

# HEATING, VENTILATION, AIR CONDITIONING SYSTEMS (HVAC)

Prof. Michele De Carli

Prof. Jacopo Vivian

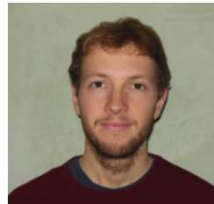
Eng. Marco Marigo

## Persons in charge of the course:

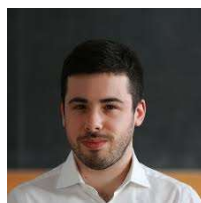
**Michele De Carli**



**Jacopo Vivian**



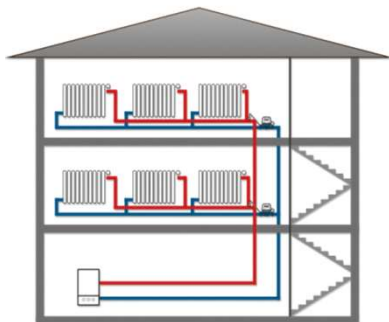
**Marco Marigo**



# What is an HVAC:

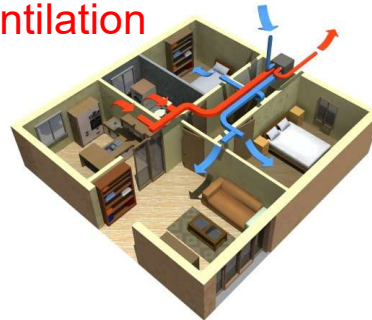
Residential, tertiary, industrial	
<p><b>Air conditioning</b></p> <p><b>Heating</b></p> <p><b>Cooling</b></p>	<p>Houses, offices, shops, hotels restaurants, educational, warehouse, hospitals, farms, food industries, ...</p> <p>Residential, tertiary, industrial, servers and data centers</p>
<b>Hot water</b>	Houses, sporthalls, swimming pools, hotels, restaurants, hospitals, farms, food industries, ...
<b>Ventilation</b>	offices, shops, hotels restaurants, educational, sporthalls, hospitals, pharmaceutical, ...

## Heating



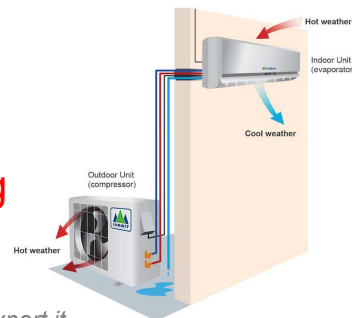
Source: herzitalia.it

## 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

## Exam rules 1/2:

- Report: 9 points

### Personal Report (7 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/balancing of a **hydronic** system
- Sizing and selecting an **air-to-water heat pump**

### Group Report (2 points)

- Sizing/balancing 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	
<hr/>		
$\Sigma$	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:
  - 26/6 morning Room Ce
  - 16/7 morning Room De
- Group Report:
  - To be delivered by mid of May (the sooner the better) in Moodle
- Personnel Reports
  - They should be uploaded in Moodle
  - either the 19/6 for the first date of the exam
  - or the 9/7 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, types of ventilation systems, full-air plants, aeraulics, mechanical ventilation for residential buildings, dehumidification, terminal units

***Michele De Carli***

**6 CFU**

- Domestic hot water (DHW) (Dr. Marigo), hydronics, control of plants, district heating and cooling networks, tools for sizing and balancing air ducts (Dr. Marigo) and water pipelines, generation systems, air to water heat pumps

***Jacopo Vivian***

**3 CFU**

# Which plants do we have in a building?

## Mechanical, electrical and plumbing (MEP)

HVAC

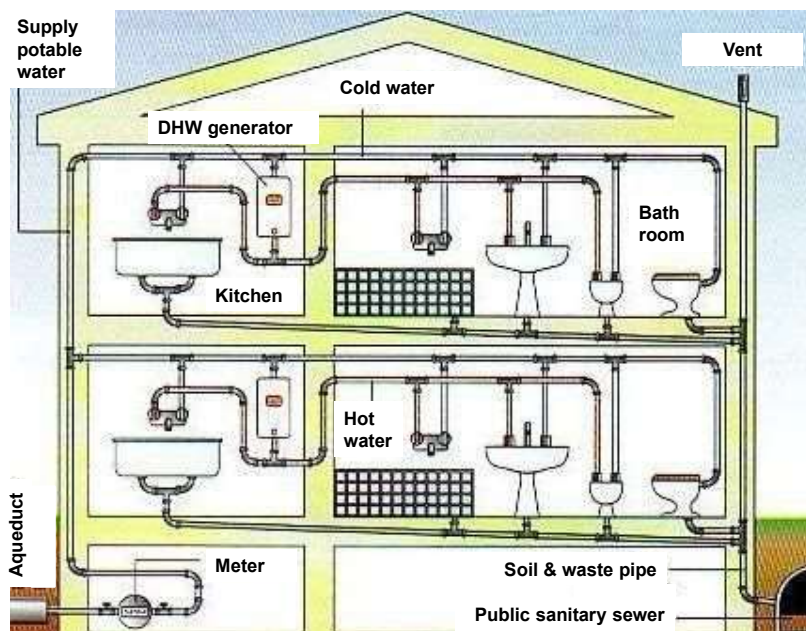
DC  
AC  
Lighting  
Information Technology  
(communication, control,  
BEM, security, audio,  
video)

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

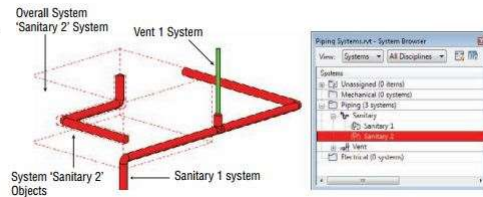
HVAC + plumbing: 25-30% of overall costs  
Electrical plants: 25-30% of overall costs } → **MEP 50%-60% of overall costs**

## Plumbing

Source: mestiereimpresa.it

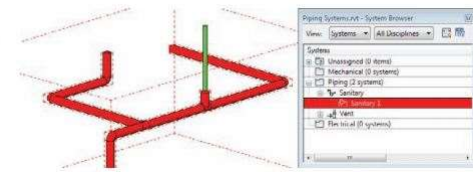


**FIGURE 9.16**  
Dual pipe systems

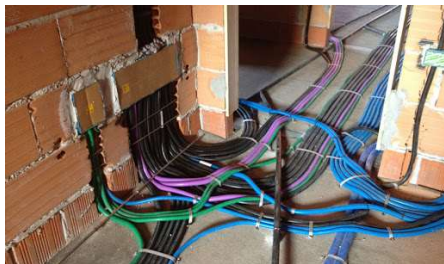


Source:  
[cadcamengineering.net](http://cadcamengineering.net)

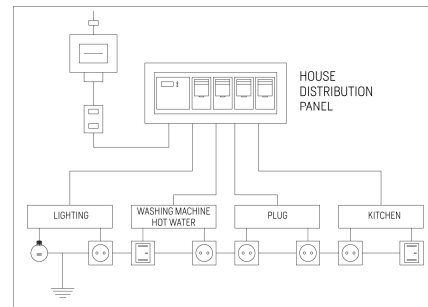
**FIGURE 9.17**  
Merged systems



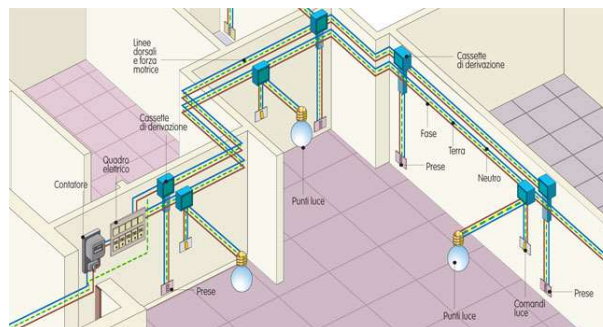
## Electrical



Source: [systemimpianti.it](http://systemimpianti.it)



Source: [stacbond.com](http://stacbond.com)



Source: [bricoportale.it](http://bricoportale.it)

## Italian regulations:

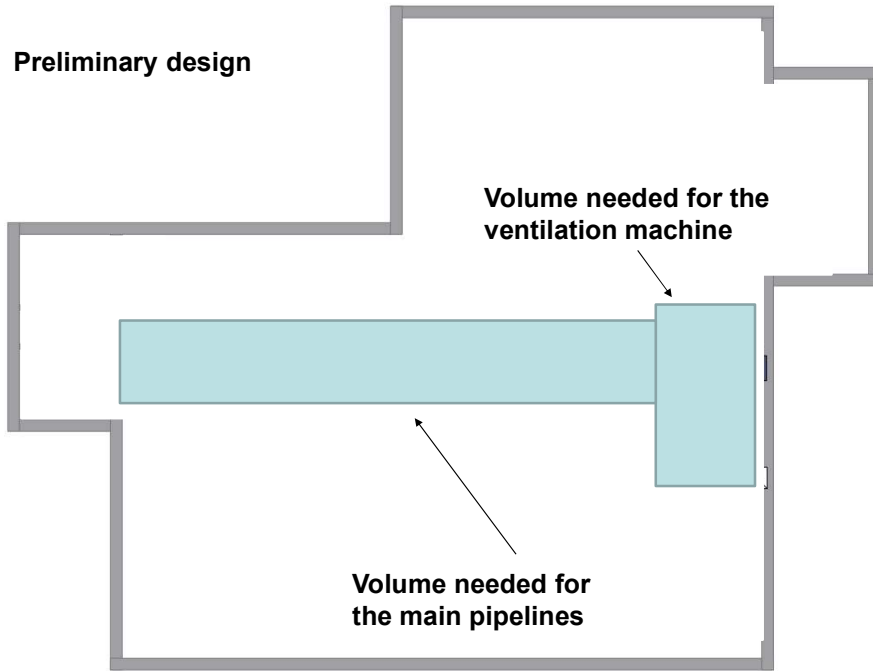
- L. 46/90 (design of buildings and HVAC)
- L. Merloni 1994 (Public works: documentation for each design phase)
- DPR 554 21/12/99 (Decree implementing the L. Merloni)
- **D. Lgs. 50/2016**

## Design phases in Italy:

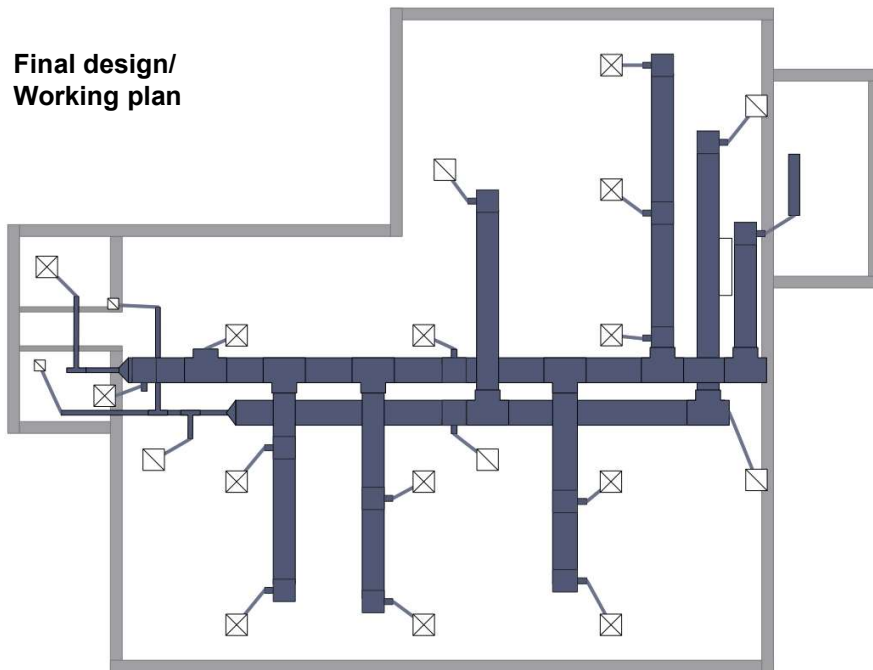
- Technical- economic feasibility design (location, size/volume, main pipelines) 1:200
- *Final design (definition of all HVAC components, sizing of secondary lines, emission systems) 1:100*
- *Working plan (thickness and details on various components) 1:50*
- Construction drawings: exact position of 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](https://www.youtube.com/watch?v=ehWJpn_ZLD8)

ASHRAE

REHVA

GBC

