HIGH PERFORMANCE HISTORIC MASONRY RETROFITS

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HIGH PERFORMANCE HISTORIC MASONRY RETROFITS

Climate Zones 4 and Up

FOAM FREE ASSEMBLIES:

with Pro Clima airtightness and vapor control system

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CONTENTS

INTRODUCTION

Historic masonry retrofits offer a unique opportunity.

A great number of historic masonry buildings exist across North America, and today they are being reimagined with an endless variety of uses, and are being renovated and reoccupied. This is rightly considered an act of sustainability in itself. Yet to fully capture the potential of this rebirth, the buildings need to be made as energy efficient as possible to help make a low-carbon future to fight climate change. We can do this safely and robustly. Therefore historic masonry buildings cannot take a pass on addressing climate change mitigation.

The most important thing we can do to make these buildings – and all buildings for that matter – comfortable, healthy, robust and very energy efficient, is to make their enclosures air tight. Airtightness is first. Unfortunately, unhelpful and wrongheaded, yet pervasive, myths abound:

Myth #1: Historic building walls need to breathe air. Therefore, making them air tight is unacceptably risky.

Myth #2: Insulating inboard of masonry construction will always cause freeze-thaw damage to the masonry structure and destroy the building, not preserve it.

Myth #3: Our masonry townhouses and other buildings are well built for their climates, thereby making air tightness unnecessary.

Myth #4: Historic masonry buildings are already energy efficient, particularly in relation to post WWII construction — so these buildings should not be burdened with further efficiency requirements.

Working backward let's set the record straight:

#4 Response: Yes, 19th Century masonry buildings are more efficient than the glaringly inefficient glass boxes of the last sixty years. So what? They can be made much more energy efficient and in the face of climate change we have an obligation to do so.

#3 Response: And yes, many historic townhouses and other buildings are quite pleasant for stretches of the year. But they are frigid in winter and stifling in July and August. The windows leak, the walls leak and lack insulation, and ventilation is spotty at best — making drafts insufferable in winter; and with windows wide open in the summer, an interior coated with city soot, dust and pollen. There is no good reason to propel this misery forward, instead let's eliminate it.

#2 Response: Freeze-thaw damage potential is a serious matter and its reference should not be used as a scare tactic. It is important to realize that masonry walls freeze and thaw all the time without damage. Often historic buildings sit abandoned with roofs missing, their walls in perfectly good condition, except at those areas where there has been a complete saturation of the brick, due to the missing roofs, during spells of freezing temperatures – such as at the top of the walls. We also typically see damage where details to shed water were improperly executed or water shedding devices like gutters and leaders were not properly maintained. The brick composition is also a factor. It's complicated. Buildings are complicated. Shed the water – it's just good building practice. Deal with it. And then you can safely start to add insulation. How much insulation can you safely add? It depends. But even modest levels of continuous insulation coupled with airtightness can transform the enclosure's performance.

#1 Response: Breathability is the most unhelpful myth — and ultimately a case of mistaken identity. Breathability is really about water vapor flow – water vapor needs to be able to flow through the enclosure so it dries properly, and as insulation levels rise the importance of vapor drying capacity rises too. But breathing air indiscriminately is as dangerous for buildings as it is for people — what you inhale matters. Air flow across the wall enclosure is a building's biggest liability. Air flow can carry tremendous amounts of water with it, saturating wall assemblies and potentially leading to freeze-thaw wall destruction and failure, and/or mold and rot.

To read more on high performance construction and historic preservation see the Sallan.org article by 475 Partner Ken Levenson, *"Historic Preservation & Passive House Working Together in NYC"*, Feb 2011.

Luckily we know we can make our historic buildings very energy efficient while retaining their essential historic fabric. Renovating our historic masonry buildings to high-performance standards should be a win-win proposition — for the occupants, for our cities, and for the climate — with historic preservation and energy efficiency working together.

We can even make the historic buildings better and longer lasting in the process. This book is a guide through the construction details that can help you do just that.

Ventilation - Breathing the Right Air:

We can no longer install exhaust only ventilation systems that just intermittently suck outside air randomly through enclosure cracks. Now provide low volume continuous balanced and distributed ventilation that utilizes a high-efficiency heat exchange core, providing superior energy efficiency and indoor air quality. In retrofits 475 offers a unique high-performance ventilation solution - ductless, decentralized, through-wall ventilation systems manufactured by Lunos. The Lunos e^2 and e^{GO} systems enable you to provide optimal ventilation without running ductwork throughout the interior walls and ceilings. Find out more at foursevenfive.com.

Why Foam Free?

Foam plastic insulation dominates high-performance and green construction today, a clear victory of the power of chemical company marketing over common sense. First used in buildings as roof insulation, now it too often metastasizes around our entire building enclosure.

But if we are really trying to make green buildings, trying to make a more sustainable built environment, trying to combat climate change you should be aware that foam fails you in these efforts. Foam fails for many reasons: it's made of dangerous toxic ingredients, it's a fire accelerant and fire hazard, it has degrading thermal insulation values, it can excessively shrink, it's hygrophobic, it's prone to cracking - ultimately it provides unpredictable and unreliable performance. For detailed explanations, see our 'Foam Fails' blog series, where we delve into these issues, backed by cited research.

And foam fails in a way very specific for historic buildings. Historic preservation efforts ask that new installations be reversible. Spray foam, once installed, can be practically impossible to remove entirely - making it essentially irreversible.

Admittedly, this information may cause disorientation – given the near sacrosanct position foam currently holds in the high-performance construction industry - but we can do better. We can do much, much better. And this ebook provides a construction guide on how to do it better in historic masonry retrofits.

Download the Drawings

The detail drawings shown in this ebook are available in CAD format for easy copying and editing, **at foursevenfive.com.**

Disclaimer: Note that these drawings are diagrammatic and are not intended for direct use. A professional architect, engineer or builder must evaluate and customize per specific job requirements.

CONSTRUCTION DETAIL NOTES

ABOUT PRO CLIMA SYSTEMS:

1. Pro Clima is the world leader in complete air and vapor control systems, optimizing insulation performance, minimizing condensation risk, avoiding structural damage and protecting indoor air quality.

2. Pro Clima systems consist of interior and exterior components: membranes, tapes, caulks, gaskets, primers and accessories.

3. At the interior, INTELLO and DB+ smart vapor retarders provide airtightness with vapor variable permeability, preventing wetting in winter months and allowing drying inward in summer months.

4. At the exterior SOLITEX membranes provide robust waterproof and airtight control while remaining vapor open and allowing for maximum outward drying.

5. Exterior tapes are also waterproof, airtight and vapor permeable to support optimal performance.

6. Follow all product installation instructions - available on product pages by download at foursevenfive.com

7. If you have any questions regarding Pro Clima system products contact us at 800-995-6329 or info@foursevenfive.com

GENERAL NOTES:

1. These drawings are diagramatic and are not intended for direct use. A professional architect, engineer or builder must evaluate and customize per specific job requirements.

2. These notes and details are for cold & mixed climates where space heating requirements dominate.

3. As climate gets colder & interior insulation levels increase, the risk of freeze-thaw grows. To ensure that freeze-thaw damage is avoided; the encloser must successfully shed water, be airtight, and encourage vapor diffusion drying. Insulation should be limited to safe levels and WUFI Pro hydrothermal analysis completed.

4. High performance retrofits of historic masonry buildings typically require a “gut” renovation. All interior surfaces of masonry walls typically must be exposed, inspected and repaired as required. Often only basic wood interior structural elements are all that remain after demolition. Historic interiors must be rebuilt from salvaged elements and/or recreated.

WATER SHEDDING NOTES:

1. Historic masonry buildings were typically detailed to shed water very well. The first priority is to restore all such components that are not functioning (cornices, sills, drips, watertables, gutters, leaders, and at grade drainage).

2. While existing historic face brick is typically hard & relatively unabsorbent, it can have a wide variety of quality and should be inspected carefully. If excessive water absorbtion is suspected, an initial surface test with Karsten Tubes should be conducted. If the test is inconclusive, laboratory testing may be required.

3. Brick repointing should match the soft composition of historic masonry mortar. Per NYC Landmarks, the rule of thumb recipe is: “1 part white portland cement, 2.5 parts lime, 5-6 parts sand. Parts are by volume. Mix dry ingredients first before adding potable water. Use dry pigments (natural or synthetic stable oxide pigments) to tint or color mortar. Mix all ingredients thoroughly.”

4. Also inspect for and address any ground water and/or “rising damp” issues. As needed install water barriers, capillary breaks and exterior and/or interior drainage.

AIR BARRIER NOTES:

1. Air barrier components are to be connected to form a continuous air tightness control layer around the entire building enclosure.

2. Whole building airtightness and the airtightness of its components should be tested with a blower door – both depressurizing & pressurizing - while the airtightness components are accessible, verifiable & repairable.

3. The main air barrier should be located inboard of the primary insulation layer to ensure conditioned/humid air is segregated from cold building components. (This layer may also be a vapor retarding layer).

4. The secondary air barrier (or wind-tight layer) should be outboard of the primary insulation layer to prevent windwashing of the thermal insulation.

VAPOR CONTROL NOTES:

1. To help prevent freeze-thaw damage and/or mold growth, the vapor profile of the assembly should promote outward drying and prevent wetting in winter, while allowing inward drying in summer.

2. Building components outboard of primary insulation layer, typically the brick should remain vapor open to promote outward drying.

3. When possible, siding and roofing components should be back vented to promote outward drying of assembly.

4. Compoents inboard of primary insulation layer should not be vapor closed, as to prevent trapping of moisture in assembly.

5. Sheathing inboard of primary insulation may be vapor retarding: OSB or plywood.

6. Airtightness and/or structural components inboard of primary insulation should have vapor variable retarding capability.

7. In situations with greater risk of moisture damage, greater vapor perm variability inboard is recommended.

8. A schedule of vapor variable airtight materials:

Least variable ↓ Most variable	**OSB:**	0.5-2.0 perms
	DB+ :	1.5-8.5 perms
	Plywood:	0.5-10 perms
	INTELLO:	0.17-13.2 perms

9. Moisture damage risk increases with higher levels of insulation and/or outboard vapor retarding components. If unsure of risk level, use WUFI Pro software to analyze the risk. 475 can do a WUFI Pro analysis for you.

THERMAL INSULATION NOTES:

1. Dense pack insulation may be either cellulose or fiberglass.

2. Batt insulation may be: fiberglass, cellulose, sheeps wool, denim or mineral wool.

3. Where moist conditions may prevail below grade mineral wool insulation may be preferable.

4. Exterior fibrous insulation board may be: mineral wool, fiberglass or GUTEX wood fiberboard.

5. Loose fill attic insulation may be cellulose or fiberglass.

6. Inboard rigid floor insulation is GUTEX wood fiberboard.

7. Rigid insulation below floor slab is mineral wool.

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CONSTRUCTION DETAIL KEY

SEE MATERIALS DESCRIPTION INDEX (PG. 59) FOR ADDITIONAL INFORMATION

IN RED - INBOARD AIR SEALING COMPONENTS

AIR SEALING COMPONENTS:

MEMBRANE OPTIONS:
DB+
INTELLO PLUS
SOLITEX MENTO 1000
LIQUID APPLIED MEMBRANES

SHEATHING OPTIONS:
OSB
PLYWOOD

CAULKING ADHESIVE OPTIONS:
CONTEGA HF
CONTEGA LINE

TAPE OPTIONS:
TESCON VANA
TESCON PROFIL

CONCRETE

GUTEX MULTITHERM WOOD FIBER INSULATION BOARD

IN BLUE - OUTBOARD AIR SEALING COMPONENTS

OTHER BUILDING COMPONENTS:

MEMBRANE OPTIONS:
SOLITEX MENTO 1000
SOLITEX MENTO PLUS
DA

CONCRETE

BRICK

CAULKING ADHESIVE OPTIONS:
CONTEGA HF

TAPE OPTIONS:
TESCON VANA
TESCON VANA 75, 100, 150 & 200
TESCON PROFIL
CONTEGA EXO
EXTOSEAL ENCOR, FINOC, MAGOV

GUTEX MULTITHERM WOOD FIBER INSULATION BOARD

IN GREYSCALE - OTHER COMPONENTS

DRAWING PROFILE LINE

INSULATION OPTIONS:

DENSE PACK: CELLULOSE OR FIBERGLAS

RIGID: **GUTEX**, MINERAL WOOL OR FIBERGLASS

BATT: FIBERGLASS, DENIM, SHEEPS WOOL OR MINERAL WOOL

STRUCTURE

EXISTING FOUNDATIONS

CELLARS: INTRODUCTION

Historic masonry buildings' connection to the ground can often be fraught with issues and should be carefully considered. The most important issues involve ground water penetration of the structure and preventing it. Address bulk-water issues with perimeter drainage and outboard waterproofing, including a plastic sheet at grade, below cellar floor. Address rising damp with capillary breaks and sacrificial mortar.

After bulk-water and rising damp issues, airtightness, vapor control and continuous insulation must be addressed.

AIRTIGHTNESS:

Brick and stone foundations typically leak air - even the dirt ground itself, under pressure, can be a conduit for leakage. Install a heavy duty plastic sheet to address the ground leakage for both air and water. At the cellar walls, repointing is often necessary, followed by either a lime-plaster airtight coating, a cementitious "smear" coat, or an airtight liquid membrane such as STO Gold Coat.

The primary air barrier will not be the masonry foundation, instead the primary air barrier should be inboard of the insulation layer, keeping the conditioned air in the conditioned space - with INTELLO membranes by Pro Clima. Inboard of the membrane it is recommended to have a service cavity, to limit the number of penetrations and protect the air control layer.

VAPOR CONTROL:

Vapor control is provided by the INTELLO membrane as well, preventing vapor diffusion wetting of the assembly in the winter months and allowing diffusion driven drying inward in the summer.

INSULATION:

Below grade, inboard of the foundation walls we often recommend mineral wool insulations, a material that can be severely wetted in a flood, then dry and retain its usefulness. And today there is no longer a need to put foam insulation below your ground floor slab - either install wood fiberboard by GUTEX above the slab or install ROXUL mineral boards below the slab (ROXUL has officially approved the use of its ComfortBoard IS for these applications).

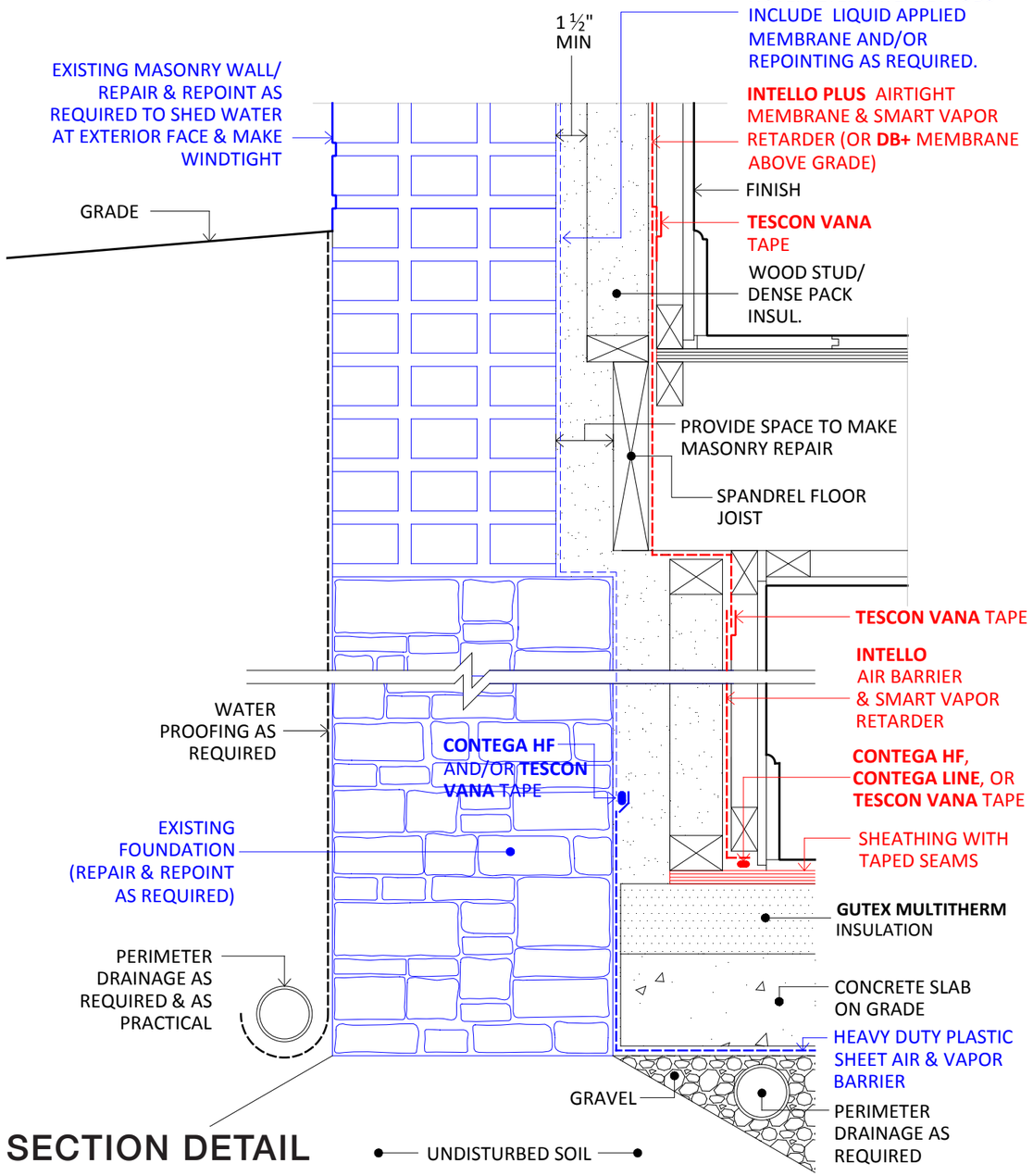
CONTINUITY:

The ultimate success of your airtight and insulation control layers will be continuity - the trickiest part being the connections between floors and walls.

photo credit: Cramer Silkworth

1a CONDITIONED CELLAR W/ RIM JOISTS - INSULATION ABOVE SLAB

Disclaimer: Note that these drawings are diagrammatic and are not intended for direct use. A professional architect, engineer or builder must evaluate and customize per specific job requirements.



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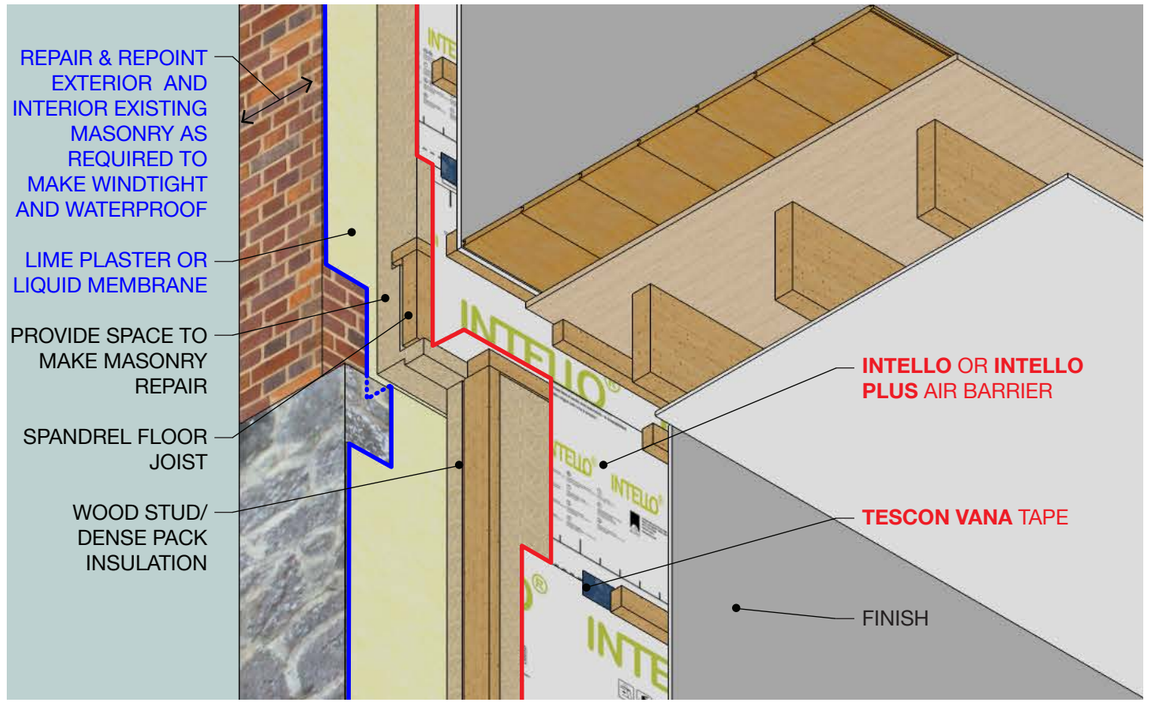
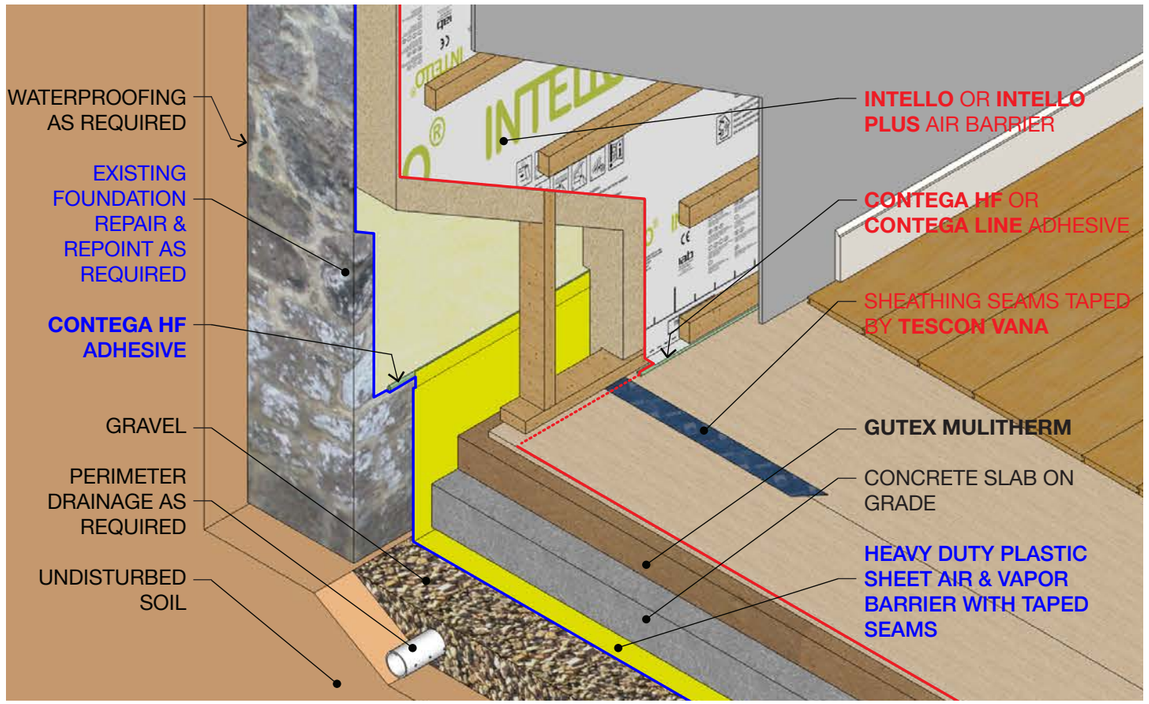


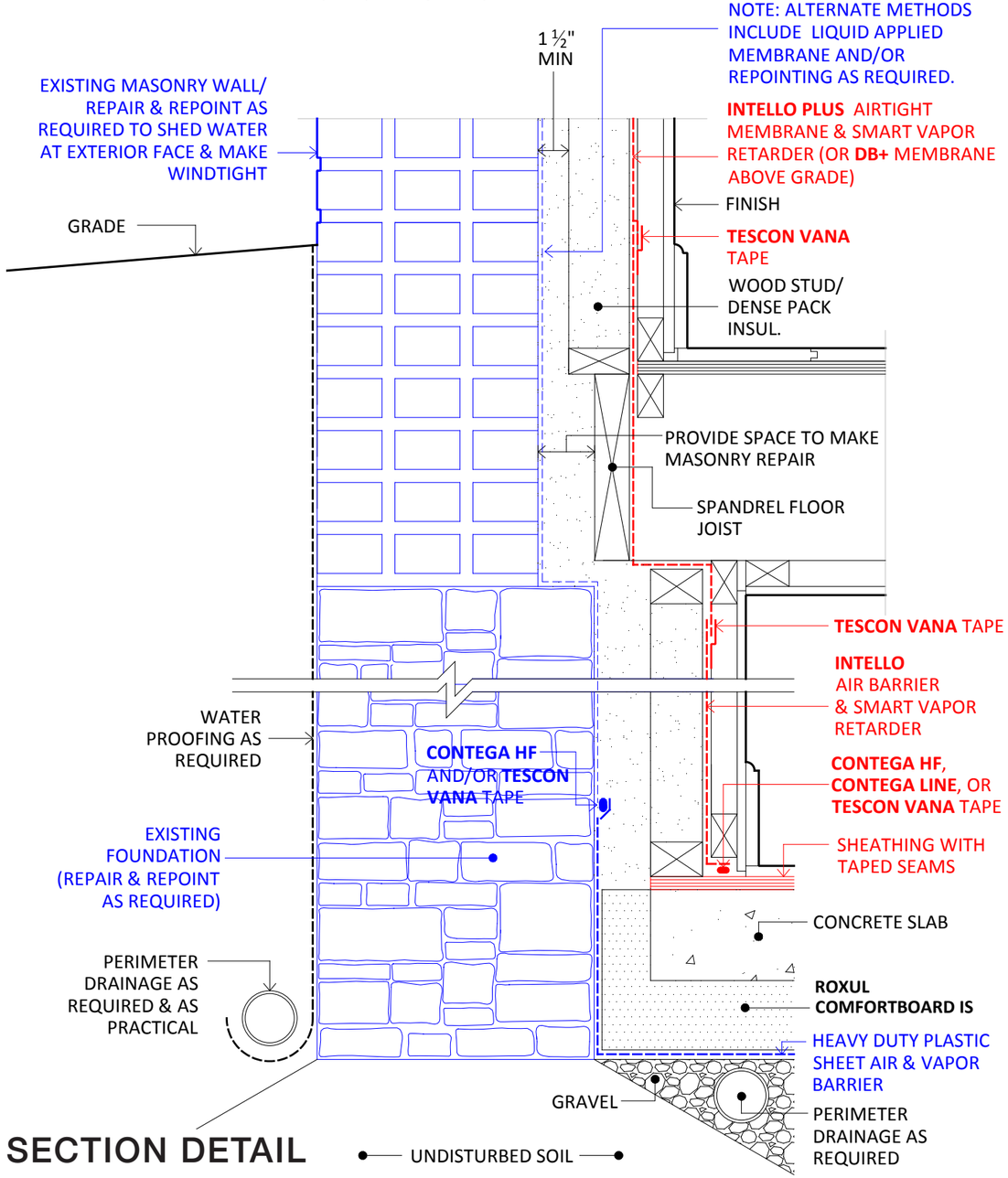
View up at first floor connection



View down at cellar floor connection

1b CONDITIONED CELLAR W/ RIM JOISTS - INSULATION BELOW SLAB

Disclaimer: Note that these drawings are diagrammatic and are not intended for direct use. A professional architect, engineer or builder must evaluate and customize per specific job requirements.



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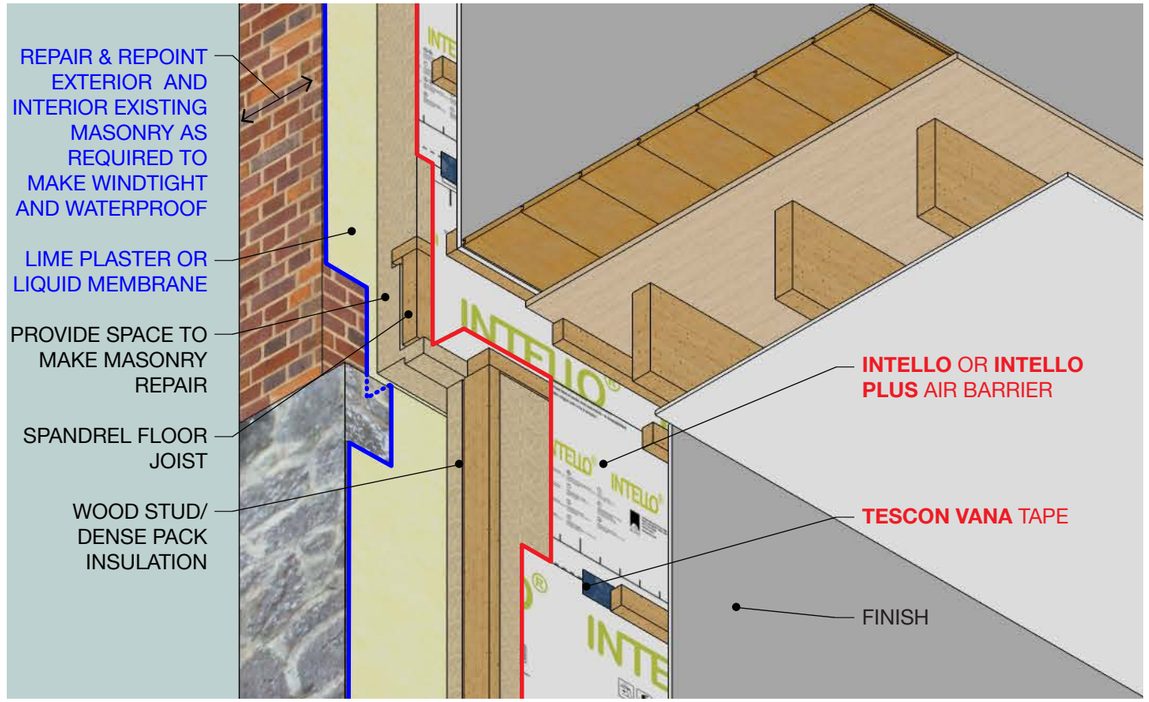
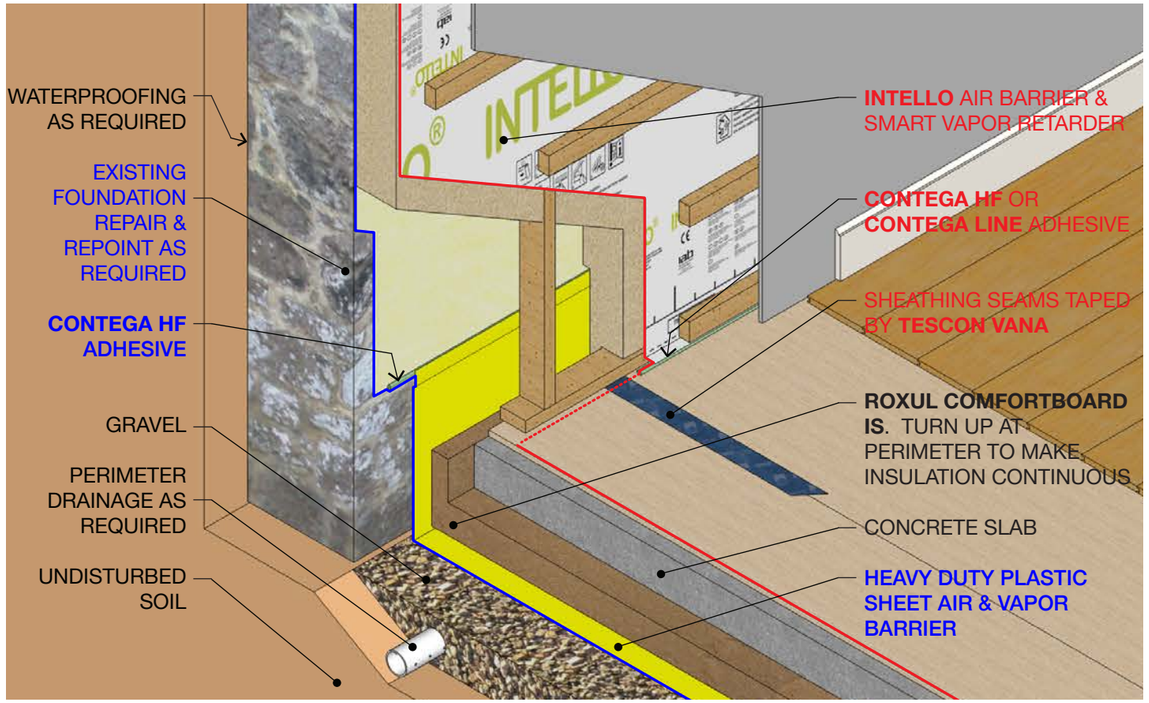


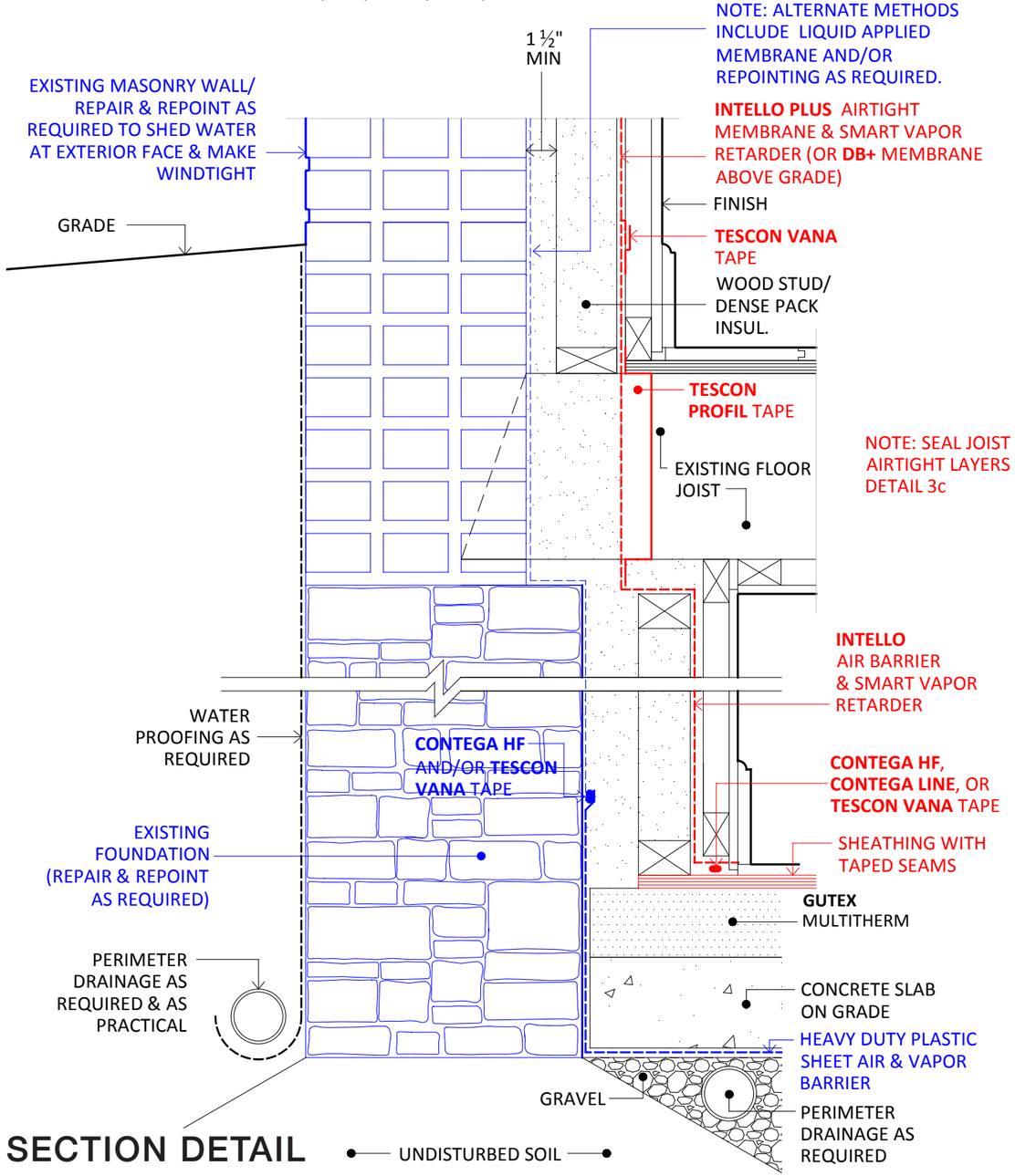
View up at first floor connection



View down at ground connection

1c CONDITIONED CELLAR - EXTERIOR WALL WITH JOIST POCKETS

Disclaimer: Note that these drawings are diagrammatic and are not intended for direct use. A professional architect, engineer or builder must evaluate and customize per specific job requirements.



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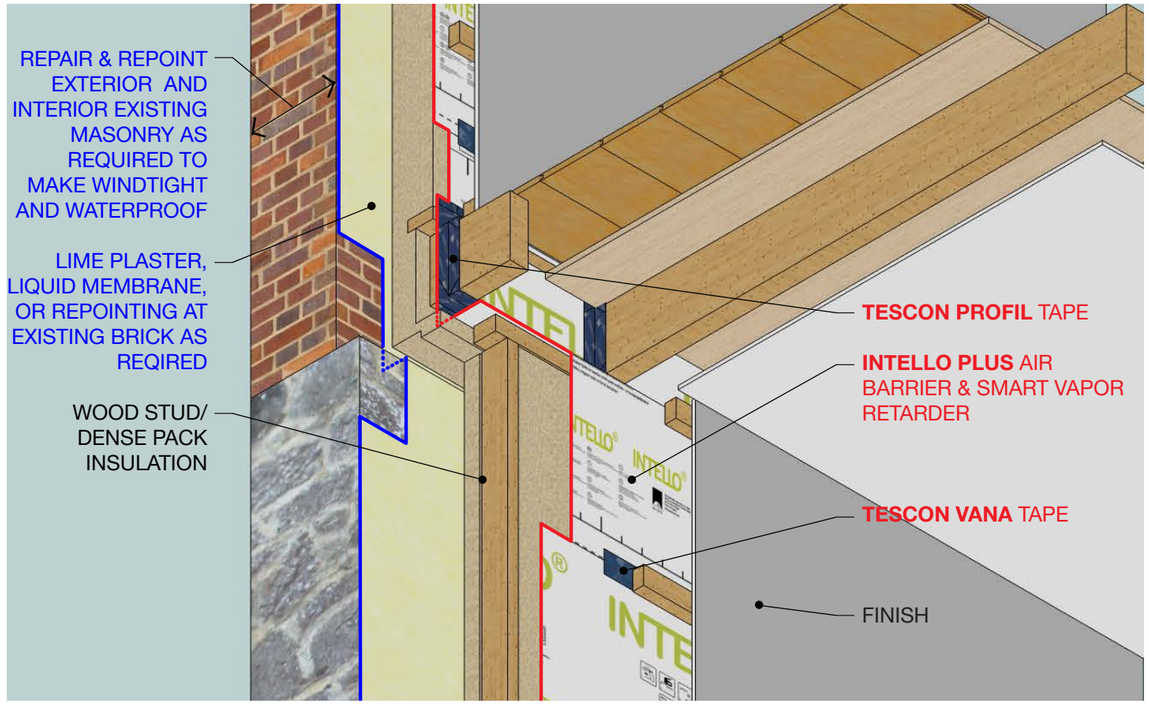
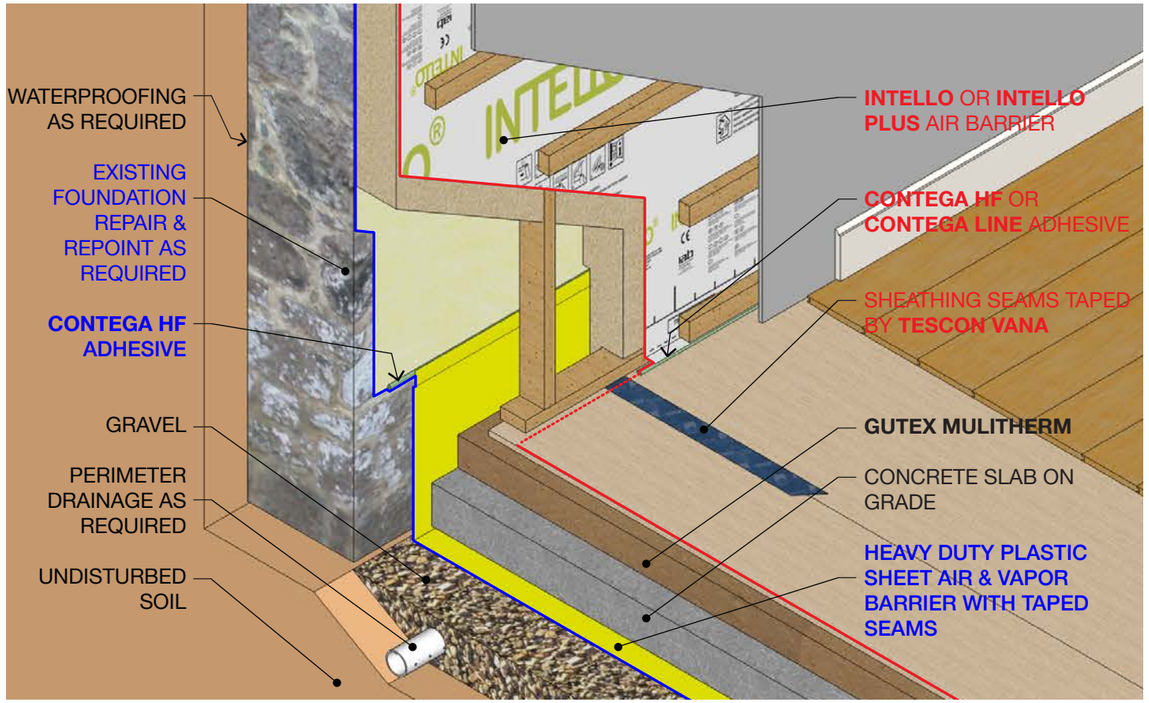


View up at floor connection



View down at ground connection

1d CONDITIONED CELLAR AT PARTY WALL

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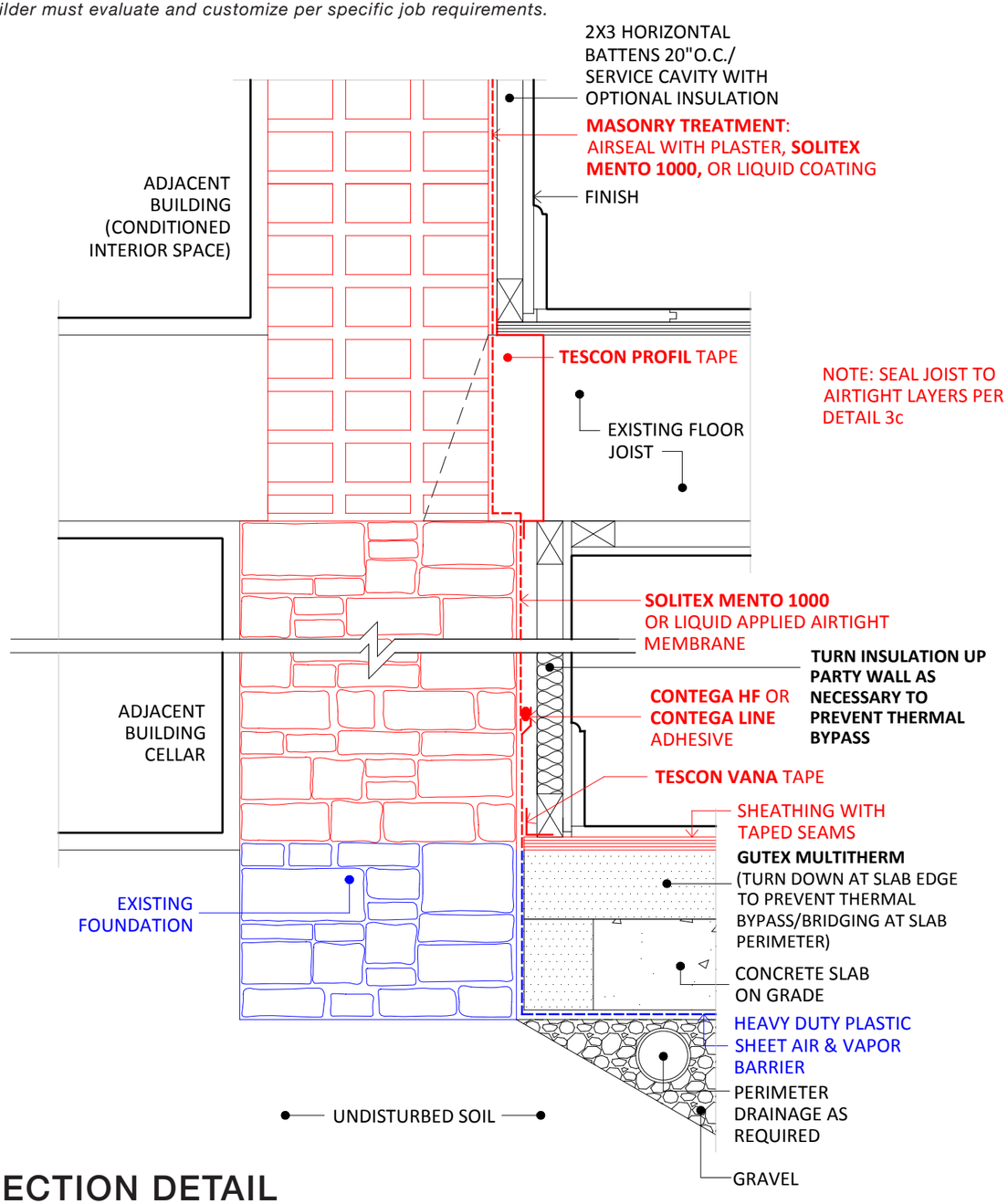
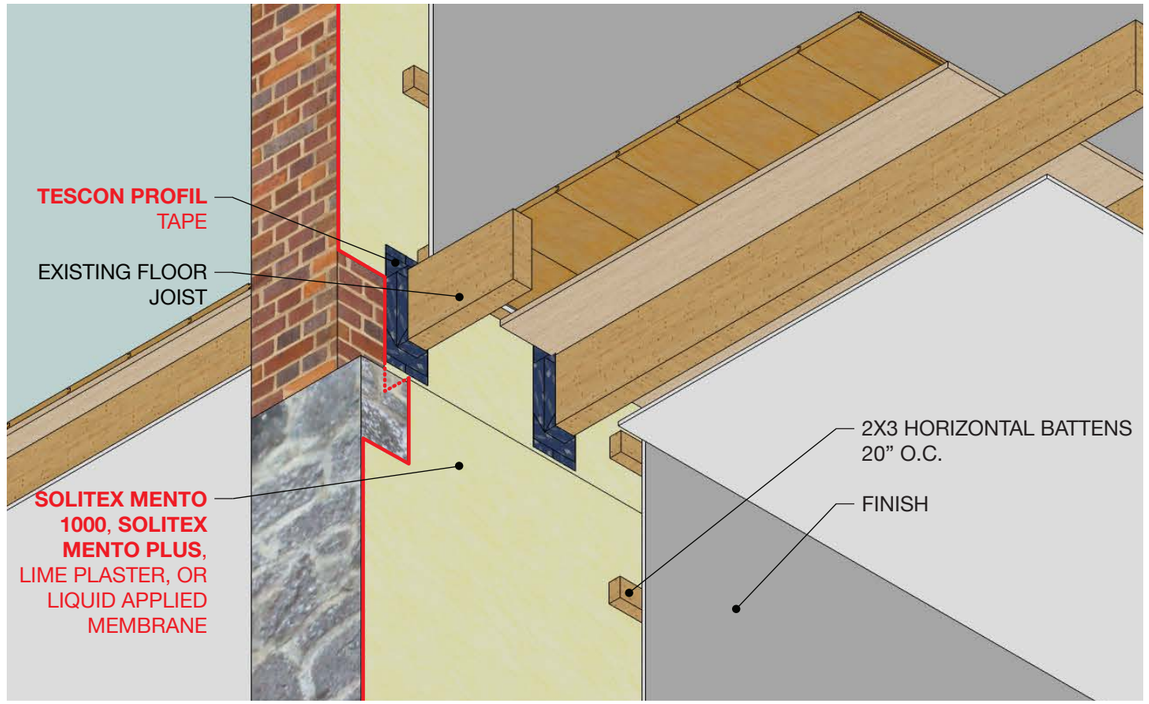
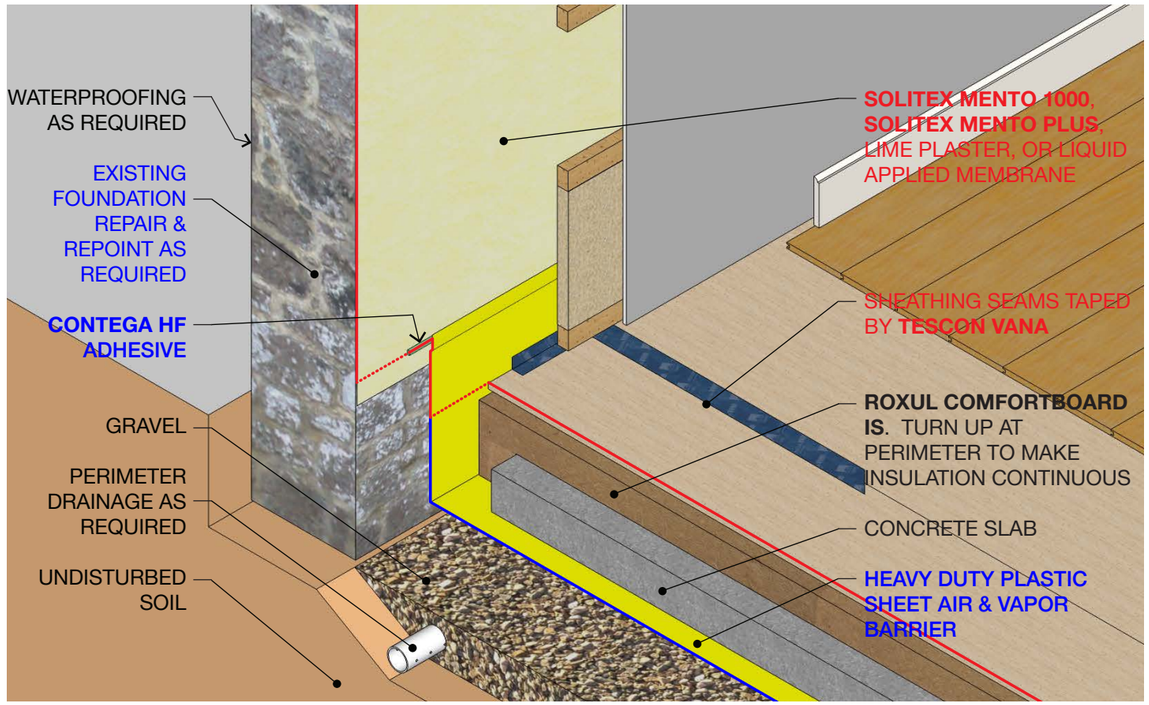


NOTE: SEAL JOIST TO AIRTIGHT LAYERS PER DETAIL 3c

SECTION DETAIL



View up at floor connection



View down at ground connection

1e UNCONDITIONED CELLAR WITH RIM JOISTS

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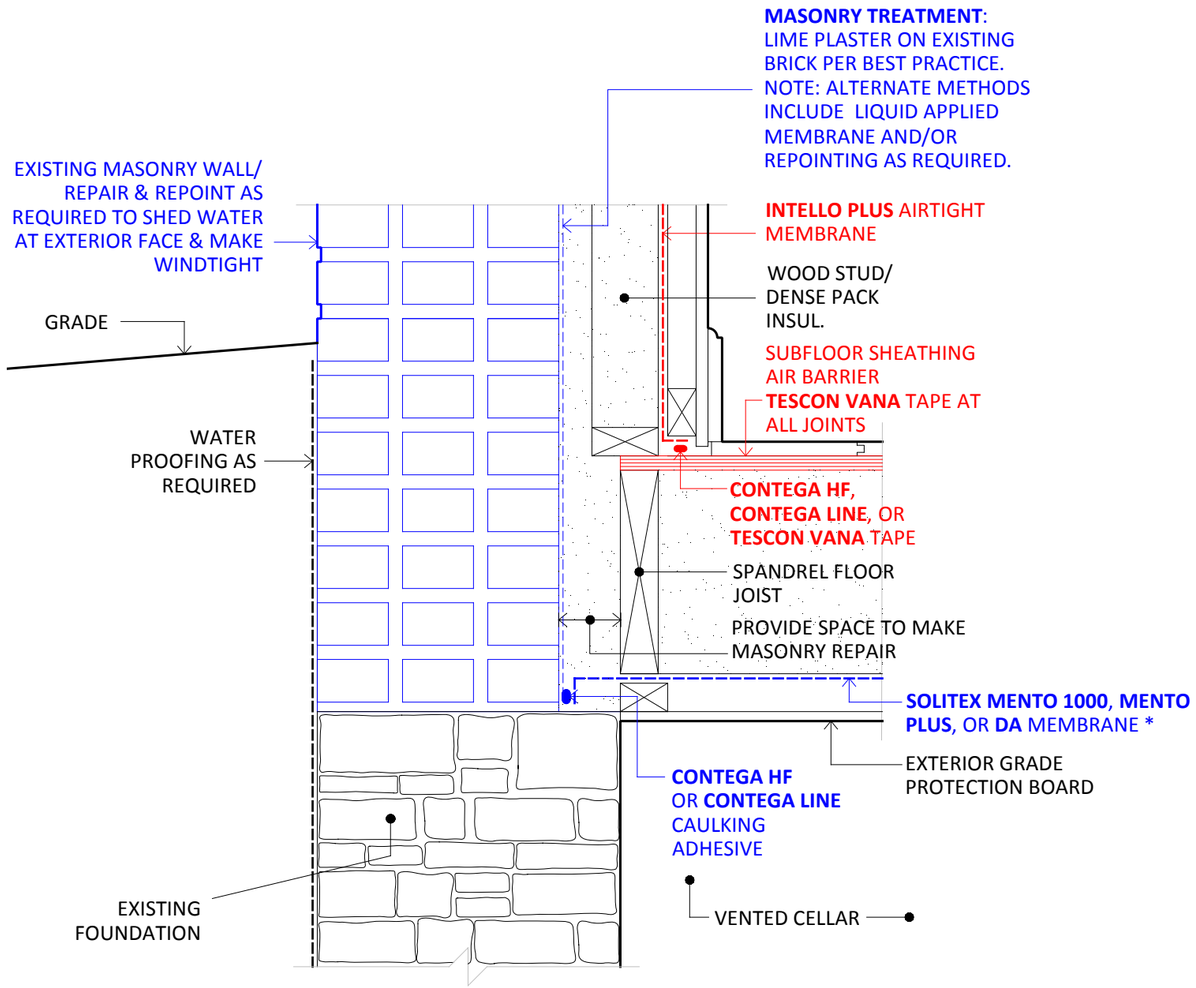
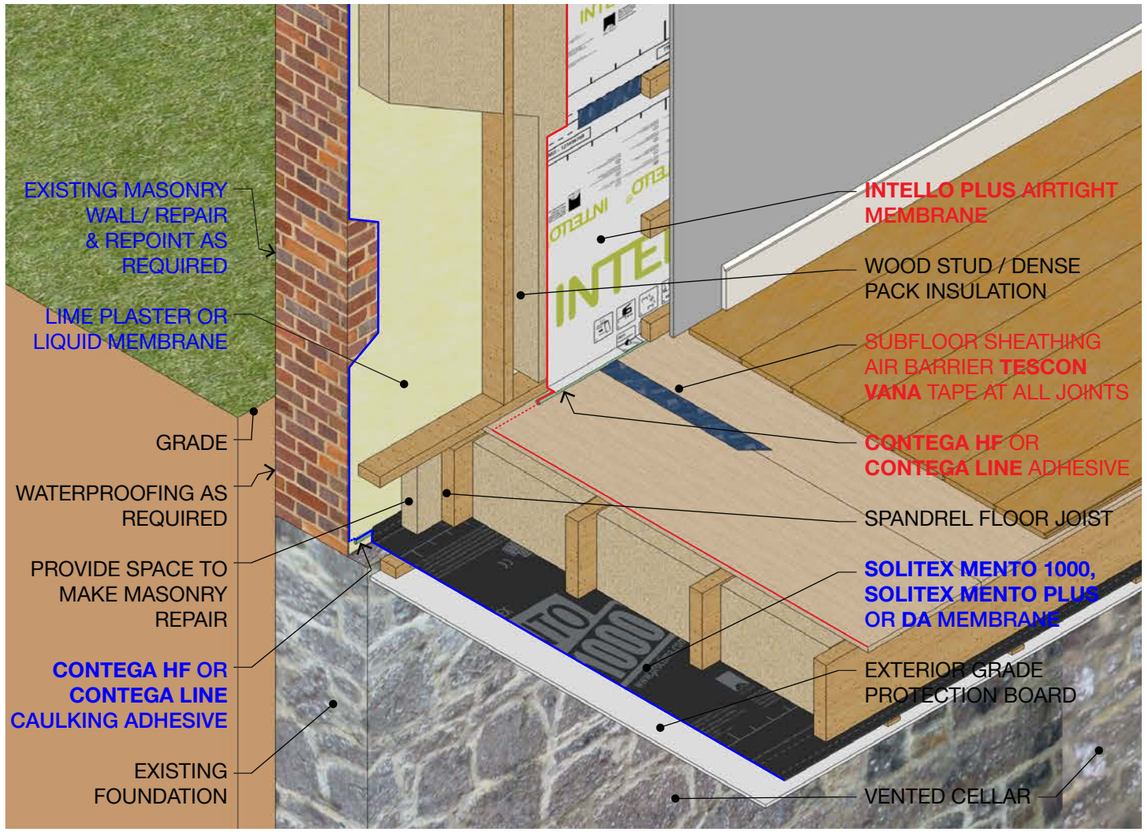


*AT DRY AND/OR WELL VENTED CELLAR OR CRAWL SPACE, **SOLITEX MENTO 1000** OR **PLUS** IS TYPICALLY USED. AT CELLARS OR CRAWL SPACES WITH PERSISTENTLY HIGH HUMIDITY LEVELS THE **DA** MEMBRANE MAY BE MORE APPROPRIATE.



View down at ground floor connection

SECTION DETAIL

1f UNCONDITIONED CELLAR WITH JOIST POCKETS

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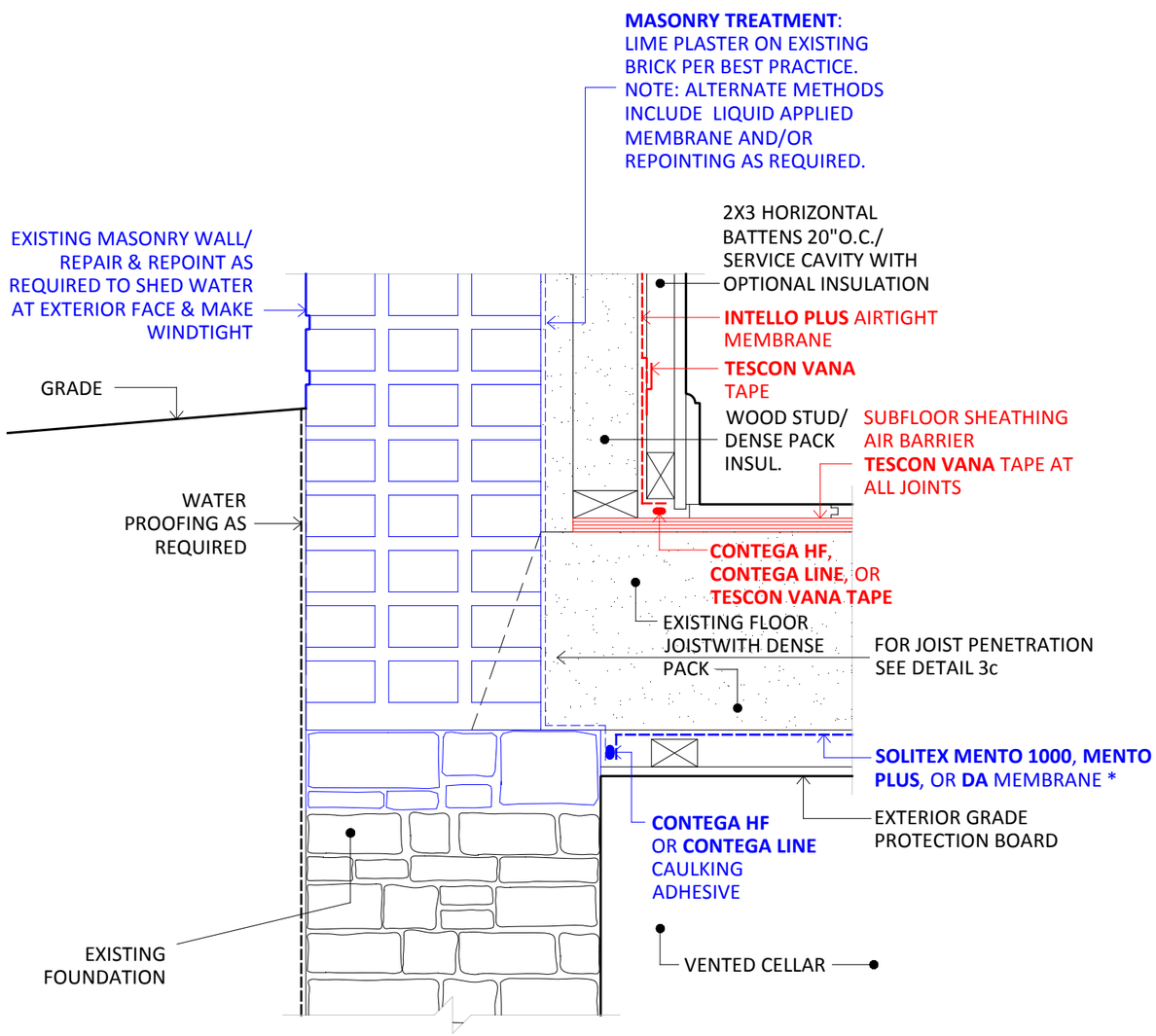

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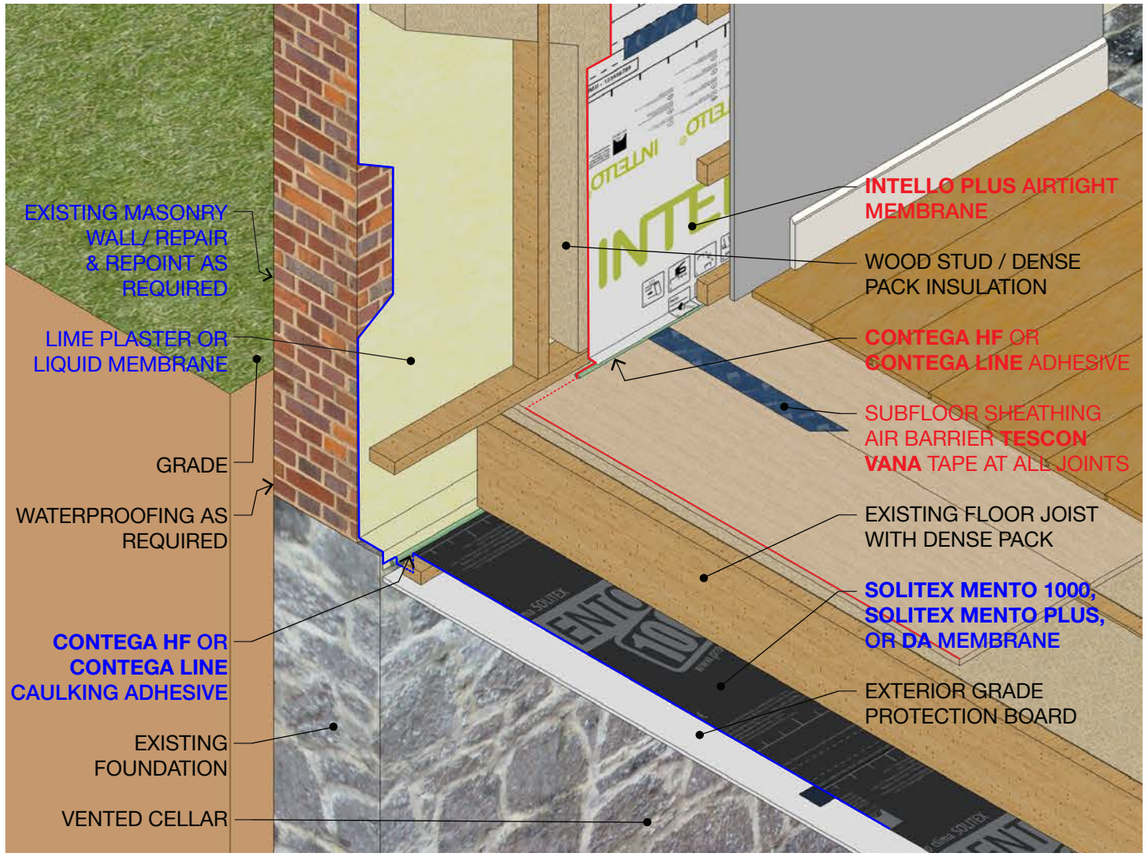
SECTION DETAIL



View down at ground floor connection

1g UNCONDITIONED CELLAR AT PARTY WALL

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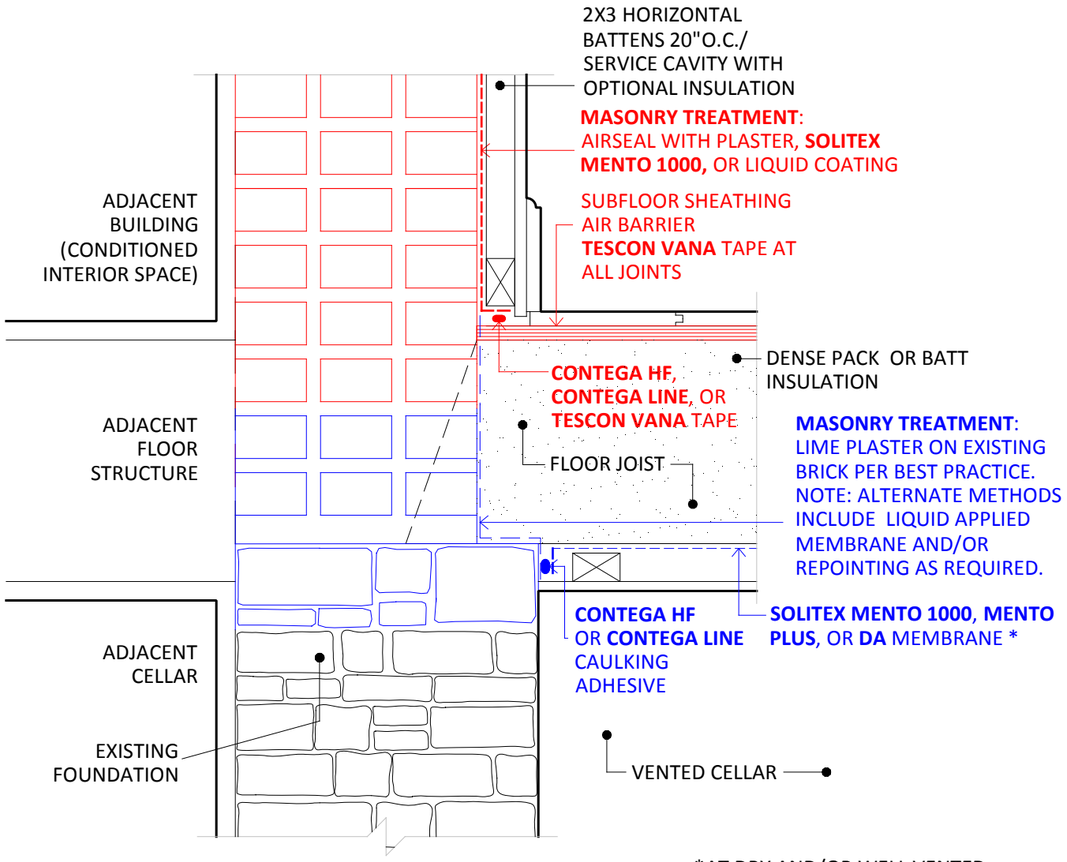

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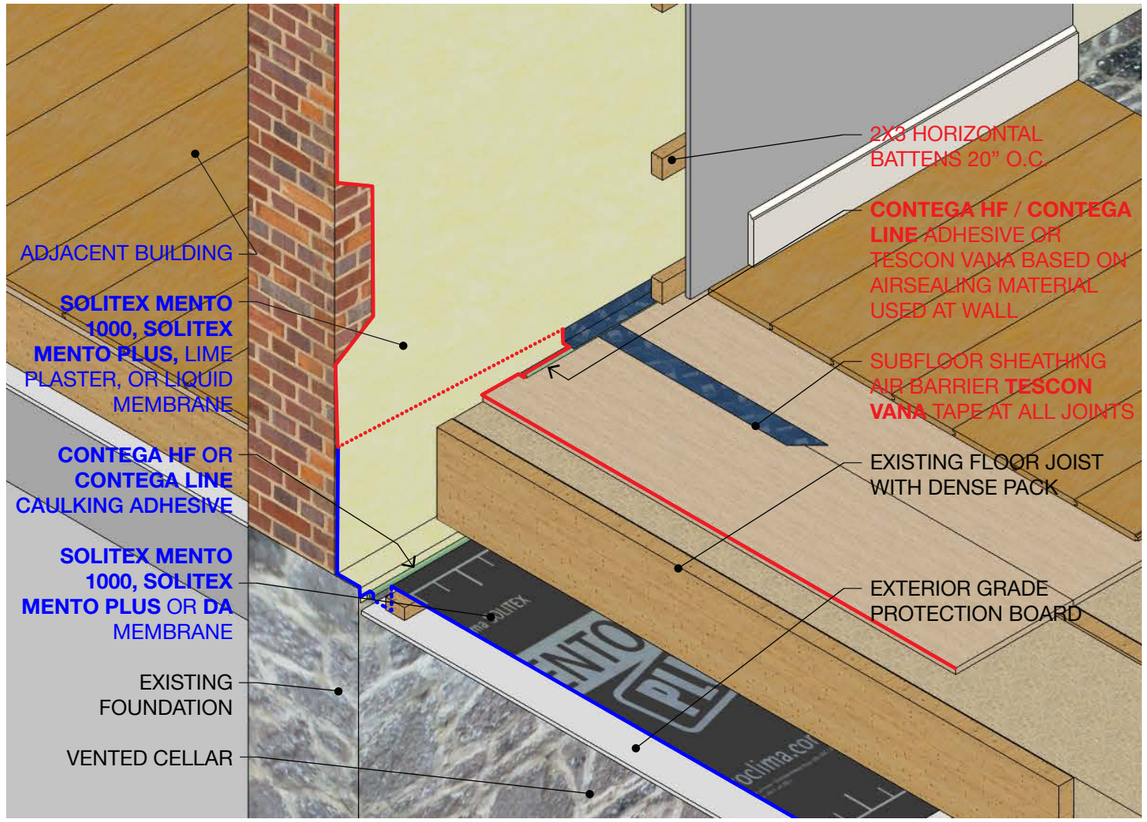


View down at ground connection

SECTION DETAIL

WALLS: INTRODUCTION

Like the foundations, historic masonry walls leak air - even three wythe brick. And like foundations the first order of business is not air leakage but addressing bulk water issues. For walls this is typically by restoring the traditional water shedding details to good working order: the cornices, the sills, the water tables, the drips, the pointing, the leaders and so on. And if the historic construction had poor shedding details like a badly flashed rowlock brick sill, then fix it with a more robust detail. Shed the water and many other problems will be avoided.

AIRTIGHTNESS & VAPOR CONTROL:

To achieve airtightness, typically all the interior masonry must be exposed and made accessible - for inspection, repair, treatment and testing.An area of inaccessible interior masonry is leaky masonry. This means cutting away the sub-floors at the masonry, moving spandrel/rim joists away from wall faces and removing all decorative plaster that has cavities between itself and the masonry, like at interior crown mouldings. (Plaster finishes that are in full contact with the masonry and are in sound condition, can be perfectly good air barriers.)

While we want to optimize our insulations by surrounding them in airtightness, the primary air barrier will be inboard of the insulation layer - keeping the conditioned air within the conditioned space. We want the masonry wall to provide “windtightness” - a term that denotes its secondary emphasis. We also want it to be vapor permeable so that the masonry can dry inward. To achieve vapor permeable windtightness there are three basic approaches:

1. The most robust approach is to apply a lime plaster coating to the interior face, making it airtight while the lime helps prevent any future mold growth.

2. Or install a liquid applied membrane like STO Gold or Emerald Coat. Note that for the liquid membrane to be effective further pointing and even a cementitious “smear coat” may be required to smooth out the masonry surfaces first.

3. Or it may be that just more diligent repoint can b enought. Like with most things, it depends. For party walls - shared masonry walls between connected rowhouses - the air barrier at the face of the masonry, is the primary air barrier, as there is typically no thermal insulation at party walls.* This air barrier can be vapor open or retarding and there is a wider array of options available: lime plaster, liquid membranes, fabric membranes like Pro Clima’s SOLITEX Mento 1000 or even OSB or plywood sheathing.

One crucial aspect of dealing with masonry wall surfaces are the joist penetrations. Ideally there would be no wood penetrations, but this is typically not feasible. The best thing that we can do to prevent moisture damage at the wood joist masonry pocket is to keep the conditioned air from flowing into it in the winter. Please take a careful look at the Penetrations section of this ebook - successfully dealing with penetrations is a must for success.

The primary air barrier - at non-party walls - will be inboard of the insulation layer, keeping the conditioned air in the conditioned space. INTELLO, INTELLO Plus or DB+ membranes by Pro Clima are used. The membranes also provide vapor control, preventing vapor diffusion wetting of the assembly in the winter months and allowing diffusion driven drying inward in the summer. Inboard of the membrane it is recommended to have a service cavity, to limit the number of penetrations and protect the air control layer.

INSULATION:

Above grade, we often recommend dense-pack cellulose insulations, a material that actively helps dry moisture out of an assembly. Also possible are dense-pack mineral wool or fiberglass insulations or even batt insulations (surrounded by airtightness batt insulation installations can more readily provide high-performance results).

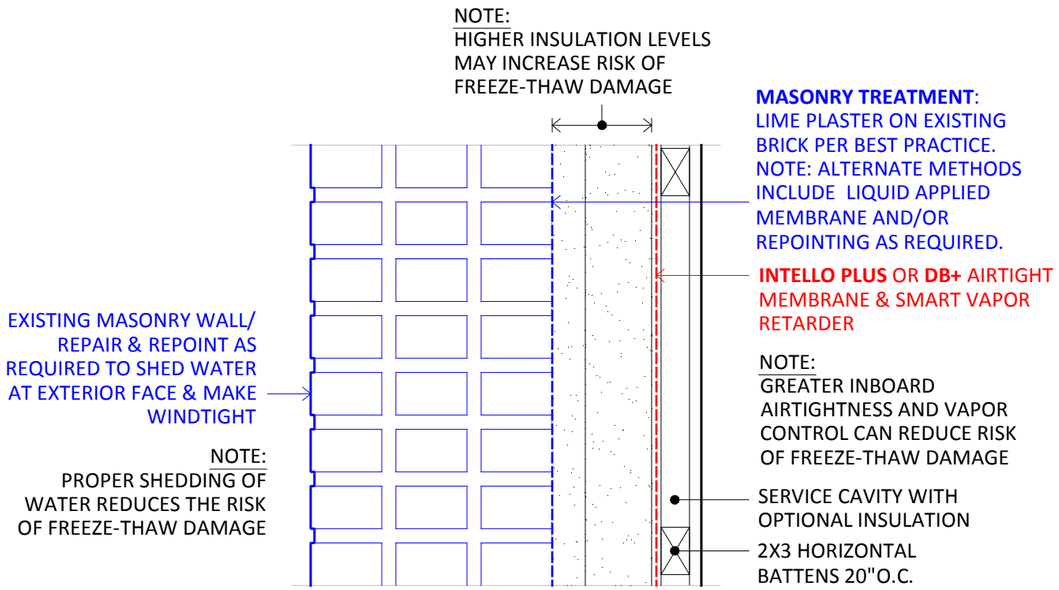
Freeze-thaw damage, as noted in the opening of this ebook and in the Construction Detail Notes, is a serious concern and needs to be fully examined before installing inboard insulation as illustrated in these pages. However, as we also note the risks can be mitigated and relatively high levels of insulation can be safely achieved. Again, it all depends. So do your homework on that, and given that freeze-thaw concerns are dealt with properly, one concern that remains, with added insulation and colder assembly surfaces, is the potential for mold growth. The best protection against this is robust inboard airtightness and vapor control with INTELLO membranes. Lime plaster can also help.

Thermal bridging of existing structural elements should also be carefully considered, not only for condensation risk but in terms of degrading the effectiveness of high levels of insulation - particularly where there are are existing concrete floors forming a continuous connection with the exterior masonry wall. Consequently, even though you may be able to insulate to very high levels, it may not make sense. Luckily even moderate insulation levels can provide high-levels of performance, even Passive House levels, provided there is good airtightness.

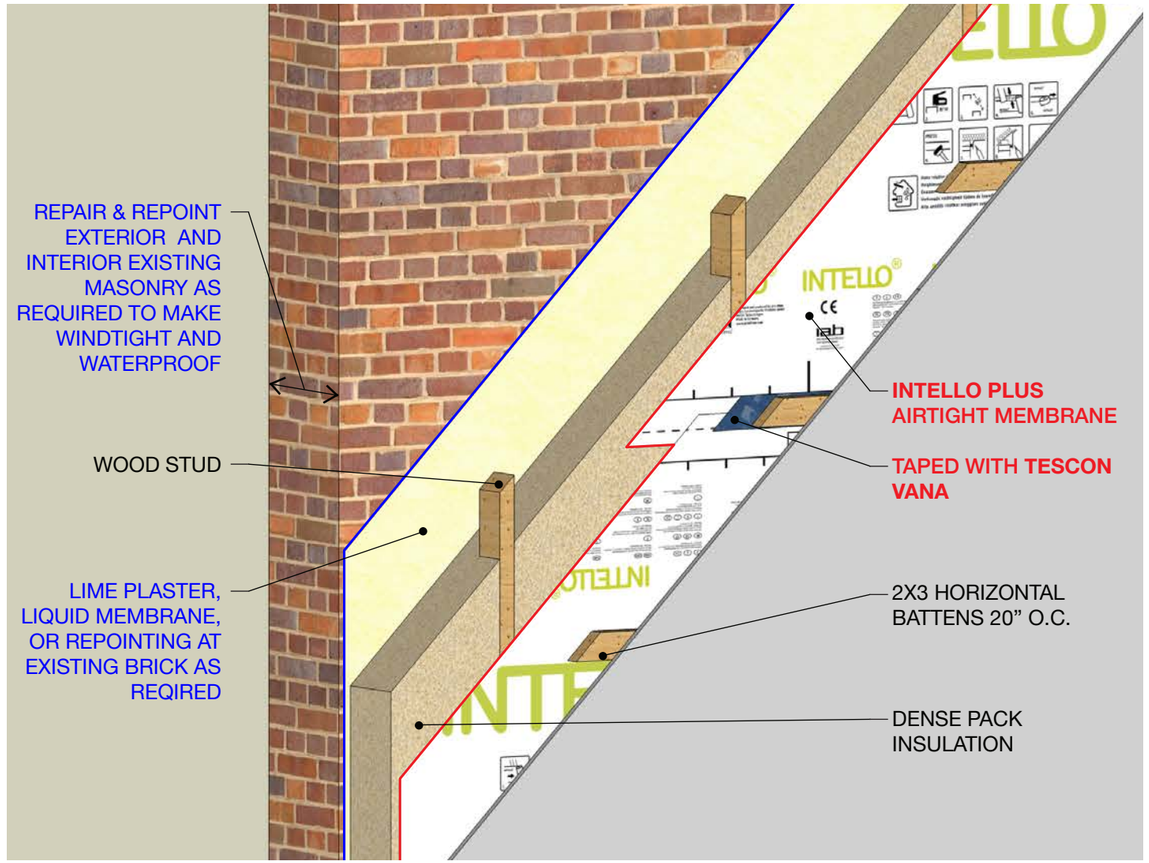
** Thermal insulation may be necessary and desirable at party walls near the connection to the exterior walls, ground slab and roof, often a couple of feet in width to avoid thermal bypass/bridging.*

2a TYPICAL WALL ASSEMBLY

Disclaimer: Note that these drawings are diagrammatic and are not intended for direct use. A professional architect, engineer or builder must evaluate and customize per specific job requirements.



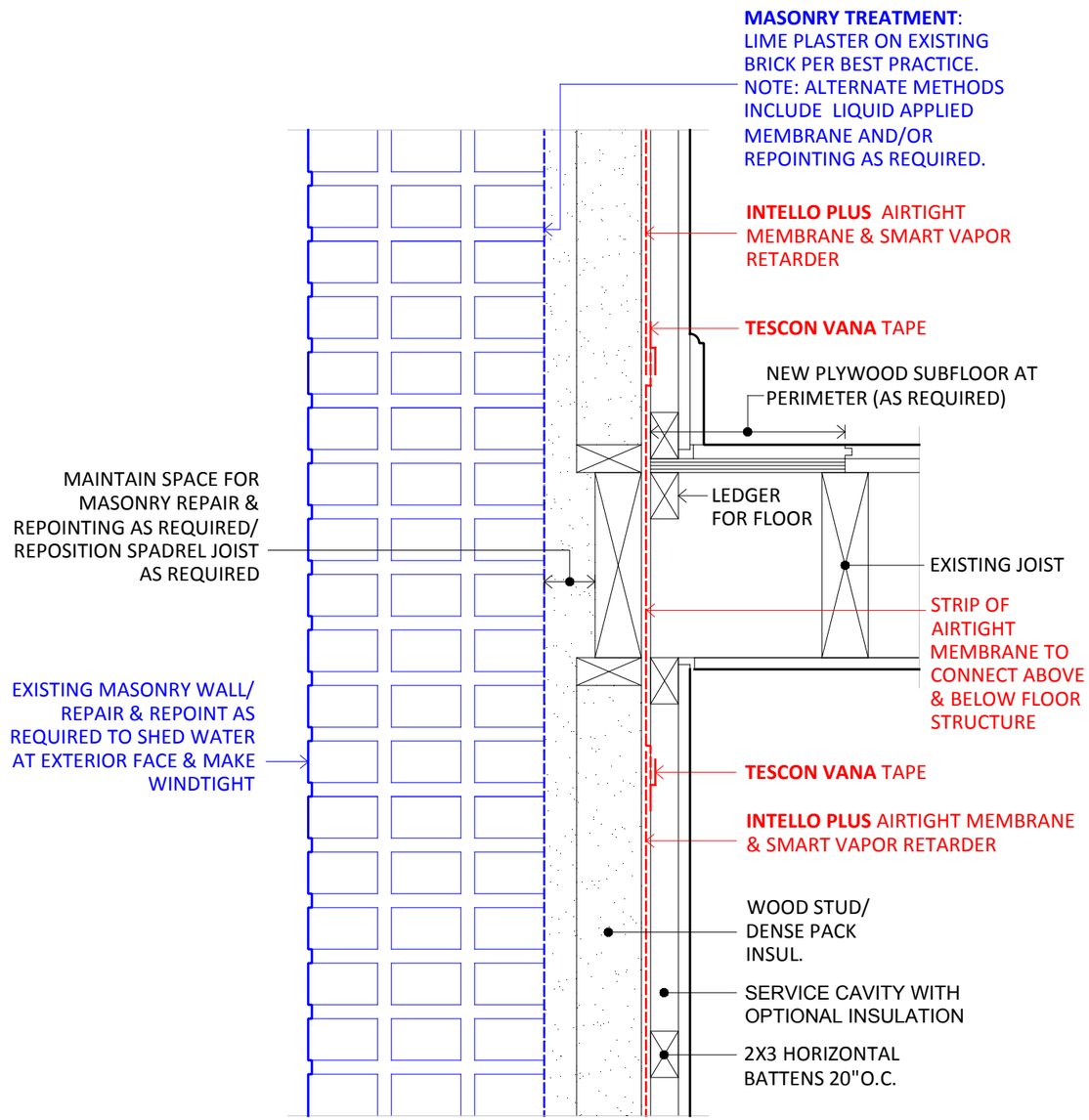
SECTION DETAIL



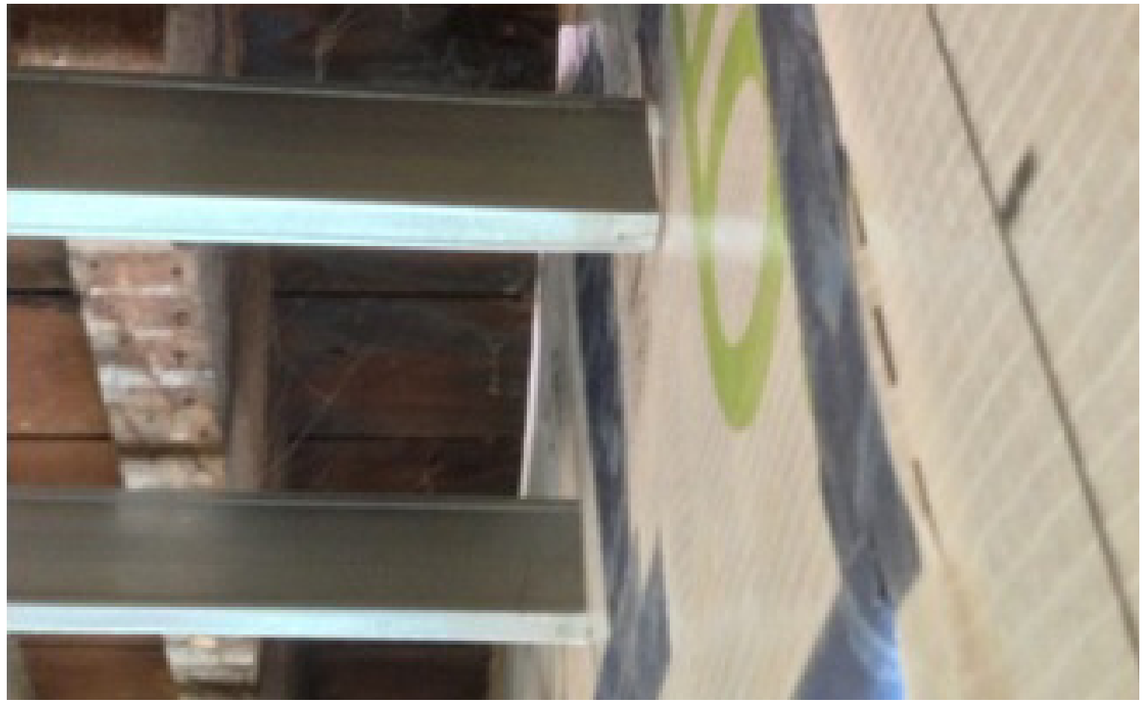
View at typical wall assembly

2b FLOOR INTERSECTION AT EXTERIOR WALL W/ RIM/SPANDREL JOISTS

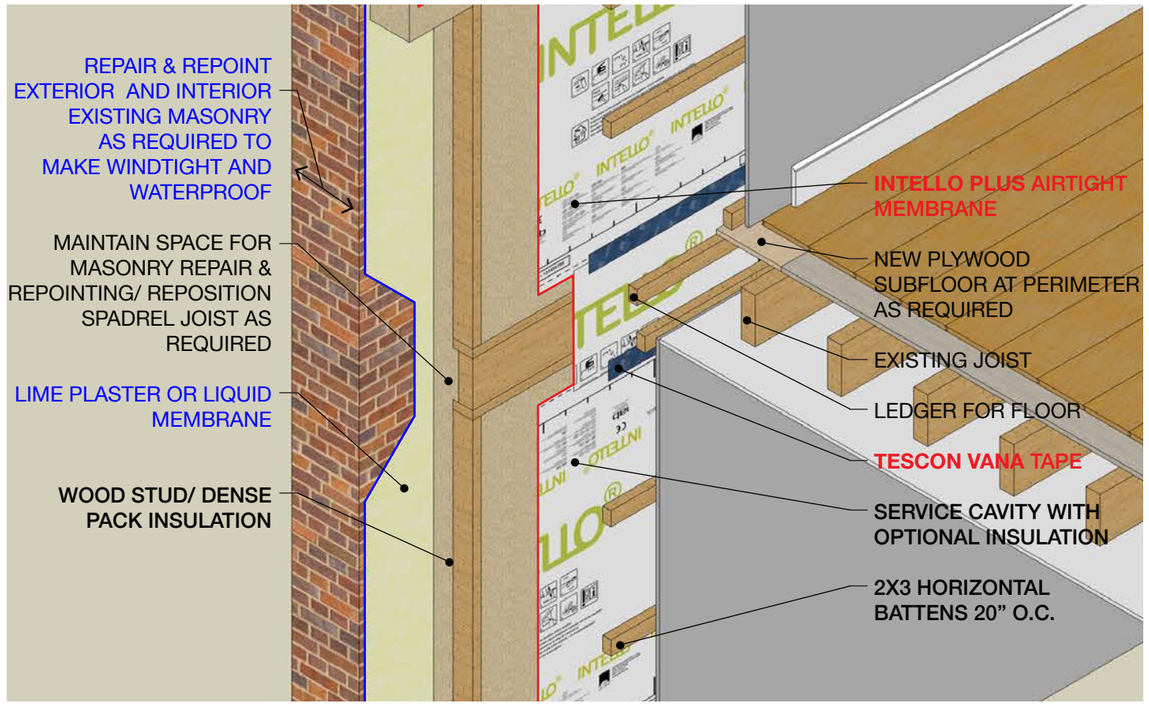
Disclaimer: Note that these drawings are diagrammatic and are not intended for direct use. A professional architect, engineer or builder must evaluate and customize per specific job requirements.



SECTION DETAIL



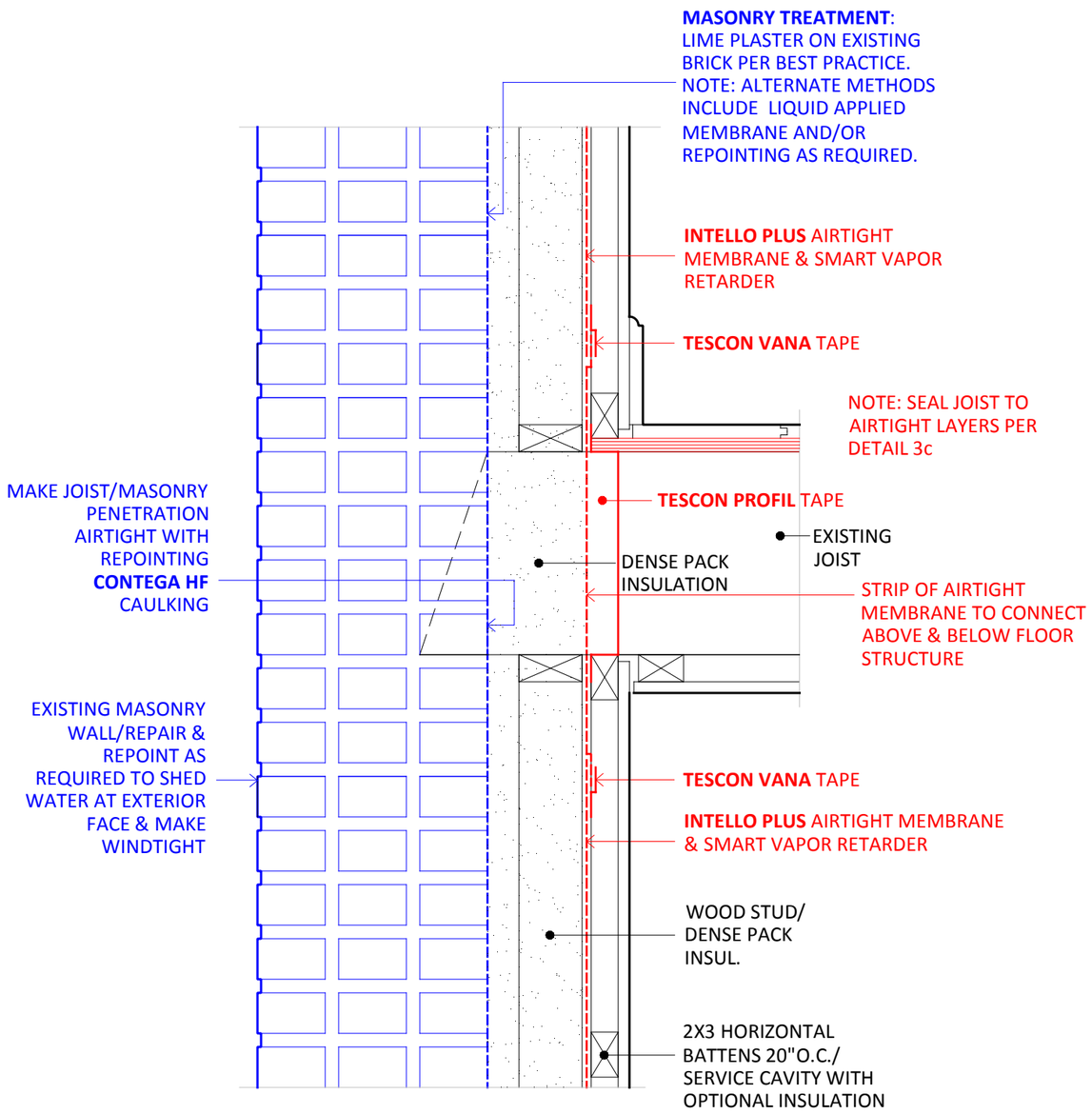
Looking up at sub-floor, pulled away from membrane.



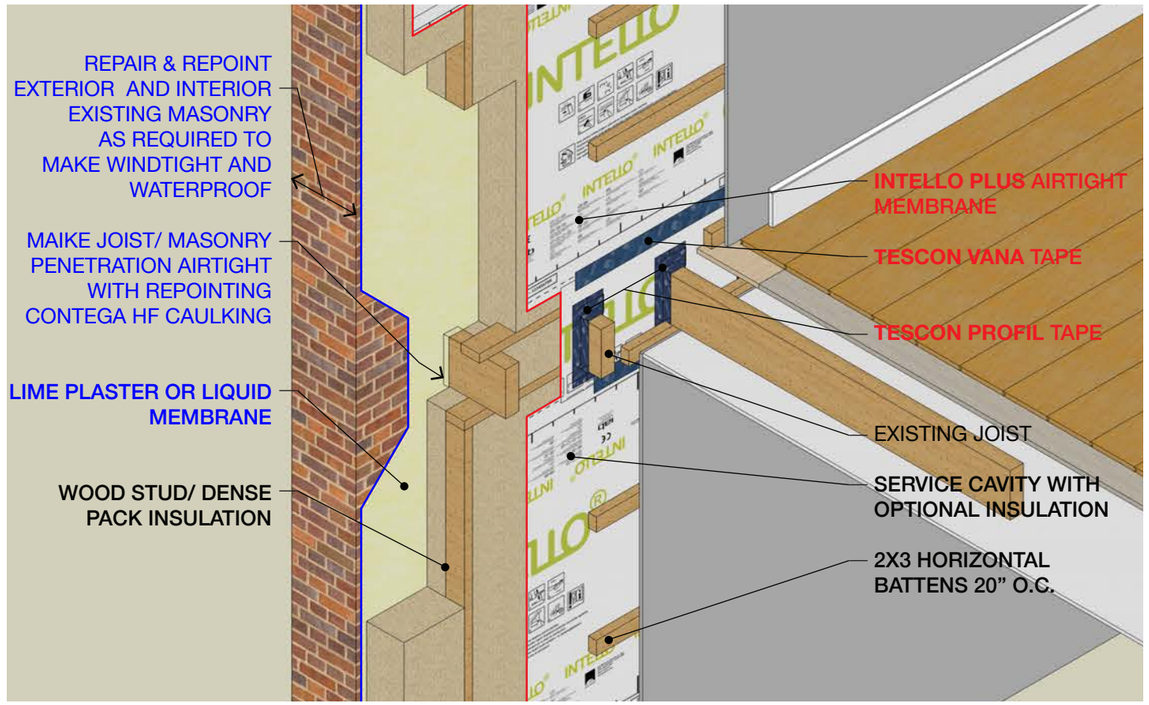
View down at floor connection

2c FLOOR INTERSECTION WITH JOIST PENETRATIONS

Disclaimer: Note that these drawings are diagrammatic and are not intended for direct use. A professional architect, engineer or builder must evaluate and customize per specific job requirements.



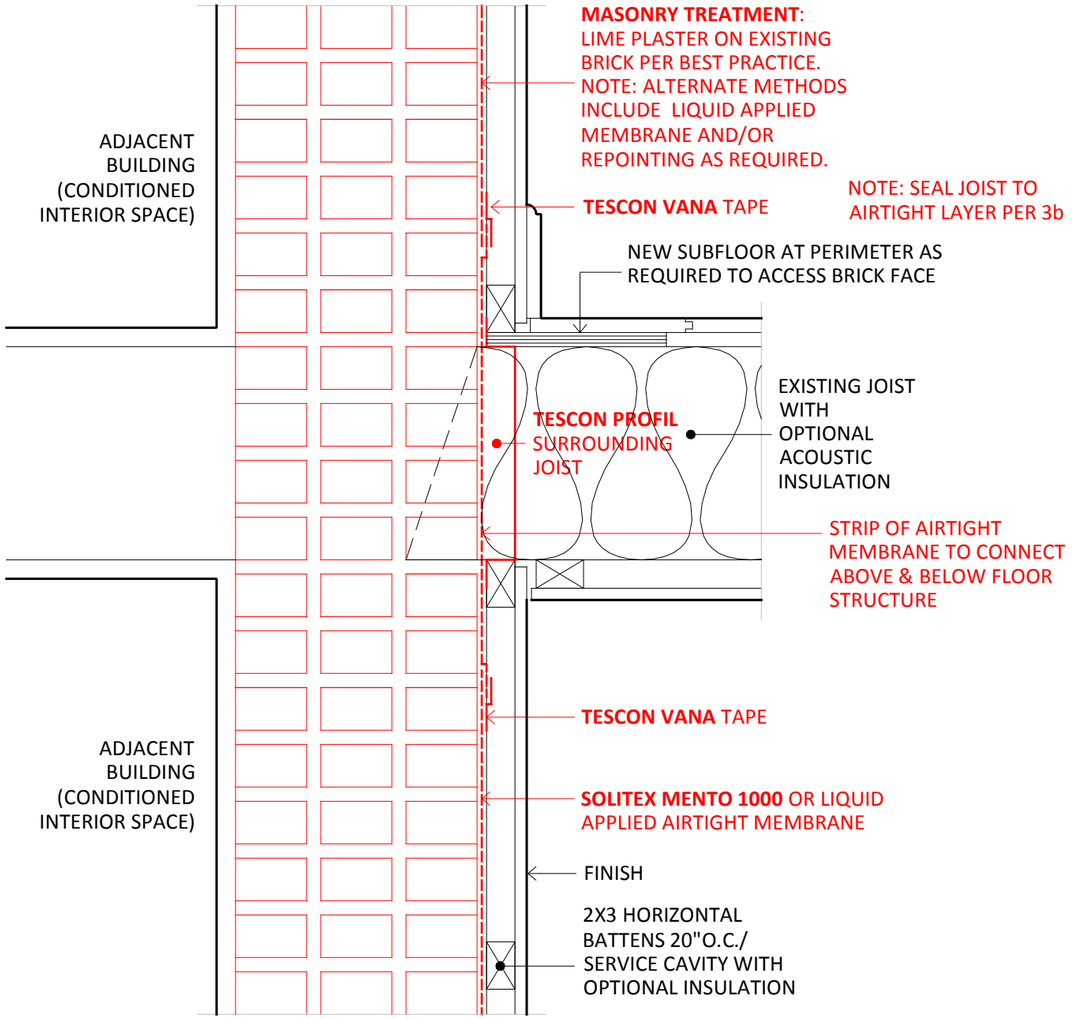
SECTION DETAIL



View down at floor connection

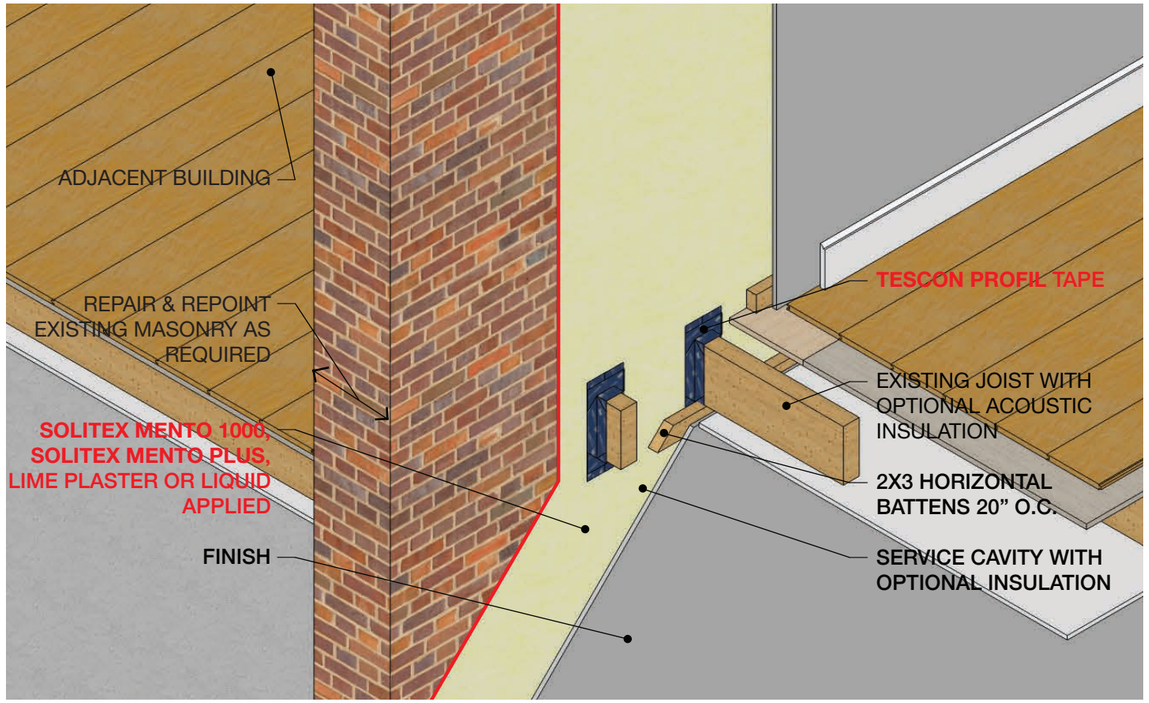
2d FLOOR INTERSECTION AT PARTY WALL

Disclaimer: Note that these drawings are diagrammatic and are not intended for direct use. A professional architect, engineer or builder must evaluate and customize per specific job requirements.



SECTION DETAIL

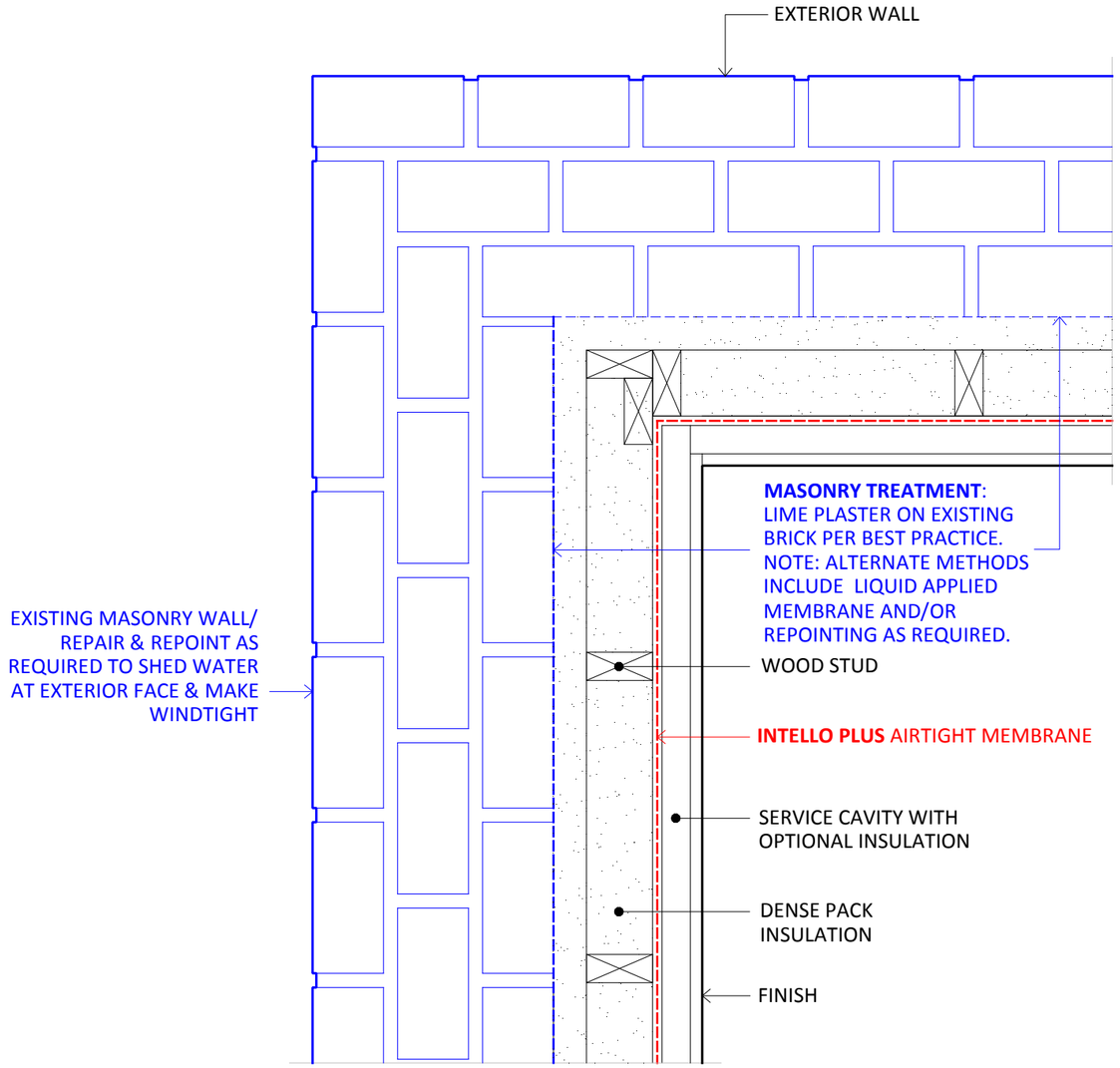
Looking up at gap where flooring boards were removed.

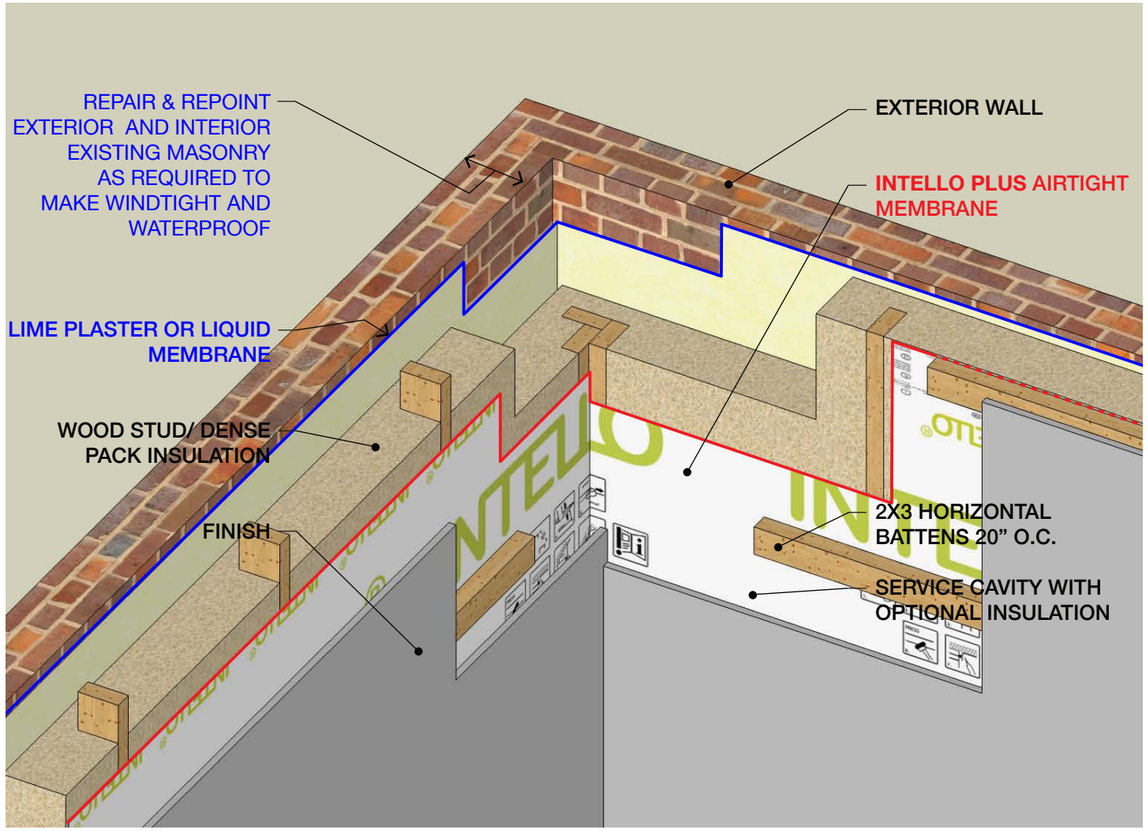


View down at floor connection

2e PLAN AT CORNER/INTERIOR WALL INTERSECTION

Disclaimer: Note that these drawings are diagrammatic and are not intended for direct use. A professional architect, engineer or builder must evaluate and customize per specific job requirements.



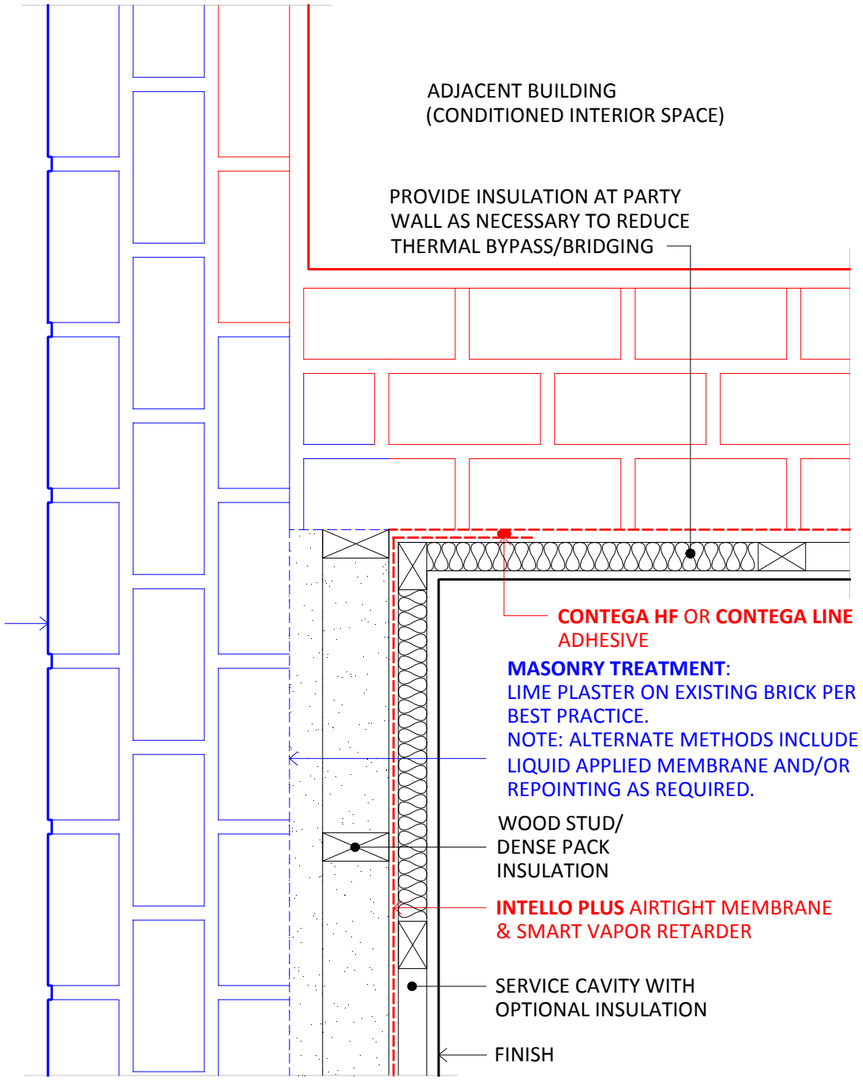


View down at wall intersection

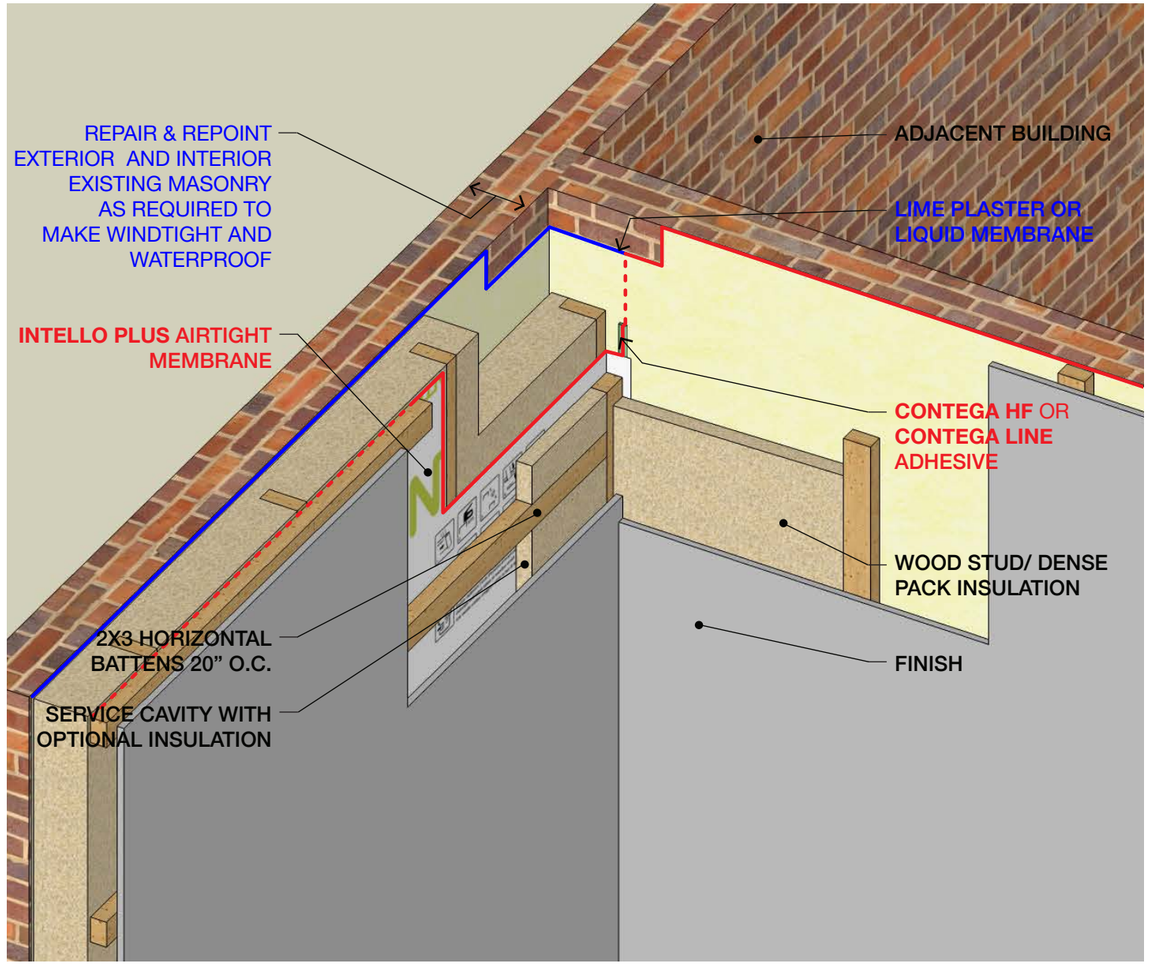
PLAN DETAIL

2f PLAN AT CORNER/ADJACENT BUILDING

Disclaimer: Note that these drawings are diagrammatic and are not intended for direct use. A professional architect, engineer or builder must evaluate and customize per specific job requirements.



PLAN DETAIL



View down at wall intersection

PENETRATIONS: INTRODUCTION

Every penetration adds risk of failure to our complete airtight enclosure and so they should be made as rare as possible. And where unavoidable penetrations must be fully integrated into the airtight system. To limit penetrations we recommend a service cavity inboard of the inboard airtight layer - providing a dedicated space for electrical and plumbing infrastructure and eliminating literally hundreds of penetrations.

WINDOWS & DOOR PENETRATIONS:

Windows and doors comprise the biggest and most obvious penetrations. The window and door units themselves should be completely airtight and very well thermally broken, so that integration becomes a matter of carefully connecting the interior (inboard) and exterior (outboard) window components to the surrounding control layers. Typically this means connecting inboard INTELLO to window frames with TESCON Profil tape - a split back tape designed for tight inside corners. Outboard the window frames are often being connected to the exterior brick or masonry sills - surfaces that can be porous and uneven. CONTEGA EXO tape connected to the exterior side of the frame is vapor open, and then is connected to the masonry with CONTEGA HF caulk adhesive. The window frame should be surrounded with insulation - at the sill, sit the window on intermittent blocks if needed for support with insulation between them. Also overlap insulation at the face of frames to the greatest extent possible - the frames are the weak thermal link.

JOIST PENETRATIONS:

Ideally there would be no wood penetrations, but this is typically not feasible. The best thing that we can do to prevent moisture damage at the wood joist masonry pocket is to keep the conditioned air from flowing into that pocket in the winter. Our primary inboard air barrier should keep that conditioned air away from the joist pocket but we also want a good seal at the masonry face itself. Consequently plaster connected with Pro Clima CONTEGA FC felt tape can be a robust solution or using the liquid membrane to make the connection. At these areas repointing alone will never be good enough.

At party walls, while condensation is not typically a worry, the joist is penetrating the primary air barrier, so we also need to carefully seal them. We typically apply a first coat of STO Gold or Emerald Coat, then tape each joist to the STO. If sheathing or SOLITEX Mento 1000 membrane is used as an air barrier then those need to be taped to the joists as well. If plaster on the brick is being utilized then connection with CONTEGA FC felt tape between joists and plaster is recommended.

One should avoid sistered joist penetrations as it provides a hard to seal gap beween the joists. Often a drill hole can be made at those joint locations then filled with CONTEGA HF caulk adhesive as a stopper. If you cannot make such a “stopper” you may need to seal the two joists together from wall to wall. Try to avoid this.

DUCT, PIPE & WIRE PENETRATIONS:

Ducts, pipe and wire penetrations should be limited to, in the best case, just those few services that absolutely must go to the exterior - the ventilation ducts, the water service, etc… Again the penetrating duct, pipe or wire should be integrated with the control layers, this is possible with flexible tape and EPDM connections. Do not use foam to airseal penetrations. It will crack and fail.

3a WINDOWS AND DOORS

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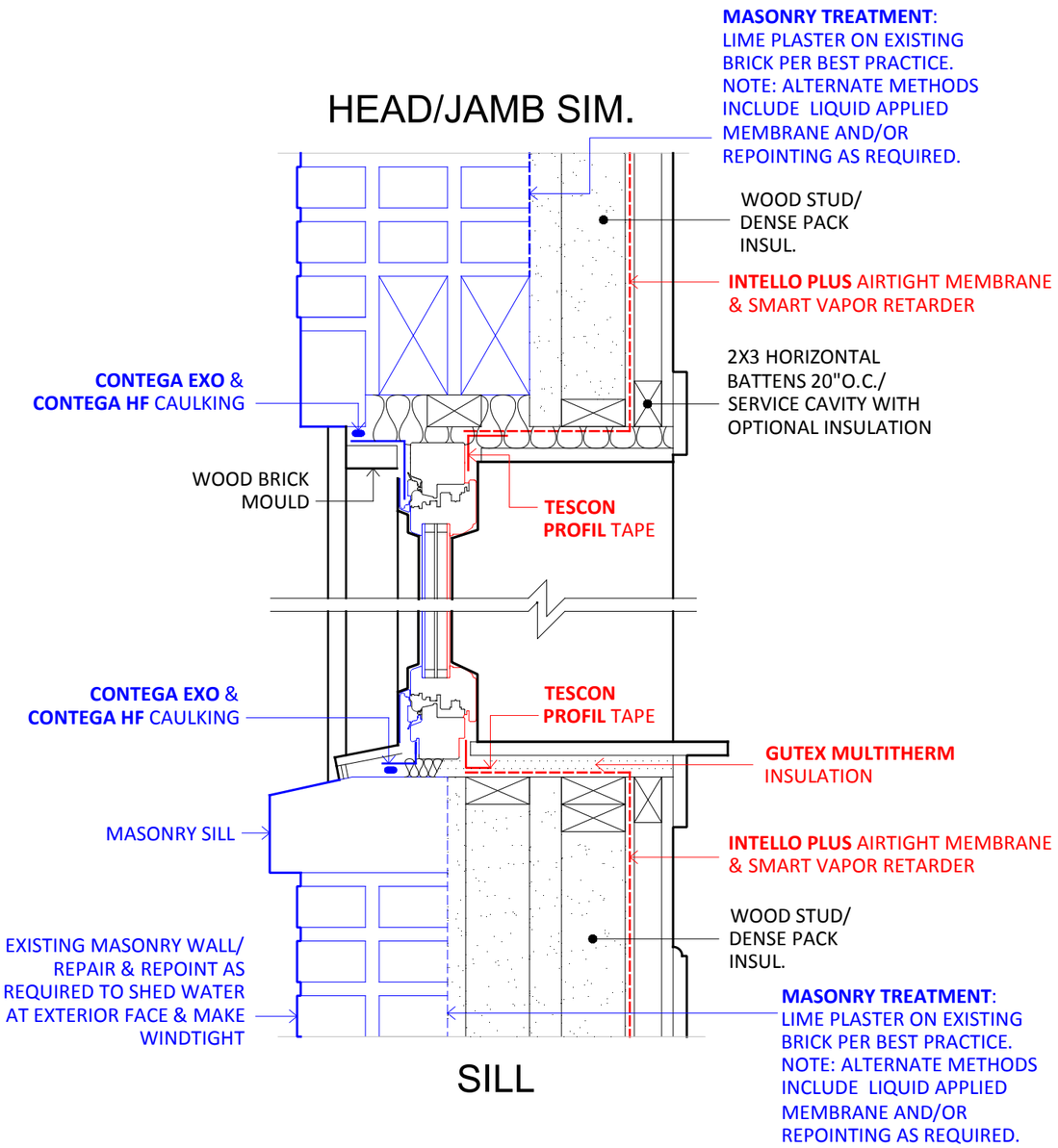
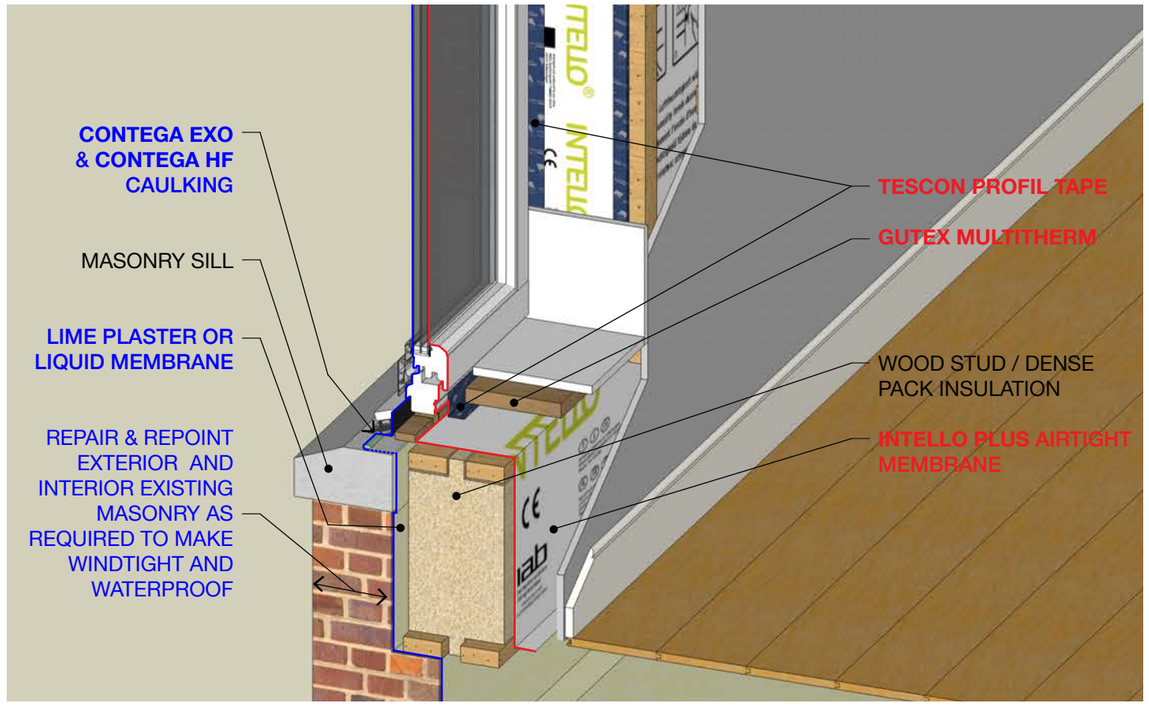


SECTION DETAIL

View up at window head



View down at window sill

3b ROOF WITH LAMILUX SKYLIGHT

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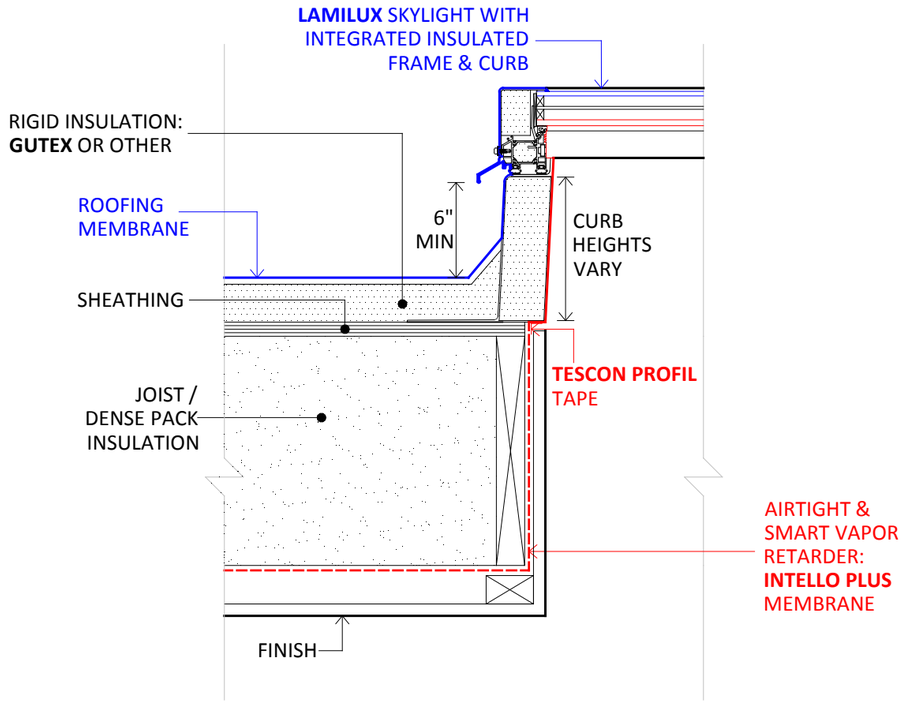
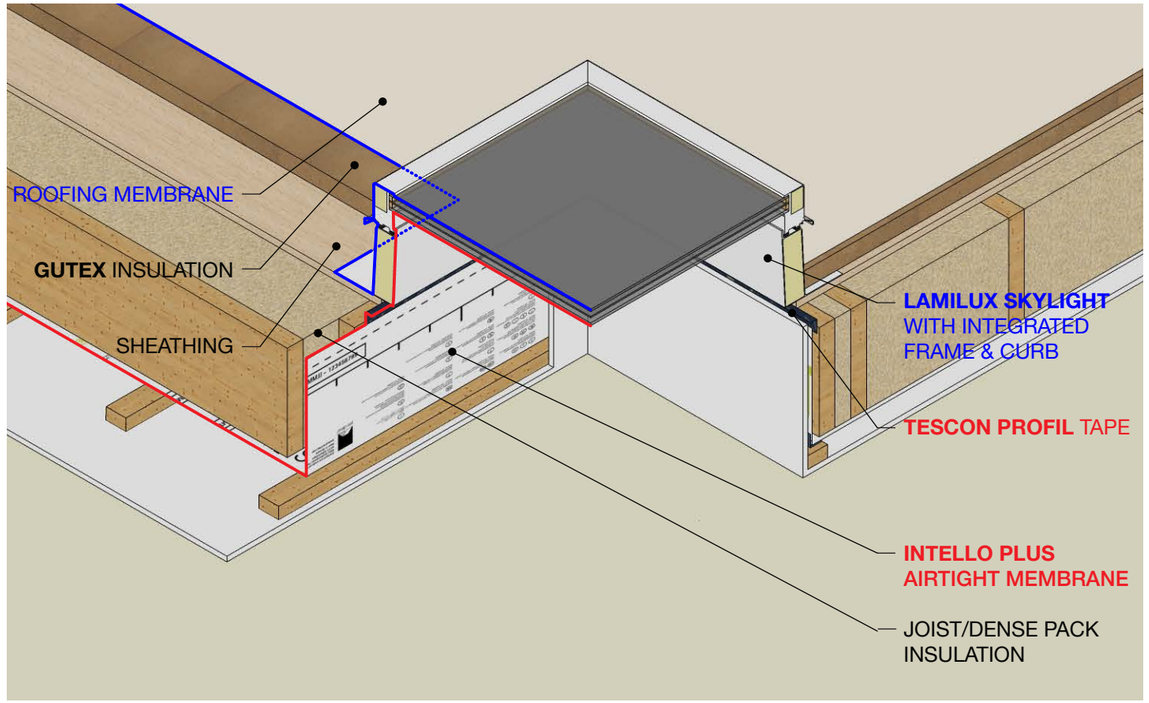


SECTION DETAIL

Two Lamilux FE skylights installed side by side



View down at Lamilux skylight

3c JOIST PENETRATIONS

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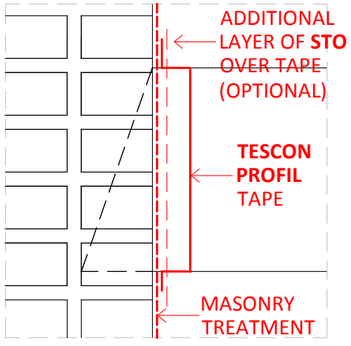
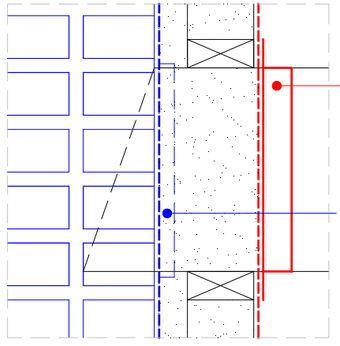
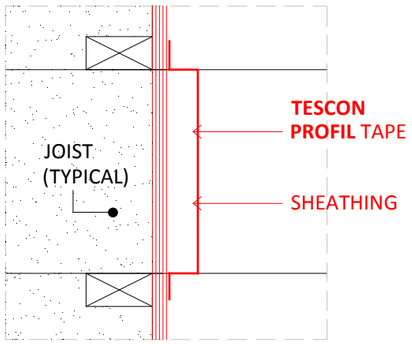
JOIST TO PARTY WALL



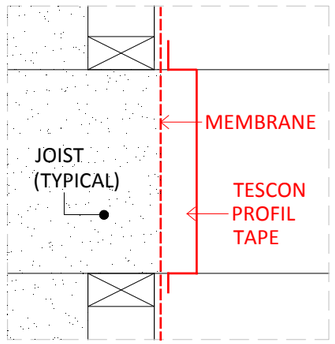
JOIST TO EXTERIOR WALL



JOIST THROUGH SHEATHING



JOIST THROUGH **INTELLO**



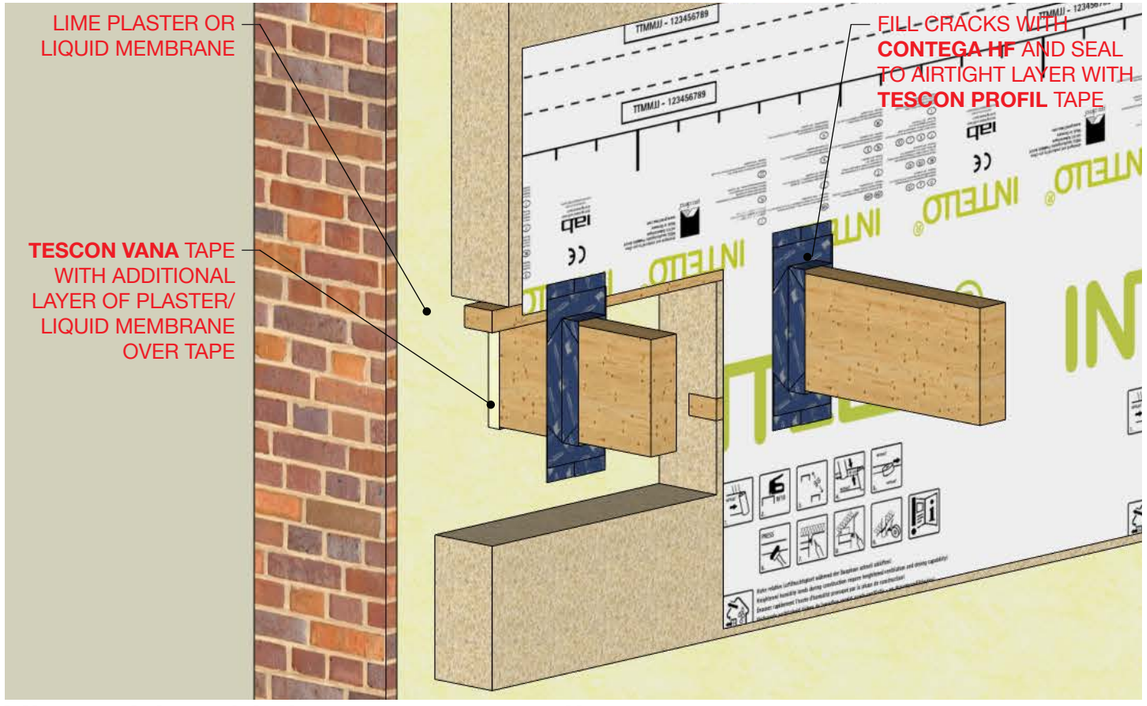
NOTES:

1. SEE 3D DETAIL AND INSTRUCTIONAL VIDEO FOR DETAILED WALK-THRU

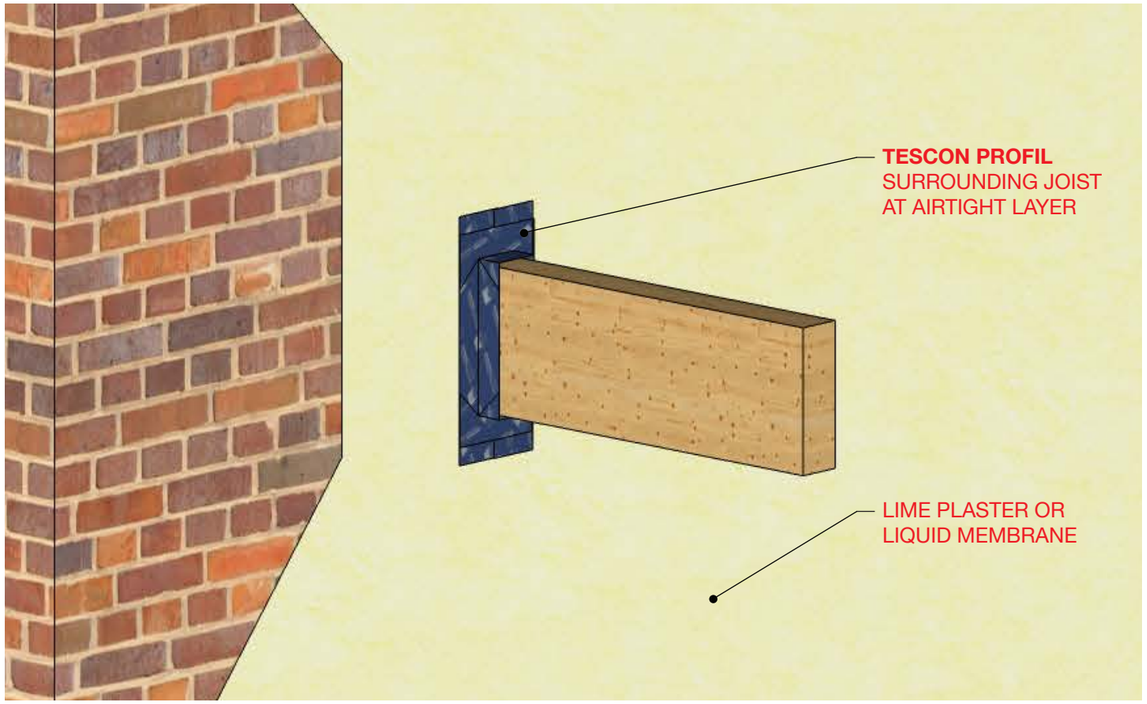
2. FILL ALL WOOD JOIST CRACKS WITH **CONTEGA HF** BEFORE TAPING

3. WOOD JOISTS WITH VERY ROUGH SURFACES MAY REQUIRE SANDING PREP FOR TAPING

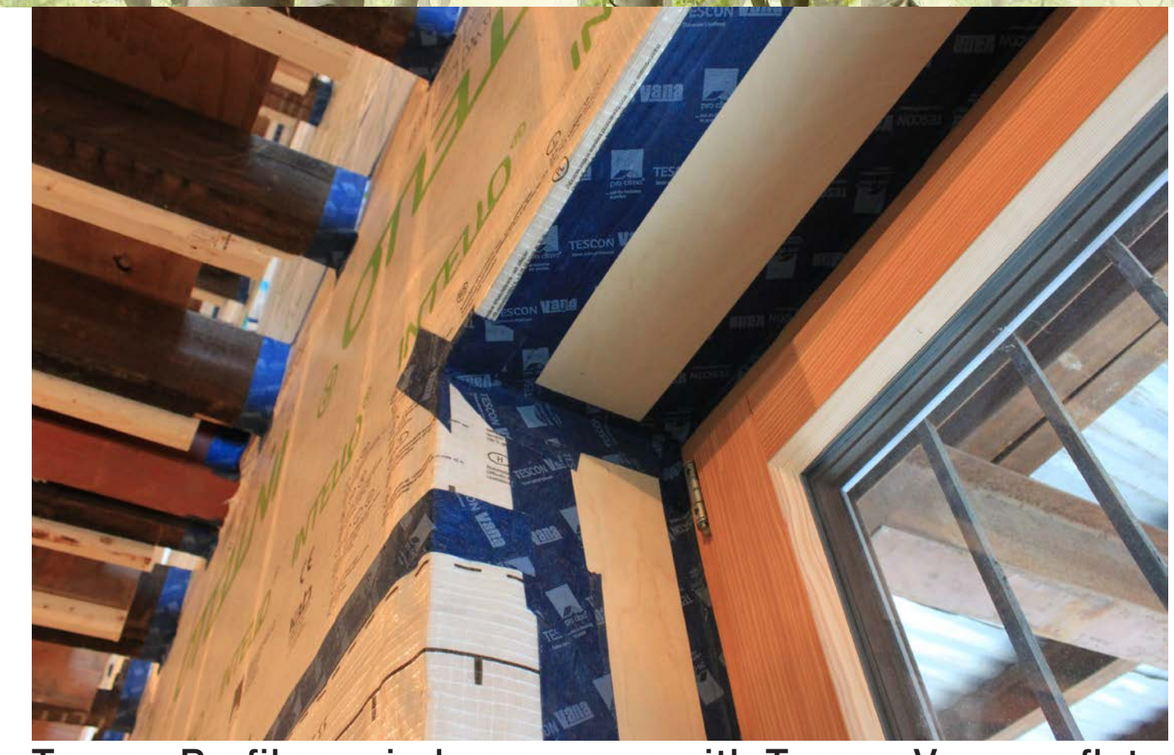
SECTION DETAIL



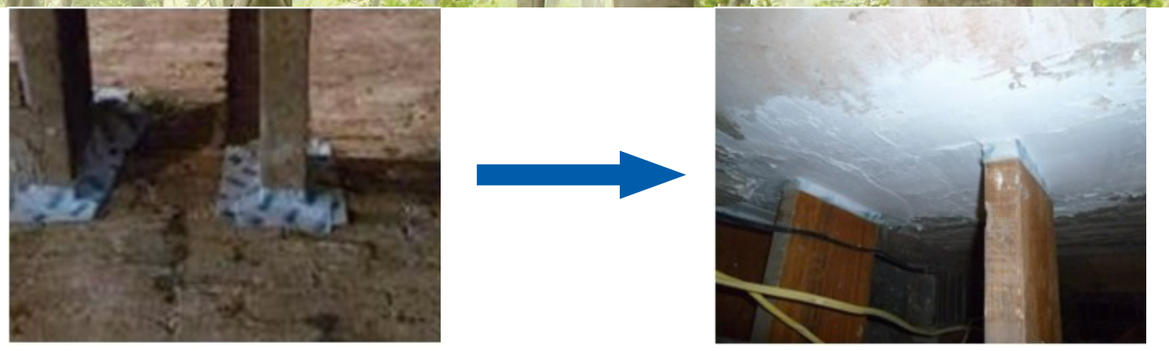
View side of joist to party wall



View side of joist through intello exterior wall



Tescon Profil on window corners with Tescon Vana on flat seams - beams connect at Intello with Tescon Profil



Contega FC with Contega HF adhesive on joist (top left), then apply plaster (top right) Tescon Profil on joist (bottom)

Roflex 100, Roflex 50, Roflex 20

Window connection to wall with Intello and Tescon Vana

3d PIPE PENETRATIONS

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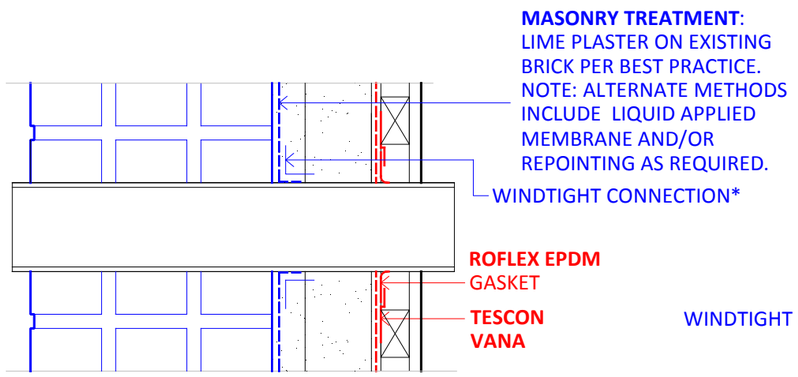
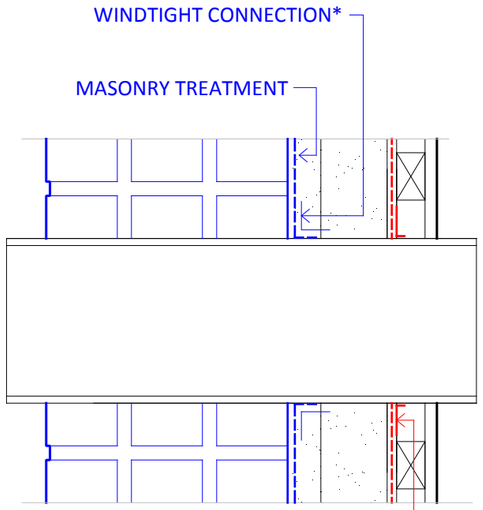
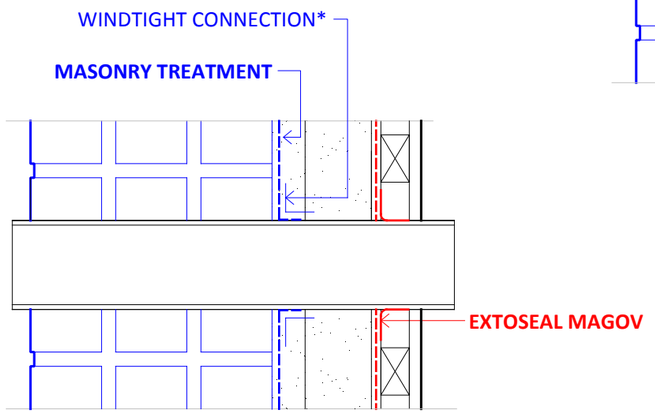


ROFLEX 20 (0.6"-1.2" DIA PIPE)
30 (1.2"-2" DIA PIPE)
50 (2"-3.5" DIA PIPE)
100 (4"-4.7" DIA PIPE)
150 (4.7"-6.7" DIA PIPE)
200 (6.7"-8.7" DIA PIPE)



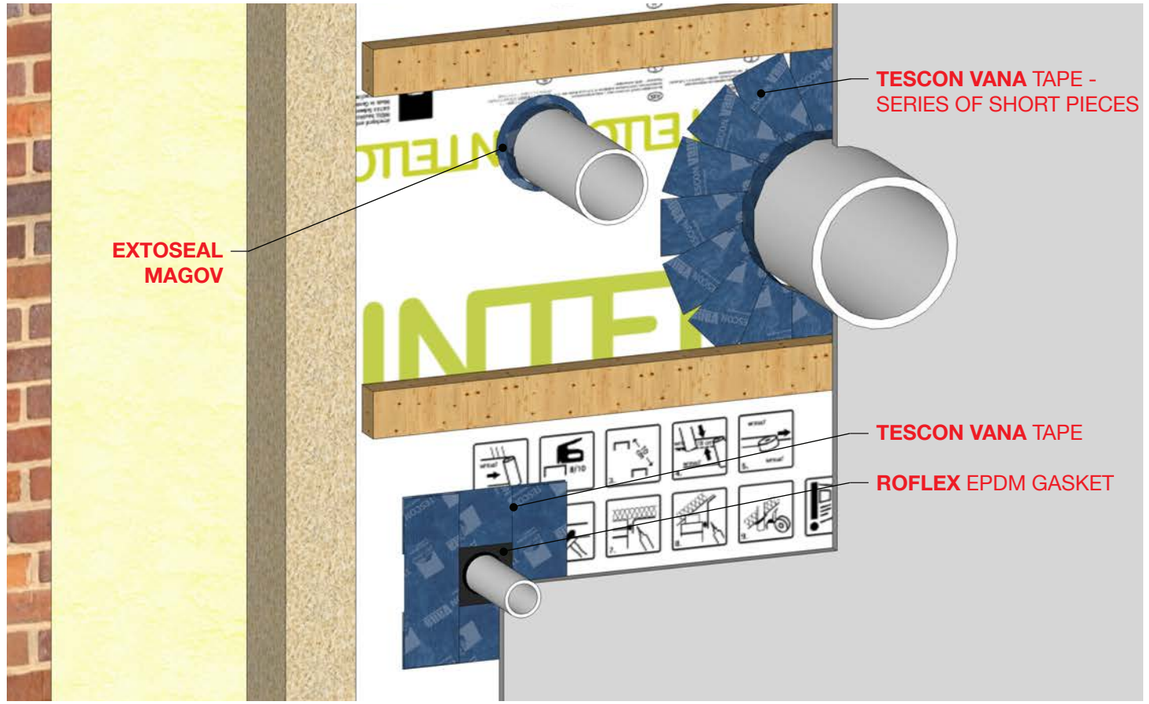
TESCON VANA



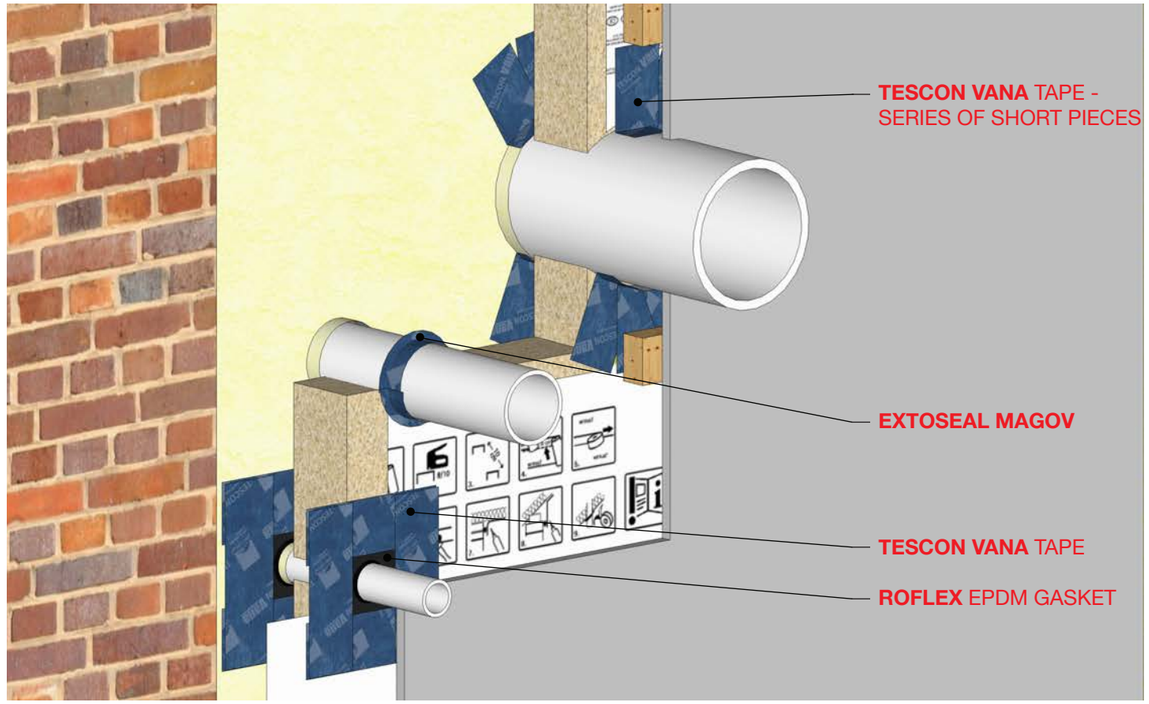
EXTOSEAL MAGOV

*CONNECTION MAY BE:
-ROFLEX GASKET & TAPE
-TAPE
-LIQUID MEMBRANE CONTINUED ONTO PIPE

SECTION DETAIL



View of pipe penetrations at interior air barrier



View of pipe penetrations at interior brick face

3e WIRE PENETRATIONS

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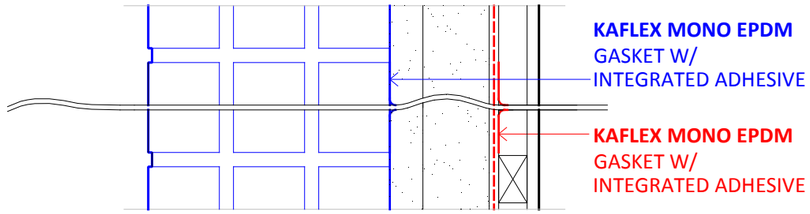
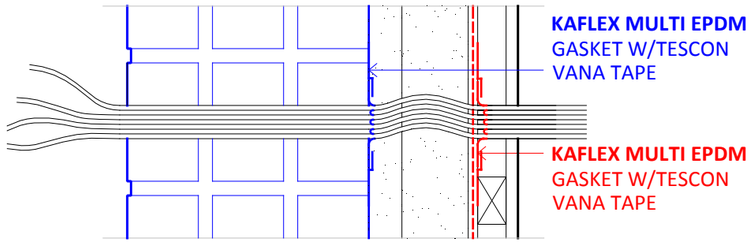
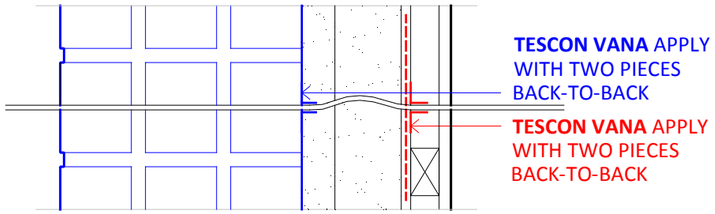


KAFLEX Mono

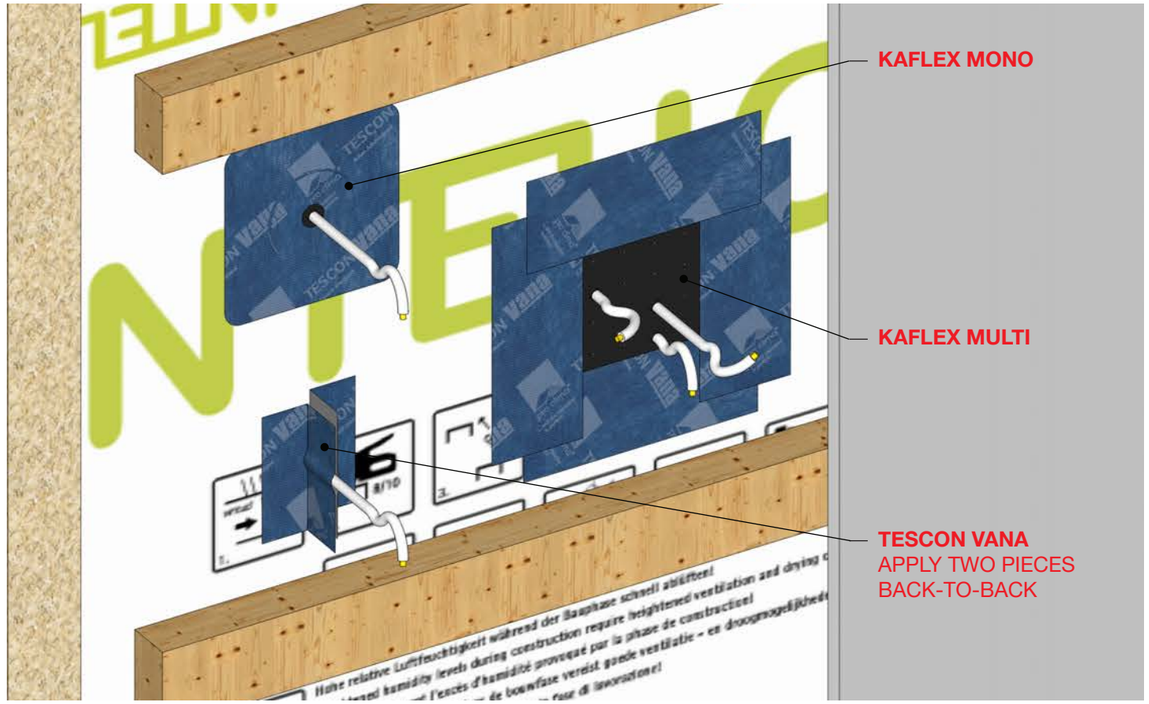


KAFLEX Multi



TESCON VANA,
PROFIL OR
KAFLEX POST

Images: Kaflex Mono, Kaflex Post, Kaflex Multi



View side of wire penetrations

SECTION DETAIL

ROOFS: INTRODUCTION

Roofs on historic masonry buildings come in all shapes and configurations. In this guide we are concentrating first on the typical low-slope/flat roofs common on historic townhouses and warehouses. These roofs are typically of wood construction, often having a vented space or “cockloft” within the roof assembly.

The general approach here is to transform the roof construction to a high-performance unvented flat roof – where the formally vented space is now used for thermal insulation and additional insulation may be applied, if edge details permit, on top of the existing roof deck.

The roof deck should be exposed and repaired and/or replaced as required. Don’t simply add insulation on top of the existing roof and then add another roof – as this results in two vapor barriers within the assembly. Two vapor barriers within an assembly can trap moisture between them and is a known cause of potential long-term moisture problems.

AIRTIGHTNESS AND VAPOR CONTROL:

The new roof membrane serves as the outboard air barrier and so the terminations at the roof edges are a critical consideration in maintaining airtightness. The roof is also a vapor barrier and so vapor control and airtightness inboard of the insulation is critical. This is achieved with the INTELLO smart vapor retarding airtight membrane that also ties into ajoining control layers at the surrounding walls.

INSULATION:

Between the roofing and the interior INTELLO there should be as much insulation as is reasonably possible, as it doesn’t subtract from floor area like at the walls and it is a thermal boundary to the extreme outdoor temperatures, unlike the relatively moderate temperature differences found at the ground boundary. R-50 to R-100+ is possible. However depending on the optimization levels as low as R-60 may be possible to reach Passive House level performance.

Insulation on the roof deck can be GUTEX wood fiberboard or ROXUL mineral wool boards. Insulation at roof cavity should typically be dense-pack cellulose or fiberglass.

4a UNVENTED FLAT ROOF AT EXTERIOR WALL

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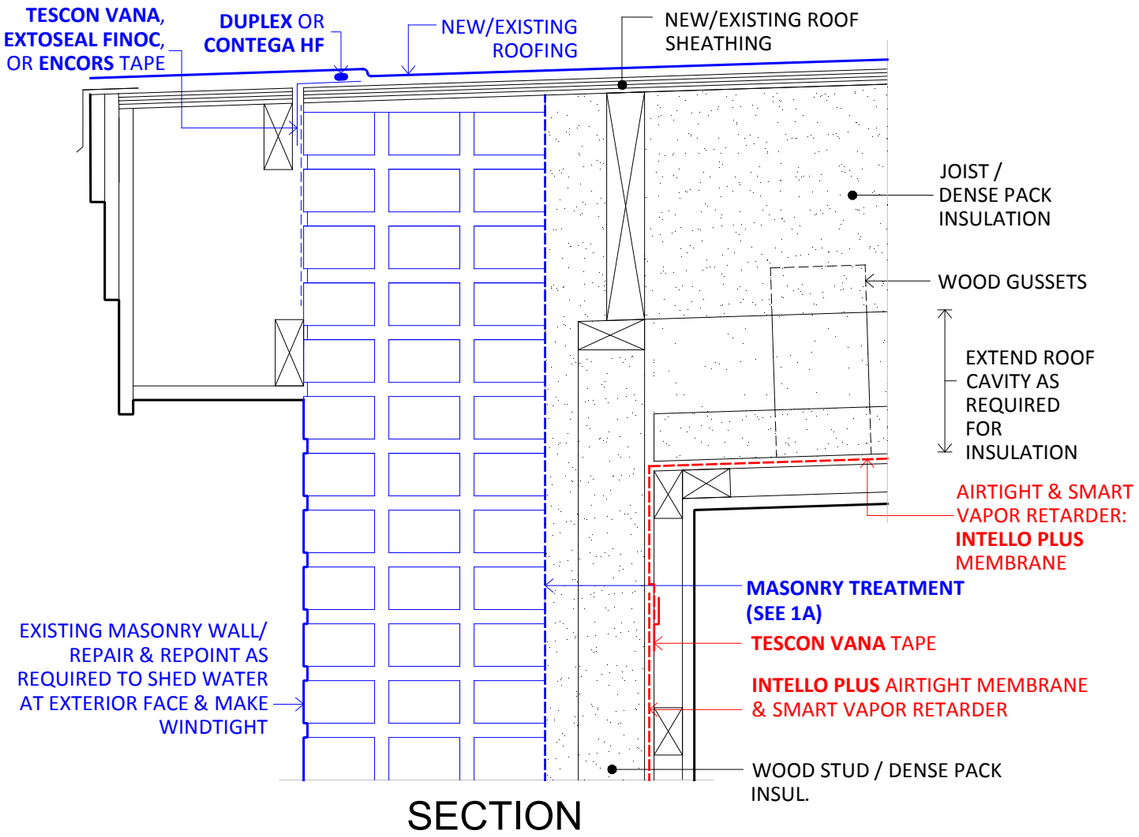
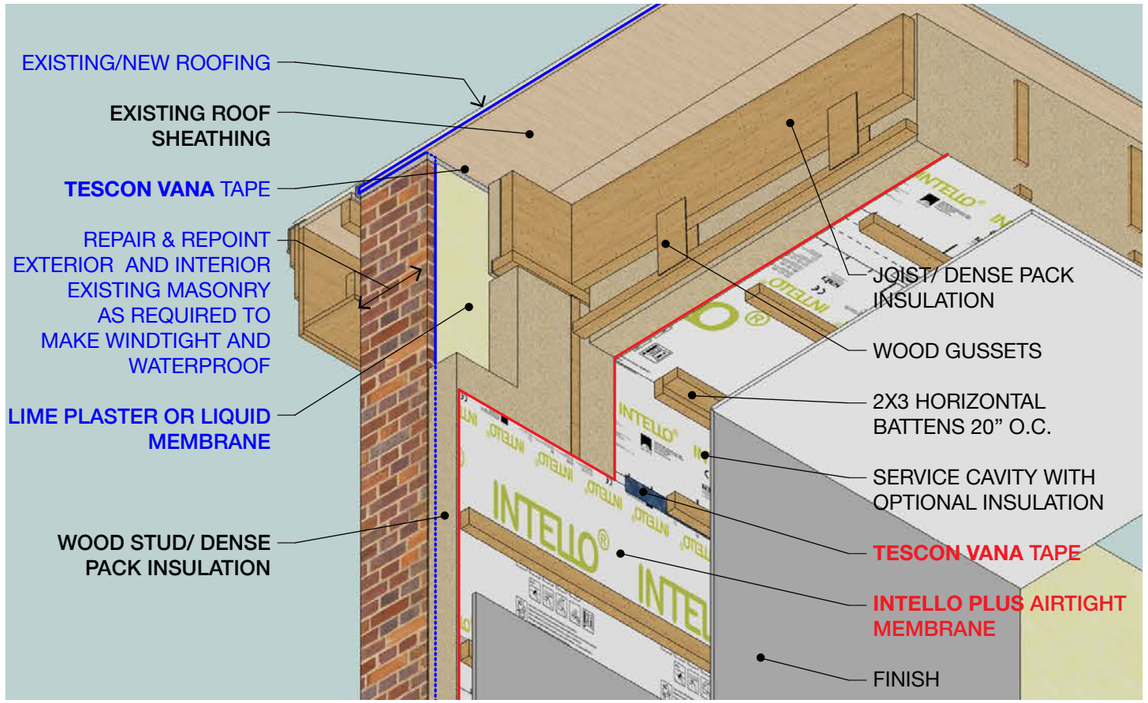


SECTION

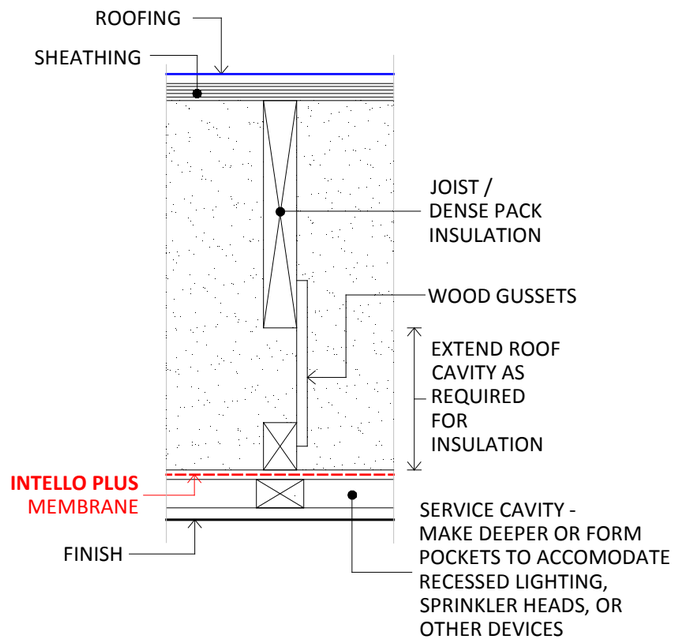
NOTE: SEE 475 BLOG POST

- "UNVENTED FLAT ROOFS: A TECHNICAL DISCUSSION"
- THE TEN GOLDEN RULES FOR FOAM-FREE FLAT ROOFS

SECTION DETAIL



View up at roof connection



CROSS-SECTION AT ROOFING

4b UNVENTED FLAT ROOF AT PARTY WALL

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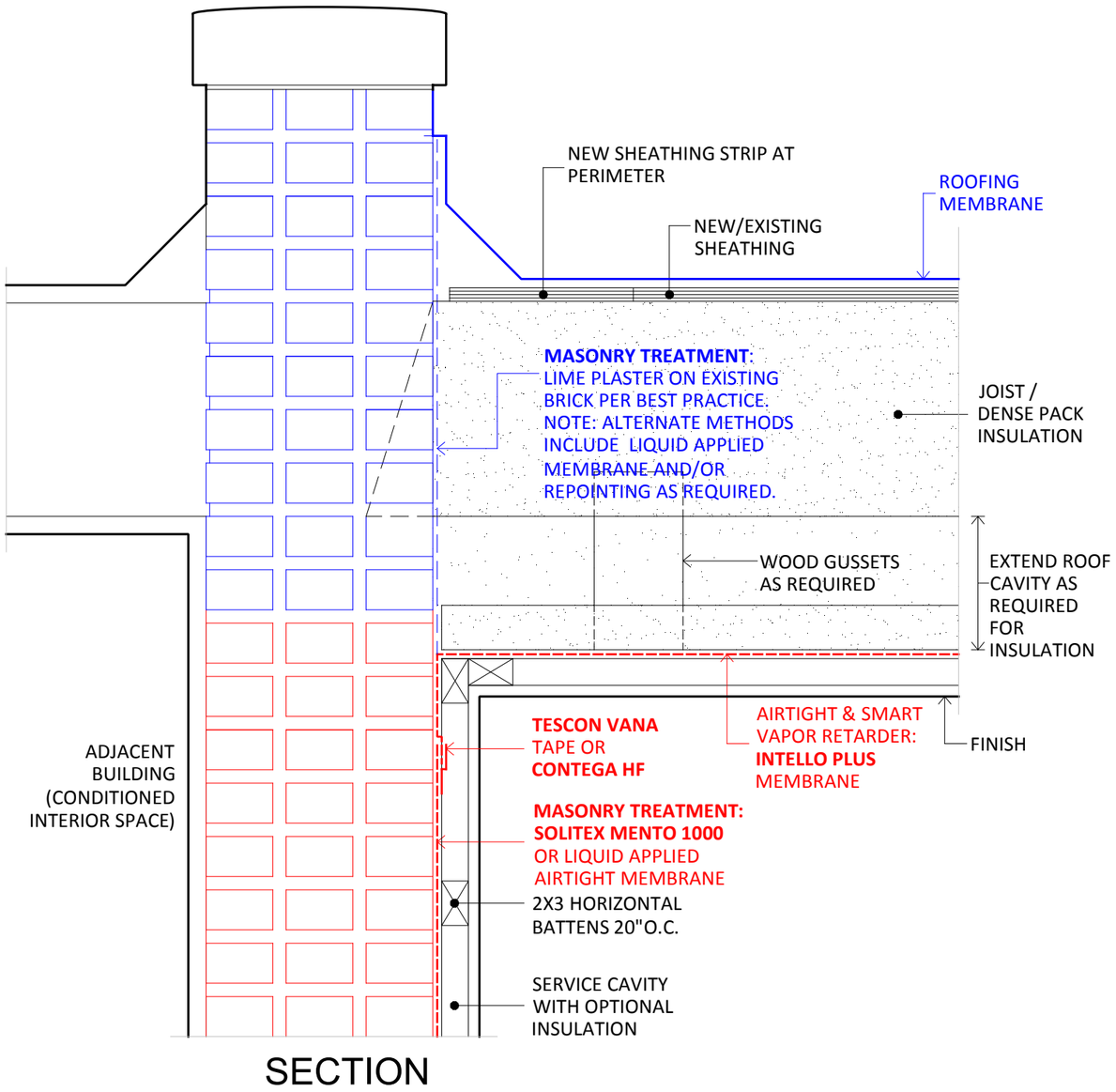
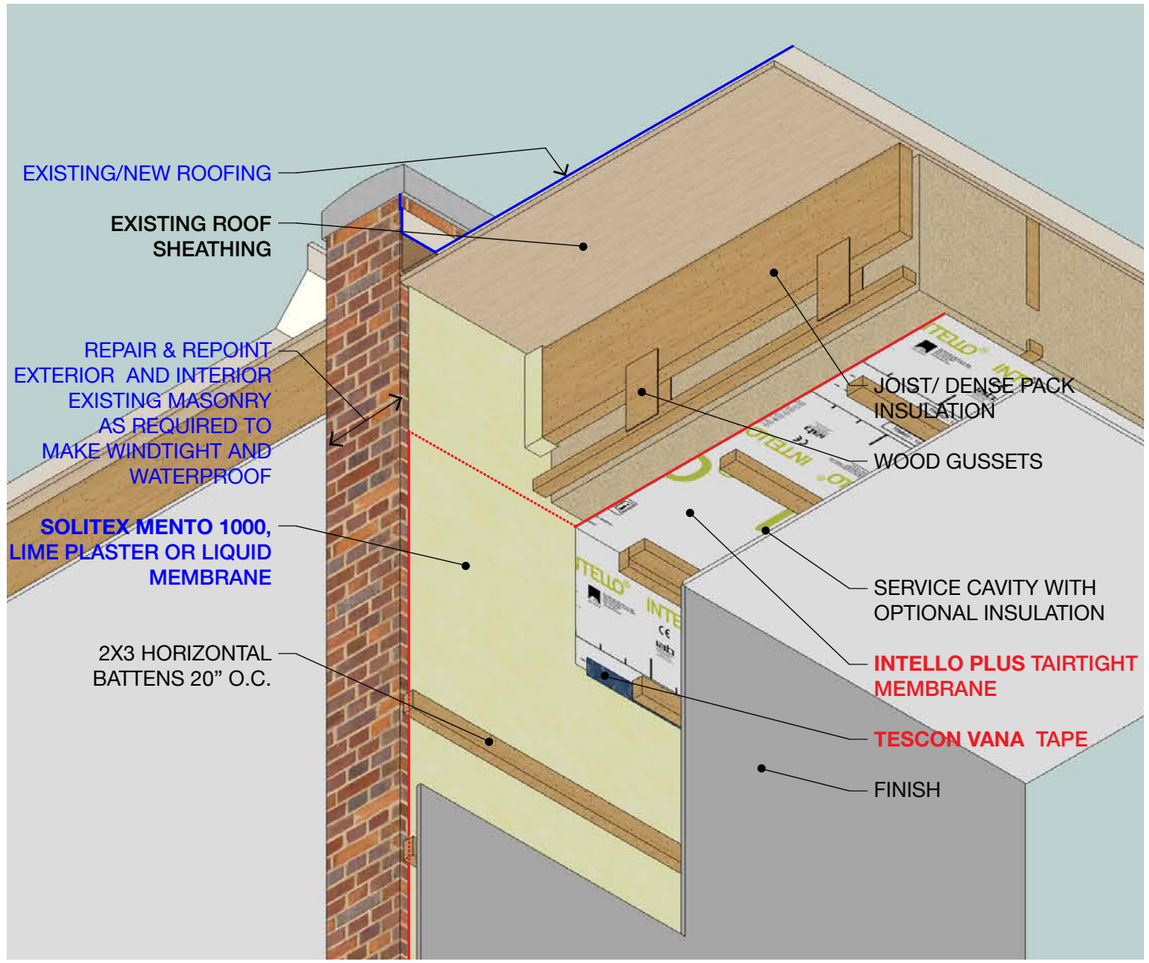


SECTION



View up at roof connection

SECTION DETAIL

4c FLAT ROOF WITH TOP INSULATION

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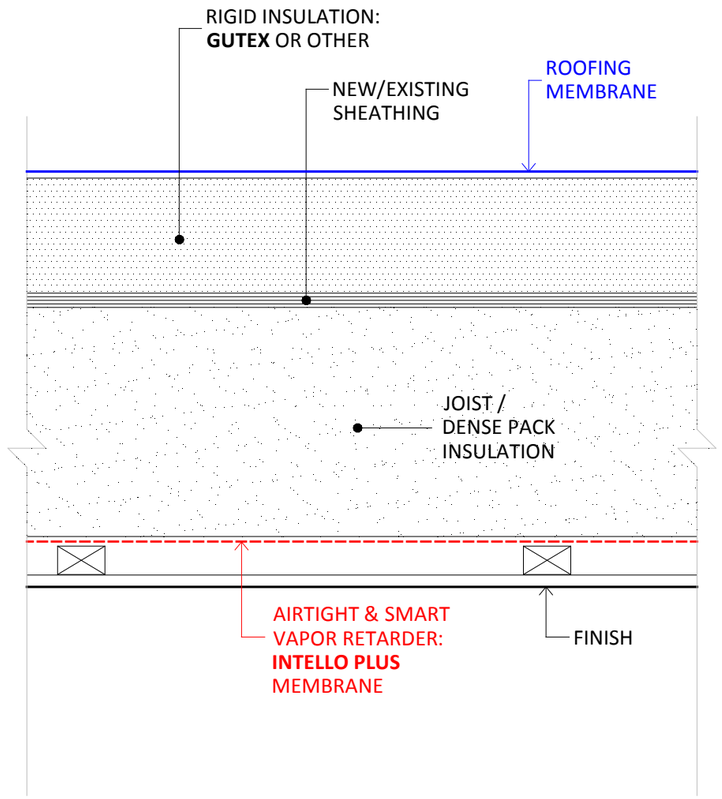
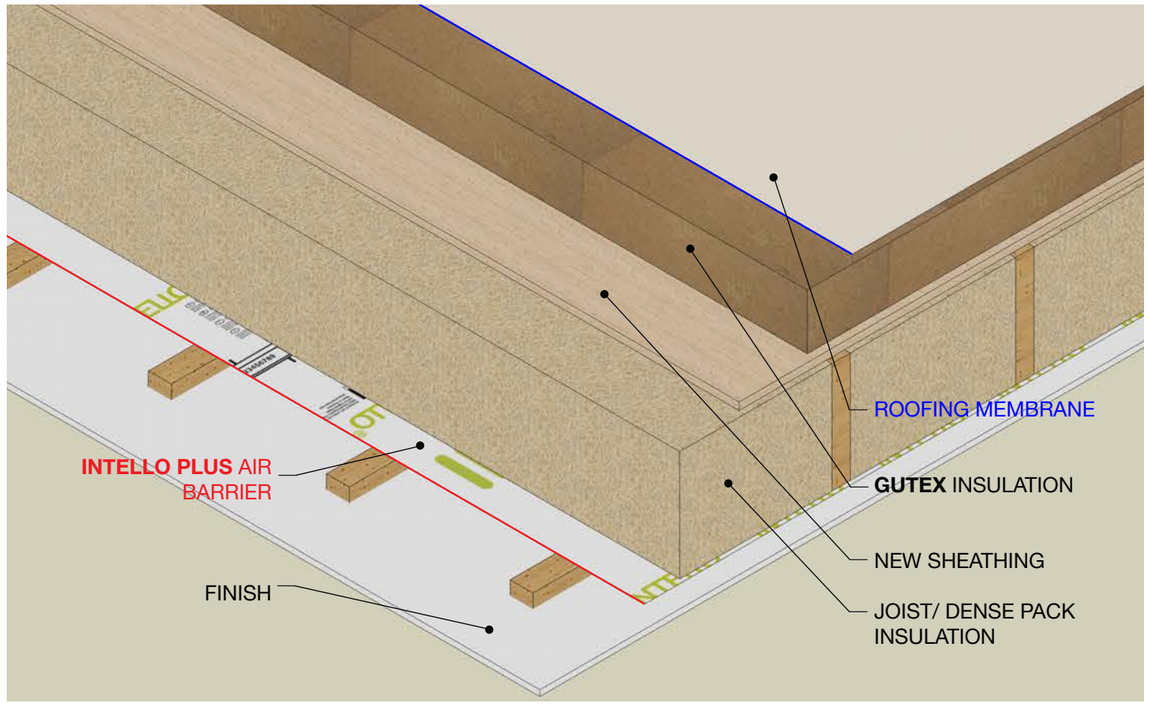


SECTION DETAIL

View up at roof/wall connection



View down at roof

MATERIALS DESCRIPTION INDEX

AIR & VAPOR CONTROL LAYERS

DB+

Vapor variable (perm 0.8 to 5.5), interior use only, paper based, airtight membrane.

INTELLO

Intelligent vapor retarder for first class interior air sealing of walls and ceilings. Designed for use with batt insulation. Offers high diffusion tightness in winter (0.17 perm). Maximum diffusion openness in summer (13.20 perm).

INTELLO PLUS

Intelligent vapor retarder for first class interior air sealing of walls and ceilings with an integrated reinforcement layer for use with dense pack. Offers high diffusion tightness in winter (0.17 erm). Maximum diffusion openness in summer (13.20 perm).

SOLITEX MENTO 1000

Vapor open housewrap and roof underlayment. Provides superior weather protection which resists 33' of water column. Remains air tight and actively vapor open with its monolithic TEEE film layer.

SOLITEX MENTO PLUS

Vapor open housewrap and roof underlayment with a reinforcement layer that is suitable for dense pack insulation. Withstands 33' water column. Remains air tight and actively vapor open with its monolithic TEEE film layer.

Lime Plaster/ Liquid Membrane

Lime plaster can not only form a robust permeable outboard airtight layer but naturally inhibits mold growth. Commonly used liquid membranes include STO Gold and Emerald Coats that can be brush or spray applied.

THERMAL CONTROL LAYERS

GUTEX WOOD FIBER BOARD

Moisture resistant wood fiberboard and weather resistive barrier for exterior walls under rainscreens and under roofing. High quality single-ply construction, tounge & groove edges at R-3.7 per inch. Available in a variety of thicknesses.

Other Insulation Options

- Dense pack cellulose
- Dense pack fiberglass
- Mineral wool
- Rigid fiberglass
- Denim batt
- Fiberglass batt

DAYLIGHT SYSTEMS

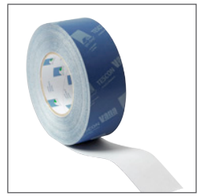
LAMILUX FE

High performance skylight that has a thermal bridge free frame to optimize the performance of your Passive House and high performance construction. Available in a variety of types and sizes include roof exit hatch.

LAMILUX ENERGYSAVE

A PHI Certified skylight that has a thermal bridge free frame to optimize the performance of your Passive House construction. Highest air sealing class - 4, and Uskylight (installed): 0.148 BTU/hr.ft2.°F (0.84 W/m2K).

AIR & VAPOR CONTROL TAPES AND ADHESIVES



TESCON VANA

All-around interior and exterior vapor open (8 perms) air sealing for permanent airtight taped bonding of membranes, plywood, OSB, concrete and a variety of airtight substrates.

TESCON VANA 75, 100, 150 & 200

Tescon Vana tapes comes in a variety of widths. Standard Vana is 2 3/8" (60mm). All numbers following the name refer to the width of the tape in millimeters.

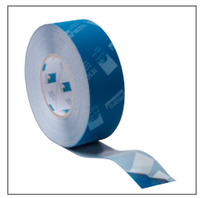
CONTEGA HF

All-around adhesive caulk for interior and exterior airtight connections between and uneven substrates or difficult junctions. Exceptionally high adhesion properties while also remaining elastic. Zero-VOC available in 310ml cartridges and 600ml sausage tubes.

CONTEGA LINE

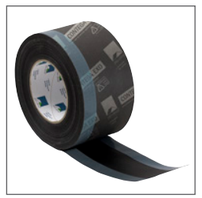
Adhesive on a roll for instant flexible air seal adhesion on interior between practically all construction materials, including uneven surfaces. Zero-VOC, and available in 50' roll lengths.

PENETRATION AIR SEALING



TESCON PROFIL

Same high performance tape properties as Tescon Vana with a 3 split release paper to make airtight connections and waterproof seals at corners, window-frames and beams. Interior and exterior use and vapor open at 8 perms.

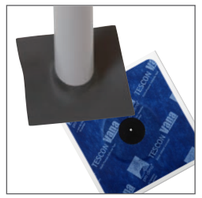


CONTEGA EXO

Waterproof, very vapor open (38 perms), air-sealing tape to connect window frames and openings to WRBs, concrete, masonry, OSB, or plywood. Three adhesive strips gives the tape the flexibility to be used before and after installation of the window frame.

EXTOSEAL MAGOV

Highly elastic adhesive tape for airtight seals around penetrations of all types and sizes. Strong, but flexible, butyl rubber molds to fit rough and uneven substrates and wrap any shape necessary.



ROFLEX / KAFLEX

These EPDM gaskets create quick, durable, and flexible air sealing for wires (KAFLEX), and pipes (ROFLEX). Available in a variety of sizes and types to fit the needs of the penetration.

VENTILATION

LUNOS e^2

A decentralized through-wall ventilation system with a built-in regenerative heat recovery core. Operating in pairs, these fans provide continuous ventilation without the need for duct-work and recovers heat at 90.6% tested efficiency.

LUNOS e^{GO}

All-in-one through-wall room ventilation system with a built-in regenerative heat recovery core. Designed for bathrooms and small spaces without the need for ductwork and recovers heat at 85% tested efficiency.

475

HIGH PERFORMANCE
BUILDING SUPPLY

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