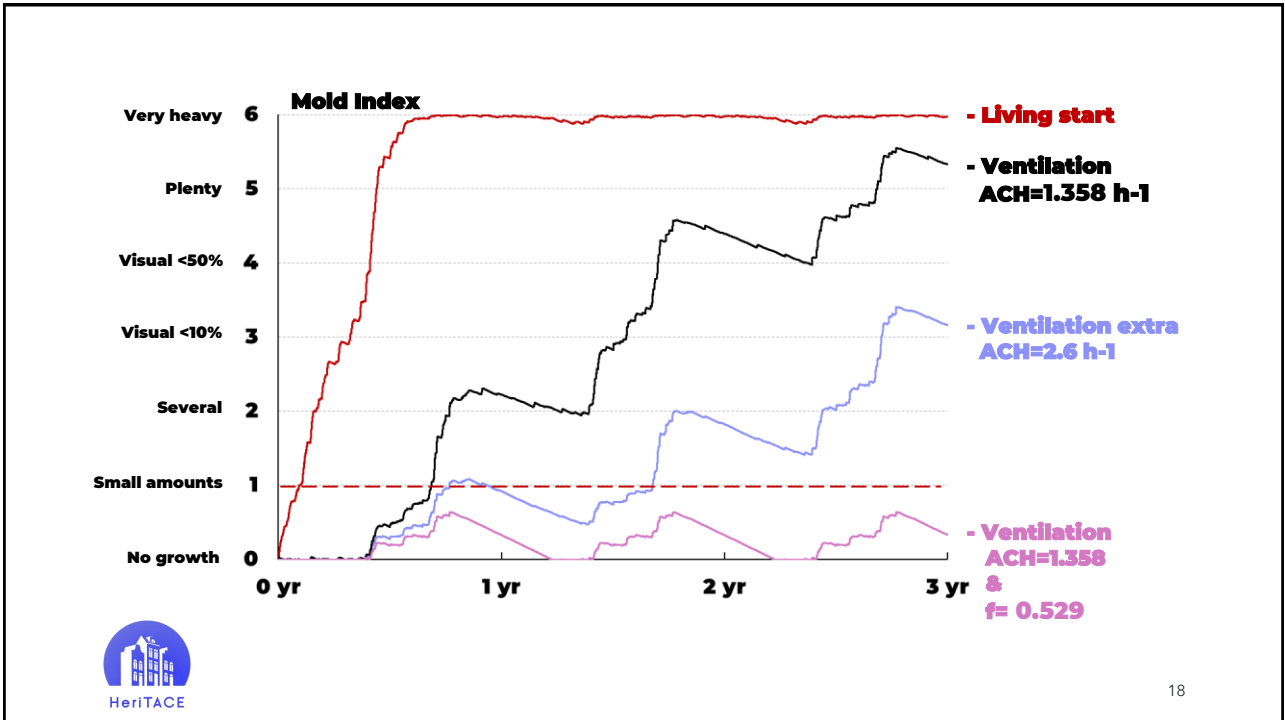
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