ZERO-CARBON SOLUTIONS LTD

# Passivehouse Construction Check List

This list is based on the similar list published by the Passivehouse Institute in Darmstadt, Germany. It has been translated into English, updated and reworked to suit UK applications with their permission. The list does not claim to be complete or list all items and issues needing consideration, only to give an outline of the passivehouse construction process.

This is a work in progress. The current version can be downloaded from Zero-Carbon Solutions' web site. Follow the *Literature* menu item.

NOTE: Items in **bold** below require specific quality control steps.

## 1. Site planning

- How suitable is the site for a passivehouse? - see the *Plot Evaluator* on www.zerocarbonsolutions.com, follow the *Literature* menu item to download it.
- Does the site have access and utilities connections?
- Is planning permission for a passivehouse likely?
- Is a compact building shape possible? Terraced houses or larger blocks are an advantage.
- Is a southerly orientation (±30°) and large south-facing window areas possible?
- Consider shading factors preventing the use of solar gains - any trees with conservation orders?

## 2. Pre-planning

- Compact buildings - possible to extend existing buildings to get fewer external walls?
- Dimension south-facing glazing for solar gains. Dimension east/north/west facing glazing for sufficient light, not larger than necessary.
- Minimise winter shading:
  - garden walls
  - vegetation
  - balconies
  - roof overhangs
  - outbuildings.
- Simple envelope shape, if possible avoid steps in walls, dormer windows, etc. Clearly define the thermal (heated) envelope and the airtight layer.
- Floor plans:
  - make installation zone(s) compact and concentrated, e.g. by placing bathrooms above or next to kitchens, etc.
  - consider routing of, and space for, ventilation ducts.
- Separate cold basement if present:
  - airtight
  - no cold bridges.
- Acquire local climate data in a form suitable for use with PHPP. Verify if calculated by Meteonorm or similar interpolation software.
- **Carry out the first iterations of PHPP to see if the ideas add up in passivehouse terms**.
- Contact local Planning Office to discuss initial ideas and site plan. Explain passivehouse ventilation system since this does not follow current English building regulations. (Zero-Carbon Solutions can deliver introductory presentations to council planning and building control officers in case this is deemed beneficial).

## 3. Planning towards passivehouse realisation

- Plan wall/foundation/roof construction and insulation thickness.
- Avoid cold bridges in the design - modify as required. Mitigate by minimising or optimising cold bridging if avoidance is impossible.

- Plan in enough space for building technology. Make sure there is space and access for regular maintenance.
- Floor plans:
  - short pipe lengths for cold, hot and waste water
  - short ventilation ducts - cold air ducts outside the heated envelope, warm ducts inside.

## 4. Planning: building elements

- Ultra-insulated construction elements according to passivehouse rules, for external elements the rule is U ≤ 0.15 W/m²K - strive for 0.1 W/m²K. Use "Details for Passive Houses" (Springer Verlag, ISBN 978-3-211-29763-6) as a guide (available through Amazon).
- **Design connection details to eliminate cold bridging - if in doubt calculate and verify.**
- **Design connection details to assure airtightness.**
- Optimise glazing
  - type of glazing
  - frames/casings
  - glass area
  - sun shading, etc.
- **Calculate the specific space heating demand using PHPP**.

## 5. Planning: ventilation

- Routing of ventilation ducts:
  - keep cold ducts outside the heated envelope. If they need to be inside then only for very short lengths and highly insulated
  - keep warm ducts inside the heated envelope. If they need to be outside then only for very short lengths and highly insulated
  - use short ducts with smooth walls
  - keep flow velocities below 3 m/s throughout
  - design measurement and flow balancing facilities into the system
  - consider fire protection
  - consider noise factors, including noise reduction.
- Air inlets:
  - avoid short-circuiting air flows
  - consider throw widths
  - incorporate flow regulation/balancing possibilities.
- Air exhausts:
  - do not place above heating elements (if present).
- Dimension overflow openings for a pressure drop $\Delta p \leq 1$ Pa.
- Central ventilation/heat recovery unit:
  - position heat exchangers close to or inside the thermal envelope. Good positions are inside the heated envelope or in a basement
  - position air heating units inside the thermal envelope
  - add additional insulation as required in each case
  - the unit should meet or (preferably) exceed these data:
    - overall efficiency ≥ 75%
    - leakage to surrounding air < 3% of the rated flow volume
    - internal leakage (between intake and exhaust air flows) < 3% of the rated flow volume
    - high electrical efficiency, power consumption < 0.45 Wh/m³ air
  - have suitable regulation/control facilities
  - low noise rating
  - excellent heat insulation.
- Ventilation user controls:
  - settings: high, normal, low
  - possibly time-limited booster functions in kitchens, toilets and bathrooms.

- Kitchen extractors connected to the ventilation system should have good extraction capabilities at a very low flow rate and be fitted with grease filters. However, it is preferable to use circulation only extractors with active coal and grease filters.
- Optionally, consider installing a ground heat exchanger to keep intake air frost free. This can either be a ground-to-air exchanger or a ground-to-liquid exchanger with a liquid-to-air exchanger close to the ventilation unit. In large parts of the UK this will probably not be required. If required, consider:
  - airtightness
  - distance between cold channels and the building
  - summer bypass/cooling facilities
  - extraction of condensate
  - cleaning.

## 6. Designing additional building technology

- Sanitation, hot water:
  - short pipes, very well insulated
  - routed *inside* the thermal envelope.
- Sanitation, cold water:
  - short pipes, normal insulation.
- Insulate warm water and heating fittings.
- Use water-saving taps, etc.
- Connect washing machines and dish washers to the *hot* water supply.
- Waste water:
  - short branch pipes, preferably a single (internal) discharge stack
  - preferably, the stack should be ventilated into a roof void, otherwise through an insulated external pipe.
- Sanitation and electrical/communications installations should preferably not penetrate the airtight layer but be cast into the foundation and sealed. In case the airtight layer has to be breached an efficient seal must be ensured (sleeves, tape, sealant).
- Use energy efficient appliances. The most modern models can be difficult to source in the UK but some importers of German appliances may be able to supply them. The inventory should be sensible vis-a-vis PHPP.

## 7. Construction phase - envelope

- **Site management:** Check that all materials supplied actually correspond to the materials specifications. Run a clean site with minimal waste.
- **Freedom from cold bridges**. On-site quality control.
- **Integrity of the insulation**. Unbroken insulation layers - no gaps in insulation materials.
- **Airtightness:** Check transitions, e.g. between walls and floors, seals where pipes, cables or flues are carried through the airtight layer and seams that form part of the airtight layer while still accessible.
- **Airtightness: Carry out a pressure test as early in the construction phase as possible!**
  - *When?* As soon as the airtight envelope is finished and while it is still accessible, i.e. before fixes (coordinate with relevant trades).
  - *How?* $n_{50}$-test using a blower door or the ventilation system. All leaks must be located while the building is pressurised (smoke, handheld anemometer, if necessary, thermography).

## 8. Construction phase - ventilation

- **Airtightness**. Check that piping and duct-work conserve the integrity of the airtight envelope.
  - ducts: make sure they are clean and leak free
  - central ventilation unit: check accessibility for filter change and noise reduction measures
  - check duct insulation - is it present where required and correctly installed?
- **Flow settings in normal operation:**
  - measure intake and exhaust air flows - compare them to ensure they are balanced
  - compare fresh and stale air distribution
  - measure electrical power consumption.

## 9. Construction phase, after fixes - additional building technology

- **Airtightness:** ensure that airtightness is preserved when installations are carried through the airtight layer. Consider wall constructions incorporating an internal installation void.
- **Heat insulation of pipes and fixtures:** check correctness and integrity.

## 10. Induction of owners and tenants

- **User manual:** binder with user instructions, technical manuals for equipment, warranties and contact details for service and maintenance functions.

## 11. Certification

- Apply for a *Quality-Assured Passivehouse* certificate from the Passivehouse Institute or their UK representatives.

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