Materials for Architecture and Technological Innovation (6 CFU)

Materials Technologies for the Environment (6 CFU)

Prof. Alberto De Capua

MpA 11 Closings

- **traditions**
- **innovations**

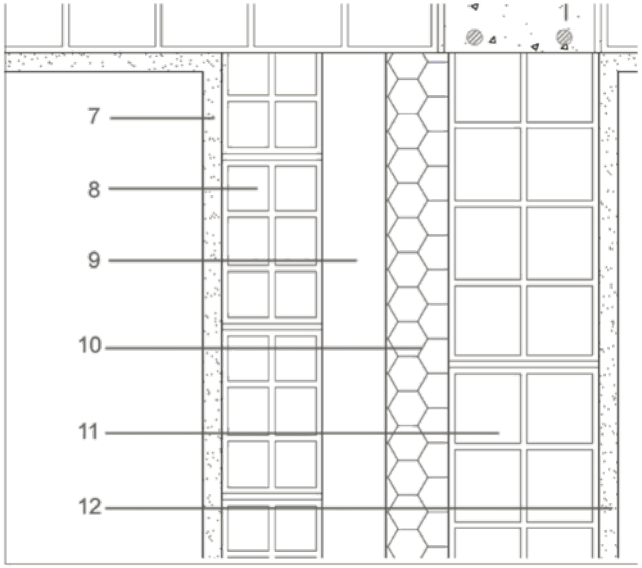
The classification of the structural elements according to UNI 8290:

Classes of technology Units	*Technology Units*	*Classes of Technical Elements*
CLOSINGS	VERTICAL CLOSINGS	OUTER WALLS WINDOW FRAMES
	LOWER DIAFRAMS	GROUND SLABS HORIZONTAL WINDOWS
	DIAFRAMS ON EXTERNAL SPACES	SLABS ON EXTERNAL SPACES
	UPPER CLOSINGS	ROOFS HORIZONTAL EXTERNAL WINDOWS

VERTICAL CLOSINGS

Outer walls composed by different elements

Types of blocks



7 — internal plaster 1.5 cm

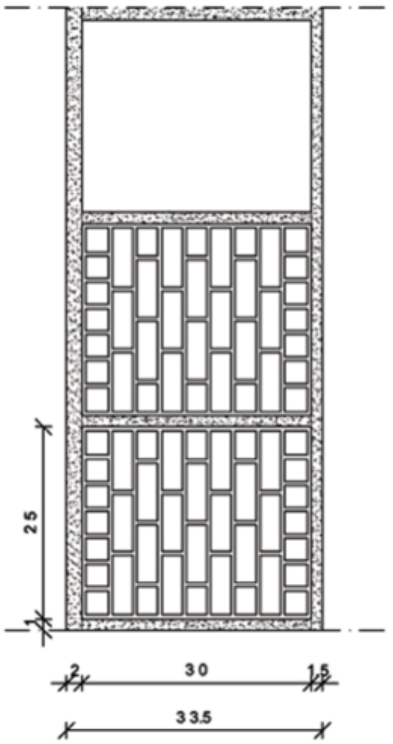
8 — hollow brick 12x8x25 cm

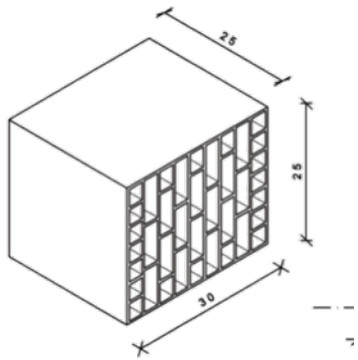
9 — air space 4 cm

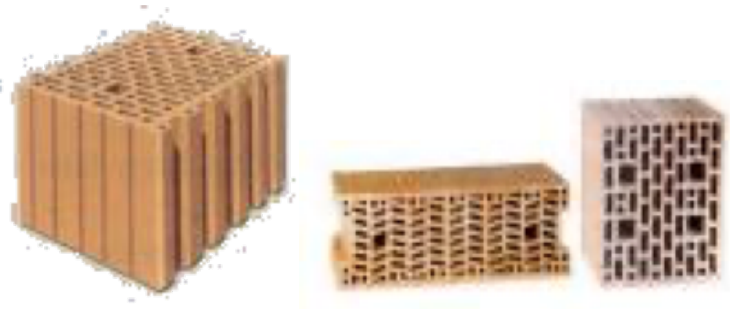
10 — mineralized wood wool insulation

11 — honeycomb 12x25x25 cm

12 — external plaster 2 cm





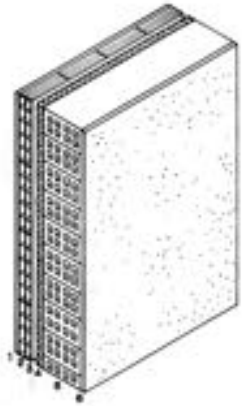
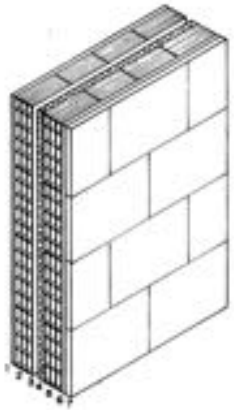
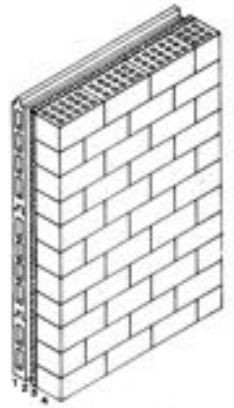
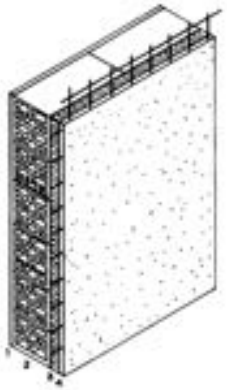
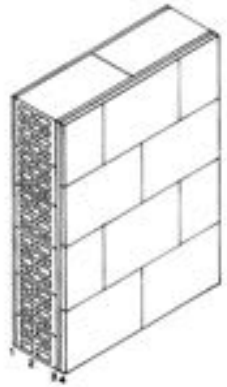
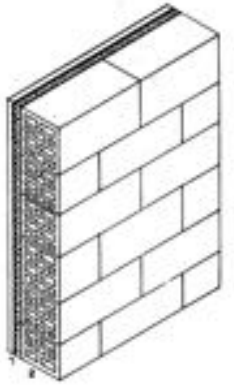


Porous bricks

Concrete blocks

Gasbeton

VC Outer walls composed by different elements

	CON INTONACO ESTERNO	CON RIVESTIMENTO ESTERNO	FACCIA VISTA
A DOPPIA PARETE	 1 INTONACO INTERNO cm 1 2 FORATO cm 8 3 INTERCAPEDINE cm 3 4 ISOLANTE cm 2 5 MATTONI CAVI cm 25 6 INTONACO cm 1,5	 1 INTONACO INTERNO cm 1 2 FORATO cm 12 3 INTERCAPEDINE cm 4 4 ISOLANTE cm 3 5 FORATO cm 12 6 MALTA cm 1 7 RIVESTIMENTO cm 2	 1 FORATI PREINTONACATI cm 8 2 INTERCAPEDINE cm 4 3 ISOLANTE cm 3 4 BLOCCO FACCIA VISTA cm 15
A PARETE UNICA	 1 INTONACO INTERNO cm 1 2 BLOCCO ISOLANTE cm 30 3 ISOLANTE cm 3 4 RETE E INTONACO cm 2	 1 INTONACO INTERNO cm 1 2 BLOCCO ISOLANTE cm 30 3 MALTA O COLLANTE cm 1 4 RIVESTIMENTO cm 2	 1 CARTONGESSO cm 5 2 BLOCCO ISOLANTE A FACCIA VISTA cm 30

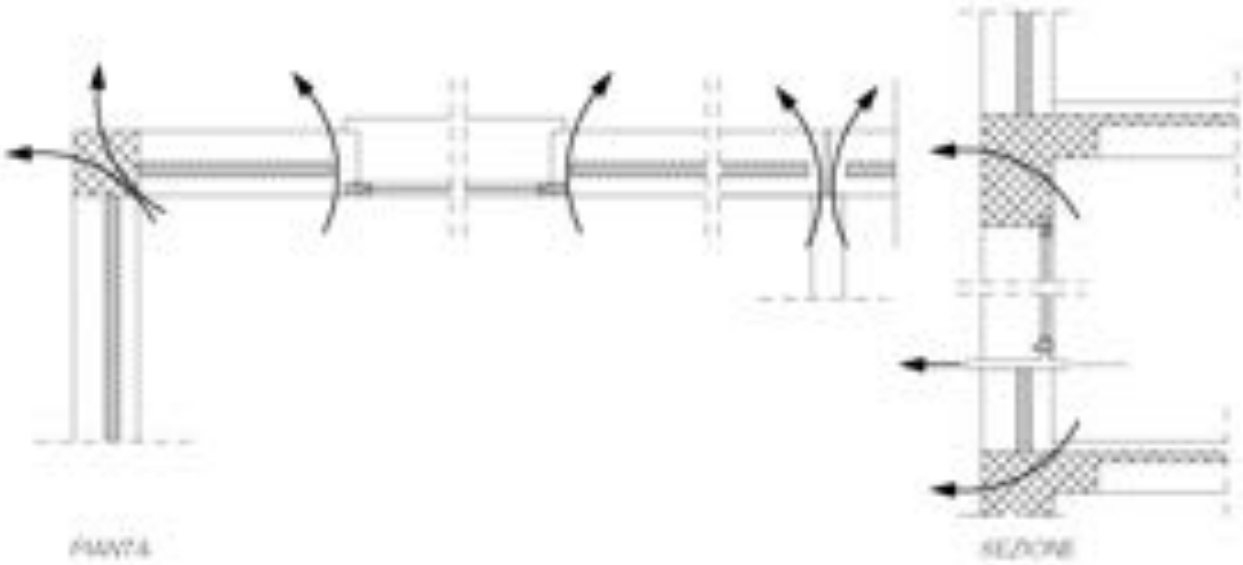
VC Thermal Bridge

I ponti termici sono punti singolari della costruzione a bassa resistenza termica. I principali punti che possono costituire ponte termico sono rintracciabili:

- in corrispondenza di angoli esterni verticali e orizzontali;
- negli incroci fra muri interni ed esterni;
- in corrispondenza di travi e cordoli perimetrali;
- nei contorni dei serramenti;
- nei muri di sottofinestra;
- fra elementi costruttivi adiacenti a differenti valori di trasmittanza.

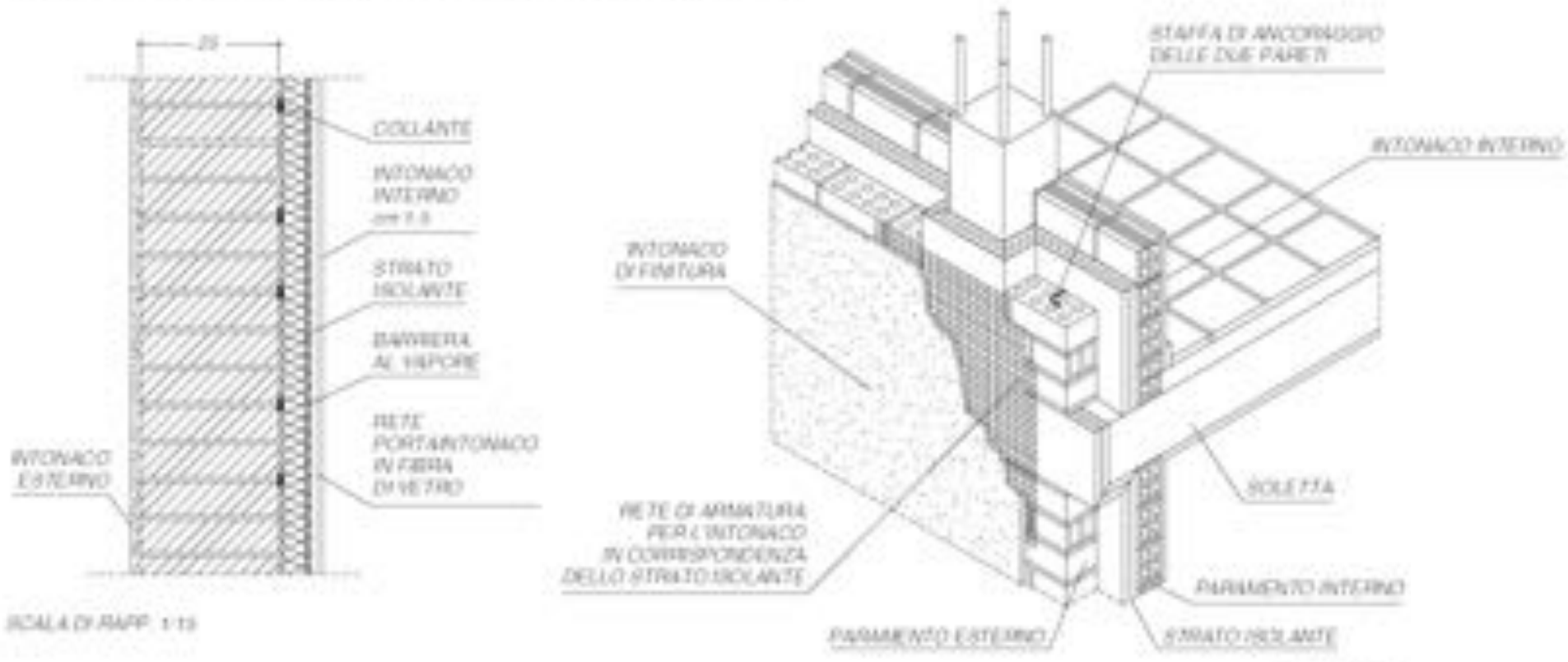
In corrispondenza dei ponti termici si ha abbassamento di temperatura superficiale, con conseguente rischio di formazione di condensa, muffe e pericolo di fessurazione della struttura. L'impiego di isolanti a forte spessore, non accompagnato da un adeguato controllo dei ponti termici, accresce il rischio di condensa a causa delle elevate differenze di temperatura superficiale che si rilevano in corrispondenza delle discontinuità costruttive. I ponti termici riducono il potere isolante dell'intera parete e il bilancio termico globale della struttura.

FIG. F.1.25/1 SCHEMI DI ALCUNI PONTI TERMICI



disegni tecnici da: *il Nuovissimo Manuale dell'Architetto,* Mancosu editore, pag.F83

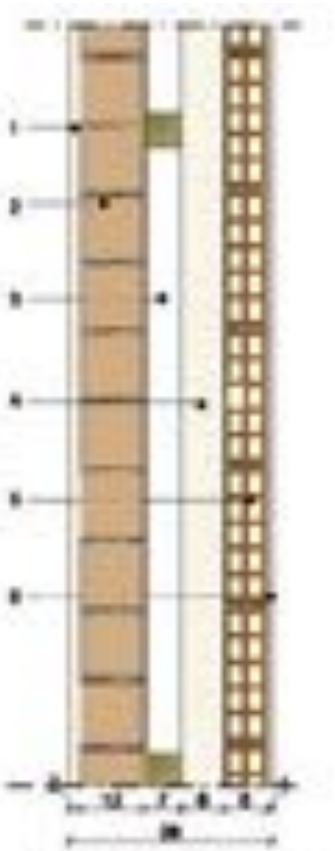
VC Outer walls composed by different elements: correction of thermal bridge



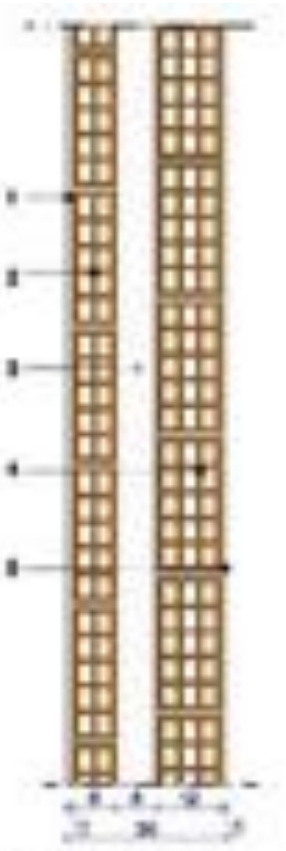
disegni tecnici da: *il Nuovissimo Manuale dell'Architetto,* Mancosu editore, pag.F85

VC Outer walls composed by different elements

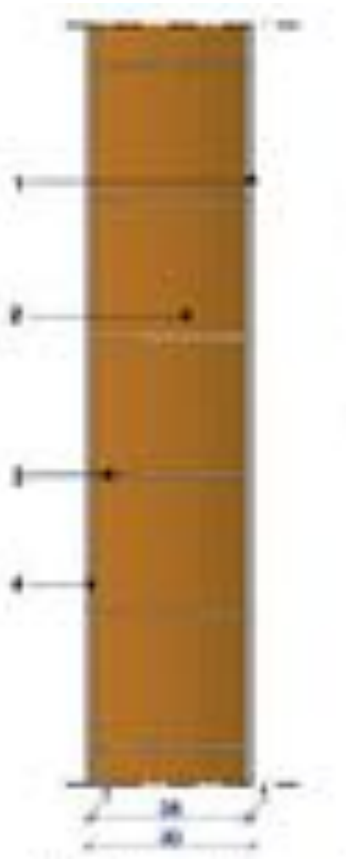
Load-bearing outer wall in lightweight brick (38 cm):
1. thermo-insulating external plaster;
2. lightweight brick blocks in paste 38 cm;
3. cementitious plaster;
4. internal plaster.



Double brick wall with insulated cavity:
1. external plaster;
2. semi-full brick 12x12x25 cm;
3. air gap;
4. thermal-acoustic insulation made of wood fibre or polystyrene;
5. perforated brick 8x25x25 cm;
6. internal plaster.



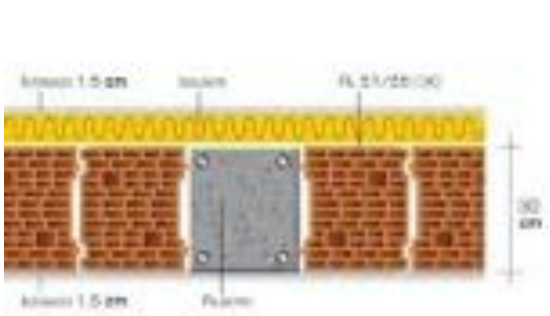
Insulated brick double wall:
1. internal plaster;
2. semi-full brick 8x12x25 cm;
3. polystyrene thermal-acoustic insulation;
4. perforated brick 12x25x25 cm;
6. external plaster.

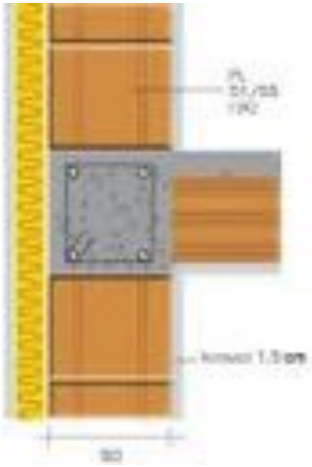


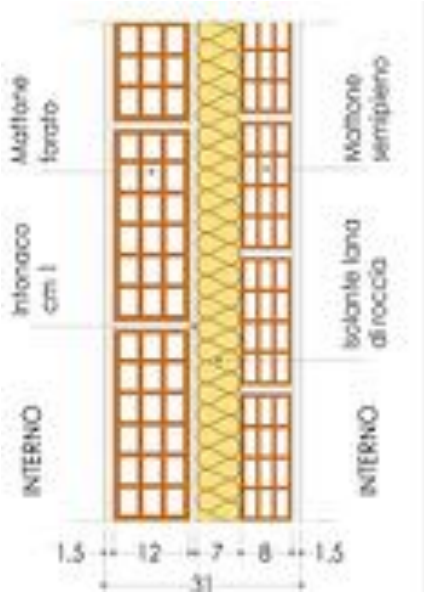
Brick wall:
1. internal plaster;
2. perforated brick blocks 28x25x25 cm;
6. external plaster.

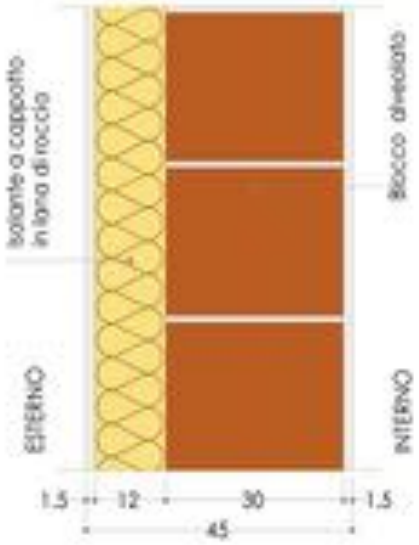
Some types of construction considered in the LCA study.


5
3
2
4
1
6

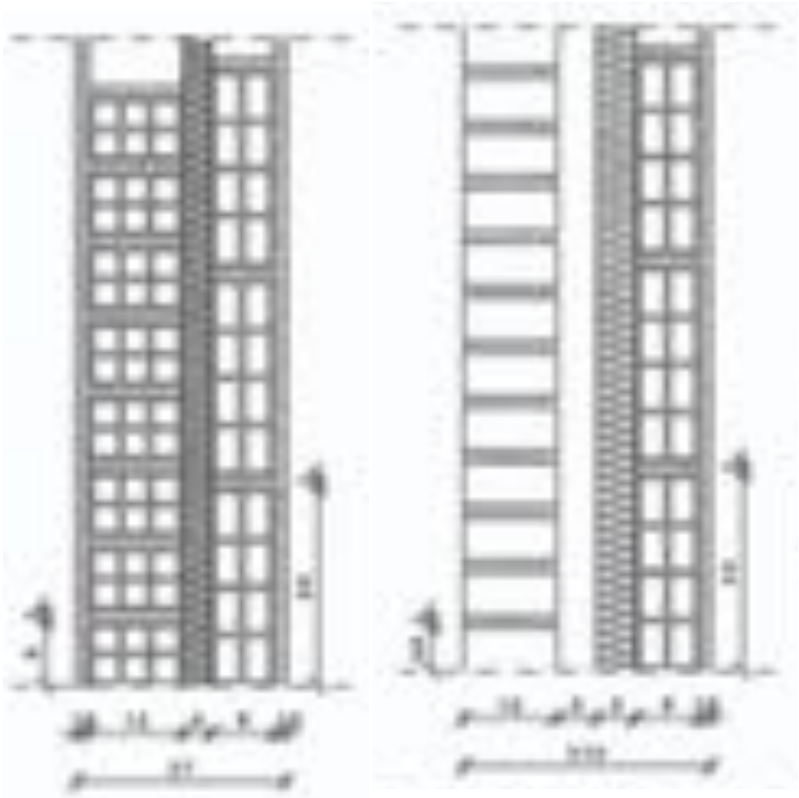




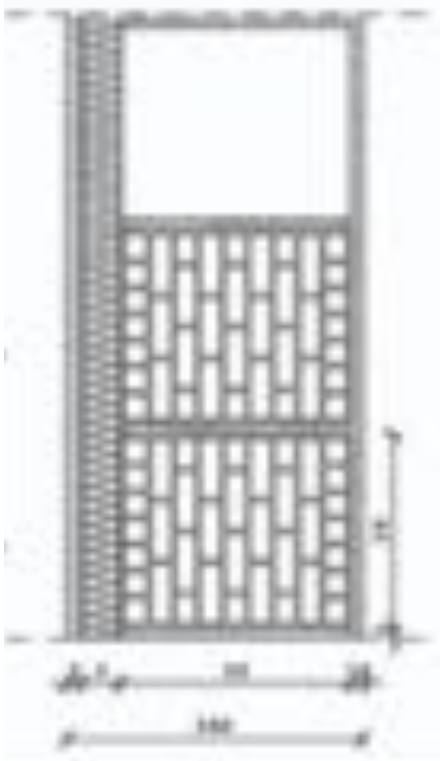

Mattone forato
Intonaco cm 1
INTERNO
Mattone semipieno
Isolante lana di roccia
INTERNO
1.5
12
7
8
1.5
31


Isolante o cappotto in lana di roccia
ESTERNO
Blocco alveolato
INTERNO
1.5
12
30
1.5
45

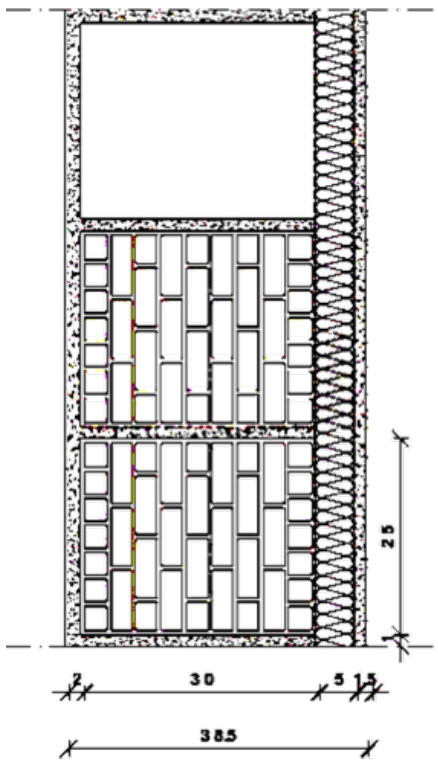
VC Outer walls composed by different elements: insulation



The installation of the thermal insulation layer in the **cavity** of the wall improves its thermal inertia and is indicated both in the case of continuous and discontinuous use of the rooms.

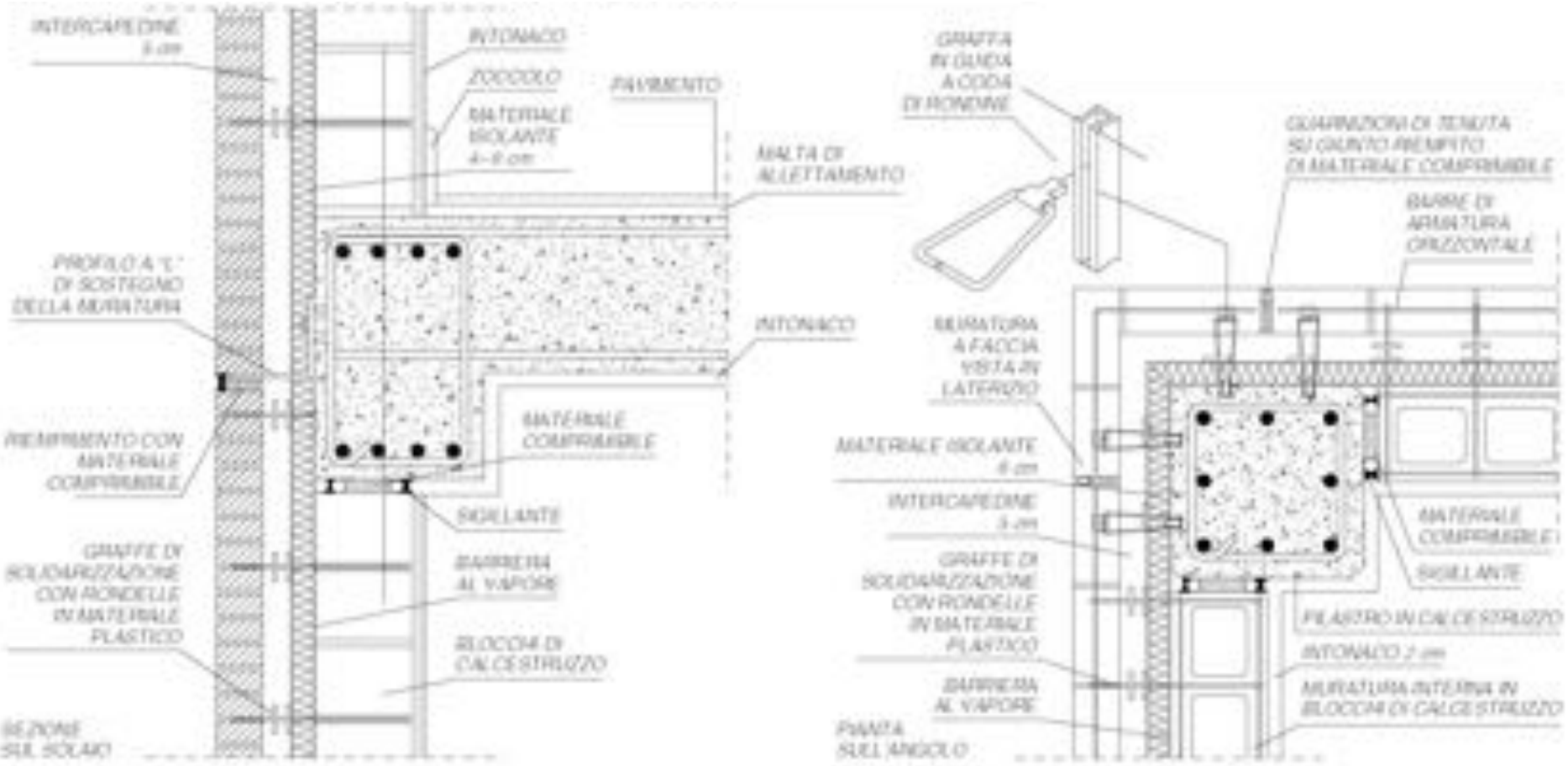


The installation of the thermal insulation layer in the **outer part of the wall** optimizes the thermal inertia by using the storage mass capacity of the supporting element.



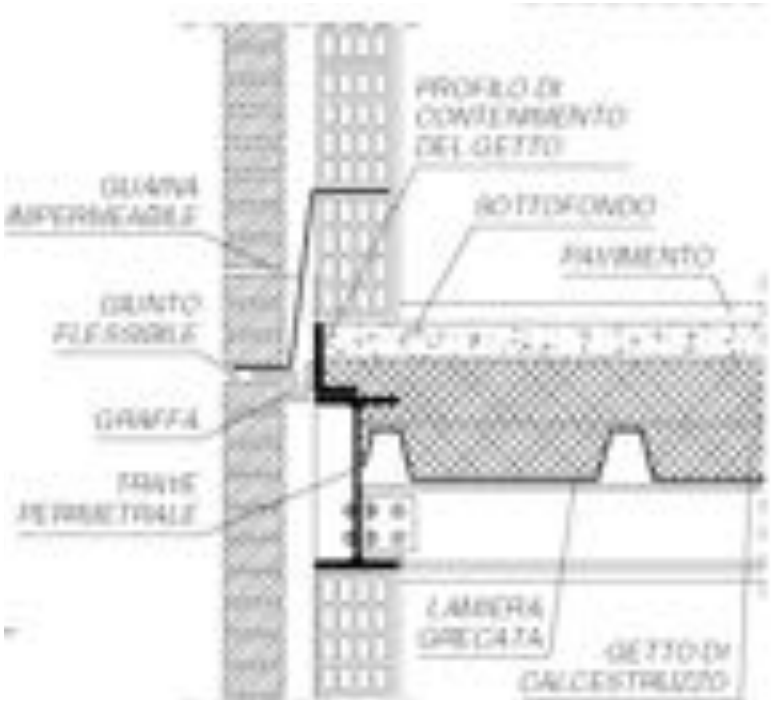
The installation of the thermal insulation in the **internal part of the wall** decreases thermal inertia.

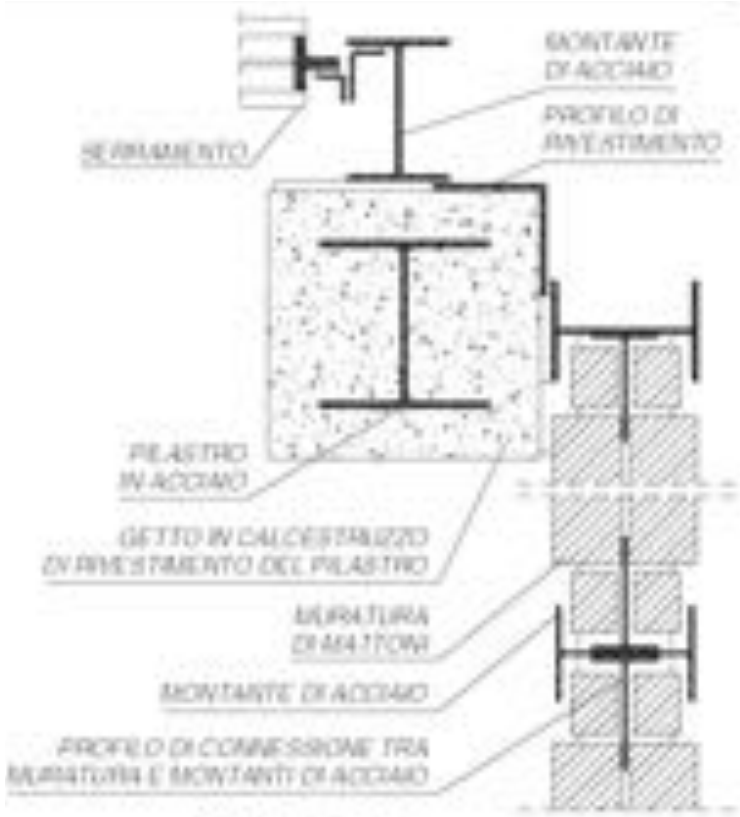
VC Outer walls composed by different elements: correlation with structural elements in reinforced concrete

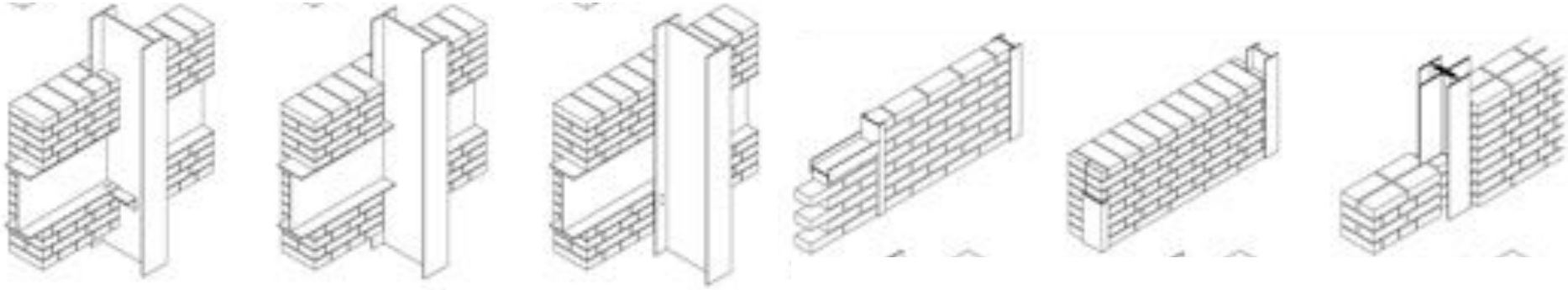


disegni tecnici da: *il Nuovissimo Manuale dell'Architetto,* Mancosu editore, pag.F47

VC Outer walls composed by different elements: correlation with structural elements in steel



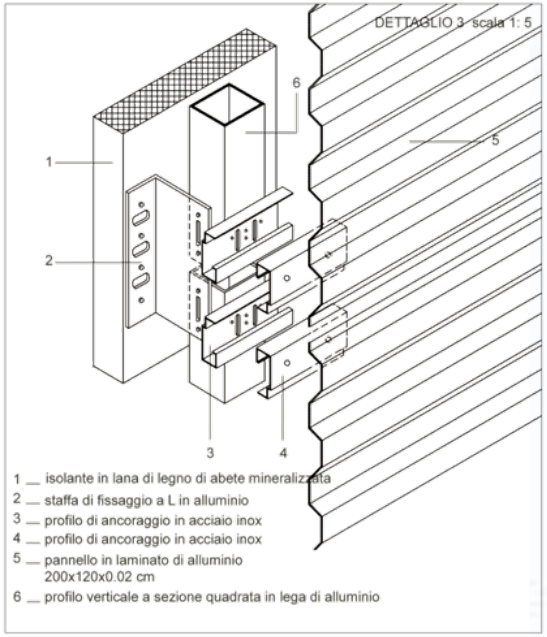


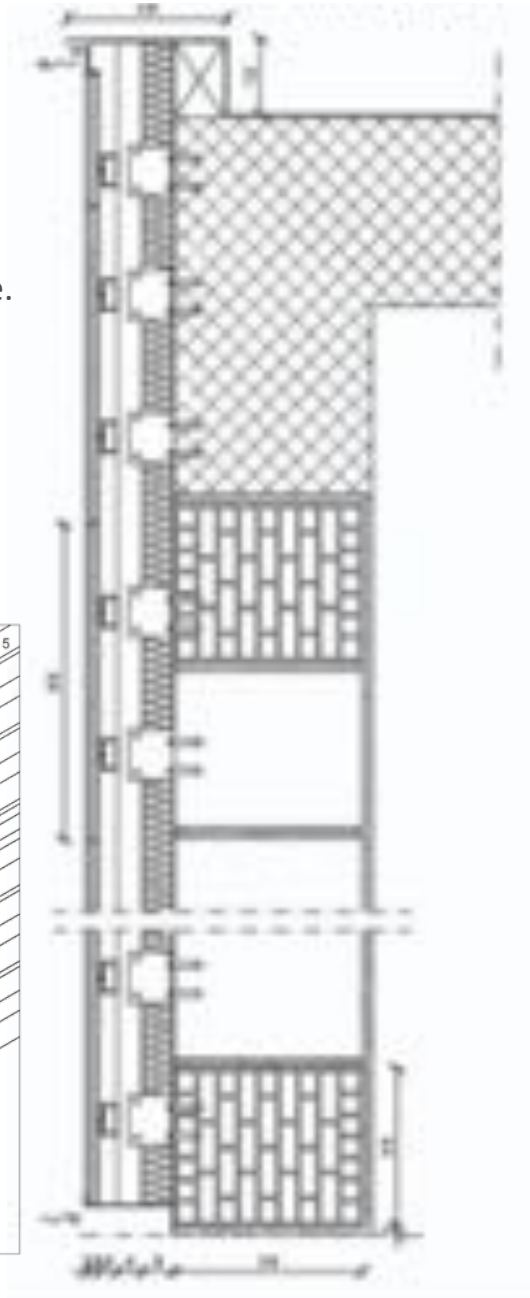


disegni tecnici da: *il Nuovissimo Manuale dell'Architetto,* Mancosu editore, pag.F47

VC insulation with ventilated facade

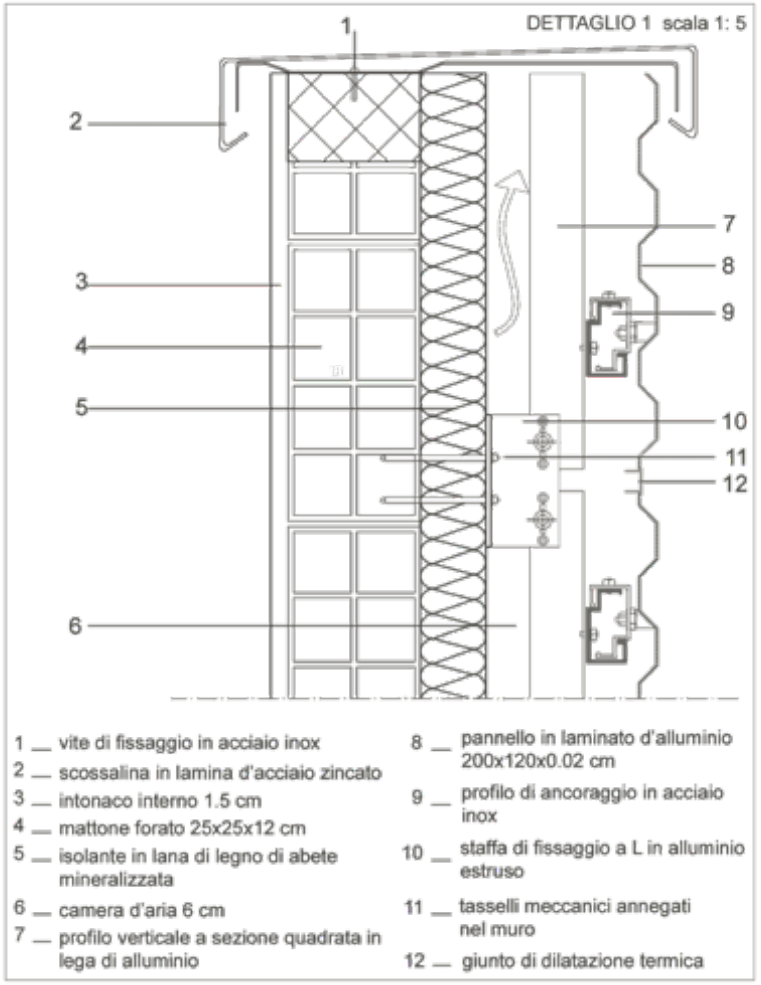
The **ventilated wall** activates an upward movement of air inside by using radiant heat from the outside.

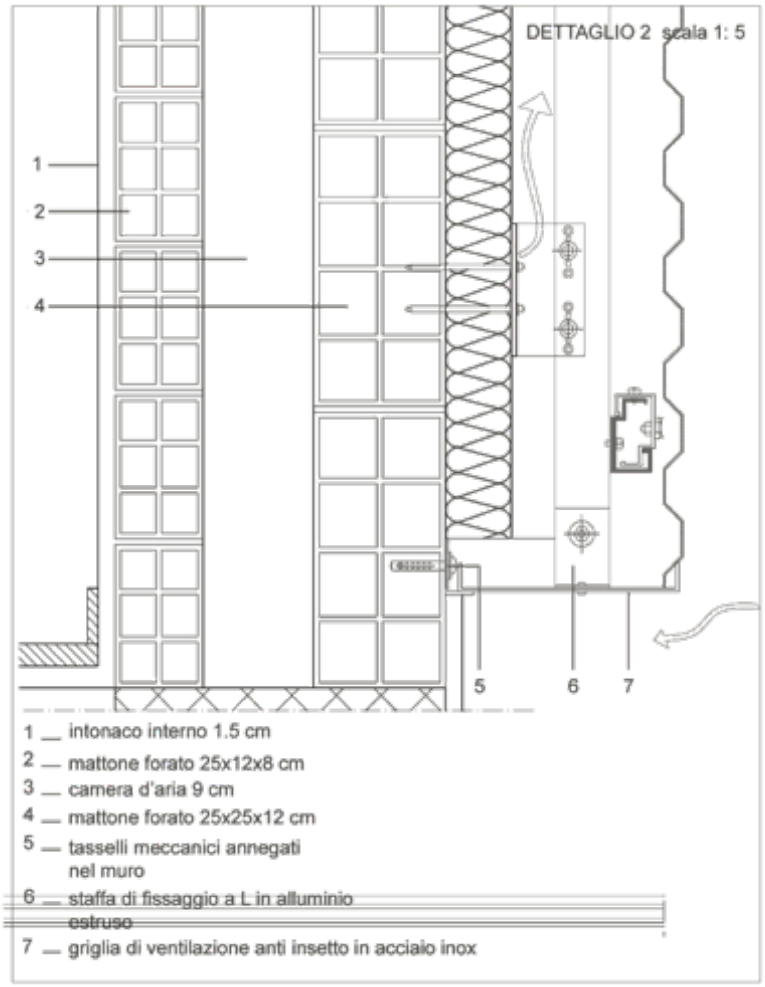




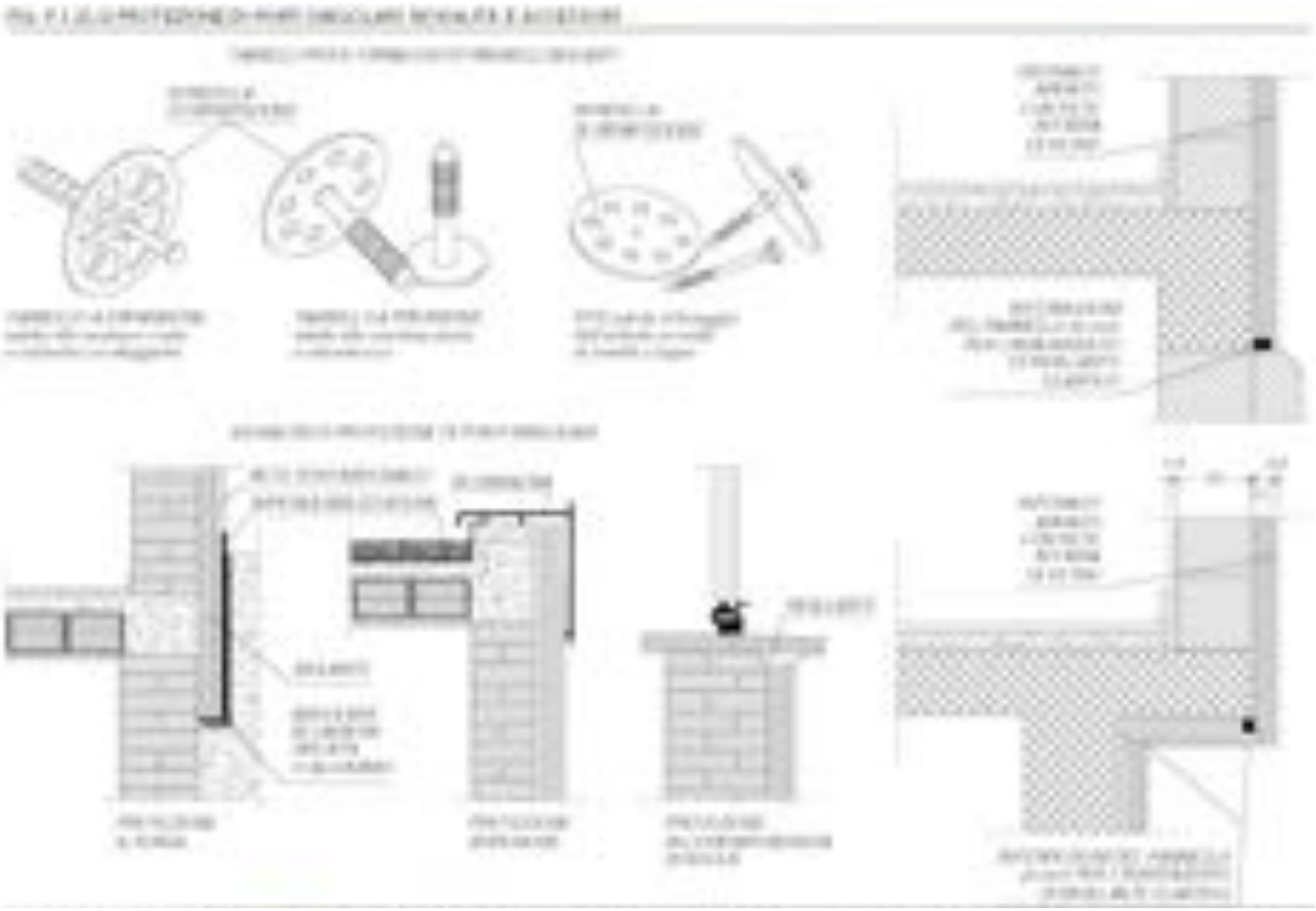
Daimler- Benz, Renzo Piano, Berlino

VC insulation with ventilated facade



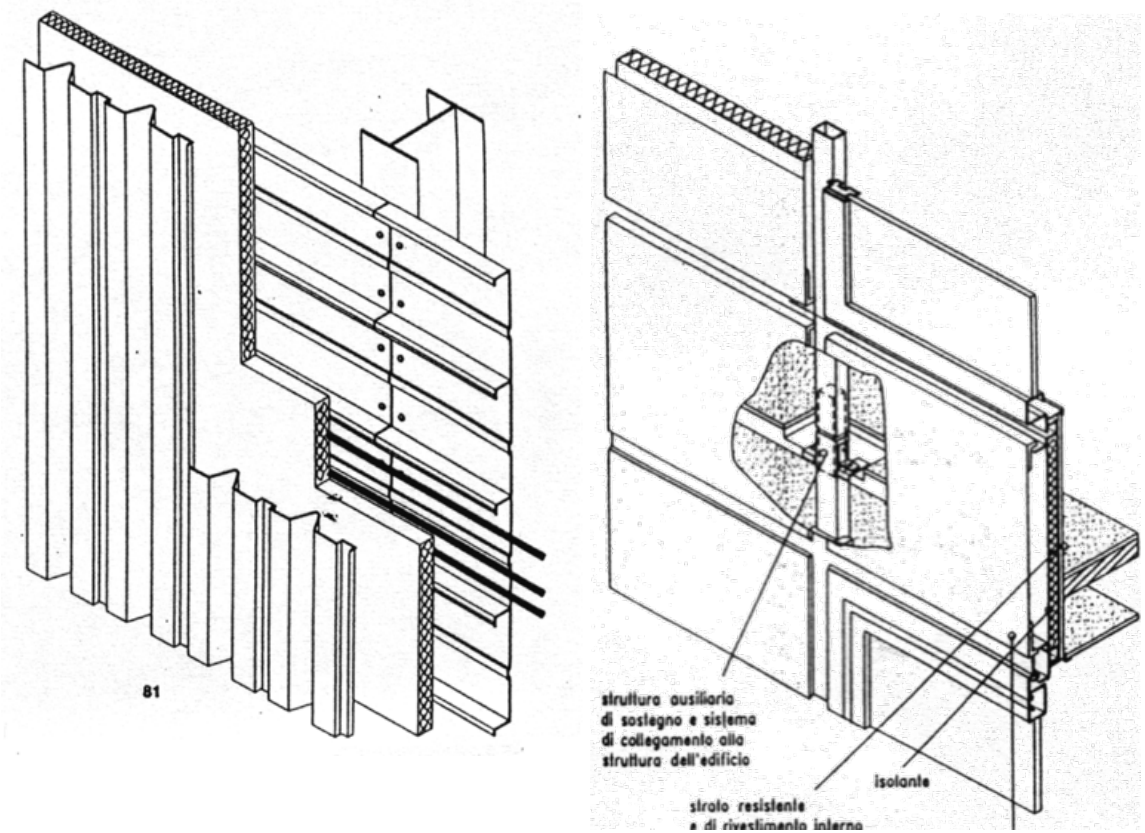


VC coat insulation



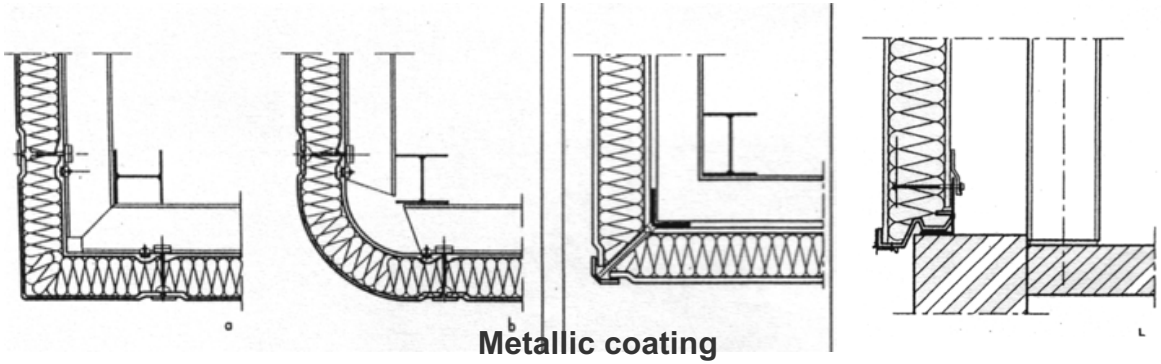
disegni tecnici da: *il Nuovissimo Manuale dell'Architetto,* Mancosu editore, pag.F79

CV composed by metallic elements and coating panel

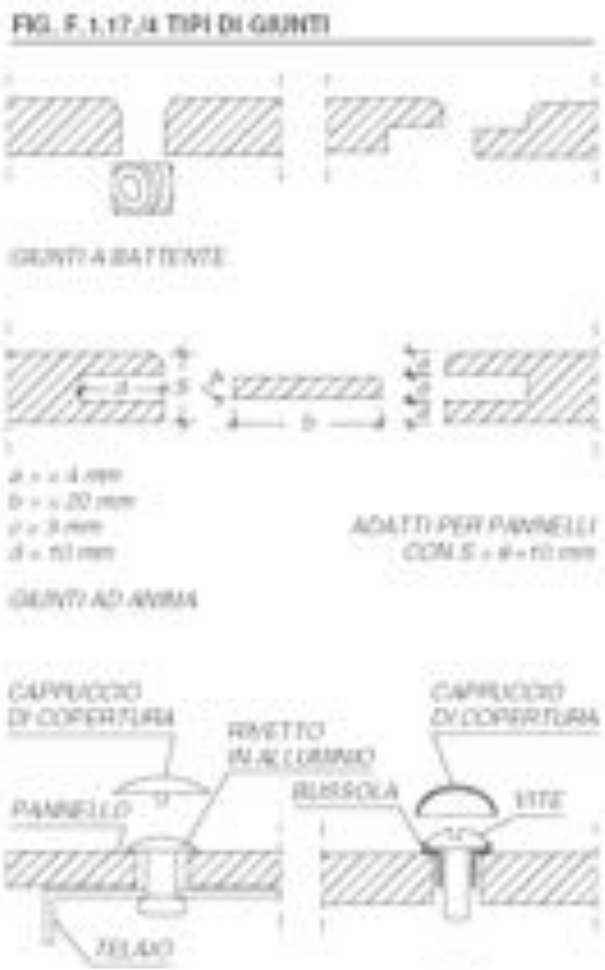


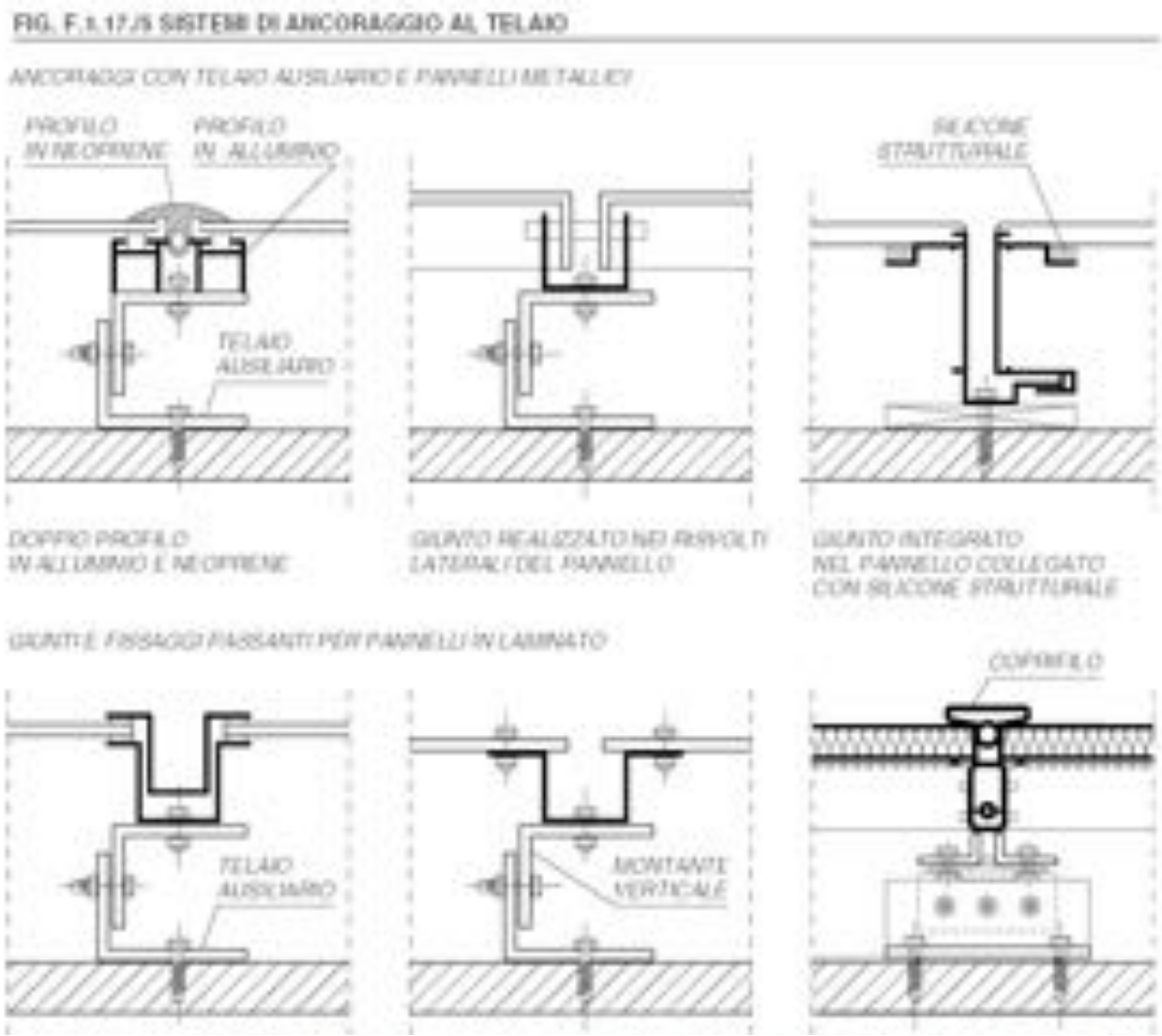

Brick coating


Plant wall


Metallic coating

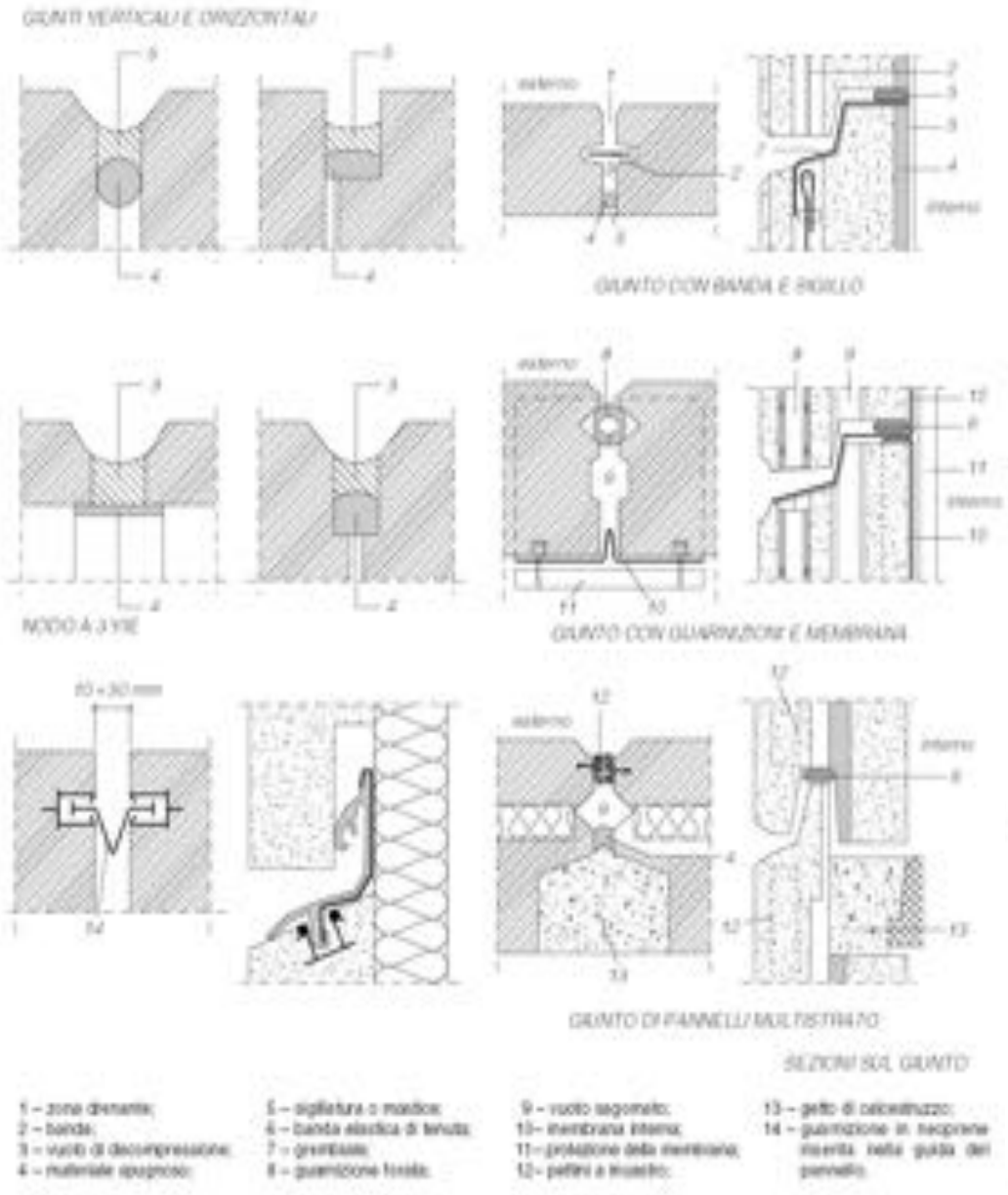
VC composed by lightweight panel

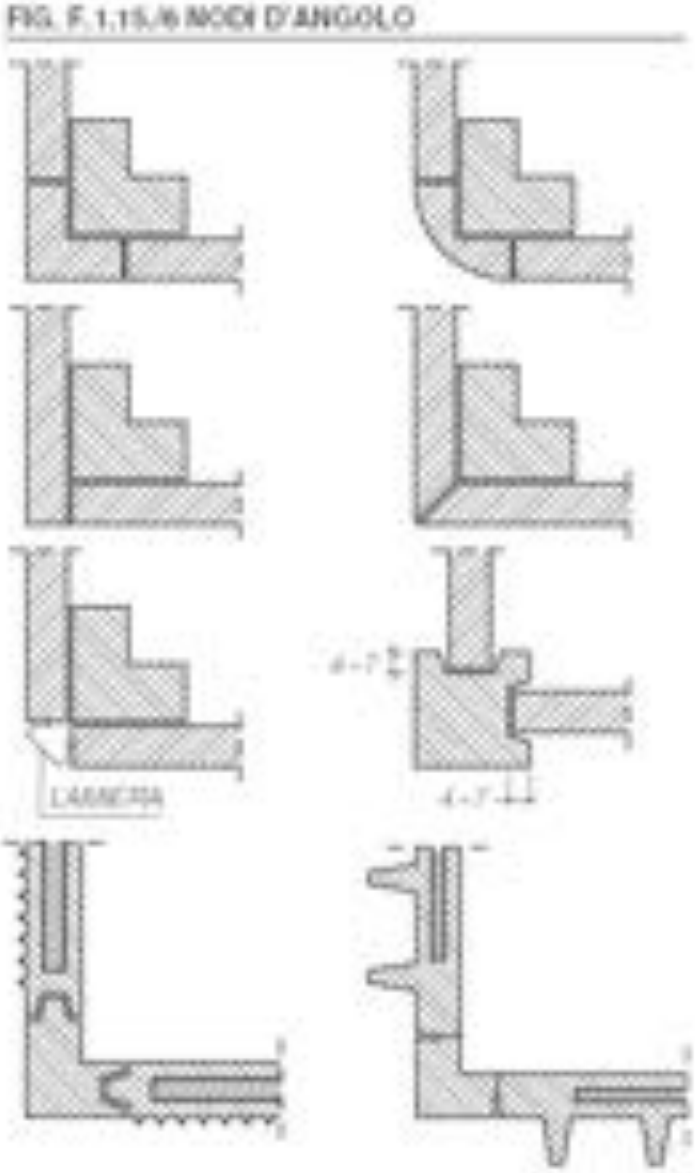




disegni tecnici da: *il Nuovissimo Manuale dell'Architetto,* Mancosu editore, pag.F54

VC composed by concrete panel





disegni tecnici da: *il Nuovissimo Manuale dell'Architetto,* Mancosu editore, pag.F49

Vertical closing

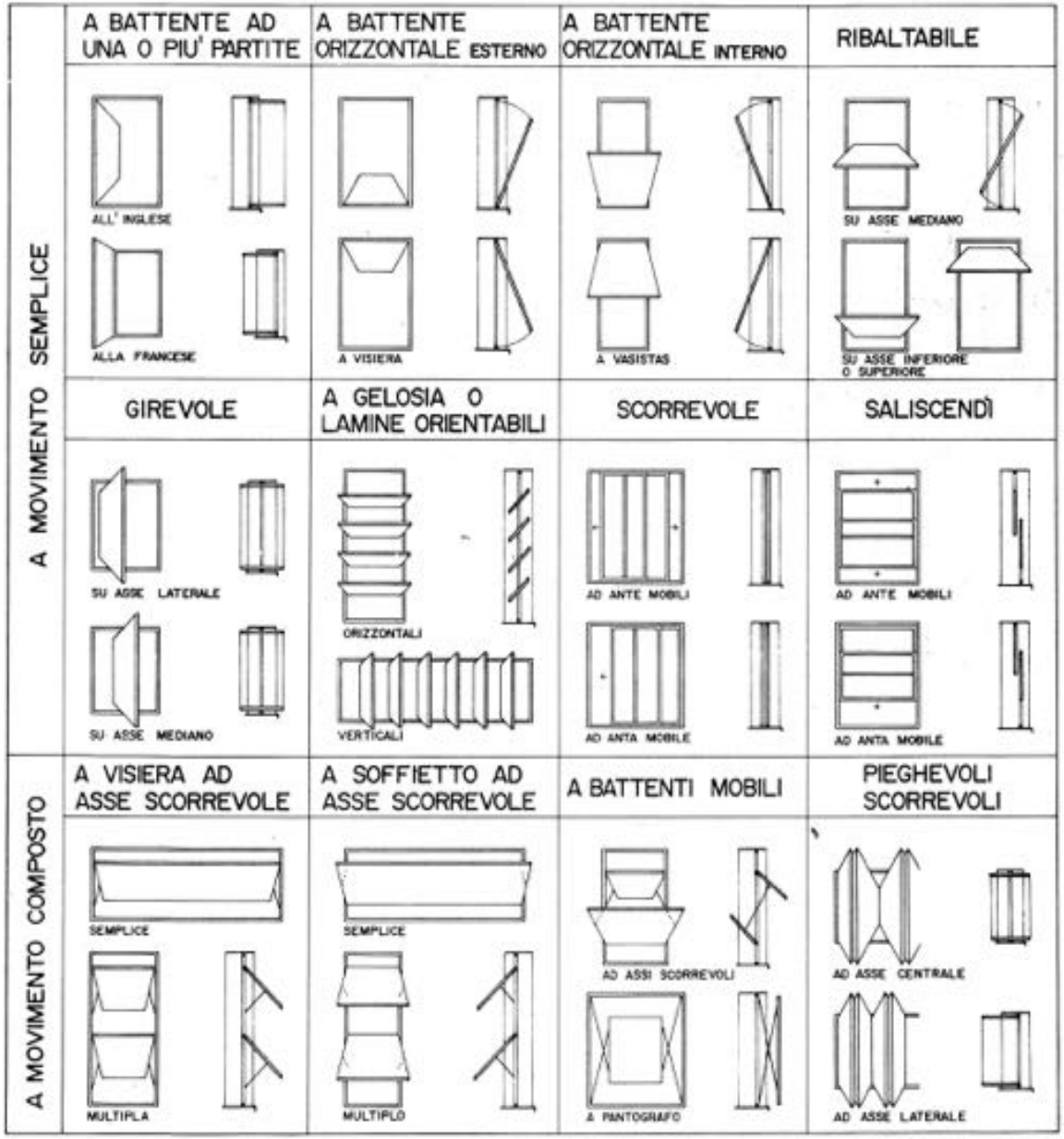
External vertical window frames

- **types of opening**: *not openable, with vertical or horizontal swing, with vertical or horizontal balance, sliding, up and down, with fan, semi-fixed.*

- **types of shading devices**: *external or internal swing shutter, external or internal folding shutter, external or internal sliding shutter, external or internal embedded sliding shutter, roller shutter.*

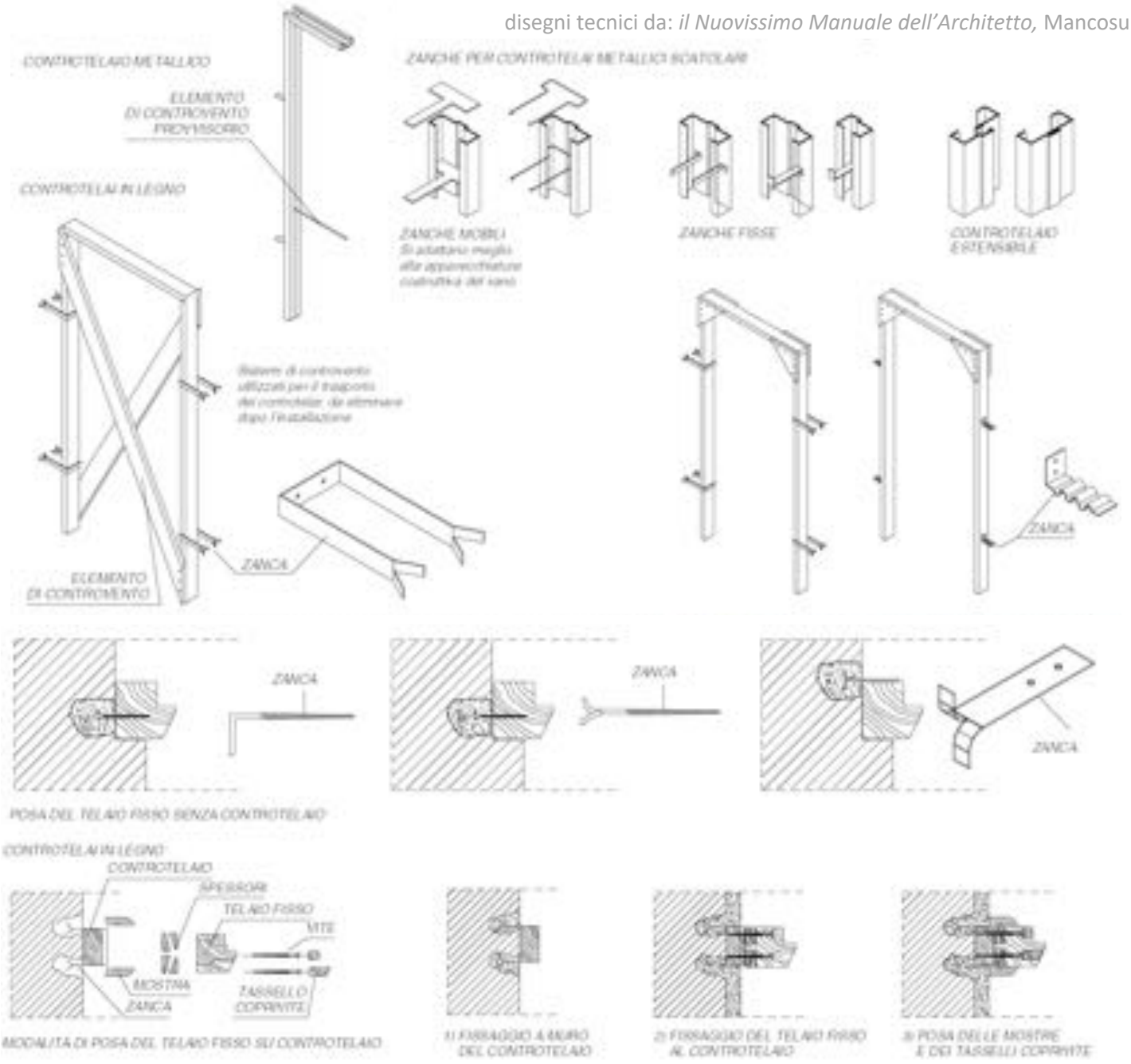
- **production systems**: *traditional frames, block frames.*

- **materials**: *wood, hot-rolled steel sections, cold-bent steel sections, aluminium, plastics.*



VC: external vertical frames - counterframes

disegni tecnici da: *il Nuovissimo Manuale dell'Architetto,* Mancosu editore, pag.F97



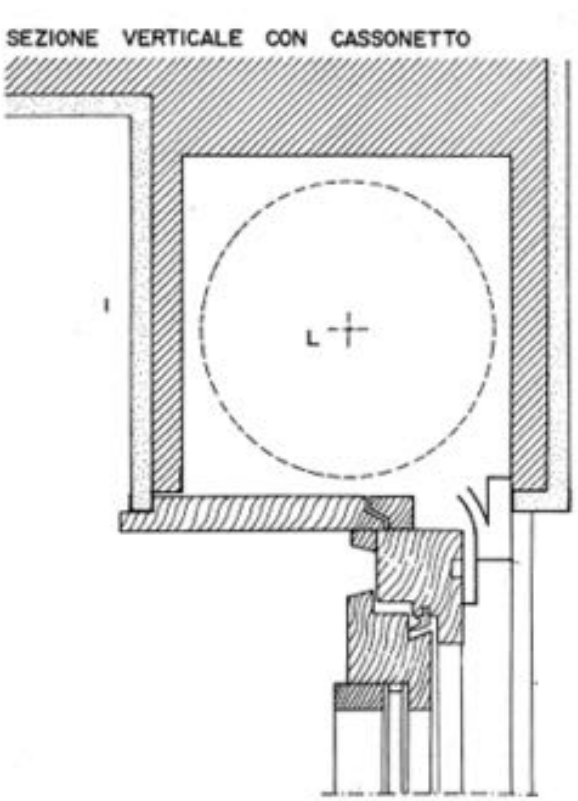
VC: wooden windows

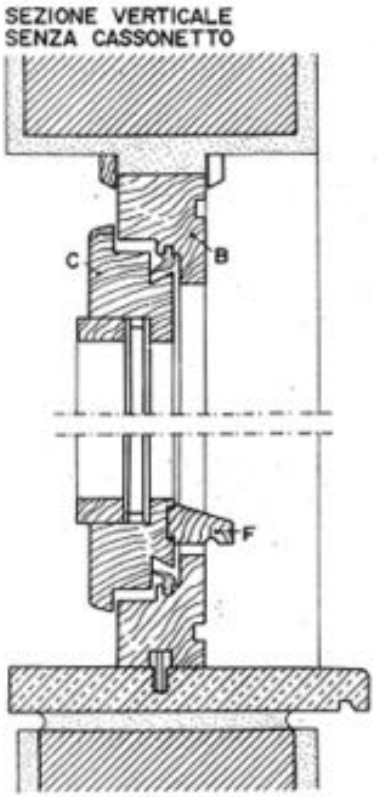
Main advantages:

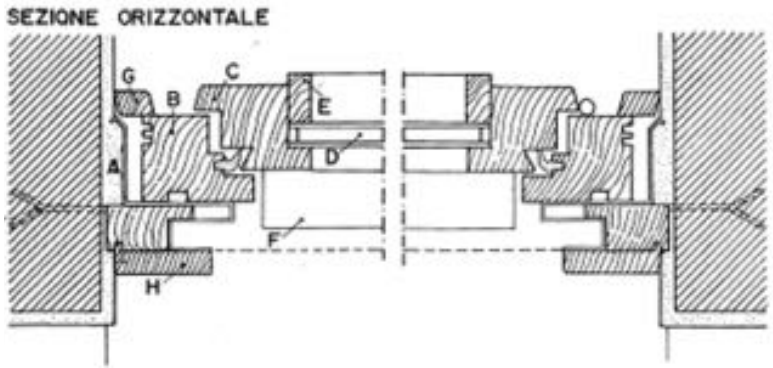
- pleasantness of the surface appearance
- lightness
- good mechanical resistance
- good thermal insulation

Main disadvantages:

- deformability
- ignitability
- difficulty in obtaining a satisfying seal
- frequency of maintenance operations

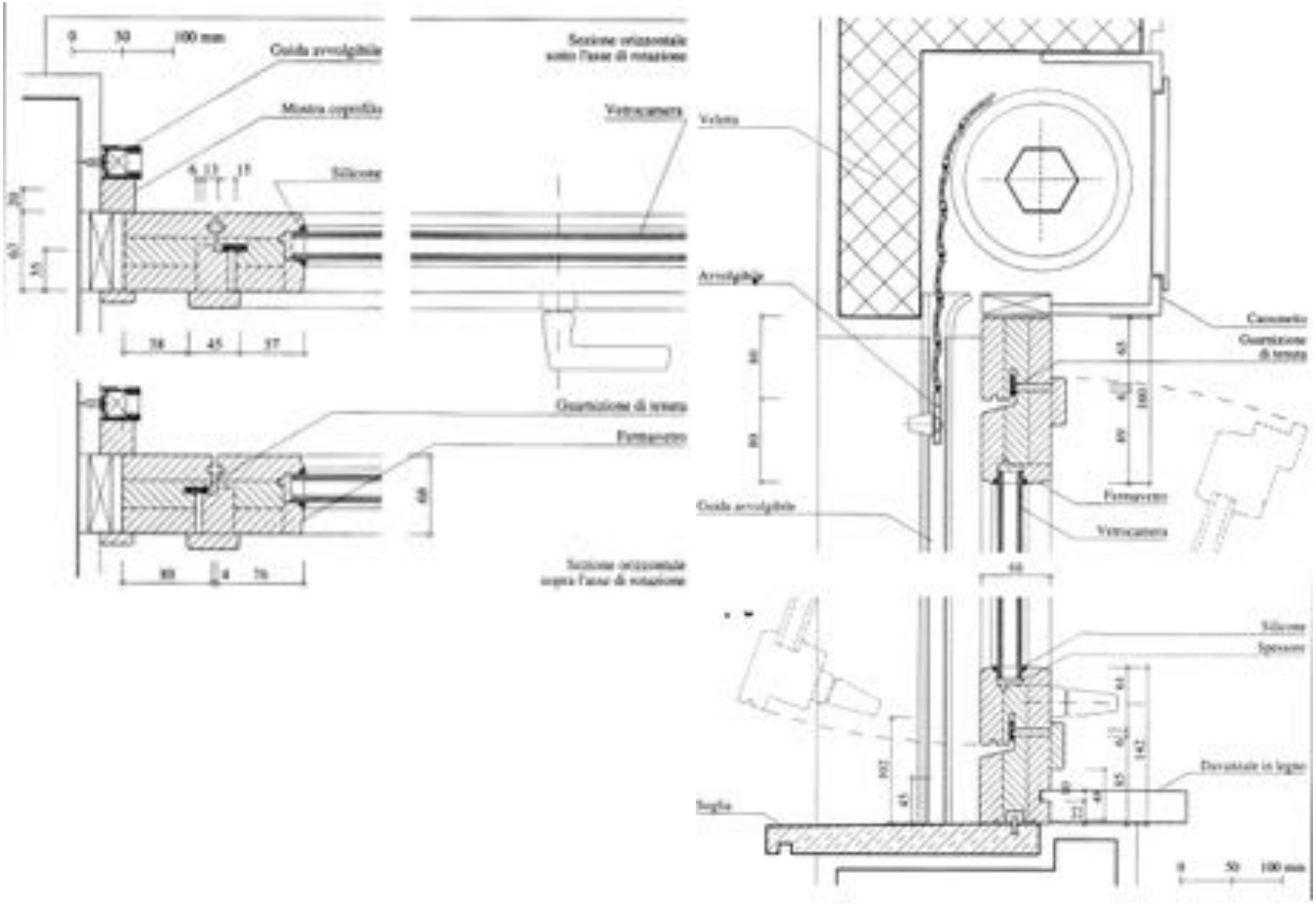






A CONTROTELAIO A MURARE CON GUIDA
B CONTROTELAIO FISSO
C TELAIO MOBILE
D VETRO CAMERA
E CORNICE FERMAVETRO
F GOCCIOLATOIO
G MOSTRE INTERNE
H MOSTRE ESTERNE
I CASSONETTO
L RULLO AVVOLGITORE

VC: glulam frames



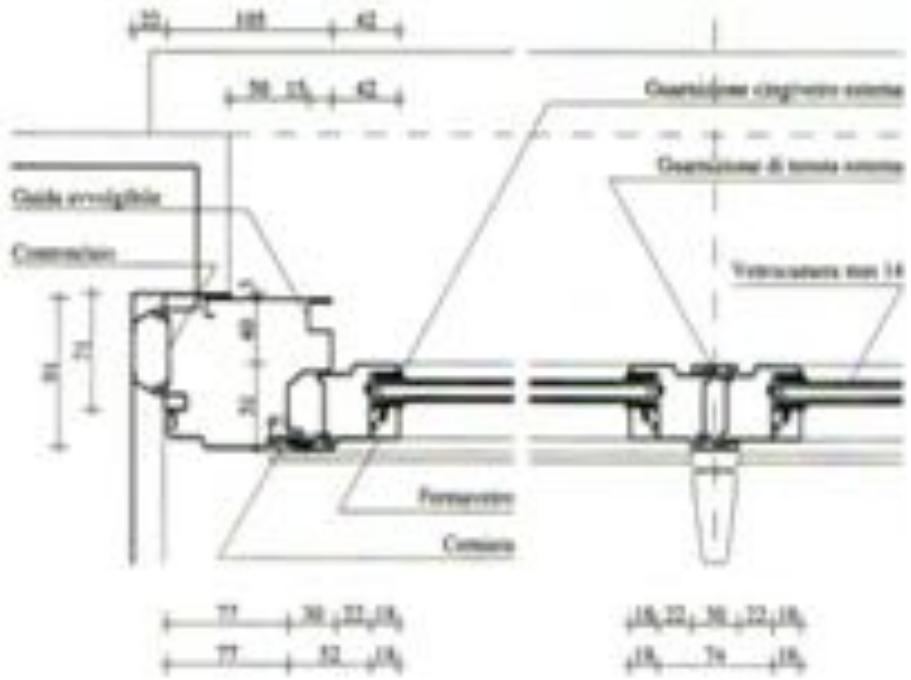
VC: steel frames

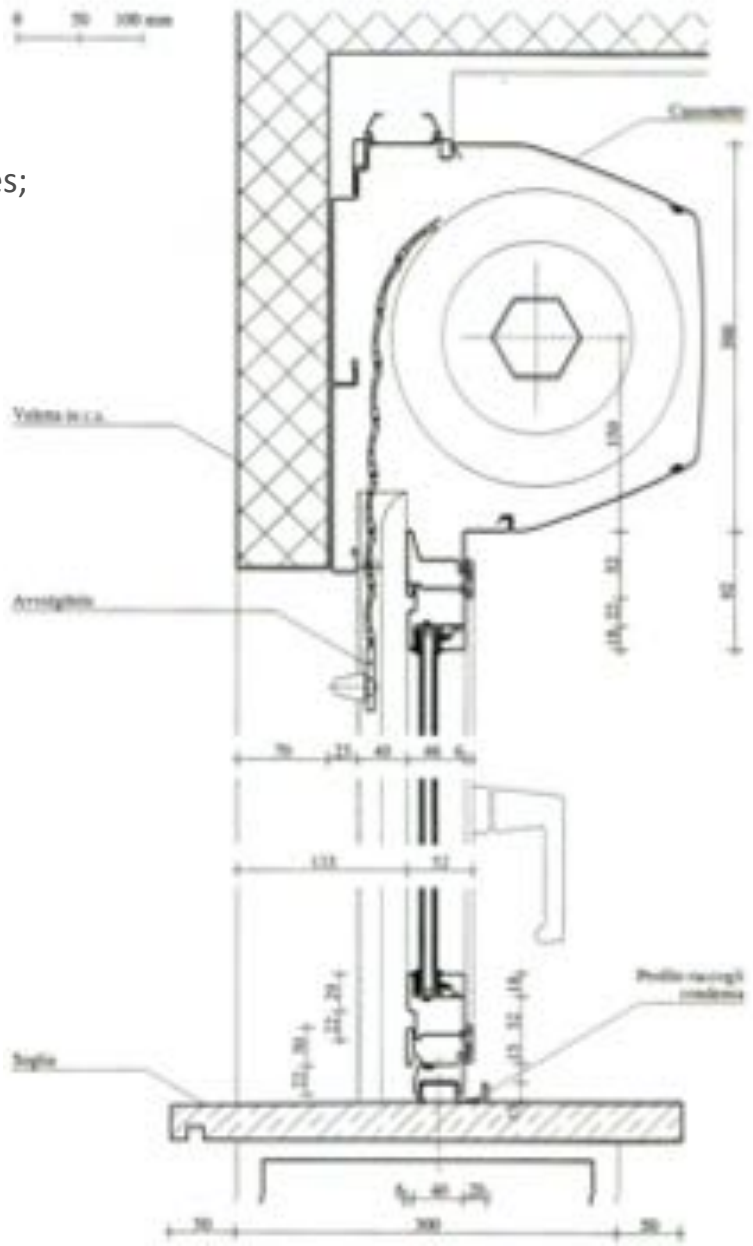
Main advantages:

- indeformability;
- good seal with sealings;
- affordability.

Main disvantages:

- oxidability;
- condensation inside the profiles;
- coldness to the touch.





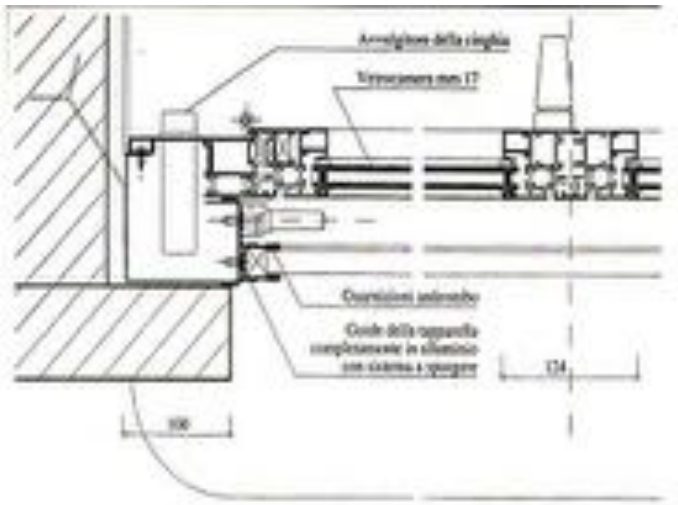
VC: steel frames

Main advantages:

- stainlessness;
- use of "thermal break" profiles (elimination of the thermal bridge);
- mechanical resistance;
- indeformability over time;
- lightweights;
- minimum maintenance requirements.

Main disvantages:

- cold feeling to the touch;
- risk of condensation in the profile;
- limited repairability of the profile (detachment of the varnish).



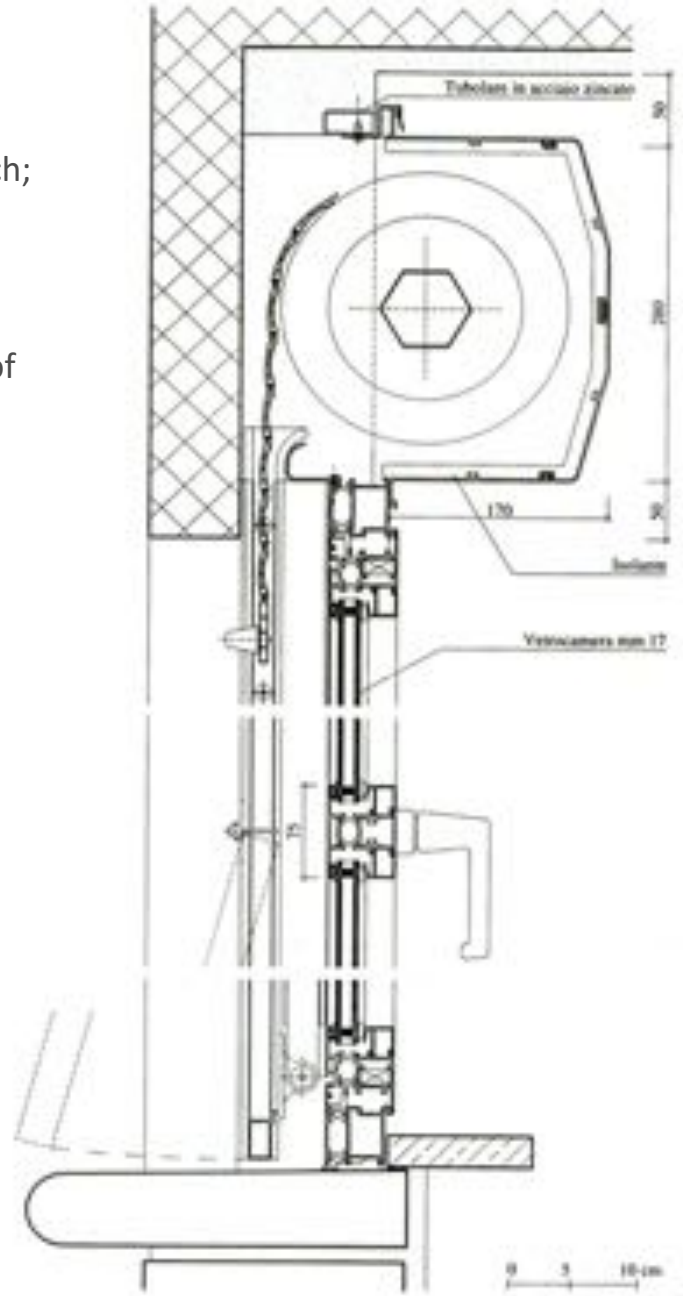
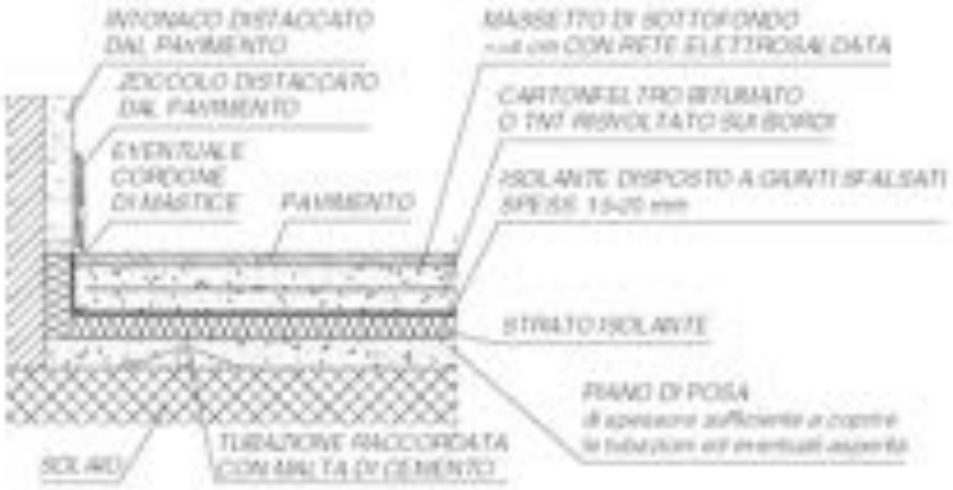
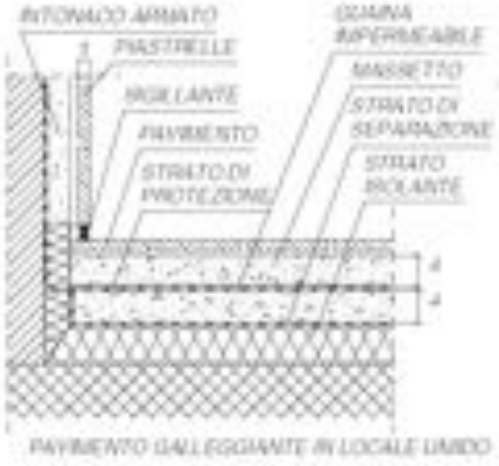


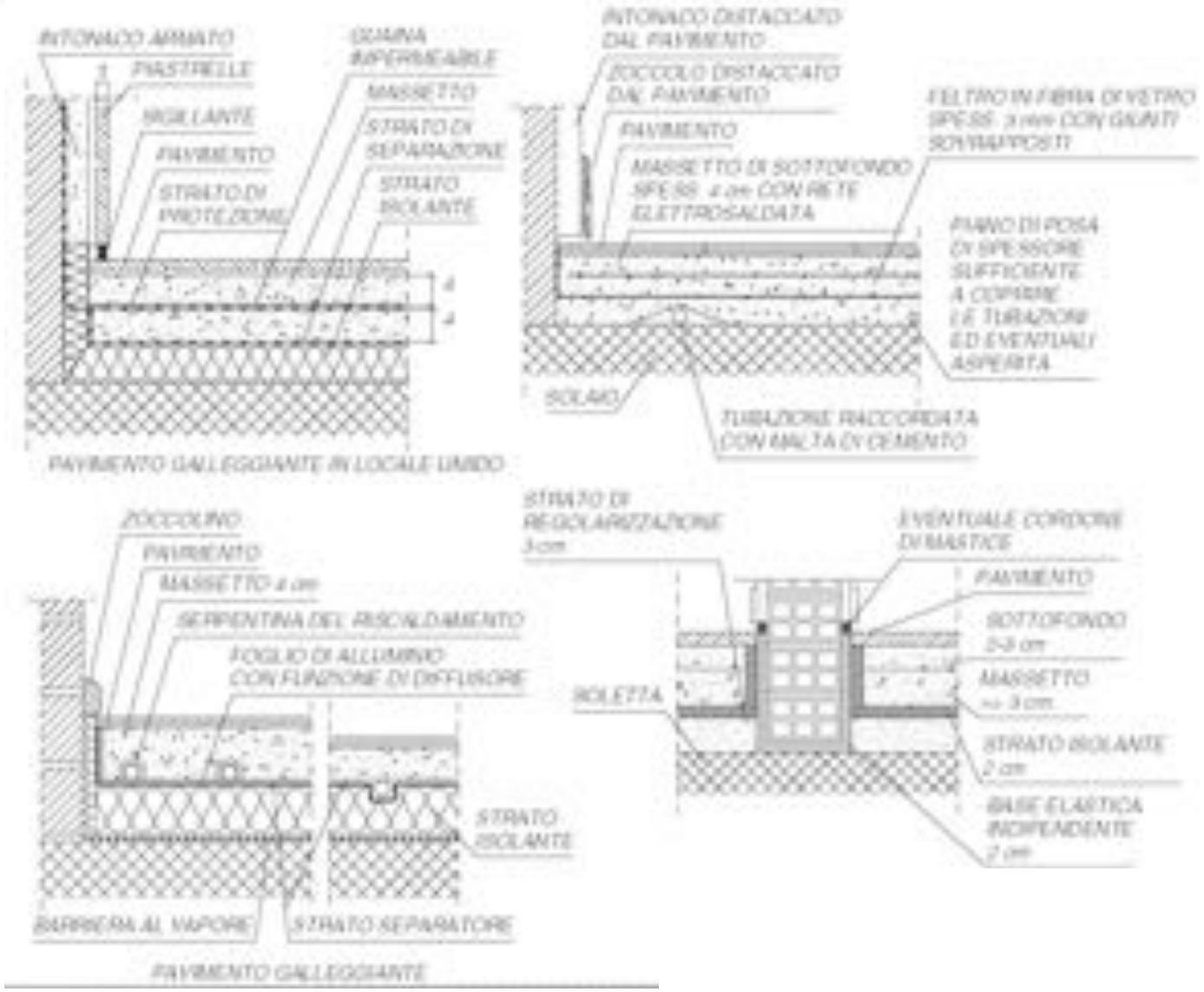
FIG. F.2.3./5 PAVIMENTO GALLEGGIANTE DETTAGLI COSTRUTTIVI





disegni tecnici da: *il Nuovissimo Manuale dell'Architetto,* Mancosu editore, pag.F149

FIG. F.2.3./5 PAVIMENTO GALLEGGIANTE DETTAGLI COSTRUTTIVI



disegni tecnici da: *il Nuovissimo Manuale dell'Architetto,* Mancosu editore, pag.F149

Upper closings

Shape of the roofs:

The inclination of the surfaces of the roof (slope), expressed in degrees or in %, may vary according to the climatic characteristics of the site and the nature of the elements that constitute the roof covering.

- **Flat roof** up to 5% of inclination
- **Sloped roof** more than 5% of inclination (between 24% and 45%)

FIG. F 2.6/2 DENOMINAZIONE DELLE PARTI COSTITUENTI IL TETTO

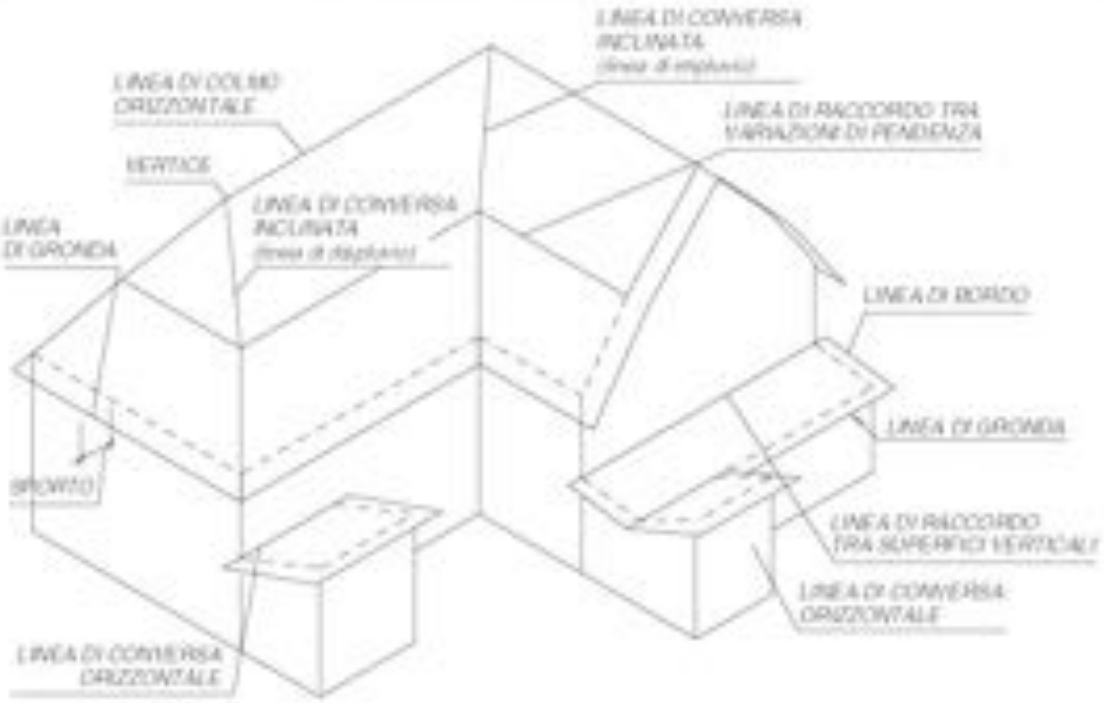
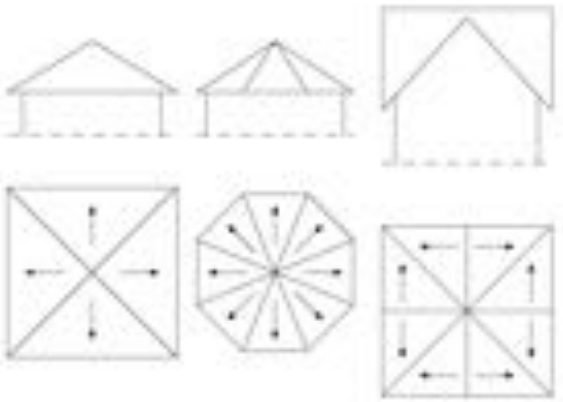
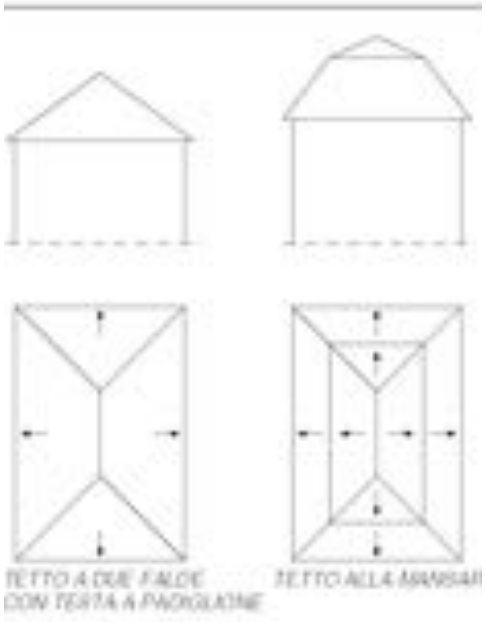


FIG. F 2.6/3 TIPI DI COPERTURE DISCONTINUE





Upper closings

The combination of the layers that constitute the roof can have different degrees of complexity and differentiation, in relation to the:

Functions, among the others:

- Accessible roofs only for maintenance;
- Accessible roofs for pedestrians;
- Accessible roofs also for vehicles;
- Roof gardens.

Typologies, among the main ones:

- Continuous not insulated roofs;
- Continuous isolasted roofs;
- Insulated inverted roofs;
- Insulated ventilated roofs.

Plane roofs

FIG. F.2.5./2 COPERTURA ISOLATA E VENTILATA

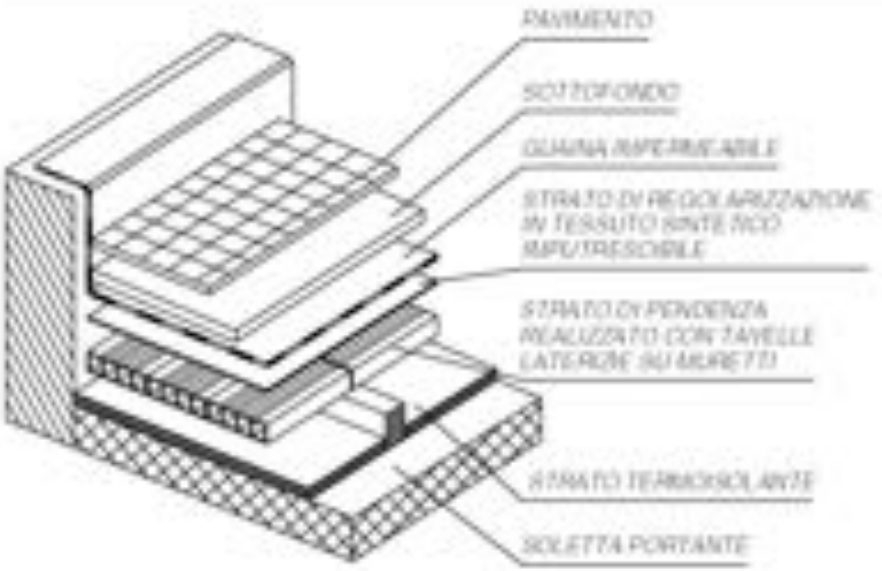
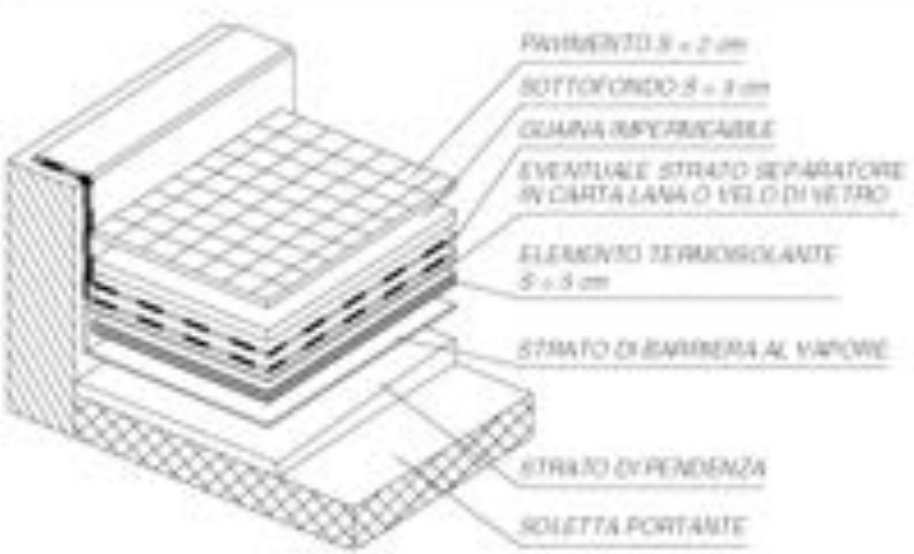
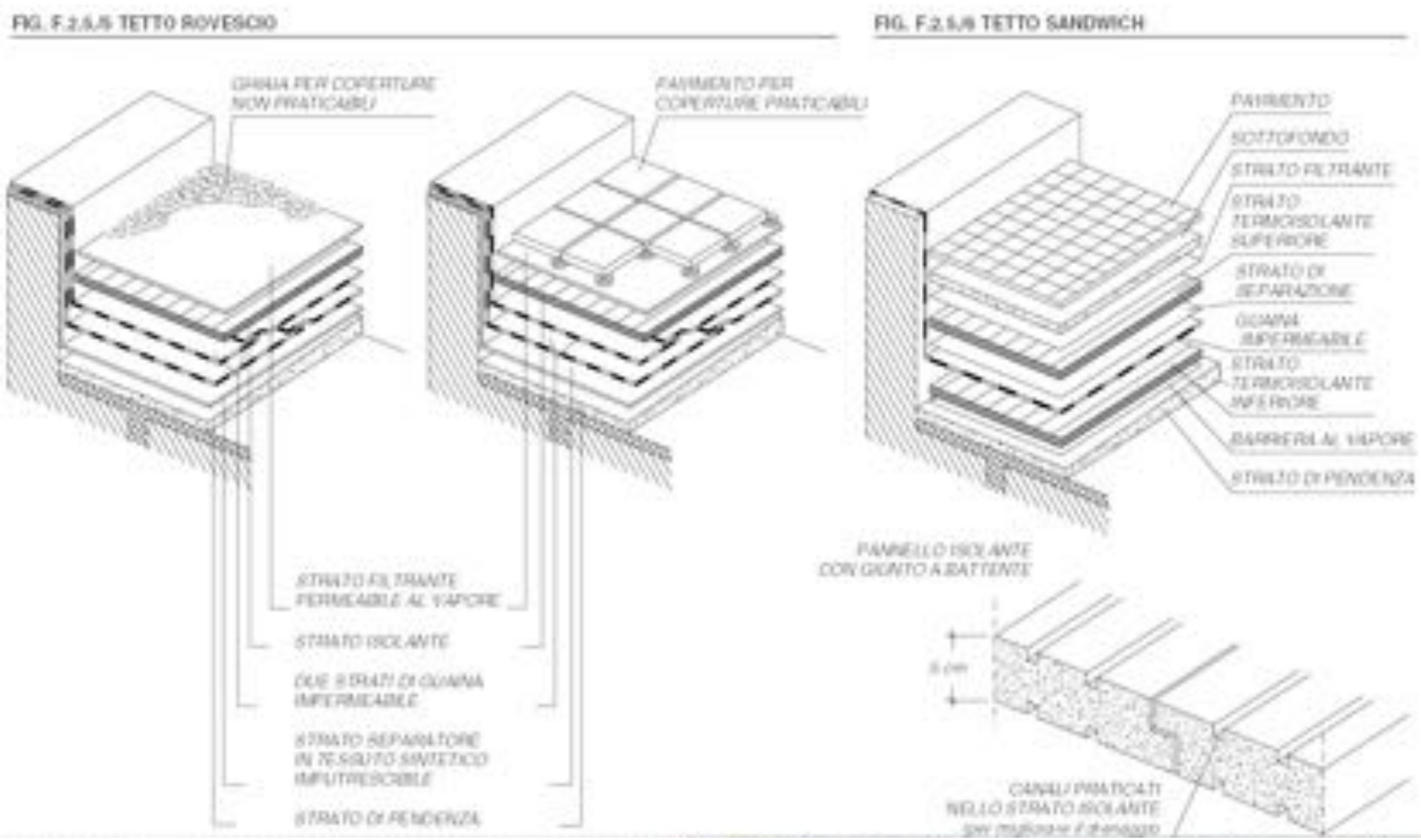


FIG. F.2.5./3 COPERTURA ISOLATA NON VENTILATA DEL TIPO "TETTO CALDO"



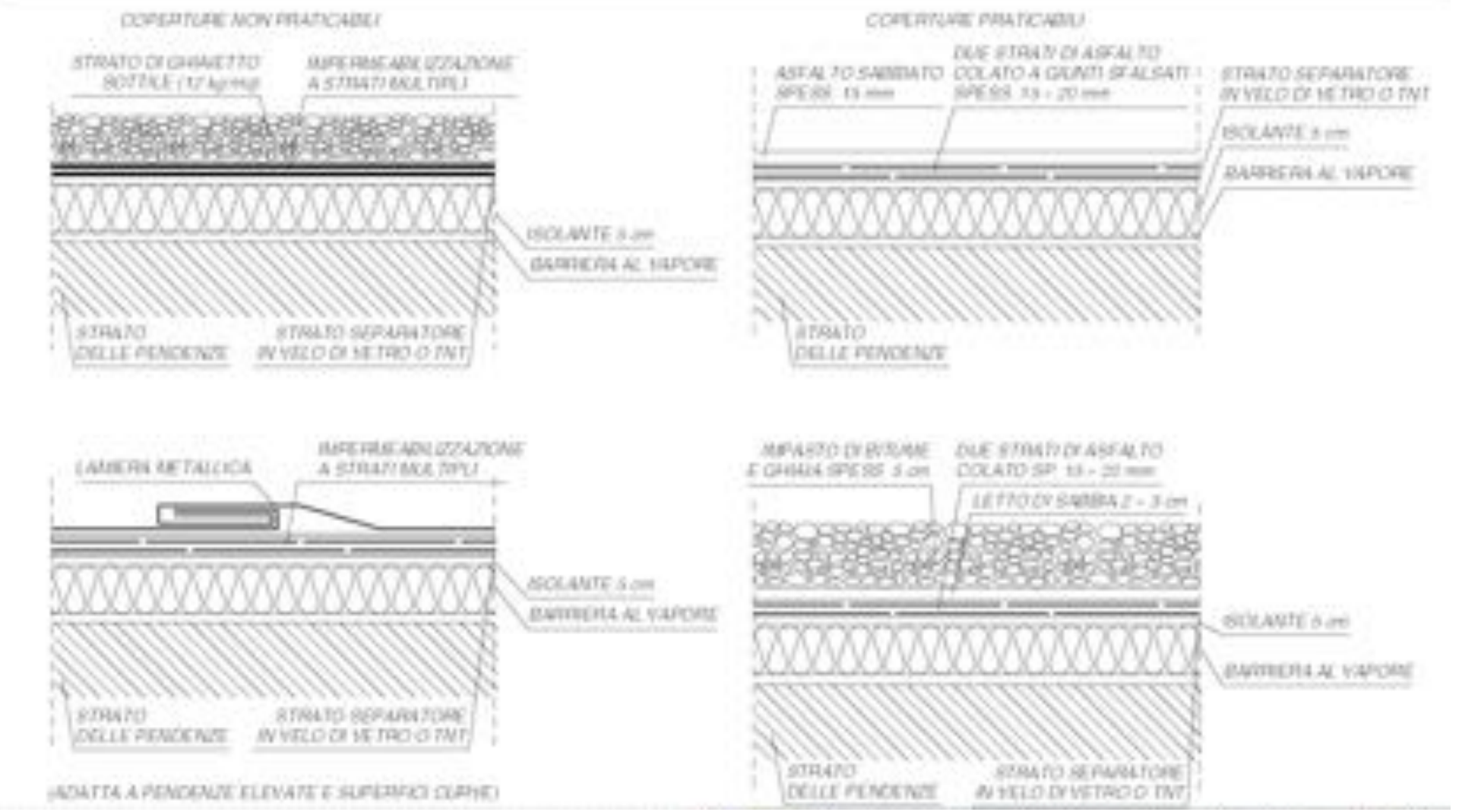
disegni tecnici da: *il Nuovissimo Manuale dell'Architetto,* Mancosu editore, pag.F155

Plan roofs



disegni tecnici da: *il Nuovissimo Manuale dell'Architetto,* Mancosu editore, pag.F156

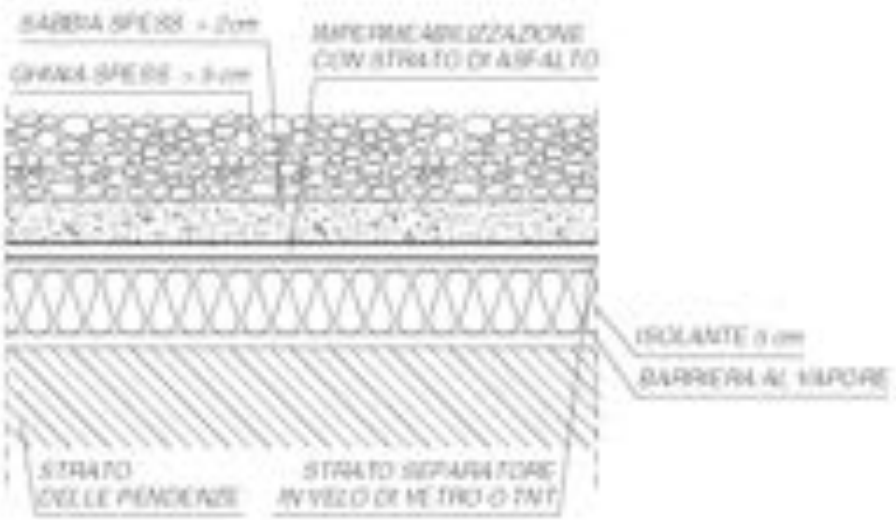
Plan roofs

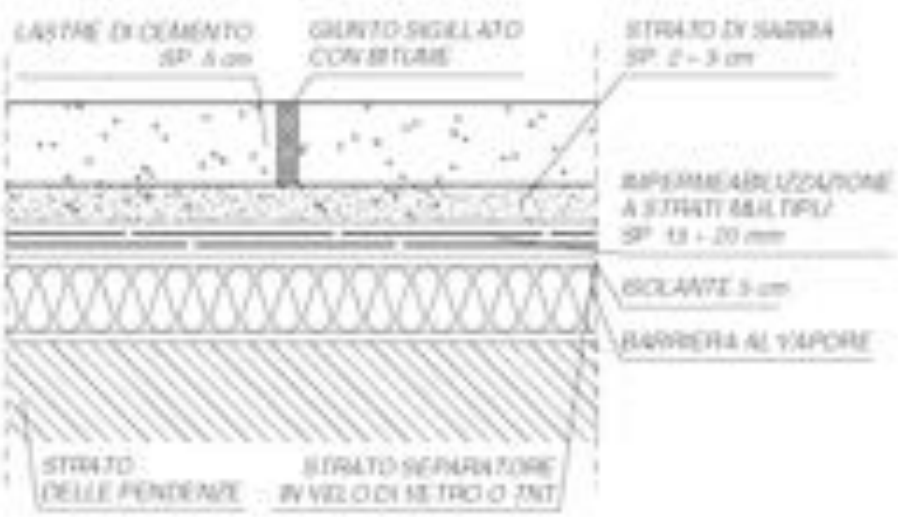


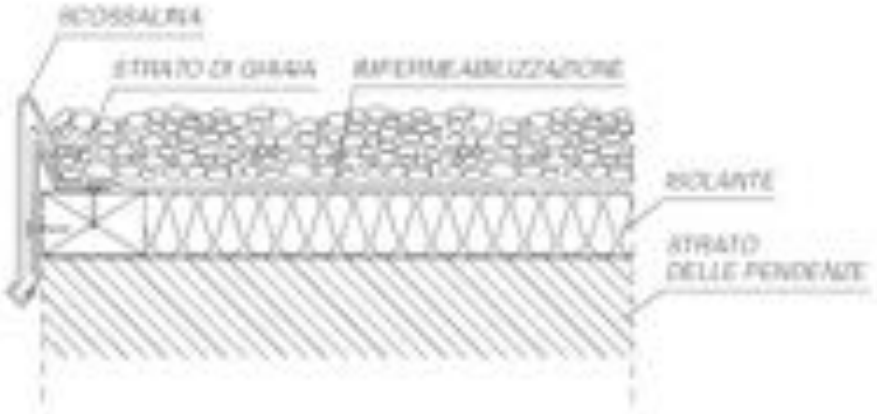
disegni tecnici da: *il Nuovissimo Manuale dell'Architetto,* Mancosu editore, pag.F158

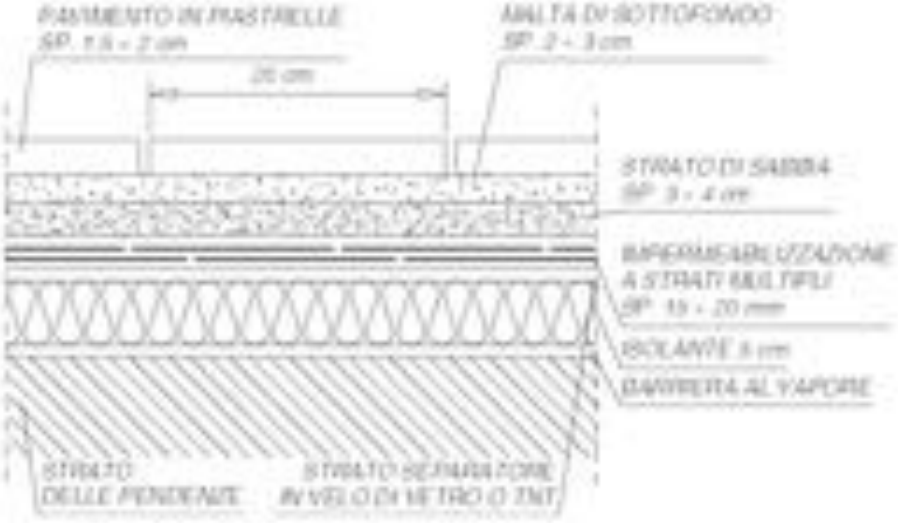
Plan roofs

FIG. F.2.5/13 COPERTURE PRATICABILI E NON PRATICABILI

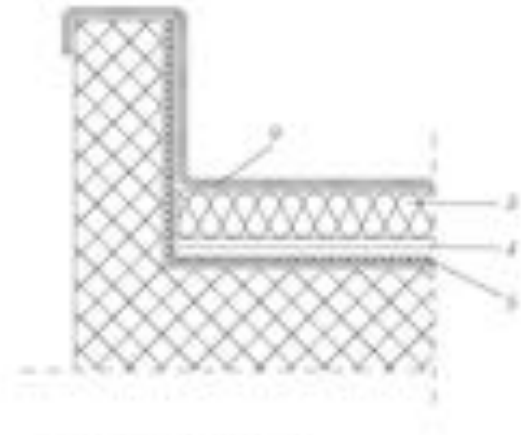


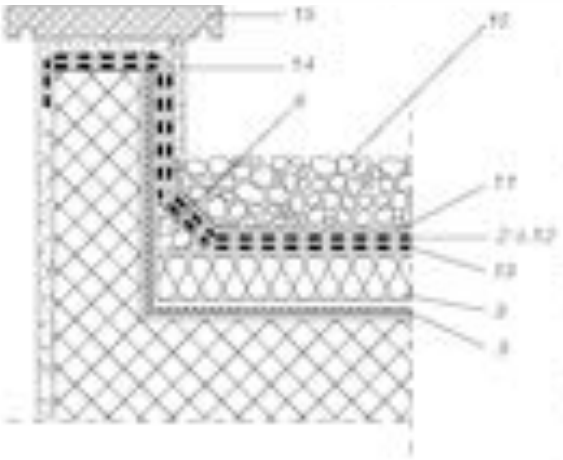




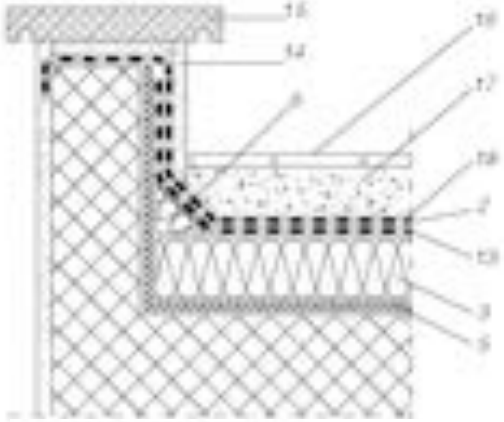


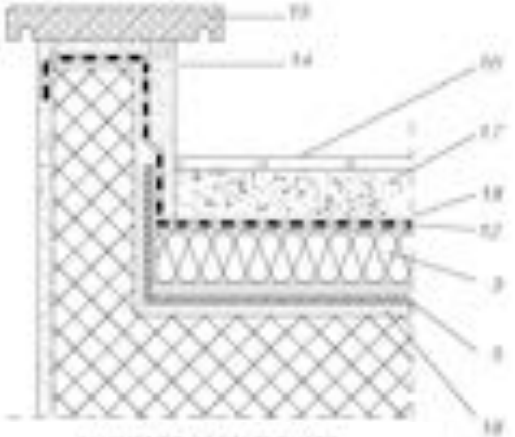
disegni tecnici da: *il Nuovissimo Manuale dell'Architetto,* Mancosu editore, pag.F158



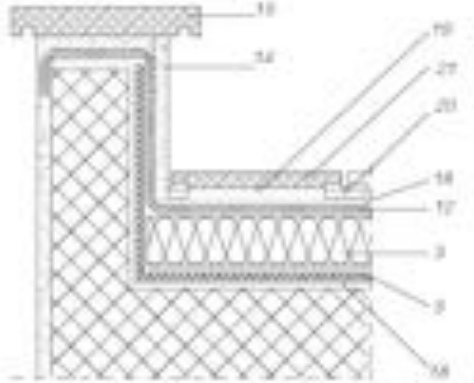


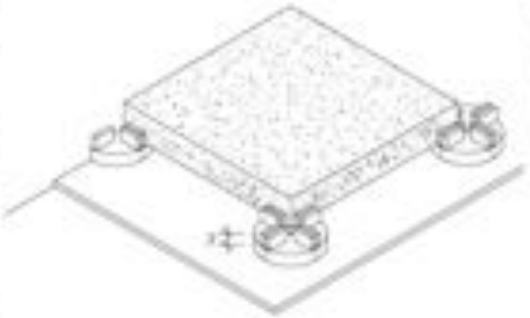
COPERTURE PRATICABILI





PAVIMENTO SOPRAELEVATO
IN QUADROTTI DI CALCESTRUZZO





1 MEMBRANA BITUMINOSA ARDESIATA AUTOPROTETTA
incollata per rinvenimento a fiamma
S= = 3,5 kg/mq

2 MEMBRANA BITUMINOSA ARDESIATA AUTOPROTETTA
incollata per rinvenimento a fiamma
S= = 4 mm - P = 4kg/mq

3 STRATO ISOLANTE S = 5 cm

4 SPALMATURA DI BITUME A CALDO
per il fissaggio dell'isolante

5 BARRIERA AL VAPORE REALIZZATA
CON MEMBRANA BITUMINOSA
rinvenuta a fiamma

6 ELEMENTO DI RACCORDO TRA I PIANI

7 MEMBRANA BITUMINOSA ARDESIATA AUTOPROTETTA
incollata per rinvenimento a fiamma
S = = 4,5 kg/mq

8 VERNICE PROTETTIVA RIFLETTENTE

9 MEMBRANA SINTETICA ARMATA AUTOPROTETTA
incollata con adesivo o con fissaggio
meccanico

10 ZAVORRA IN GHIAIA S = circa 5 cm-P = 80 = 75 kg/mq

11 EVENTUALE STRATO DI PROTEZIONE IN TNT
POLIESTERE - P = 300 gr/mq

12 MEMBRANA SINTETICA ARMATA

13 MEMBRANA BITUMINOSA
posata per rinvenimento
a fiamma o mastio asfaltico armato

14 INTONACO DI CEMENTO RETINATO

15 COPERTINA

16 PAVIMENTO S = 1,5-2 cm

17 MASSETTO DI SOTTOFONDO S = 3 cm

18 TNT IN POLIESTERE P = 300 g/mq

19 STRATO DI VENTILAZIONE

20 SOSTEGNI DEL PAVIMENTO

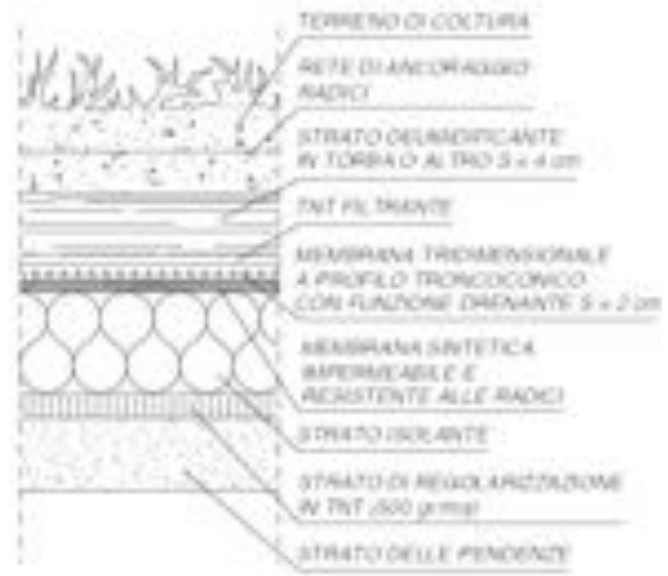
21 PAVIMENTO IN QUADROTTI DI CALCESTRUZZO

Roof garden

FIG. F.2.5./15 TETTO GIARDINO REALIZZATO CON IL SISTEMA DEL TETTO CALDO

FIG. F.2.5./16 TETTO GIARDINO REALIZZATO CON IL SISTEMA DEL TETTO ROVESCIO

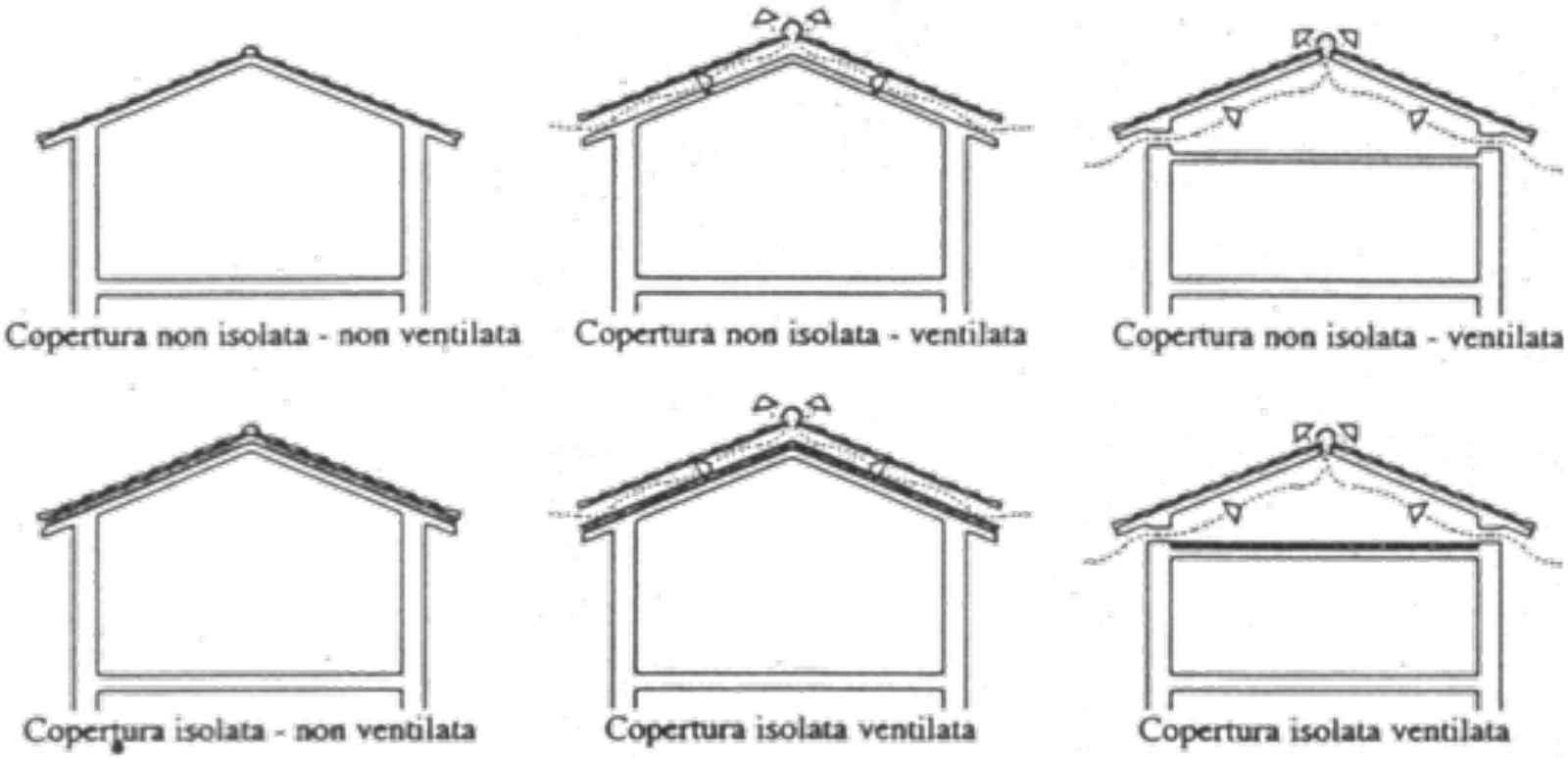
FIG. F.2.5./17 TETTO GIARDINO REALIZZATO CON L'IMPIEGO DI MEMBRANE TRIDIMENSIONALI



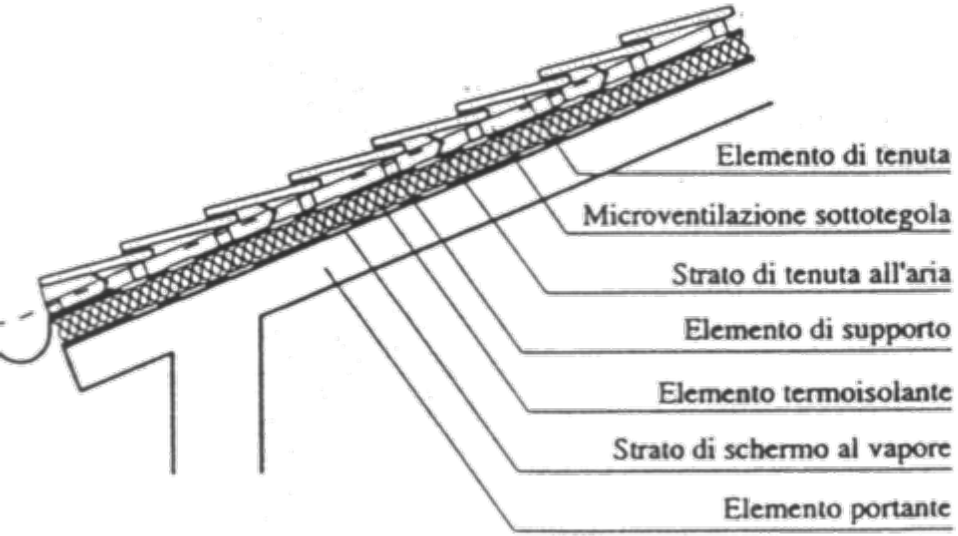
disegni tecnici da: *il Nuovissimo Manuale dell'Architetto,* Mancosu editore, pag.F160

Roofs in relation to **thermohygrometric performance**:

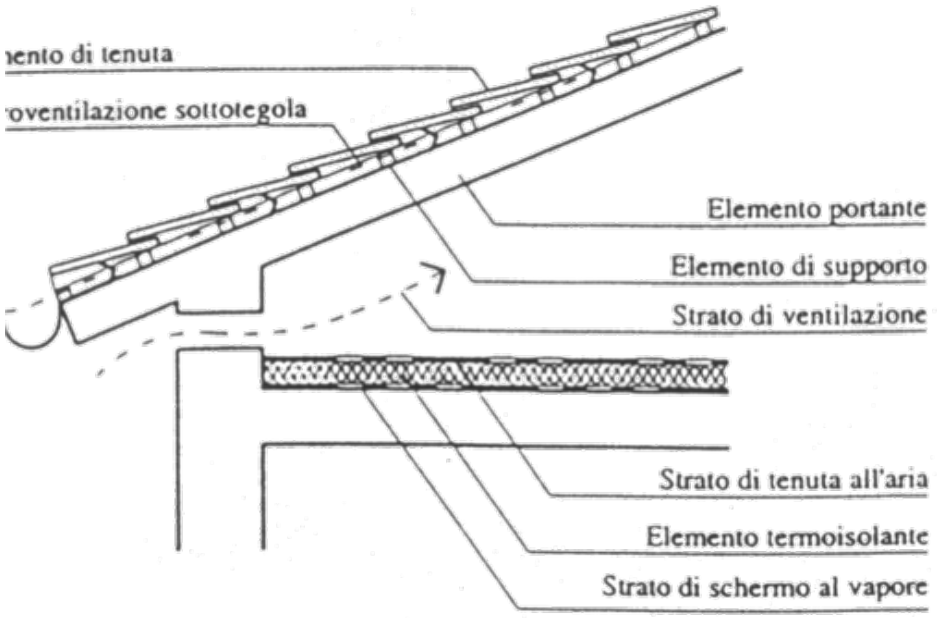
- Non-insulated, non-ventilated roof
- Non-insulated ventilated cover
- Non-ventilated insulated cover
- Ventilated insulated cover



Sloped roofs

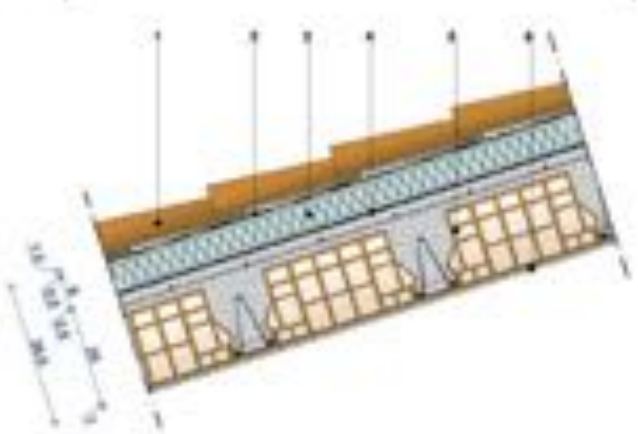


Insulated non-ventilated



Isolated ventilated

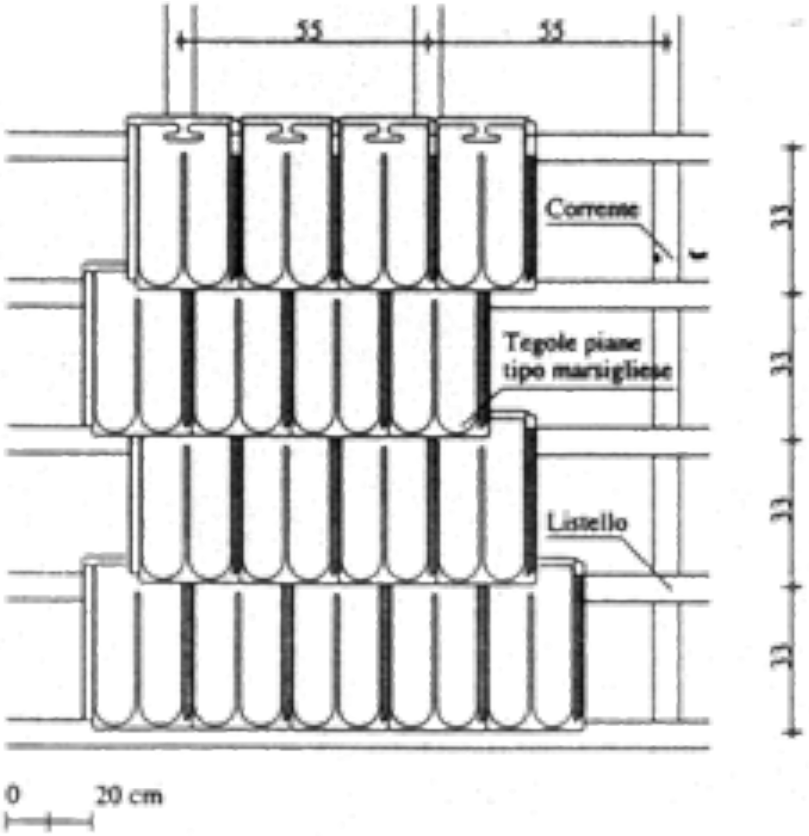
Sloped roof

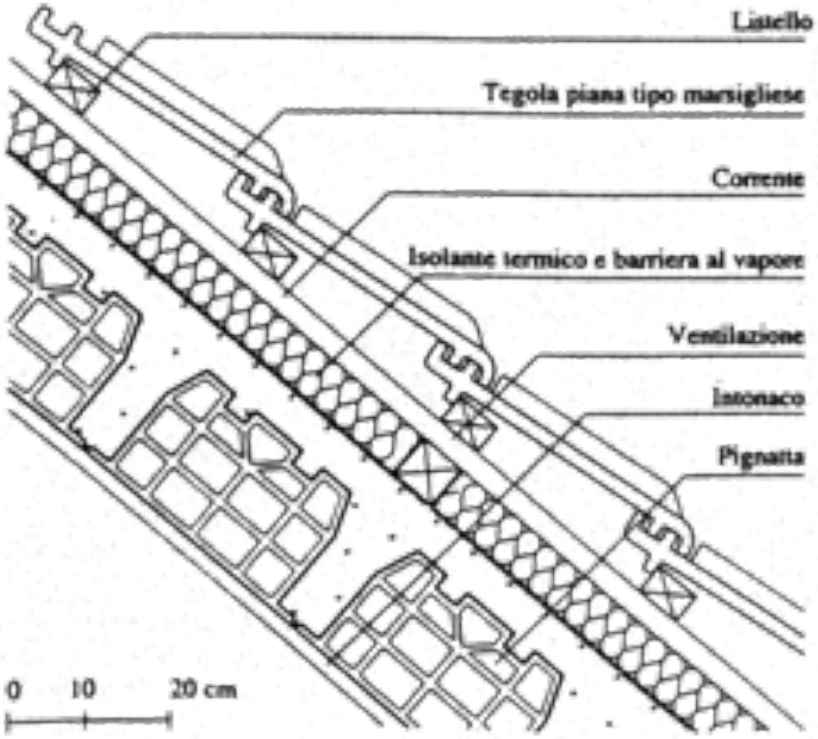


3g - Copertura isolata in laterizio su solaio in latero-cemento (misure in cm).
Legenda:
1. coppi e tegole
2. guaina impermeabilizzante
3. isolante termico
4. barriera al vapore
5. solaio in latero-cemento
6. intonaco interno

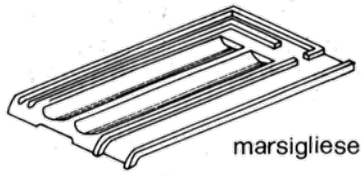
3h - Copertura isolata e ventilata in laterizio su solaio in latero-cemento (misure in cm).
Legenda:
1. coppi e tegole
2. strato di tenuta
3. pannello isolante preformato
4. solaio in latero-cemento
5. intonaco interno

Alcune tipologie costruttive considerate nello studio LCA

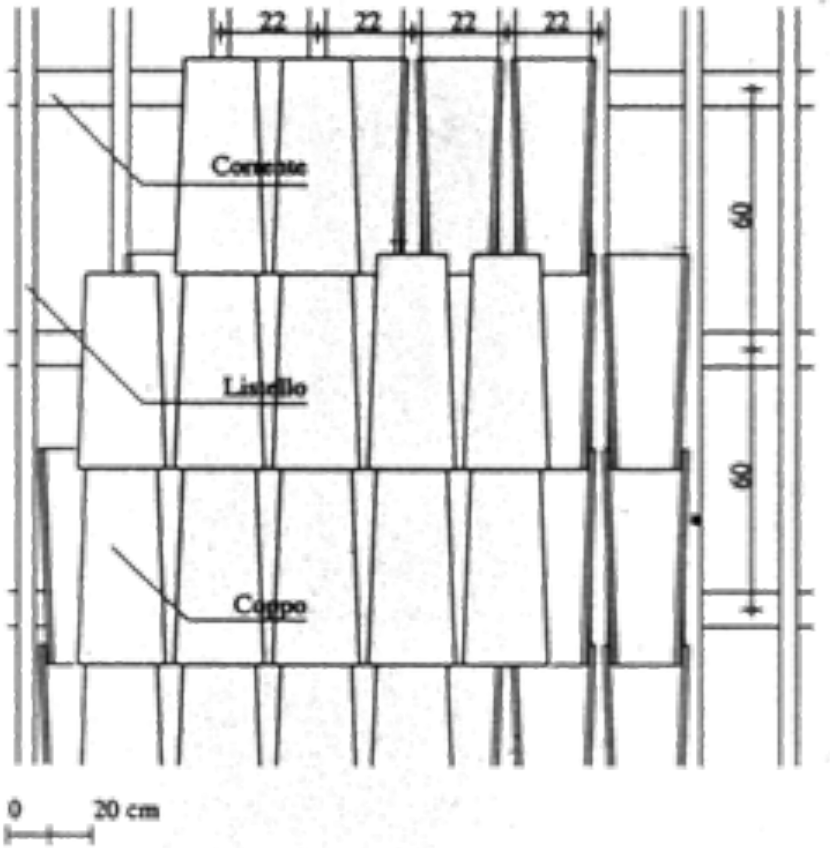


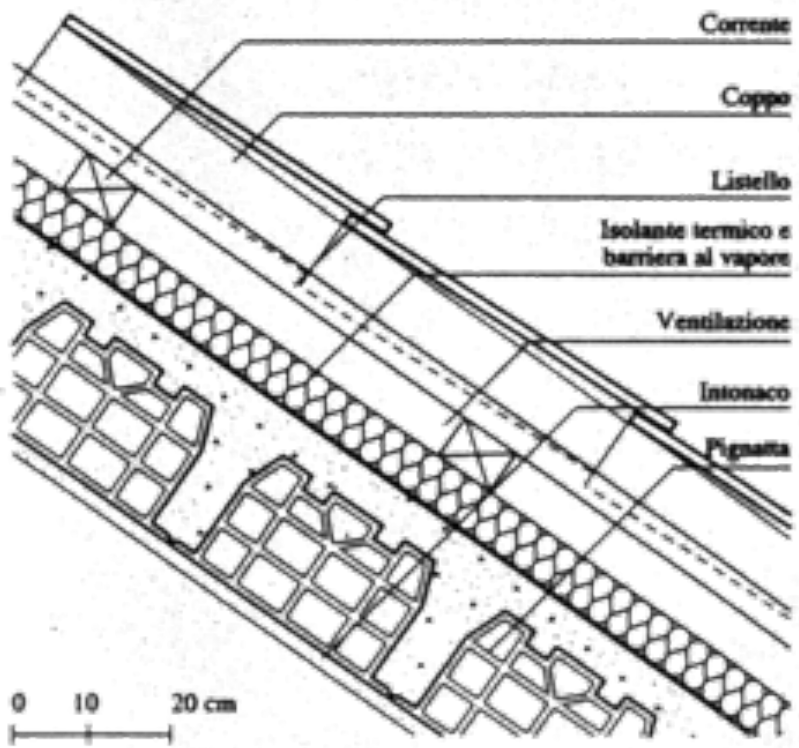


Insulated ventilated roofs with Marseillaise tiles



Sloped roof





Insulated ventilated roofs with tiles (coppi)