HEATING, VENTILATION, AIR CONDITIONING SYSTEMS (HVAC)

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Eng. Marco Marigo

Persons in charge of the course:

Michele De Carli

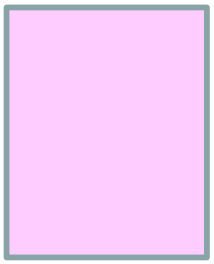
Marco Marigo

What is an HVAC:

Residential, tertiary, industrial

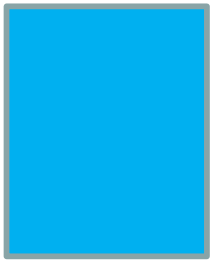
Air conditioning

Heating



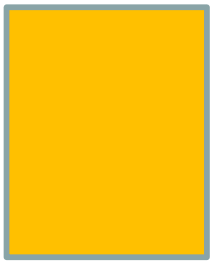
Houses, offices, shops, hotels restaurants, educational, warehouse, hospitals, farms, food industries, …

Cooling



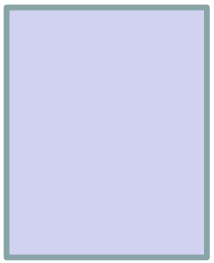
Residential, tertiary, industrial, servers and data centers

Hot water



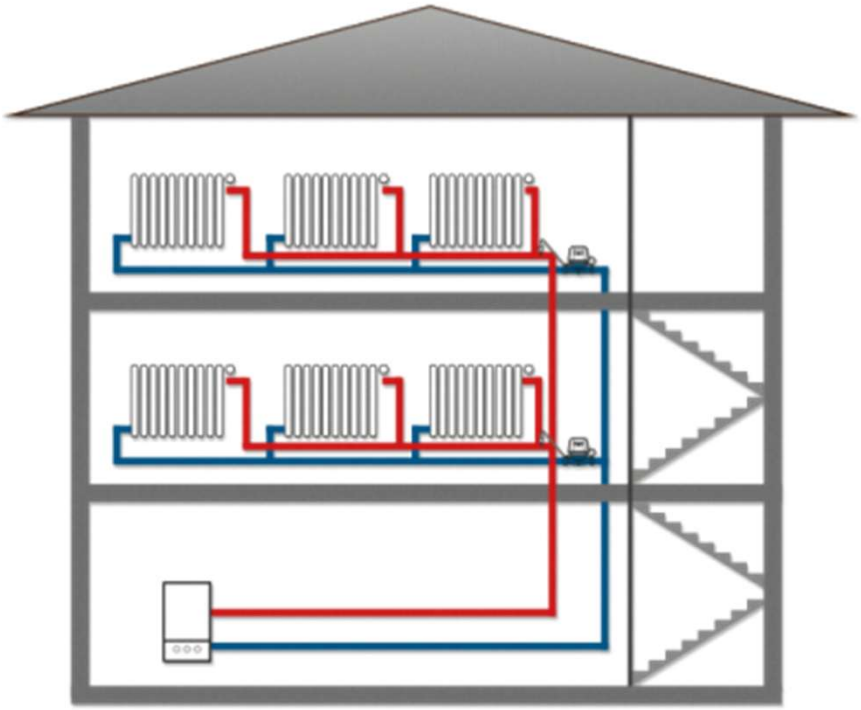
Houses, sporthalls, swimming pools, hotels, restaurants, hospitals, farms, food industries, …

Ventilation



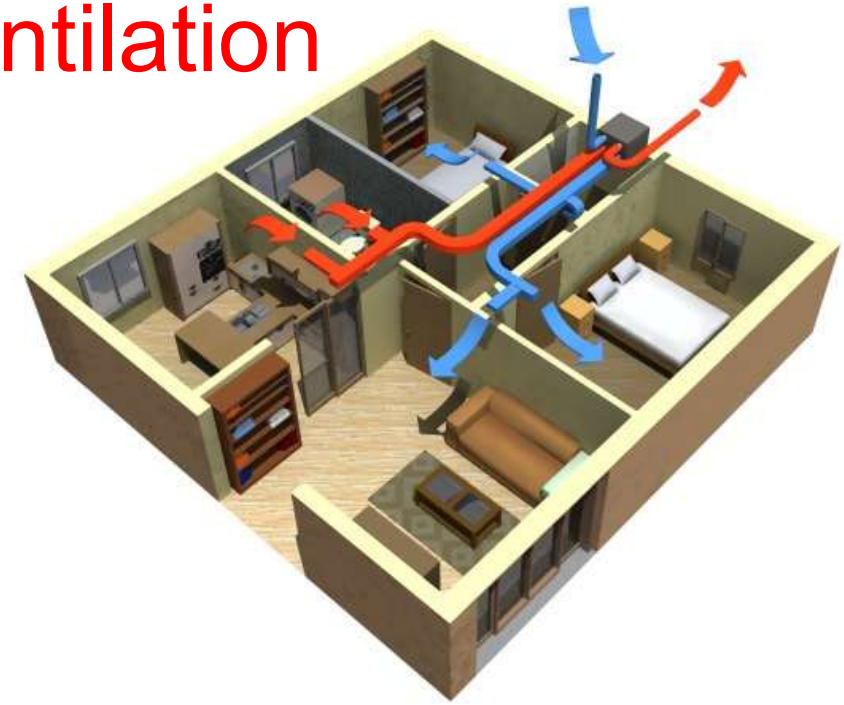
offices, shops, hotels restaurants, educational, sporthalls, hospitals, pharmaceutical, …

Heating



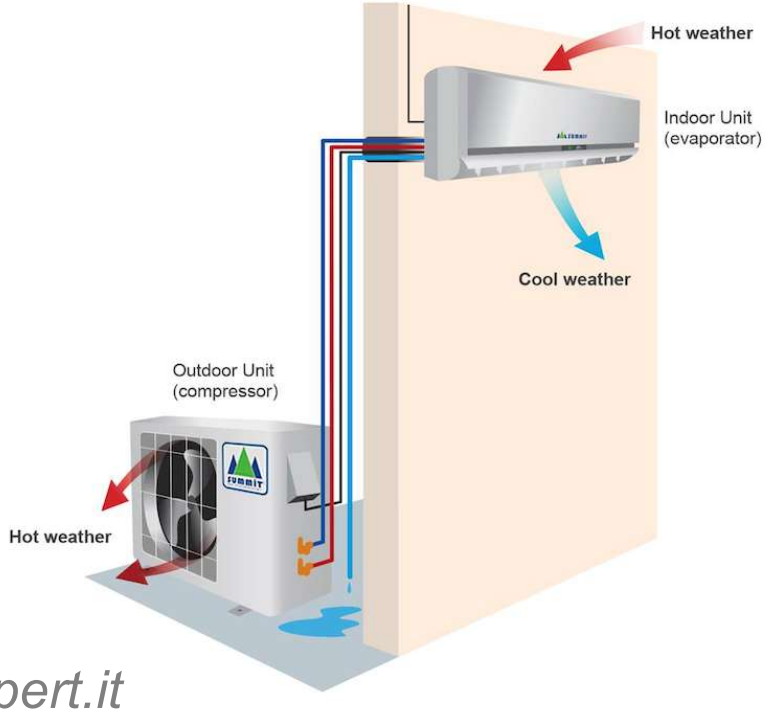
Source: herzitalia.it

Ventilation



Source: ahoraarchitectura.it

Air-conditioning



Source: climaexpert.it

HVAC (1/2)

- Problems related to IEQ (Indoor Environmental Quality)
- Climate, peak power, energy and loads
- Recap on heat transfer, building envelope, energy consumptions
- Sizing of Domestic Hot Water (DHW)
- Types of plants (full air, water, primary air)
- Types of ventilation in rooms, mechanical ventilation for residential buildings and control of humidity.
- Air Handling Units (AHU)
- Aeraulics (air ducts distribution, terminal air diffusers) sizing, choice, balancing

HVAC (2/2)

- Types of terminal units (radiators, fan-coils, chilled/active beams, radiant systems)
- Hydronics (piping, distribution, valves) sizing and balancing
- Generation systems: boilers, air source heat pumps
- Control of hydronic systems
- District heating and cooling networks
- Introduction to BIM

Exam rules 1/2:

- Report: 9 points

Personal Report (6 points)

- Calculation of **peak power for heating** of your house
- Calculation of **peak power for cooling** of your house
- DHW consumption **energy + sizing**
- Sizing of a **radiant floor**
- Sizing and selecting an **air-to-water heat pump**

Group Report (3 points)

- Sizing/balanging of a full air system for a large building

To be uploaded in Moodle.

Exam rules 2/2:

- Exam:

• 1 long written question	7 points
• 2 short written questions (2 x 4 =)	8 points
• 1 oral question	6 points
• report	9 points
$\sum$	30 points

Duration of the written part: 1 hour

At the end of the written part, the oral question will start. First In First Out (the first who delivers the written answers will be the first one in answering the oral question).

Potential dates of the exam:

- Exams:
  - 23/6 at 12:00 Room Me
  - 14/7 at 9:00 Room Me

- Group Report:
  - To be delivered by mid of May (the sooner the better) in Moodle

- Personal Reports

  They should be uploaded in Moodle

  - either the 16/6 for the first date of the exam

  - or the 7/7 for the second date of the exam

  The report has to include all Excel files, the Word document and PDF: all compressed in a .zip file named:

  NAME_SURNAME_HVAC

Subdivision of the Reports:

PERSONAL REPORT:

- Calculation of **peak power for heating** of your house (*De Carli*)
- Calculation of **peak power for cooling** of your house (*De Carli*)
- DHW consumption **energy + sizing** (*Marigo*)
- Sizing of a **radiant floor** (*De Carli*)
- Sizing and selecting an **air-to-water heat pump** (*De Carli*)

GROUP REPORT:

Sizing and balancing air ducts (*Marigo*)

Which plants do we have in a building?

Mechanical, **electrical** and **plumbing** (**MEP**)

HVAC

DC
AC
Lighting
Information Technology (communication, control, BEM, security, audio, video)

Potable water, hot water, sewerage, stormwater, natural gas, rainwater collection and storage

HVAC + plumbing: 25-30% of overall costs
Electrical plants: 25-30% of overall costs

→ MEP 50%-60% of overall costs

Plumbing

Source: mestiereimpresa.it

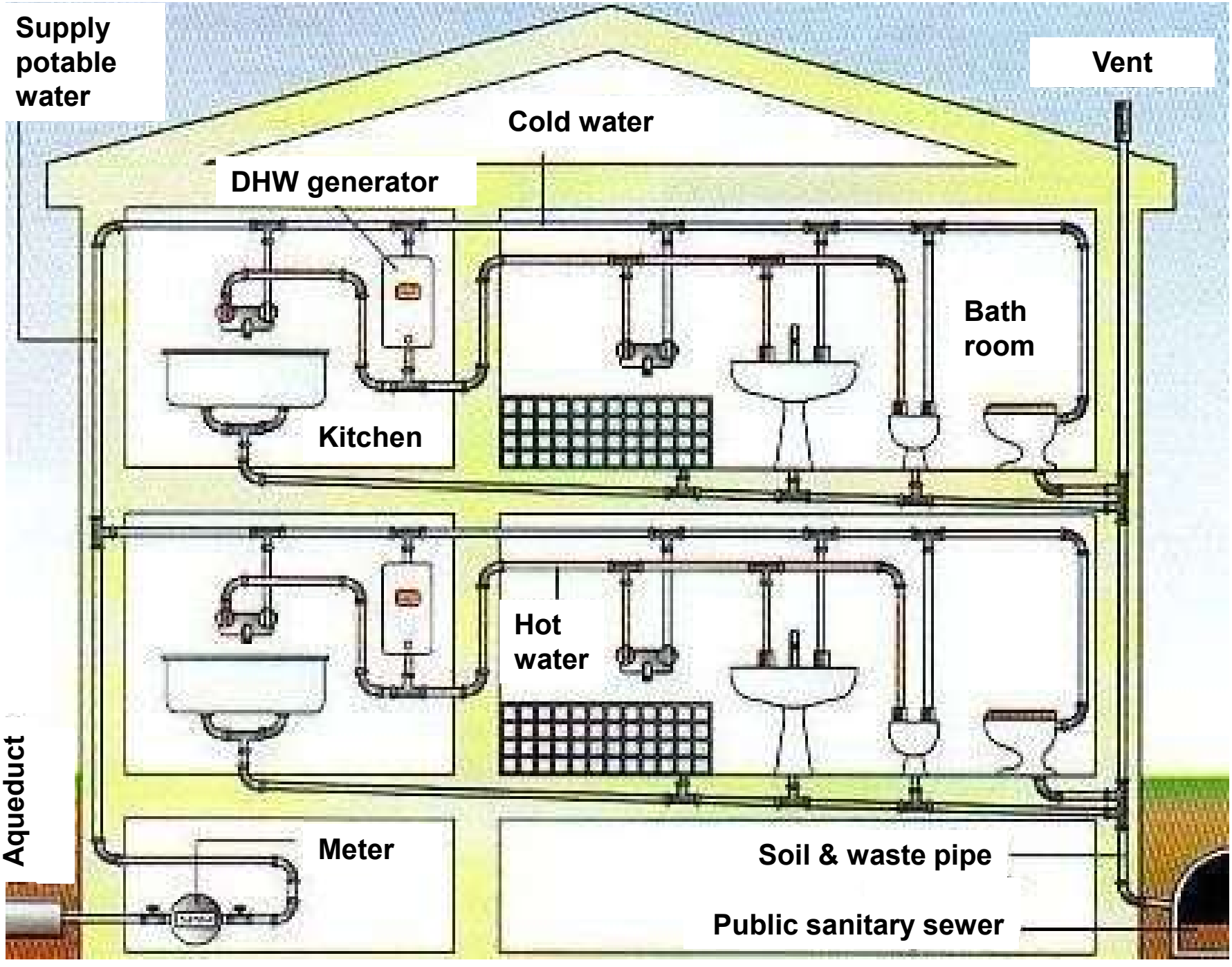
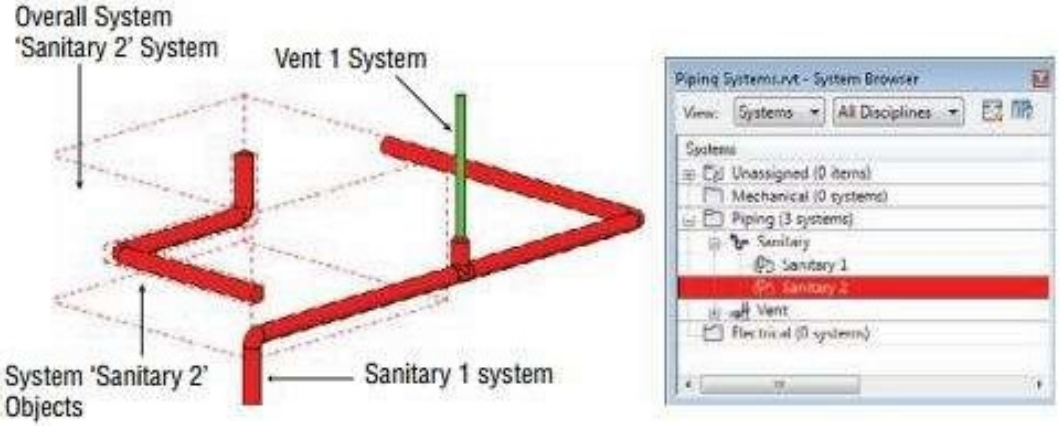
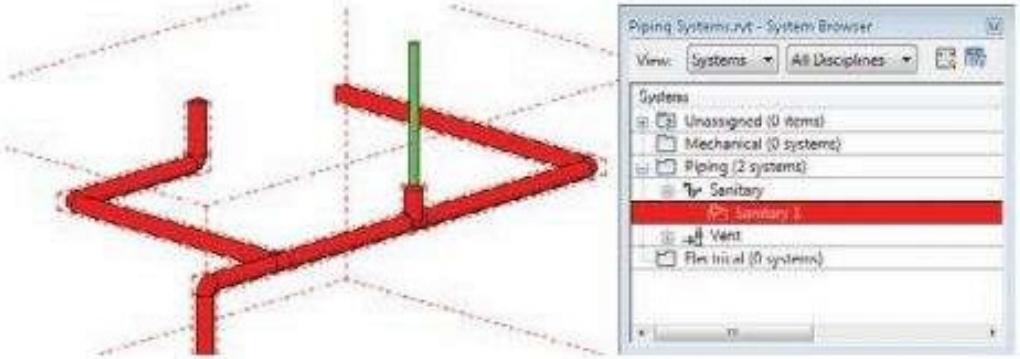


FIGURE 9.16
Dual pipe systems



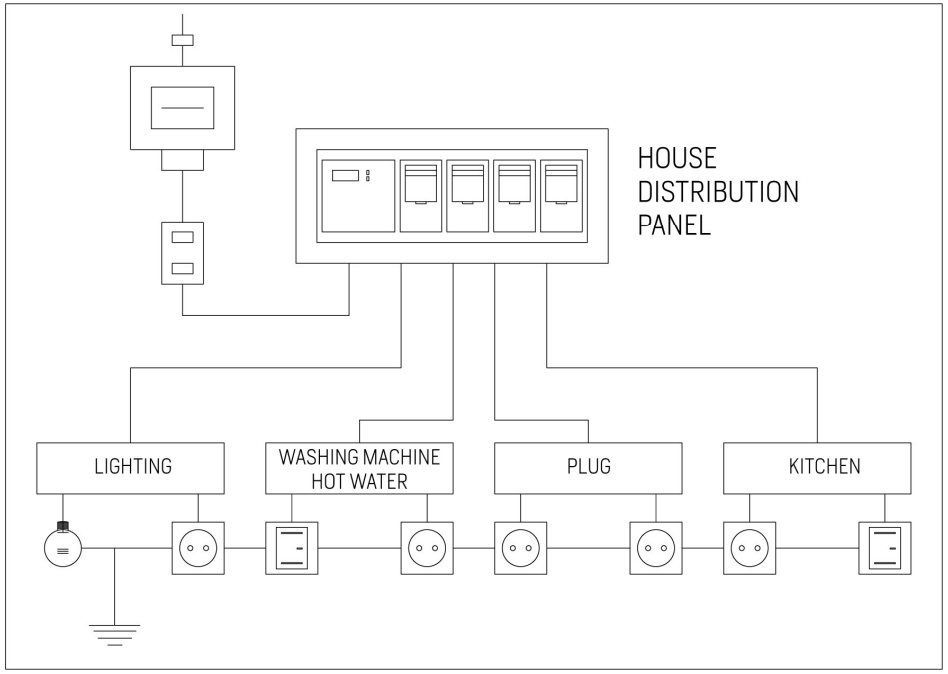
Source: cadcamengineering.net

FIGURE 9.17
Merged systems

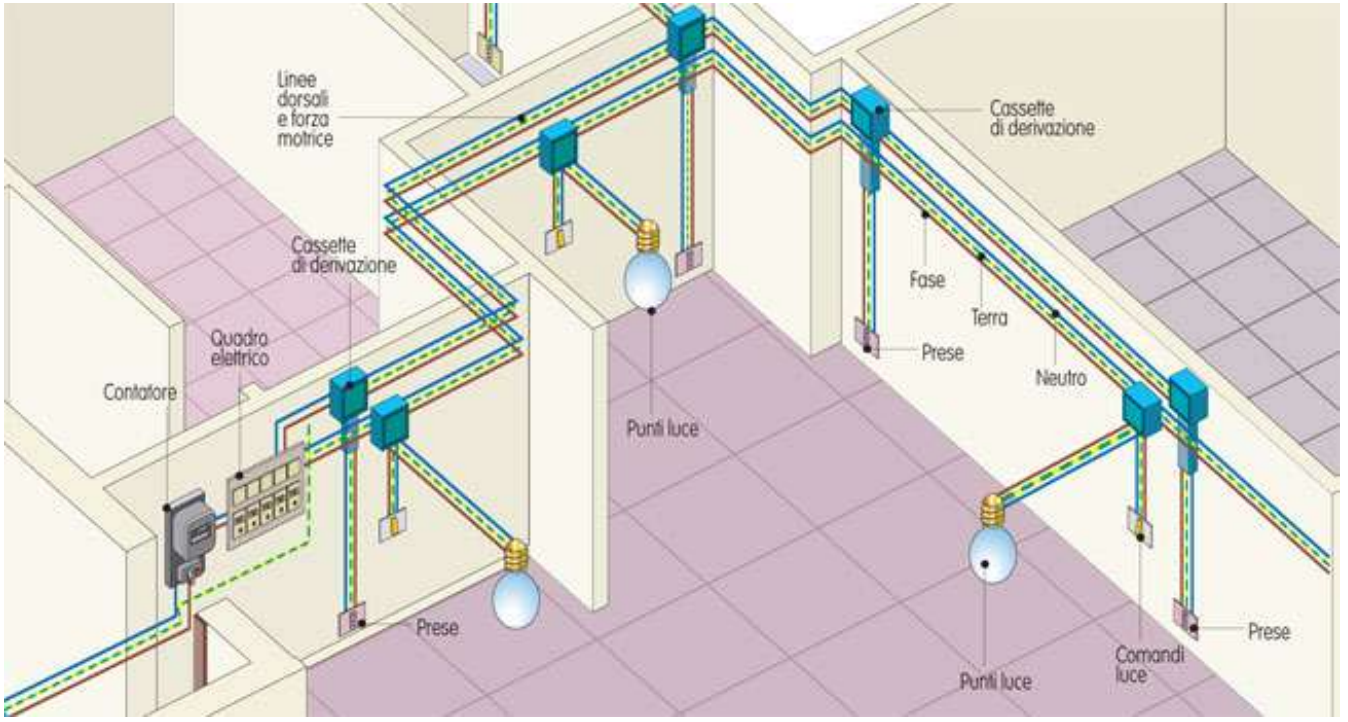


Electrical

Source: systemimpianti.it



Source: stacbond.com



Source: bricoportale.it

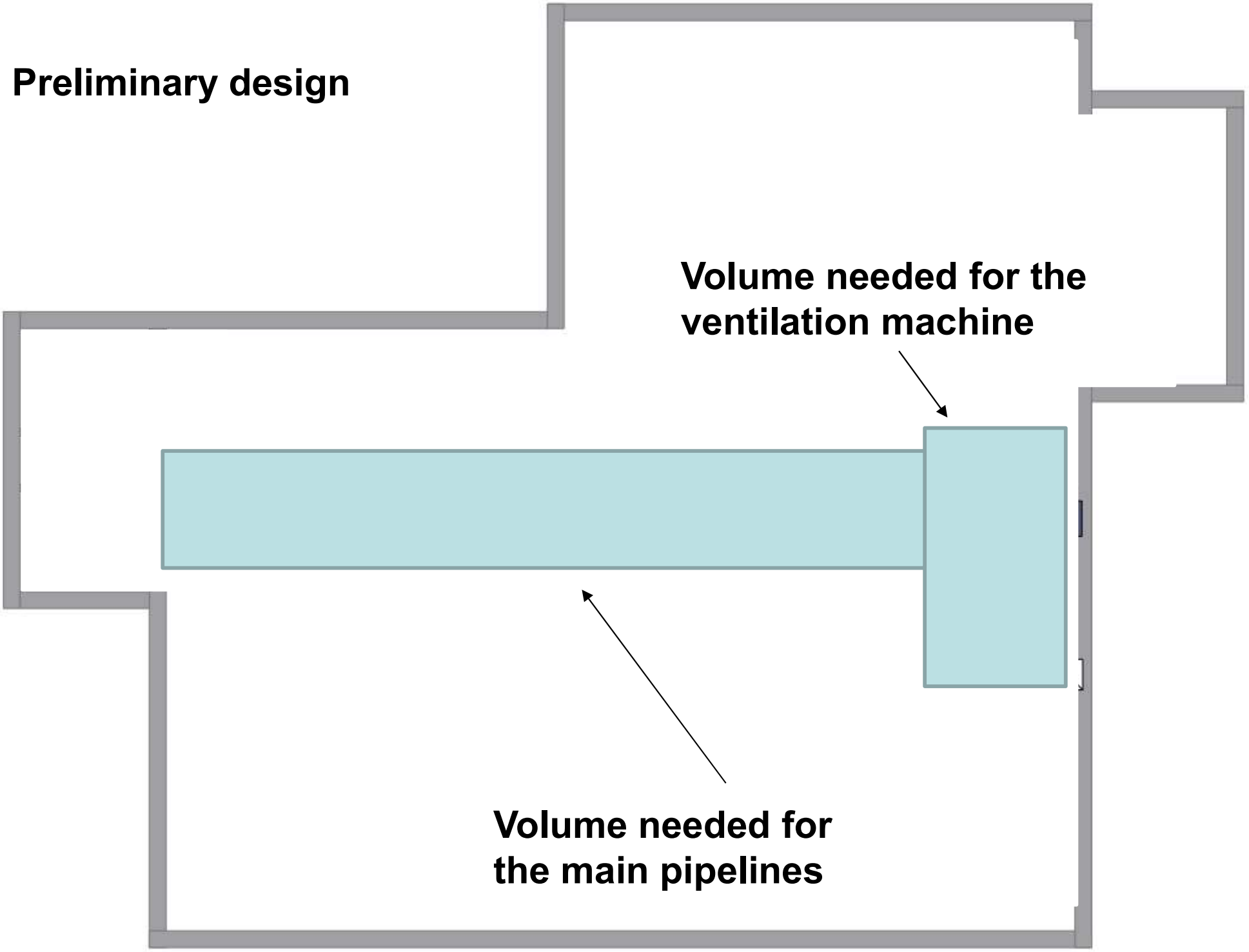
Italian regulations:

- L. 46/90 (design of buildings and HVAC)
- L. Merloni 1994 (Public works: documentation for each design phase)
- DPR 554 21/12/99 (Decree implementing the L. Merloni)
- **D. Lgs. 50/2016**

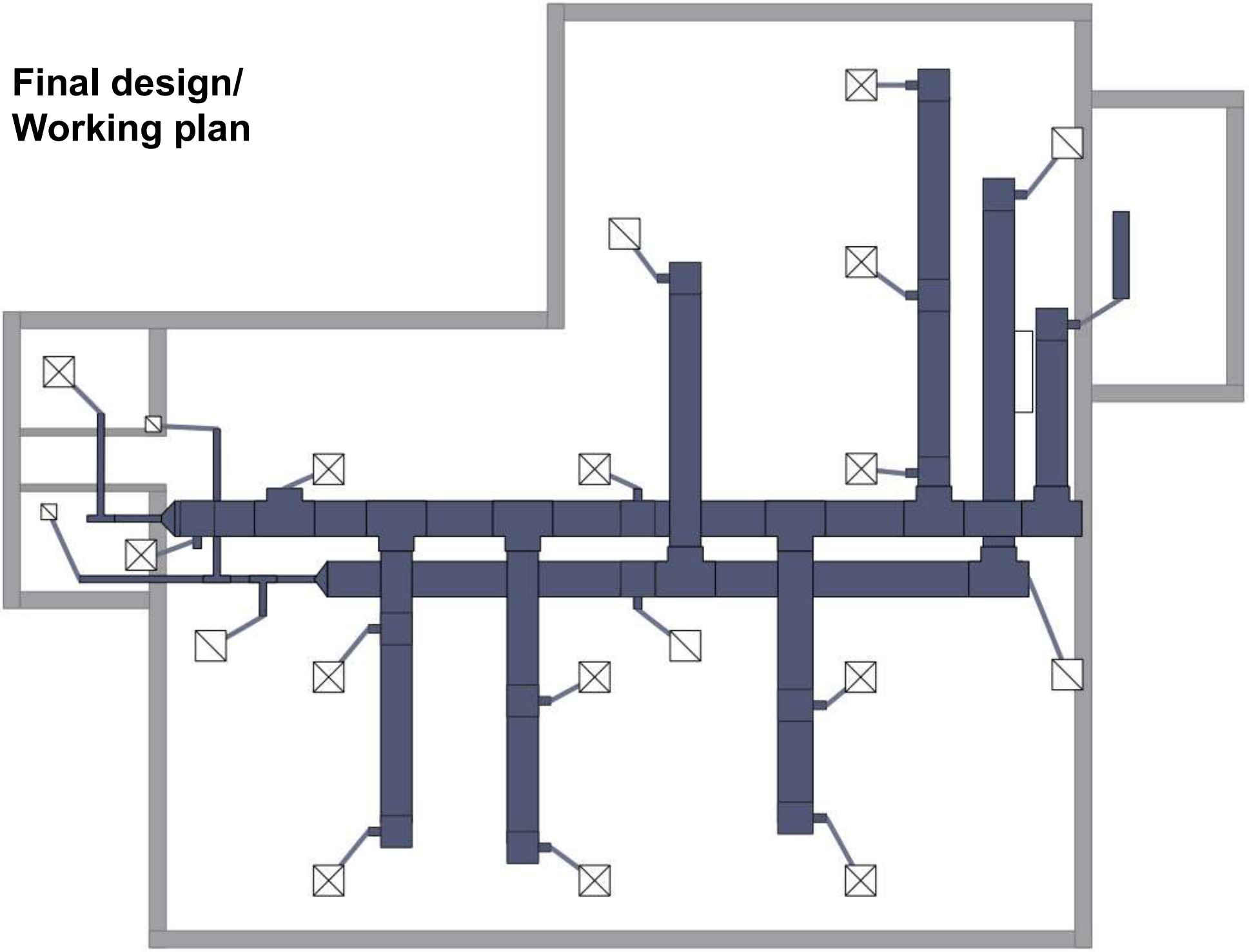
Design phases in Italy:

- Technical- economic feasibility design (location, size/volume, main pipelines) 1:200
- *Final design (definition of all HVAC components, sizing of secondary lines, emission systems) 1:100*
- *Working plan (thickness and details onvarious components) 1:50*
- Construction drawings: exact position of each component (e.g. shipyards, prefab constructions)
- “As built”
- Test
- Facility management

Preliminary design



Final design/ Working plan



Standards:

- UNI (CTI)
- CEI
- UNI CIG: Comitato Italiano Gas
- EN (CEN)
- ISO
- ASHRAE

Italy

EU + associated Countries

Worldwide

North America, Commonwealth and Middle East

Associations:

- AiCARR (Associazione italiana del Condizionamento dell'Aria, Riscaldamento e Refrigerazione)

http://www.aicarr.org/

https://www.youtube.com/watch?v=ehWJpn_ZLD8

ASHRAE

GBC

REHVA