

KILOWATT HOUSE

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(DIFFICULT) SUSTAINABLE RETROFIT OF

ART MODERNE

CONCRETE 'LIVE-IN LABORATORY'



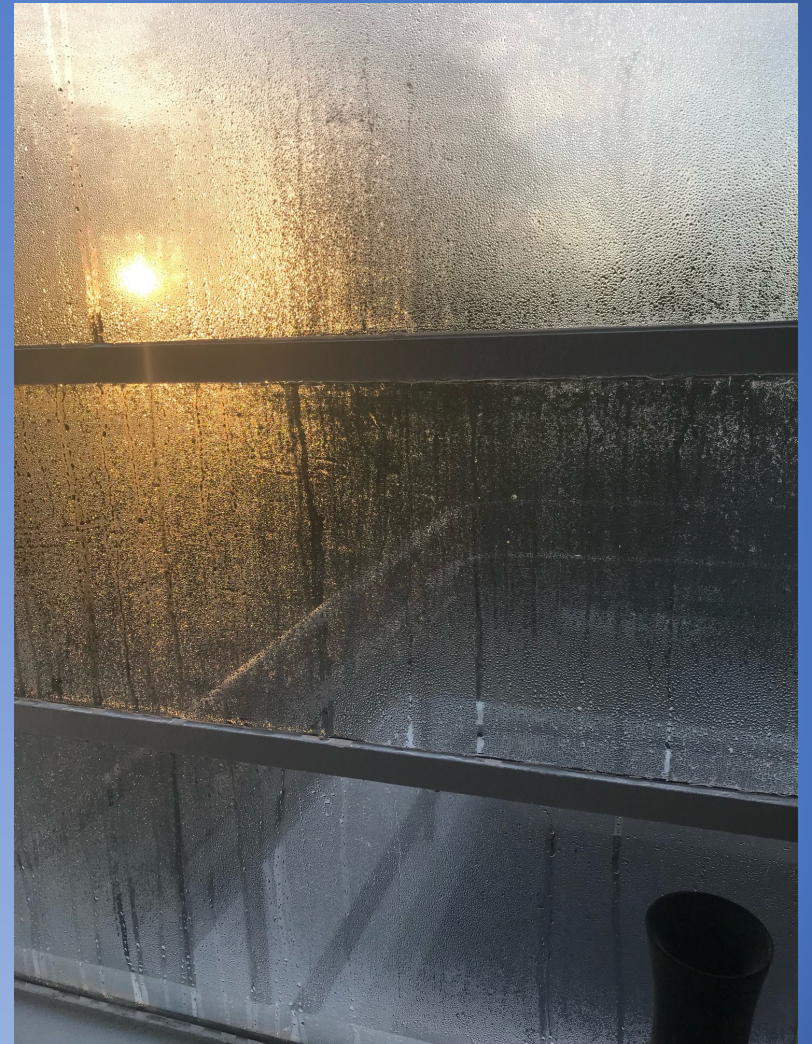
- BUILT 1936-38 IN A DISUSED QUARRY
- DESIGNED FOR ANTHONY GREENHILL BY MOLLY TAYLOR
- EXPERIMENTAL LABORATORY FOR MUSIC DRIVING COLOURED LIGHT
- ART MODERNE: ASYMETTRIC, HORIZONTAL AESTHETIC, CORNER WINDOWS, 'NAUTICAL'
- CONCRETE WALLS, CRITTALL STEEL SINGLE-PANE WINDOWS



WHY DIFFICULT RETROFIT?

- DESIGNED TO BE A LIVE-IN LABORATORY - NOT A COSY HOME!
- REINFORCED POURED CONCRETE CONSTRUCTION
- BIG FLAT ROOF AREA, HIGH CEILINGS, 30+ STEEL WINDOWS/DOORS

CRITTALL WINDOWS & DOORS



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- WAS CHEAP TO HEAT WITH ELECTRICITY IN THE 1930s, NOT NOW!
- PERMANENTLY DAMP: MOULD ON WALLS & CILLS, RUST ON WINDOWS
- SERIOUSLY DRAUGHTY - STEEL WINDOWS/DOORS TEND TO WARP
- GRADE II LISTING - FOCUS ON PRESERVATION, NOT INNOVATION

(BEFORE) THE PLAN

H - E - E - E - E - L - P!

- NEED TO UNDERSTAND THE PHYSICS: GREENGAUGE & WUFI PRO
- HOW TO GET MOISTURE OFF WALLS AND WINDOWS, AND AWAY
- REMOVE RECENT USELESS PLASTIC/GLASS WOOL INSULATION
- HEATING LOADS PER ROOM, RADIATORS/ASHP OUTPUT REQUIRED
- EFFECTIVE VENTILATION

THE PLAN

- SUSTAINABLE MATERIALS WHERE POSSIBLE
- REPLACE CRITTALL WINDOWS WITH DOUBLE-GLAZED HERITAGE COPIES
- SWAP INEFFECTIVE INTERNAL INSULATION FOR AN EFFECTIVE SYSTEM
- EXTERNAL INSULATION ON FLAT ROOFS
- 30 PV PANELS (11kWp) AND 2 x 13.5kWh TESLA BATTERIES
- 3 MITSUBISHI ECODAN ASHPs (2 x 8.5kW, 1 x 11.2kW – 3-PHASE)
- ADDITIONAL RADIATORS AND MVHR

CRITTALL WINDOWS & DOORS

- CENTRAL TO THE GRADE II LISTING! 🤔
- BENES CONSERVATION INSIST ON RETAINING 'ORIGINAL' WINDOWS
- BUT... CRITICAL DIMENSIONS ARE 25MM, NOT ONE INCH, SO...

DEFINITELY NOT THE ORIGINAL WINDOWS!



EXTERNAL WALLS

EXISTING

- SINGLE-SKIN 230MM REINFORCED CONCRETE WALLS AND ROOFS
- 50MM ICI 'PIONEER BLOCK' (AERATED GROUND PUMICE/CEMENT)

ICI PIONEER BLOCK



EXTERNAL WALLS

EXISTING

- SINGLE-SKIN 230MM REINFORCED CONCRETE WALLS AND ROOFS
- SOME 50MM ICI 'PIONEER BLOCK' (AERATED PUMICE/CEMENT)
- VARIETY OF EXPANDED POLYSTYRENE SHEETS (LOOSE) & FIBREGLASS WOOL, ALL WITH BIG AIR GAPS (FROM 2002-4 REFURBISHMENT)
- MODERN PLASTERBOARD AND PLASTER SKIM COAT

EXTERNAL WALLS

PLAN

REPLACE CURRENT INEFFECTIVE INSULATION COVERING PIONEER BLOCK WITH A 3-LAYER SYSTEM OF WICKING MATERIALS (FOR CONCRETE):

- 20MM + 20MM DIATHONITE THERMACTIVE LIME PLASTER
- 40MM GUTEX THERMOROOM FIBRE PANELS (+ 5-8MM ADHESIVE)
- 5MM + 5MM LIME GREEN SOLO LIME PLASTER TOP COAT
- BREATHABLE PAINT

AIR SOURCE HEAT PUMPS

- ZONING: DAILY USE FOR 2; GUEST AREA; BIG ROOM
- PIPES OF ANY SIZE TO USING EXISTING HOLES IN STRUCTURE
- NEIGHBOUR'S WORRY ABOUT NOISE BASED ON INACCURATE INTERNET INFO



ROOF INSULATION

- TWO FLAT ROOFS AND 3 EXTERNAL BALCONIES
- BRING FLAT CEILINGS INSIDE THE 'WARM ENVELOPE'
- ALUTRIX 600 VCL OR ELOTENE CARRIER ADHERED TO DECK
- INNOBOND TAPERED PIR INSULATION BOARD, 210MM - 90MM
- RUBBERBOND EPDM* ADHERED TO INNOBOND

(*IF IT'S GOOD ENOUGH FOR CHICAGO AIRPORT...)

30 PV PANELS



MVHR

MECHANICAL VENTILATION WITH HEAT RECOVERY

- WARM AIR IS DRAWN FROM KITCHEN, BATHROOMS & WC AND EXPELLED TO OUTSIDE AFTER EXTRACTING 96% OF ITS EXCESS HEAT
- INCOMING AIR IS FILTERED, WARMED UP BY HEAT RECOVERED FROM THE EXHAUST AIR, THEN BLOWN INTO ALL LIVING SPACES,
- WE USED RADIAL LAYOUT - ALL ROOMS SERVED BY 1 (OR 2) DUCTS FROM CENTRAL SUPPLY AND EXTRACT MANIFOLDS
- CHANGES ALL THE AIR EVERY 2-3 HOURS
- EXTREMELY EFFICIENT - RUNNING COST ONLY £40 P.A.

THE TEAM

- GREENGAUGE BUILDING ENERGY CONSULTANTS
- ECOLOGICAL BUILDING SYSTEMS – CARLISLE
- SOLARSENSE (PV AND ASHP) – CLEVEDON
- PREWITT BIZLEY (RETROFIT ARCHITECTS) – WELLS
- NOVA PLASTERING – RADSTOCK
- R GROVES & SON, BUILDERS – FROME
- FORBES PLUMBING & HEATING – FRESHFORD
- KGH ELECTRICAL - CALNE

RESULTS

- OUR HOME IS WARM AND COMFORTABLE (FOR FIRST TIME EVER!)
- OUR 30 PV PANELS SAVE EST. 2.85 TONNES OF CO₂ EVERY YEAR AND GENERATED 5.59 MWH IN APRIL-AUGUST 2025
- OUR ENERGY BILL WAS £6,800 IN 2019, £1,800 IN 2025
- OUR EPC WAS E (42) IN 2021. BY 2024 IT WAS A (94)
- MVHR HAS ELIMINATED CONDENSATION, MOULD AND DAMP FEELING
- MAJOR INVESTMENT: REDUCED RUNNING COSTS, INCREASED VALUE



