HEATING, VENTILATION, AIR CONDITIONING SYSTEMS (HVAC)

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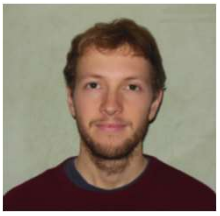
Dr. Jacopo Vivian
Dr. Laura Carnieletto

Persons in charge of the course:

Michele De Carli

Jacopo Vivian



Laura Carnieletto

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

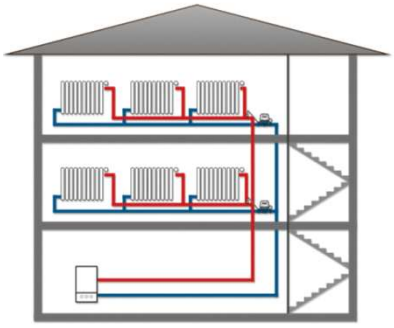
Hot water

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

Ventilation

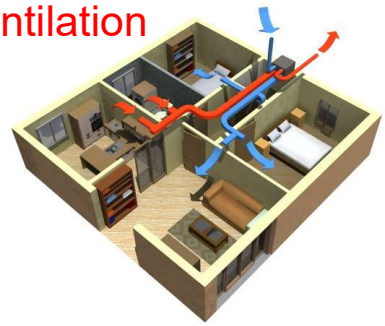
offices, shops, hotels restaurants, educational, sporthalls, hospitals, pharmaceutical, …

Heating



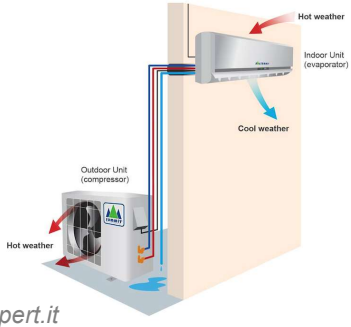
Source: herzitalia.it

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
- Energy certificates and regulations

Exam rules 1/2:

- Report: 7 points

Report
  - 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/balanging of a **ventilation** system
  - Sizing/balancing of a **hydronic** system

  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	8 points
• report	7 points
Σ	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:
  - 20/6 morning
  - 14/7 morning

- Reports

  They should be uploaded in Moodle

  - either the 13/6 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 and the Word document: all compressed in a .zip file named:

  NAME_SURNAME_HVAC

Subdivision of the program:

- Thermal comfort, IAQ, climate, heating and cooling peak power and energy demand, domestic hot water (DHW), types of ventilation systems, full-air plants, aeraulics, mechanical ventilation for residential buildings, dehumidification, terminal units, generation systems, air to water heat pumps, energy certificate

  Michele De Carli **7 CFU**

- hydronics, control of plants, district heating and cooling networks, tools for sizing and balancing air ducts (Dr. Carnieletto) and water pipelines

  Jacopo Vivian **2 CFU**

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

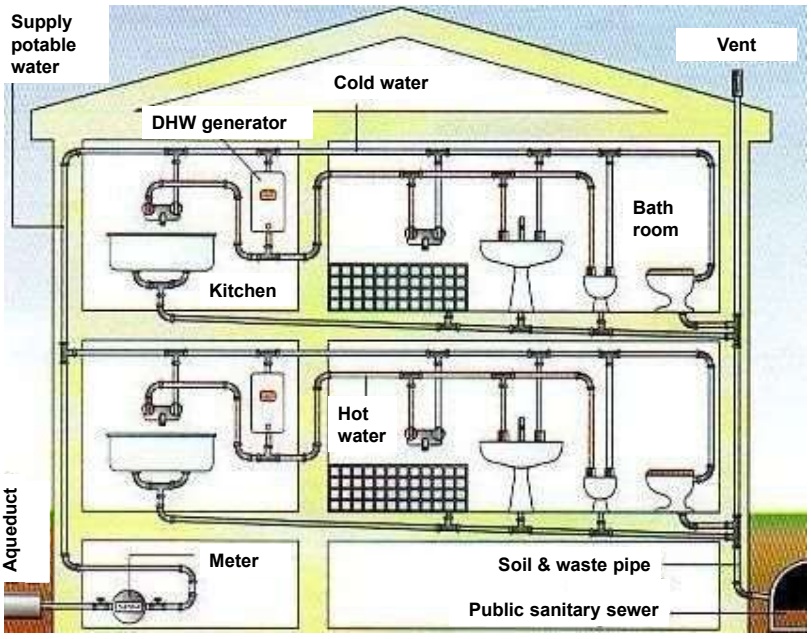
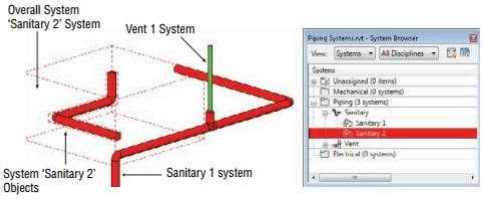
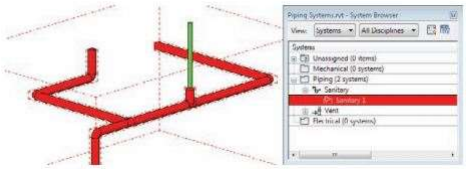


FIGURE 9.16
Dual pipe systems



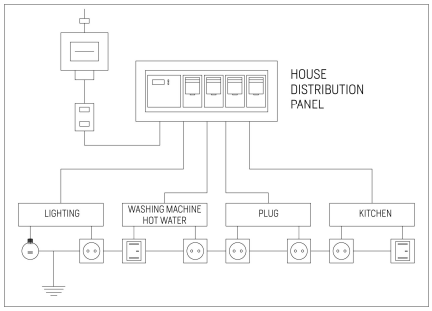
Source: cadcamengineering.net

FIGURE 9.17
Merged systems

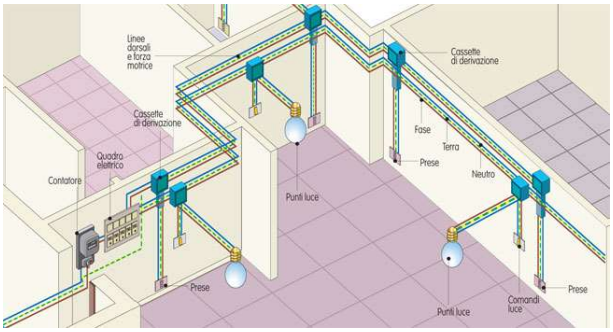


Electrical

Source: systemimpianti.it



Source: stacbond.com



Source: bricoportale.it

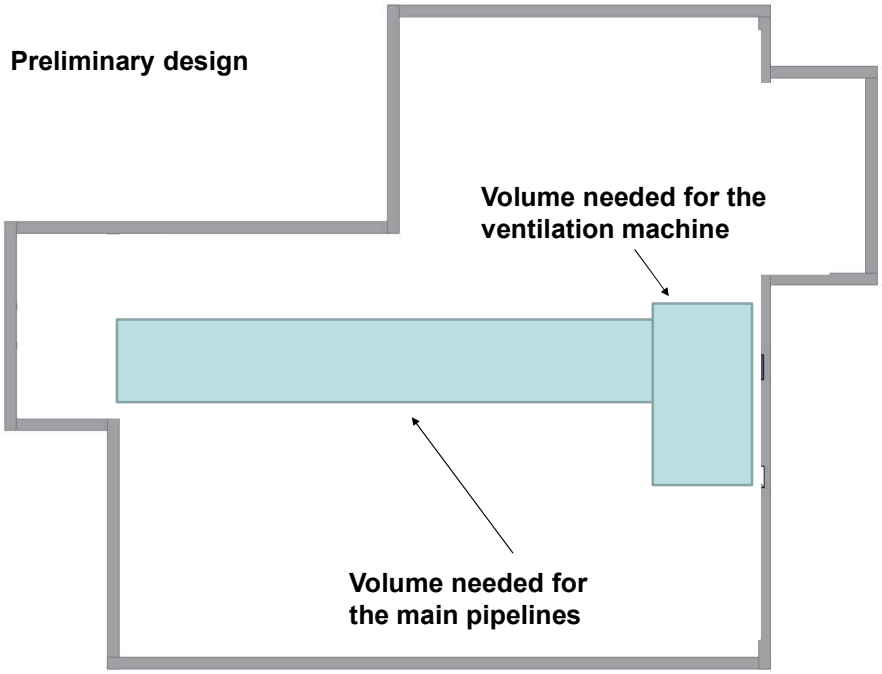
Italian regulations:

- 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**

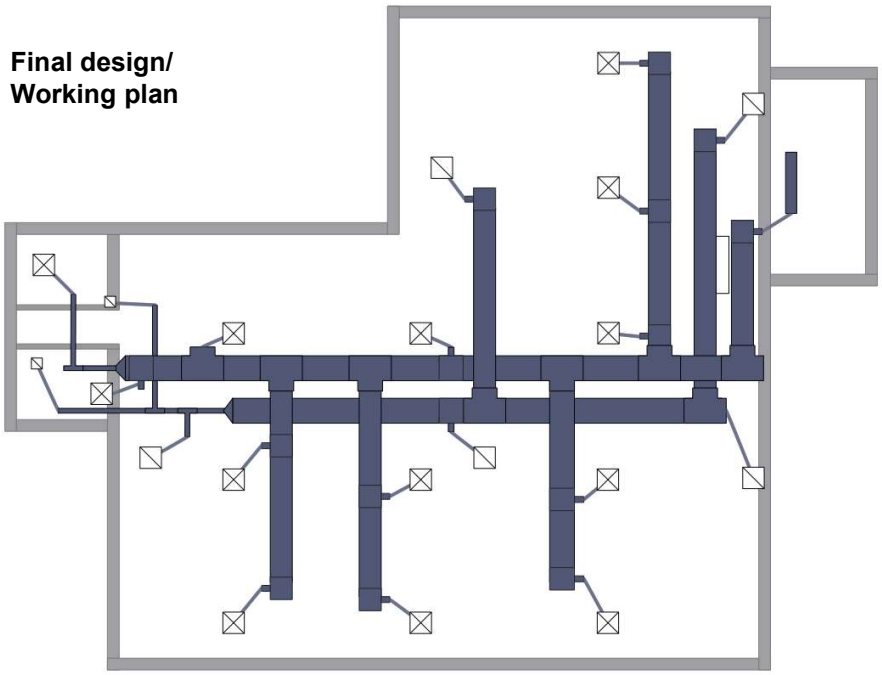
Design phases in Italy:

- 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

Italy

- EN (CEN)

EU + associated Countries

- ISO

Worldwide

- ASHRAE

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