WATER & DRAINAGE

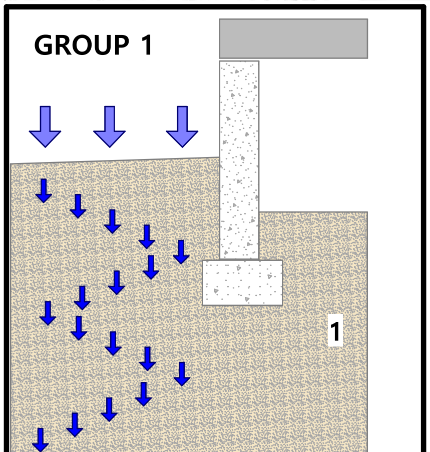
***CONSTRUCTION CONCERNS_**WATER OR WATER VAPOR GETTING INTO A STRUCTURE IS SIMPLY A PROBLEM, AND ONE THAT CAN BE LARGELY PREVENTED. MOST OF US CAN USE SIMPLE LOGIC TO UNDERSTAND HOW TO KEEP VISIBLE WATER AWAY, AND OUT. MIGRATING WATER AND WATER VAPOR IS TOUGHER BECAUSE IS DOESNT ALWAYS ADHERE TO THE RULES AND GRAVITY, AND CAN BE INVISIBLE. THE MYSTERIOUS PART ABOUT WATER VAPOR IS CAN REAPPEAR AS WATER IN PLACES YOU JUST CAN'T SEE. IF ONE CAN ANTICIPATE WATER BEHAVIOR, IT CAN BE HEADED OFF.

Table 1

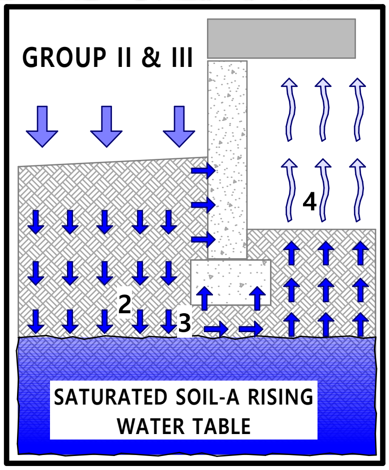
Properties of Soils Classified According to the Unified Soil Classification System

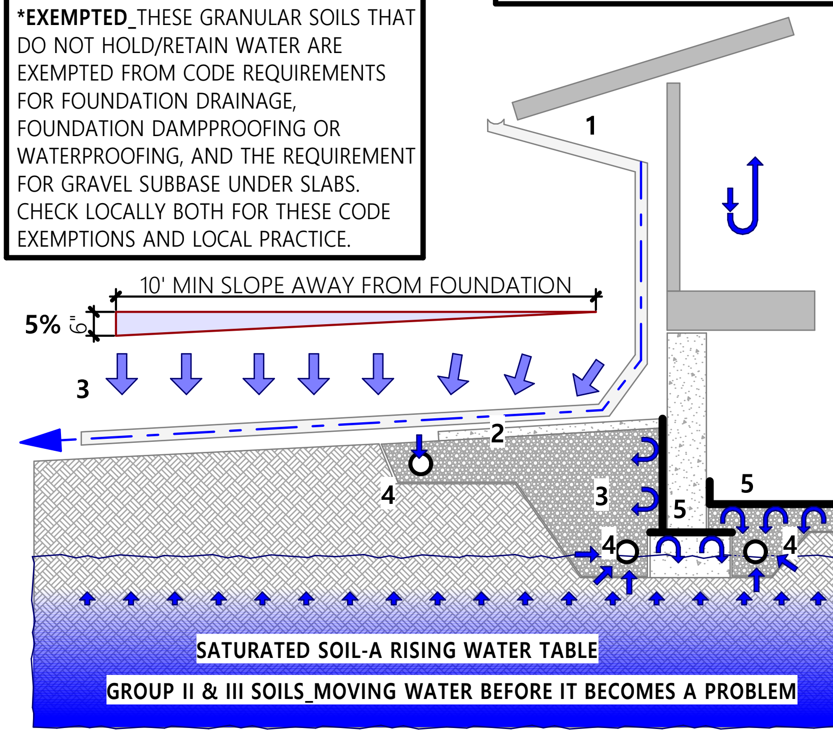
Table reference: 2012 IRC Table R405.1

Soil Group	Unified Soil Classification System	Soil Description	Drainage Characteristics (a)	Frost Heave Potential	Volume Change Potential Expansion (b)	Presumptive Load-Bearing Pressure (PSF) (d)
Group I Excellent	GW	Well graded gravel, gravel-sand mixtures, little or no fines	Good	Low	Low	3000
	GP	Poorly graded gravels or gravel sand mixtures, little or no fines	Good	Low	Low	3000
	SW	Well-graded sands, gravelly sands, little or no fines	Good	Low	Low	2000
	SP	Poorly graded sands or gravelly sands, little or no fines	Good	Low	Low	2000
	GM	Silty gravels, gravel-sand-silt mixtures	Good	Medium	Low	2000
	SM	Silty sand, sand-silt mixtures	Good	Medium	Low	2000
Group II Fair to Good	GC	Clayey gravels, gravel-sand-clay mixtures	Medium	Medium	Low	2000
	SC	Clayey sands, sand-clay mixture	Medium	Medium	Low	2000
	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	Medium	High	Low	1500(c)
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	Medium	Medium	Medium to Low	1500(c)
Group III Poor (a)	CH	Inorganic clays of high plasticity, fat clays	Poor	Medium	High	1500(c)
	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Poor	High	High	1500(c)
Group IV Unsatisfactory (a)	OL	Organic silts and organic silty clays of low plasticity	Poor	Medium	Medium	By Test
	OH	Organic clays of medium to high plasticity, organic silts.	Unsatisfactory	Medium	High	By Test
	PT	Peat and other highly organic soils	Unsatisfactory	Medium	High	By Test



***EXEMPTED_**THESE GRANULAR SOILS THAT DO NOT HOLD/RETAIN WATER ARE EXEMPTED FROM CODE REQUIREMENTS FOR FOUNDATION DRAINAGE, FOUNDATION DAMPPROOFING OR WATERPROOFING, AND THE REQUIREMENT FOR GRAVEL SUBBASE UNDER SLABS. CHECK LOCALLY BOTH FOR THESE CODE EXEMPTIONS AND LOCAL PRACTICE.





SOIL TYPE MATTERS

***WELL DRAINING SOILS_**GROUP I (GRANULAR) SOILS, DRAIN WELL AND THEREFORE DO NOT 'HOLD' WATER.

***NOT SO WELL DRAINING SOILS_**GROUP II & GROUP III (COHESIVE SOILS) DO NOT DRAIN AS WELL AND DO 'HOLD' WATER.

***THE CODE_**THE CODE MAKES A DISTINCTION IN THESE SOIL TYPES RELATIVE TO WATER MANAGEMENT. WELL DRAINING SOILS (MAY BE) EXEMPT FROM FOUNDATION WATERPROOFING AND OR VAPOR BARRIERS OTHERWISE REQUIRED FOR FOUNDATIONS IN GROUP II & III SOILS.

***CHECKING THAT SOIL_**EXPLORATION HOLES AND EXAMINATION OF SOIL SAMPLES ARE WELL & GOOD AS FAR AS THEY GO. FAR MORE COMPLETE AND THE CLEAREST WAY TO DECIDE ON PROJECT SPECIFIC WATER MANAGEMENT TECHNIQUES IS TO OBSERVE THE FOOTING EXCAVATION AND EXAMINE THE 'CUT' THROUGH THE SOIL. DUMPING A MORE SERIOUS AMOUNT OF WATER, OR OBSERVING A RAIN FALL, IN A FOOTING TRENCH, REPRESENTS A REAL TIME DRAINAGE STUDY.

WATER/WATER MIGRATION/WATER VAPOR

1*GROUP I SOILS_WELL DRAINING SOILS ALLOW SURFACE WATER QUICKLY INTO THE SOIL, AND BELOW THE DEPTH WHERE CONSTRUCTION IS AFFECTED.**

2*GROUP II & III SOILS_ MAY RETAIN WATER FOR LONGER PERIODS OF TIME, AND IN FACT WITH SOME CLAYS, PERMANENTLY. WHEN SOIL GETS SATURATED MOISTURE WILL INVOLUNTARILY TRY TO FIND A DRYER ENVIRONMENT AND WILL MOVE SIDEWAYS AND VERTICALLY. WATER WILL MIGRATE UNDER A FOUNDATION (OR THROUGH A FOUNDATION) TO THE AREA BELOW A FLOOR (OR SLAB).

3*WET TO DRY_ NATURAL TRANSFERANCE. (SEE d2.4)

4*VAPOR_WHEN WATER CAN TRAVEL NO FURTHER BY MIGRATION IT WILL EVAPORATE.

***DRY TIME_**WHEN THE RAIN STOPS FALLING THE EXTERIOR SOIL WILL DRY (EVAPORATE) AND THE MOTIVATION FOR IT TO ENTER THAT ENVIRONMENT UNDER THE HOME WILL SUBSIDE. THE CLEARING SKY AND SUN HASTEN THAT TRANSITION AS EVAPORATION RATE IS INCREASED.

GENERAL PROTECTION STATEGIES

1*MOVING ROOF WATER AWAY_ DEEP OVERHANGS, GUTTER SYSTEMS, EXTENDED DOWNSPOUT LEADERS

2*SLOPING _SLOPING GRADE AWAY FROM ALL FOUNDATIONS IS ESSENTIAL AND REQUIRED. LESS PERMEABLE SURFACES WILL MOVE THAT WATER MORE COMPLETELY.

3*GRAVEL MANAGEMENT_GRAVEL SLAB SUBBASE AND GRAVEL BACKILL BOTH ALLOW WATER TO MOVE FREELY TO BOTH AVOID HYDROSTATIC PRESSURES AND FACILITATE DIRECT DRAINAGE.

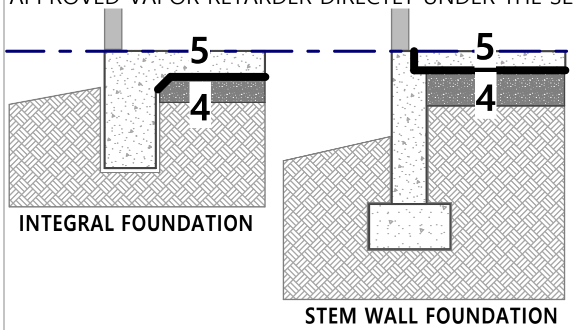
4*UNDERGROUND DRAINAGE_FOUNDATION DRAINS, UNDER SLAB DRAINS, REMOTE FRENCH DRAINS WANT TO BE INTELLIGENTLY PLACED BASED ON A GIVEN SITE/SOIL CONDITION. THE GRAVEL IS PART & PARCEL OF THIS WORKING EFFICIENTLY.

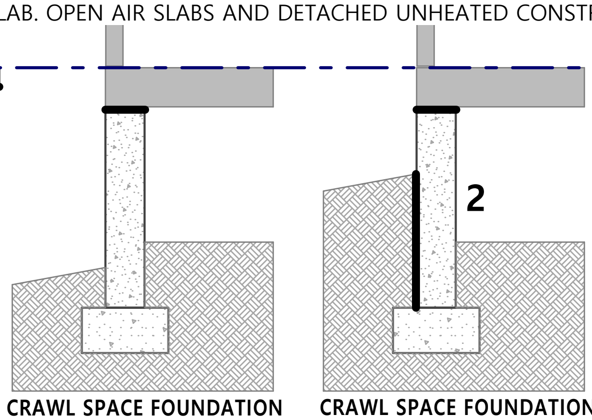
5*SEALING THE CONSTRUCTION PLANES_ANY CONSTRUCTION PLANE THAT IS PERMEABLE MAY WANT OR NEED ASSISTANCE FROM DAMPPROOFING, WATERPROOFING, AND OR VAPOR RETARDERS TO 'SEAL' THE WATER OR WATER VAPOR OUT.

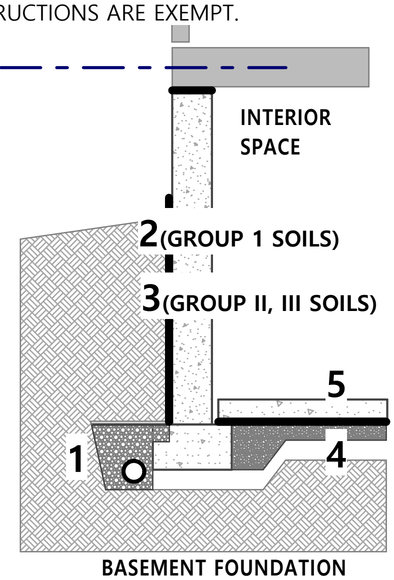
MOISTURE PROTECTION PLANES AND CODE

CODE REQUIREMENTS

1*FOUNDATION DRAINAGE_R405.1_ CODE REQUIRES A PERIMETER DRAINAGE 'SYSTEM' WHERE OUTSIDE GRADE IS HIGHER THAN INSIDE GRADE AND INTERIOR OR USEABLE SPACE IS BELOW GRADE. THIS APPLIES ALMOST EXCLUSIVELY BASEMENT FOUNDATIONS. DRAINAGE ISRECOMMENDED AROUND CLOSED CRAWL SPACES.
2*FOUNDATION DAMPPROOFING WALL PROTECTION_R406.1_ DAMPROOFING PROTECTION REQUIRED WHERE OUTSIDE GRADE IS HIGHER THAN INSIDE GRADE. DAMPPROOFING OPTIONS ARE DEFINED IN THE CODE SECTION.
3*FOUNDATION WATERPROOFING WALL PROTECTION_R406.2_WATERPROOFING PROTECTION REQUIRED WHERE OUTSIDE GRADE IS HIGHER THAN INSIDE GRADE, INTERIOR SPACES ARE BELOW GRADE, AND GROUP II, III SOILS ARE PRESENT. WATERPROOFING OPTIONS ARE DEFINED IN THE CODE SECTION.
4*SLAB SUBBASE_R506.2.2_4" OF DRAINABLE MATERIAL (GRAVEL) REQUIRED UNDER SLABS IN GROUP II, III SOILS. GROUP I SOILS EXEMPTED.
5*VAPOR RETARDER UNDER SLAB_R506.2.3_SLABS FOR ANY CONDITIONED SPACE, ATTACHED GARAGES AND PORCHES UNDER ROOF REQUIRE AN APPROVED VAPOR RETARDER DIRECTLY UNDER THE SLAB. OPEN AIR SLABS AND DETACHED UNHEATED CONSTRUCTIONS ARE EXEMPT.





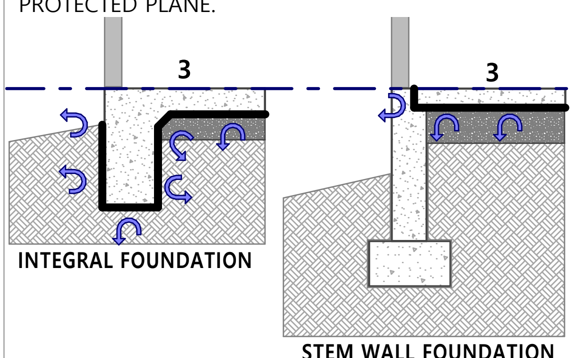


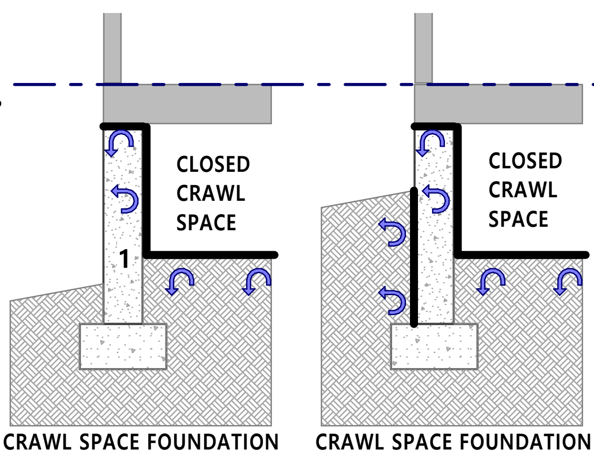
CODE REQUIREMENT CAUTIONS

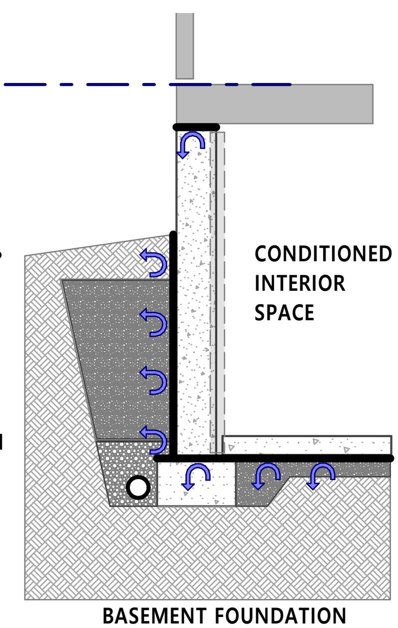
***CAUTION_**CODE REQUIREMENTS ARE MINIMUMS- NOT BEST PRACTICE.
***KNOW THE BIG PITURE_[3.14]** WITH A SENSE OF HOW ALL WATER IS MOVING AROUND A SITE EXCEPTIONS TO CODE MINIMUMS MAY BE IN ORDER. BE CONSCIOUS OF THE BIG PICTURE WHEN DECIDING ABOUT FOUNDATION PROTECTION AND USING FOUNDATION DRAINAGE AS A MOVEMENT TOOL.
***THAT SOIL_**DO **NOT** CLASSIFY A SOIL AS GROUP I JUST BECAUSE IT APPEARS DRY. IMPLICATIONS OF OPTIMISTICALLY ASSUMING A SOIL (IS GRANULAR) ALWAYS DRAINS WELL COULD BE DISASTEROUS.

PROTECTING THE CONSTRUCTION PLANES

***DO YOUR OWN THINKING_**THINK ABOUT WHERE THE WATER/VAPOR IS, AND WHERE IT LIKELY WANTS TO GO. BUILDING SCIENCE HAS BEEN DECLARING THE VALUE OF THE PROTECTION PLANE. AND GIVING GUIDANCE ON LOCATIONS.
***FIRST OBSERVATION_** THE CONSTRUCTION PLANES THAT ARE IN CONTACT WITH GROUND ARE ALL POTENTIAL CARRIERS OF THE WATER/VAPOR THAT WANTS TO BE KEPT OUT. CONCRETE FOOTINGS, CONCRETE WALLS AND CONCRETE BLOCK ARE ALL ENABLERS AS THEY ARE PERMEABLE. THE DESIGN GOAL IS TO BLOCK THAT WATER/VAPOR IN THE MOST EFFICIENT WAY POSSIBLE. SO FIRST IDENTIFY THE PLANES THAT NEED PROTECTION. THESE TYPICAL FOUNDATION SYSTEM ILLUSTRATIONS INDICATE A MOISTURE POTENTIAL (BLUE ARROWS) AND A HEAVY BLACK LINE REPRESENTING A PROTECTED PLANE.





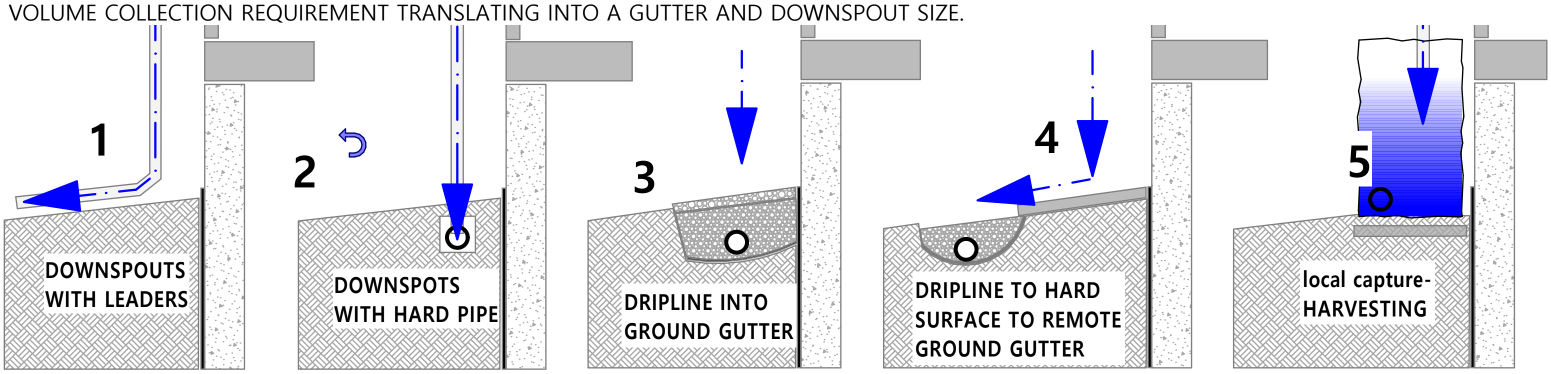


DAMPPROOFING, WATERPROOFING, VAPOR RETARDERS

***PURPOSE_**DESCRIPTIVE TERMS FOR MATERIALS THAT SHARE THE SAME GENERAL FUNCTION AS A BARRIER TO WATER/VAPOR. THEY DIFFER IN DEGREE OF PERMANENCE (HOW LONG THEY WILL DO THEIR JOB), AND PERMEANCE (HOW THOROUGHLY THEY STOP WATER/VAPOR PENETRATION).
***MATERIALS_**THESE MAY BE SPRAYED, BRUSHED, ROLLED, OR TROWEL APPLIED CEMENTITIOUS OR ASPHALTIC GOOP, OR MAY BE SHEETS OR ROLLS OF A 'MEMBRANE'. THERE IS A HUGE SELECTION SET FOR THESE PRODUCTS. SOME ARE SPECIFICALLY LISTED IN THE CODE AS (PRE) ACCEPTED, AND THE CODE LEAVES ROOM FOR OTHER PRODUCTS AS/IF ACCEPTED BY A LOCAL CODE OFFICIAL.
***THEORETICAL EFFECTIVENESS_**THE 'PERM' RATING IS A NUMERICAL QUALIFIER FOR THE EFFECTIVENESS OF THESE PRODUCTS USED FOR GUAGING RELATIVE PERMEABILITY.
***THE APPLICATION CONTINGENCY_**APPLYING ANY OF THESE MATERIALS HAS ITS OWN CHALLENGES. ACCESS TO WORK, GEOMETRY, WEATHER CAN MAKE SEEMINGLY SIMPLY TASKS A SERIOUS CHALLENGE.

GUTTERS

***WHEN THEY WORK_**A GUTTER AND DOWN SPOUT SYSTEM CAN WORK EFFICIENTLY AND FLAWLESSLY. THE SYSTEM, GUTTERS AND LEADERS, MUST BE PITCHED PROPERLY AND KEPT (ENTIRELY) UNINTERRUPTED.
***WHEN THEY DON'T WORK_**JUNK IN THE GUTTERS CAN EASILY CREATE A LIABILITY OUT OF ANY GUTTER/DOWNSPOUT SYSTEM. WHEN IT DOESN'T FLOW AT SPEED, IT BACKS UP. NOT GOOD. THE JUNK IS USUALLY TREE RELATED. AN INCREDIBLE VARIETY OF ORGANIC MATTER IS DISCHARGED FROM TREES, AND BLOWN AROUND, AND SETTLES ON A ROOF, AND IS ULTIMATELY WASHED INTO A GUTTER.
***GUTTER GUARDS_**THERE ARE QUITE A VARIETY OF GUTTER GUARDS ON THE MARKET THAT USE DIFFERENT DESIGNS TO MINIMIZE THAT JUNK GETTING INTO THE GUTTER. BIG LEAVES, PINE NEEDLES, SEEDLINGS, TWIGS ALL (UNFORTUNATELTY) RESPOND BEST TO DIFFERENT DESIGNS. A SELECTION OUGHT BE BASED ON THE MORE DOMINANT JUNK PROBLEM.
***GUTTERS DESIGNS_**SEVERAL PROFILES EXIST THAT ARE LARGELY A DESIGN/APPEARANCE/COST SELECTION. GUTTER SIZE AND THEREFORE CAPACITY NEEDS CHECKING.. SIMPLE MATH CALCULATION USING RAINFALL EVENT STATS AND CONTRIBUTING ROOF AREA(S) WILL RESULT IN A WATER VOLUME COLLECTION REQUIREMENT TRANSLATING INTO A GUTTER AND DOWNSPOUT SIZE.

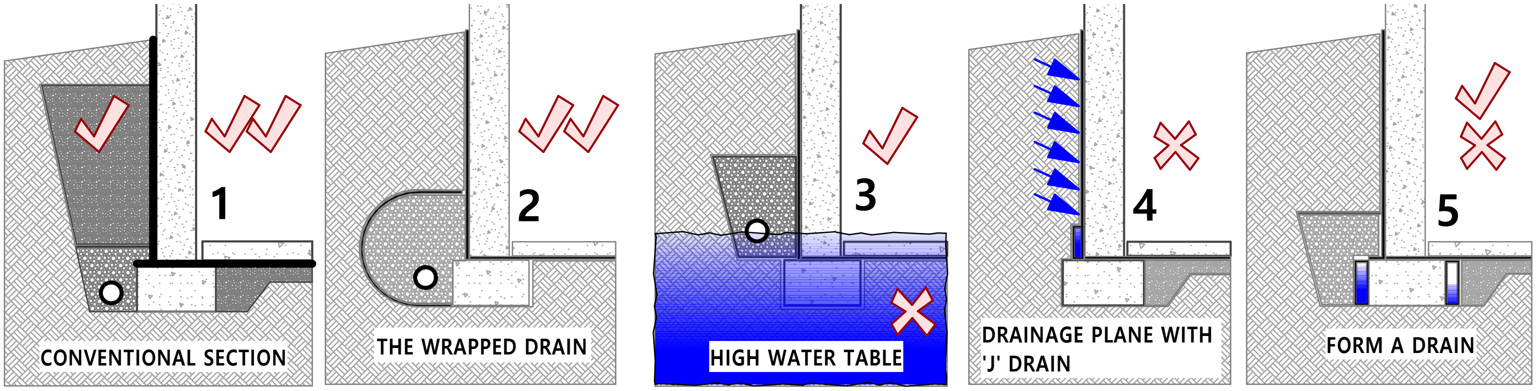


MANAGING ROOF WATER AT GRADE

WATER VOLUME CALCULATION WANTS TO CONTINUE THRU DISTRIBTION-WHATEVER SYSTEM IS USED.
1*DOWNSPOUTS WITH LEADERS_SIMPLE ENOUGH IDEA AND GEOMETRY, PLUS ONE CAN CONTINUALLY MONITOR THAT THE GUTTER SYSTEM IS FLOWING. SMART TO GET THAT WATER WELL AWAY FROM THE FOUNDATION- SO THAT IT CAN'T MIGRATE BACK TO THE FOUNDATION PLANE. THESE ARE A LITTLE UGLY AND A NUISANCE TO MOW AROUND.
2*HARD PIPE UNDERGROUND_DOWNSPOUT DIRECT TO A NON PERFORATED TAKEAWAY PIPE WHICH CAN MOVE ALL WATER WELL AWAY FROM FOUNDATION. HAVING SOME MEANS OF CHECKING SYSTEM FLOW IS ALWAYS DESIRED.
3*DRIPLINE GROUND GUTTER_GROUND GUTTER IS BASICALLY A FOUNDATION DRAINAGE TILE SET HIGHER UP THE WALL. WASHED GRAVEL AT GRADE IS A GOOD MATERIAL CHOICE FOR THE WATER DRIP LANDSCAPE SURFACE. EASY MAINTENANCE, LOOKS GOOD, NO TERMITES.
4*REMOTE GROUND GUTTER_IDEA IS TO GET WATER VOLUME AWAY FROM THE FOUNDATION PLANE. HARD SURFACE WANTS TO BE SLOPED FOR WATER AND TO KEEP CONSTANT SPASHBACK OFF THE HOUSE WALLS.
5*RAINWATER HARVESTING_PICTURED IS A RAIN BARREL WHICH CAN AT BEST BE A TEMPORARY COLLECTION/REDISTRIBUTION TOOL. INTEGRATION INTO A LARGER (MORE COMPLICATED) HARVESTING SYSTEM BECOMES A POSSIBILITY.

FOUNDATION DRAINAGE R 405.1

1*CONVENTIONAL GRAVEL DETAIL_HAS THE CONTINUOUS TILE SURROUNDED ON A GRAVEL BED WITH A LANSCAPE FABRIC FILTER. THIS SECTION SHOWING ADDITIONAL GRAVEL BACKFILL ABOVE THE LANDSCAPE FABRIC.
2*THE WRAP_THIS SPECIFICALLY REPRESENTS A (4') WIDE LANDSCAPE FABRIC BEING PLACED AGAINST/AT BOTTOM FOOTING. A 2" GRAVEL BASE IS PLACED ON THE FABRIC, THEN THE DRAIN TILE, THEN AT LEAST 6" OF GRAVEL ON TOP, THEN THE FABRIC IS WAPPED OVER THE TOP OF THE GRAVEL AND THE BACKFILL THEN PLACED. THE **IDEA** IS THE FABRIC PROTECTS THE DRAIN TILE FROM ANYTHING GETTING TO IT-FROM ANY DIRECTION- AND CLOGGING IT ALL UP.
3*TRENCH POUR FOOTING_THE FOUNDATION DRAIN IS NECESSARILY ABOVE THE FOOTING WHICH IN SOME/MANY INSTANCES IS FINE. FOR BASEMENT CONSTRUCTIONS AND HIGH WATER TABLE SITUATIONS IT IS NOT IDEAL AS THAT COLLECTION DRAIN IS ABOVE THE SLAB ELEVATION.
4*DRAINAGE PLANE & 'J' DRAIN_A BRAND NAME PRODUCT (1 OF SEVERAL). THE PREFORMED DRAIN (BEST) SITS AT BOTTOM OF WALL AND IS 'FED' BY THE WALL APPLIED DRAINAGE PLANE WATERPROOFING MEMBRANE. FAILURE OF THIS DRAIN HAS WATER EXITING ON TOP OF FOOTING WHICH IS NOT GOOD. FAILURE POTENTIAL EXISTS EVERY TIME THESE INTEGRATED DRAINS TURN A CORNER OR HAVE TO CHANGE ELEVATION.
5*FORM A DRAIN_A BRAND NAME PRODUCT THAT IS BOTH FOOTING FORM AND DRAINAGE 'SYSTEM'. CLEVER CONCEPT. SIMILARLY TO THE J DRAIN THINGS LIKE STEP FOOTING CHALLENGE THE SIMPLICITY.
****THIS PROJECT LIKES 1+2 BECAUSE OF TOTAL SYSTEM FLEXIBILITY_**THE ENTIRE PERIMETER, INCLUDING ALL UPS AND DOWNS AND INSIDE AND OUTSIDE CORNERS, AND THE BETTER/BEST SYSTEM EXTENSION TO DAYLIGHT (OR OTHER TERMINATION), CAN BE ENVISIONED AND ACCESSED. GRAVEL PLACEMENT AND DRAIN PITCH CAN BE SET UP FOR BEST TOTAL SYSTEM FLOW. THIS PROJECT ALSO LIKES GRAVEL BACKFILL.



UNDERGROUND DRAINAGE CONSIDERATIONS

HIGH WATER TABLE (d2.11, d.12)

***WET GROUND_**WATER BELOW GROUND-A HIGH WATER TABLE- UNFORTUNATELY CAN'T BE DETECTED READILY. LOCAL FLOODING HISTORY (MINOR AND MAJOR) IS A CLEAR CLUE. WET SURFACE SOIL-AND MOST IMPORTANTLY HOW LONG IT HANGS AROUND- ARE SITE SPECIFIC CLUES. IF WET GROUND HANGS AROUND AT ALL IT IS A SIGN THAT THE FOUNDATION PACKAGE IS SURELY HAVING TO DEAL WITH WATER.

***PRECIPITATION CREATED_**RAIN EVENTS WILL RAISE A WATER TABLE BECAUSE WATER SIMPLY HAS NO OTHER CONVENIENT PLACE TO GO BUT UP. UNFORTUNATELY IT CAN RAISE TO FOUNDATION LEVEL BUT NOT ALL THE WAY TO GRADE.

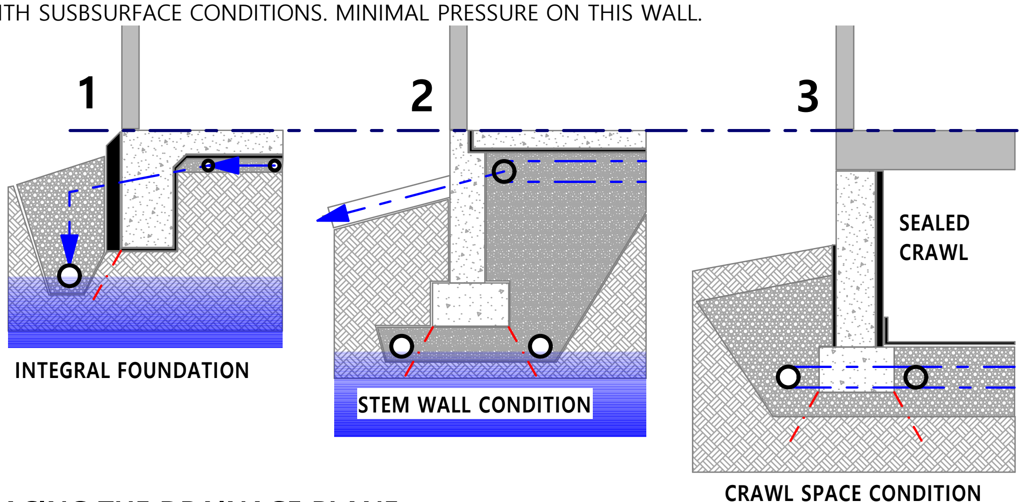
NON CONVENTIONAL DRAINAGE PLANE THINKING

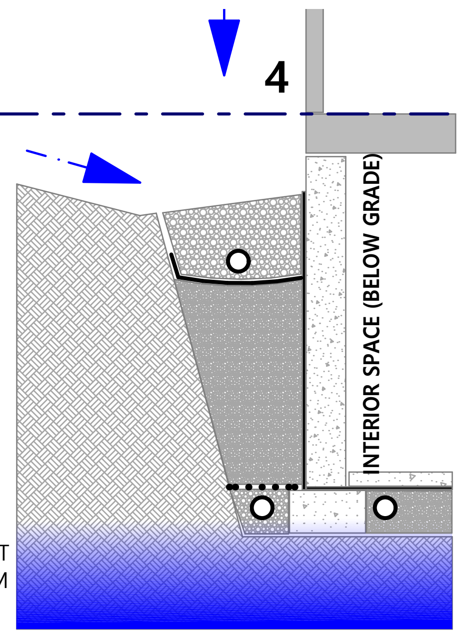
1*PROTECTING THE FOOTING_NOTHING WRONG WITH PLACING THAT FOOTING DRAIN BELOW THE FOOTING. THIS MAY BE TO MANAGE THE DRAIN ELEVATION ALL THE WAY AROUND FOR BEST EXIT STRATEGY, OR FOR PROTECTION WITH RISING WATER BEFORE IT HITS THE FOOTING PLANE. OBVIOUSLY THE FOOTING LOAD BEARING DISTRIBUTION DOES NOT WANT TO BE COMPROMISED.

2*SOFT WET SOIL_WET SOIL FOUNDATIONS MAY HAVE REGIONAL SOLUTIONS OF THEIR OWN DESIGN. THIS DETAIL SUGGESTS A COMPACTED BUT DRAINABLE GRAVEL FOOTING WITH DRAINS INSIDE AND OUT. THIS KEEPS THAT FOOTING IN BETER SHAPE BOTH IN BEARING CAPACITY AND UNDERMINING PROTECTION. DEEPER AND WIDER GRAVEL BED AS NEEDED. ENGINEERING RECOMMENDED. THE UNDER SLAB DRAINAGE IS A PRECAUTION FOR RISING WATER INSIDE THE FOOTING DRAINS. LETTING THAT UNDERSLAB PROTECTION EXIT WITHOUT INTEGRATING WITH THE FOUNDATION SYSTEM SEEMS ADVISEABLE.

3*GRAVEL PLATFORM_SHOWING CONVENTIONAL FOOTING AND FDN WALL BUT NOTE BOTH PRECAST CONCRETE PANEL FOUNDATION SYSTEMS (SUPERIOR WALLS), AND PWF (PERMANENT WOOD FOUNDATIONS) SHOW US A PRETTY INGENIOUS WAY TO APPROACH FOUNDATIONS BY SETTING A FULL/CONTINUOUS GRAVEL 'BED' OVER THE EXCAVATED AREA INCLUDING FOOTING. SO A LEVEL/CLEAN GRAVEL 'PLATFORM' IS THERE TO BUILDUP FROM. DRAINAGE (AND SOIL GAS) MANAGEMENT AS NEEDED. A MOISTURE PROTECTION PLANE (OR CONCRETE SLAB) TOPS THE GRAVEL BED.

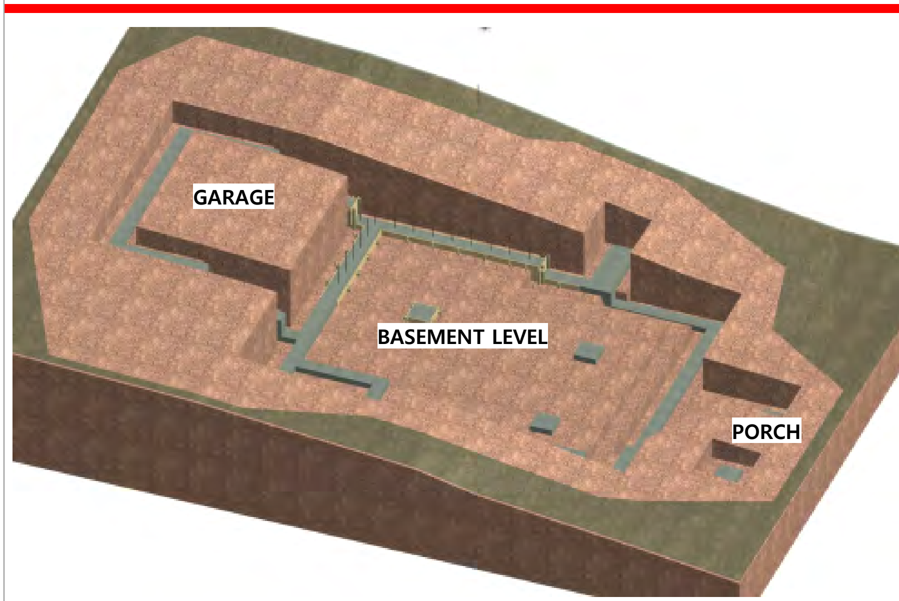
4*2 CONDITIONS/2 SOLUTIONS_AT GRADE THERE MAY BE BOTH ROOF WATER AND SURFACE GROUND WATER THAT WANTS TO BE DEALT WITH BEFORE IT BECOMES A FOUNDATION WALL CONDITION. SO A 'FRENCH DRAIN' OR UNDERGROUND GUTTER SHOWS THAT HAS ITS OWN PERIMETER SYSTEM AND EXIT STRATEGY. THE SECOND SYSTEM IS AT THE FOOTING AND CAN INCORPORATE INSIDE OR OUTSIDE DRAINS OR BOTH TO DEAL WITH SUSBSURFACE CONDITIONS. MINIMAL PRESSURE ON THIS WALL.





PLACING THE DRAINAGE PLANE

***BY SITE SPECIFIC SITUATION_**KNOWING THE WATER CONDITION ABOVE AND BELOW GRADE ALLOWS ONE TO DESIGN THE BEST LOCATION(S) FOR GRAVITY DRAIN SYSTEMS. CODE OR CONVENTION DOES NOT KNOW WHERE THE WATER IS ON YOUR SITE-SO ACCEPT THOSE DICTATES AS REPRESENTING THE WISDOM OF WATER MANAGEMENT, NOT SPECIFICALY HOW TO......



THE 3RD DIMENSION

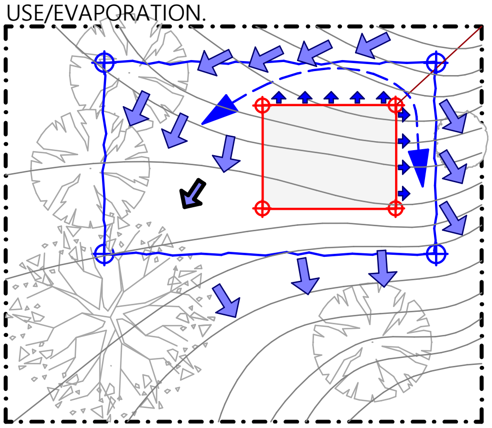
***BASEMENT LEVEL_**THE BASEMENT LEVEL ONLY HAS LIVING SPACE BELOW GRADE AND THEREFORE, BY CODE, ALL THAT NEEDS TO EMPLOY FOUNDATION DRAINS. THAT BASEMENT LEVEL FOOTING PLANE HAS A FEW MODERATE FOOTING STEPS-ONES THAT THE PERIMETER DRAINAGE LOOP CAN MANAGE.

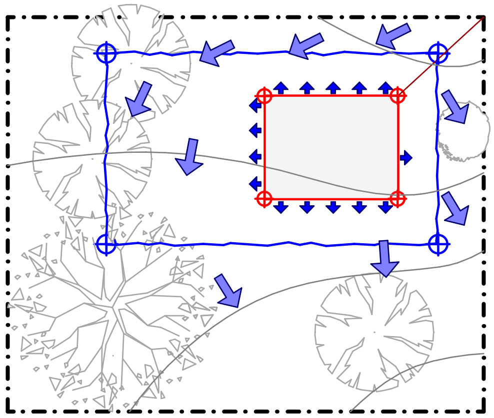
***WHOLE FOUNDATION_**WITH SOME WET SOIL CONDITIONS IT MAY BE WISE TO DRAIN ALL PERIMETER FOUNDATIONS, AND UNDERSLAB AREAS. THIS MAKES THE DESIGN PROBLEM MORE COMPLICATED. MORE THAN 1 'SYSTEM' MAY BECOME WISE. MORE THAN 1 TARGET LOCATION FOR DISCHARGE MAY BECOME WISE. THIS VIEW SELECTED TO SUGGEST SEEING THE 3RD DIMENSION MAY HELP ENVISION A BETTER SYSTEM DESIGN. THIS VIEW ALSO POINTS OUT THE FLEXIBILITY OF THE GRAVEL/FLEXDRAIN APPROACH.

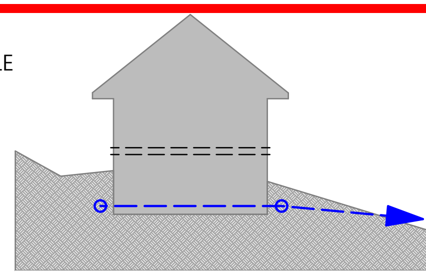
***TESTING A SYSTEM_**ONCE A SYSTEM IS BACKFILLED FLAWS IN THE SYSTEM ARE DIFFICULT TO IMPOSSIBLE TO DETECT. OBSERVING A SYSTEM FUNCTION BEFORE BACKFILLING HAS MERIT. OBSERVE A HEAVY RAINFALL OR USE A HOSE IF SITE WATER IS OPERATIONAL.

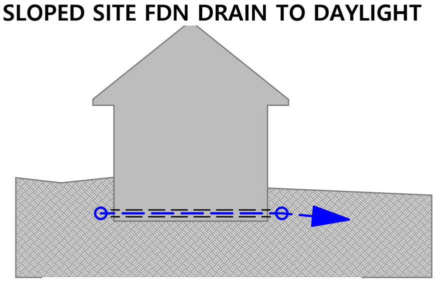
SITE CONDITIONS [d2.15]

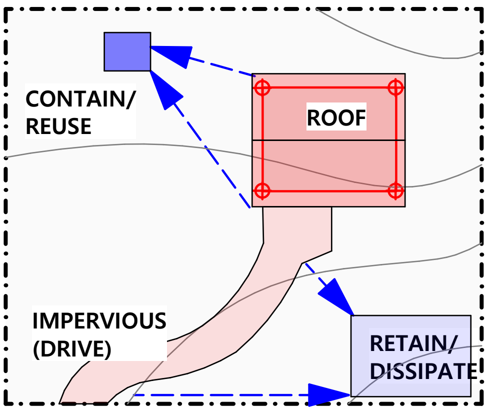
***AVAILABLE REMOVAL TARGET_**FIRST ORDER OF BUSINESS IS DETERMINING IF THE SITE HAS AVAILABLE A 'PUBLIC' UNDERGROUND STORM WATER PIPING SYSTEM, A ROAD (OR OTHER SWALE) BASED DRAINAGE COLLECTION SYSTEM, OR IF THE SITE IS SELF-RESPONSIBLE FOR RETENTION/RE-USE/EVAPORATION.


SLOPED SITE WITH AGRESSIVE RUN-OFF


FLAT SITE WITH MARGINAL RUN-OFF


SLOPED SITE FDN DRAIN TO DAYLIGHT


FLAT SITE FDN DRAIN TO ????

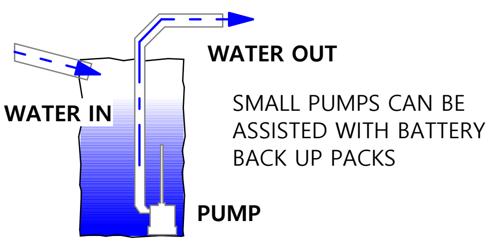


SIMPLE WATER MANAGEMENT

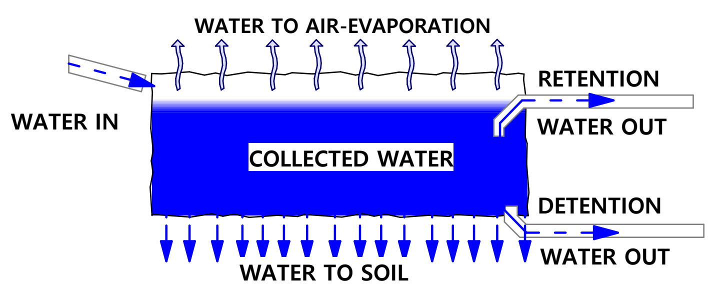
***DRAINAGE REQUIREMENT_**SITE, INCLUDING DRIVEWAYS, AND HOUSE, INCLUDING ROOF AND FOUNDATION, NEED TO HAVE THEIR WATER MANAGED. THIS IS NOT NECESSARILY ONEROUS. ROOFS CAN DRAIN TO GRADE, FOUNDATIONS CAN DRAIN TO GRADE, GRADE CAN BE SCULPTED TO MOVE ALL WATER AWAY SMARTLY. BUT SITE CONDITIONS AND LOCAL REQUIRMENTS MAY DICTATE MORE AGRESSIVE MANAGEMENT STEPS BE TAKEN.

***IMPERVIOUS REQUIREMENT_**WITH SITE INSTANCES OF LIMITED PERVIOUS SURFACE AND TOO MUCH IMPERVIOUS SURFACE ONE MAY BE REQUIRED TO RETAIN/DETAIN WATER ON SITE. THE IDEA IS PRETTY SIMPLE, AND THE SCHEMATICS BELOW REPRESENT THE SIMPLE WAYS TO RETAIN/DETAIN. NATURALLY MORE SOPHISTICATED CONSTRUCTIONS EXIST TO DO THIS

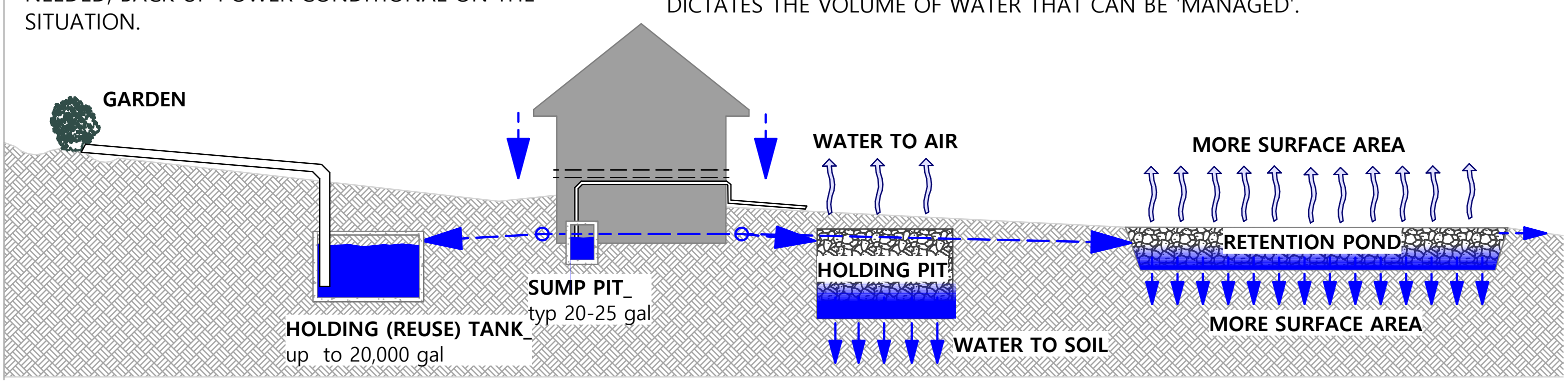
***WATER HARVESTING_**THIS IDEA GOES BACK TO THE VERY BEGINNING. IT CAN RETAIN WATER, AND BE THEN USED AS/WHEN NEEDED. HARVESTING/STORING AND WATER RE-USE IS A PROJECT SPECIFC DESIGN AND SYSTEM.



***CONTAINED AND PUMPED WATER_**WATER IS BROUGHT IN AND PUMPED OUT. THERE HAS TO BE POWER FOR THE PUMP TO WORK. AN INTERNAL (BASEMENT OR CRAWL SPACE) CONVENTIONAL SUMP PIT/PUMP WILL PICK UP INTERNAL UNWANTED WATER AND PUMP IT OUT/AWAY FROM FOUNDATION. INTERNAL SUMP PUMPS DO WANT BACK UP POWER. EXTERNAL SUMPS EXIST TO TAKE CARE OF LOCAL SITE BASED WATER COLLECTION SPOTS THAT HAVE NO GRAVITY SOLUTION. POWER NEEDED, BACK UP POWER CONDITIONAL ON THE SITUATION.



***RETAINED/DETAINED WATER_**WATER IS BROUGHT INTO AN EXCAVATED "HOLDING' PIT. WATER IS TEMPORARILY HELD UNTIL IT HAS TIME TO EVAPORATE, OR THE SOIL BELOW CAN SLOWLY DRINK MORE, OR IT FILLS AND OVERFLOWS USING A DESIGNED SPILLWAY OR PIPE ONTO GRADE, OR THERE IS A PIPED EXIT AT THE BASE OF THE PIT WHERE WATER CAN ESCAPE AT A PREDETERMINED RATE. THE TOP EXIT IDEA DEFINES IT AS A RETENTION DESIGN WHERE WATER SITS WITHIN THE HOLDING PIT FOR AN EXTENDED PERIOD. THE BOTTOM EXIT IS A DETENTION DESIGN WHERE THE OUTFLOW IS CALCULATED AND REGULAR. THE VOLUME OF THE PIT BASICALLY DICTATES THE VOLUME OF WATER THAT CAN BE 'MANAGED'.

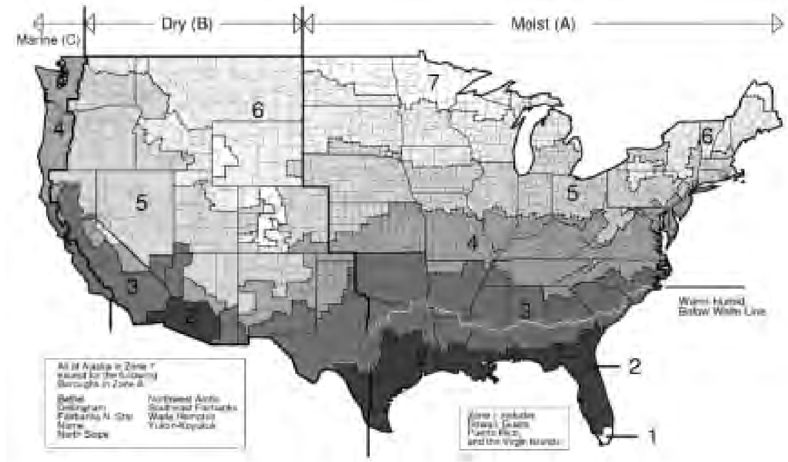


CLIMATE (ENERGY COMPLIANCE) ZONES(d2.6,d2.7,d2.8)

***ZONES**_CODE PROVIDES A CLIMATE ZONE MAP THAT IS LINKED TO MINIMUM (BY COMPONENT) INSULATION REQUIREMENTS. THIS CHART HAS BEEN EDITED TO INCLUDE ONLY THE FOUNDATION RELATED REQUIREMENTS.

***EXERCISES BELOW**_TYPICAL ZONE 3, ZONE 6 FOUNDATIONS

CLIMATE ZONE	BASEMENT[c] WALL R-VALUE	SLAB[d] R-VALUE & DEPTH	CRAWL SPACE[c] WALL R-VALUE
1	0	0	0
2	0	0	0
3	5/13[f]	0	5/13
4 except Marine	10/13	10, 2 ft	10/13
5 and Marine 4	15/19	10, 2 ft	15/19
6	15/19	10, 4 ft	15/19
7 and 8	15/19	10, 4 ft	15/19



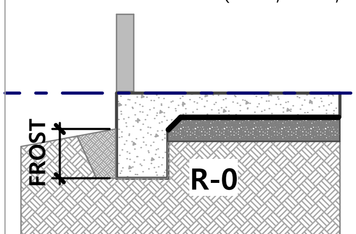
INSULATION REQUIREMENTS/OPTIONS EXPLAINED

***5/13**_THE FIRST NUMBER (5, OR 10, OR 15) REPRESENTS THE **R** REQUIREMENT IF INSULATION IS INSTALLED CONTINUOUSLY. THE SECOND NUMBER (13, OR 19) REPRESENTS THE **R** REQUIREMENT IF THE INSULATION IS IN A STUD WALL'S CAVITIES.

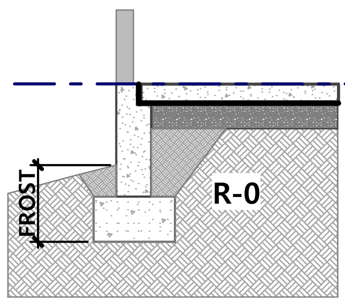
***10, 2ft**_THE FIRST NUMBER REFERS TO THE REQUIRED **R** VALUE FOR RIGID CONTINUOUS INSULATION. THE SECOND NUMBER IN FT REFERS TO THE TOTAL WIDTH (AS SHOWS IN A SECTION LIKE THOSE BELOW). THAT WIDTH (2FT OR 4 FT) CAN BE INSTALLED VERICALLY, HORIZONTALLY OR SOME OF BOTH.

***CONTINUOUS INSULATION**_RIGID/FOAM INSULATION BOARDS ARE MOST COMMOM. THERE ARE 3 FOAM TYPES (EPS,XPS, POLYISOCYANURATE) WHICH HAVE DIFFERENT PERFORMANCE CHAACTERISICS AND R VALUE RATINGS (PER INCH). ALL ARE ACCEPTABLE FOR "INGROUND INSTALLATIONS" AND ALL ARE AVAILABLE IN STANDARD BOARD SIZES SUCH AS 2'X8' AND 4'X8'.

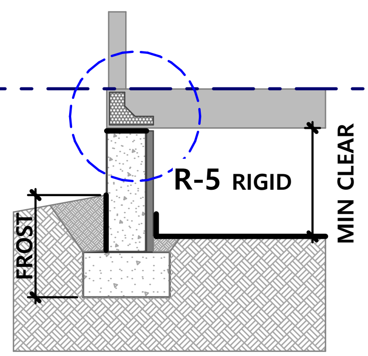
***CAVITY INSULATION**_INSULATION PLACED BETWEEN STUD WALL "CAVITIES". ALTHOUGH R CAVITY VALUES ARE LINKED TO READILY AVAILABLE "FIBERGLASS BATTS" (R-13, R-15, FOR 2X4 WALLS, AND R-19, FOR 2X6 WALLS ANY BETWEEN THE STUDS INSULATION WOULD BE ACCEPTABLE.



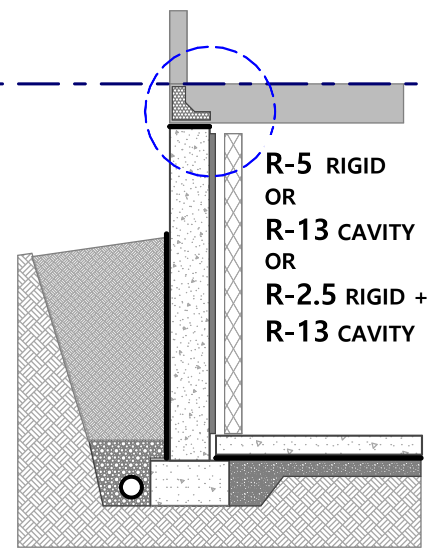
INTEGRAL FOUNDATION
ZONE 3_NONE REQUIRED



STEM WALL FOUNDATION
ZONE 3_NONE REQUIRED

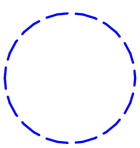


CRAWL SPACE FOUNDATION
ZONE 3_R-5 CONTINOUS/
R-13 CAVITY

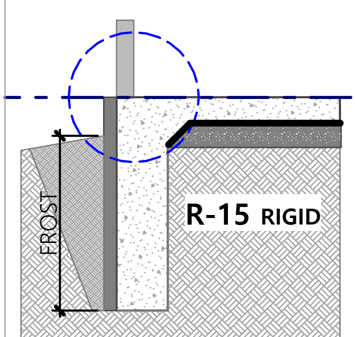


BASEMENT FOUNDATION

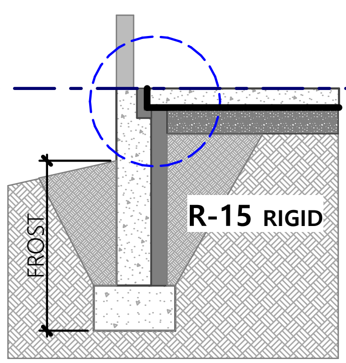
ZONE 3-12" FROST DEPTH



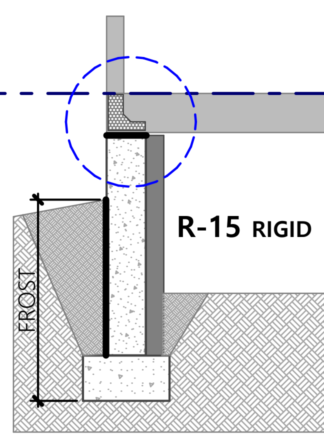
GENERAL NOTE-IT IS AWAYS THE JUNCTURES THAT ARE THE MORE DIFFICULT TO CONSTRUCT, SEAL, INSULATE.



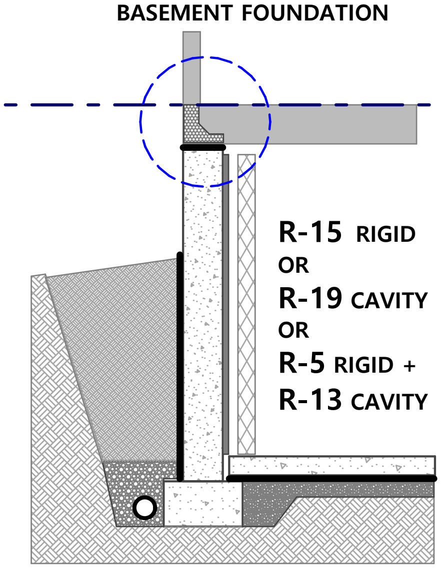
INTEGRAL FOUNDATION



STEM WALL FOUNDATION



CRAWL SPACE FOUNDATION



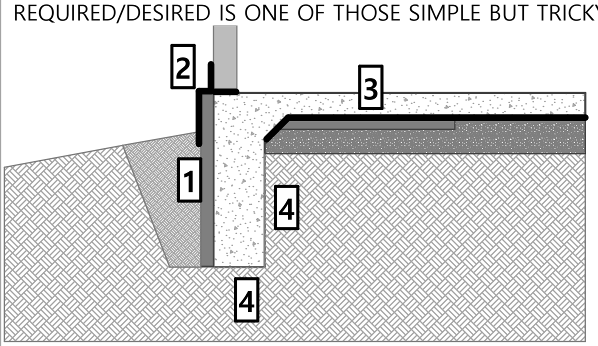
BASEMENT FOUNDATION

ZONE 6-48" FROST DEPTH

INTEGRAL FOUNDATION GENERIC CONDITIONS

***CONTINUOUS POUR MEANS NO THERMAL BREAK**_THE NATURE OF THE SIMPLE, SINGLE POUR INTEGRAL FOUNDATION. THIS CONSTRUCTION IS MOST COMMON IN WARMER CLIMATES (ON FLATTER GROUND), AND DOES NOT POSE MUCH OF A PROBLEM IN THE WARMER CLIMATE. BUT IN COLDER CLIMATES HEAT WILL ESCAPE READILY TO OUTSIDE AIR OR SOIL WITHOUT SOME BARRIER BEING INSTALLED. GETTING A SENSE FOR THE REAL TIME HEAT EXCHANGE GOING ON HERE IS MORE THOROUGHLY EXPLAINED AT THIS CHAPTER END (c3.13, c3.14)

***THE PROTECTION DETAIL**_THE NECESSARILY EXPOSED EXTERIOR RIGID INSULATION INSTALLED WHERE THERMAL PROTECTION TO OUTSIDE AIR IS REQUIRED/DESIRED IS ONE OF THOSE SIMPLE BUT TRICKY DETAILS. WISE TO CONSIDER ALL OPTIONS.



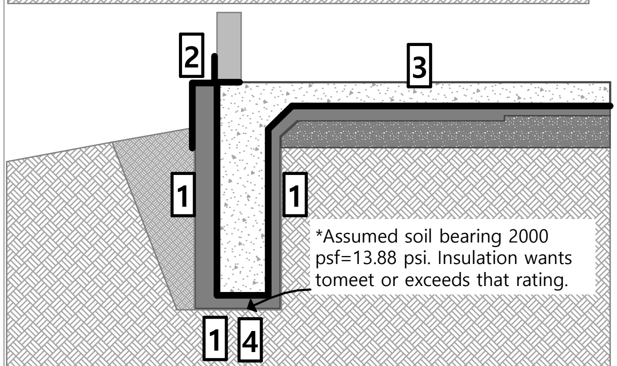
A TYPICAL SOLUTION

1*EXTERIOR INSULATION_TYPICAL OUTSIDE FACE PROTECTION. THIS OUTSIDE IS NECESSARILY EXCAVATED FOR FORMING THE OUTSIDE PLANE OF THE POUR. SO ROOM IS AVAILABLE FOR BOTH INSULATION INSTALLATION (AND DRAINAGE IF APPLICABLE)

2*PROTECTING THE INSULATION_THIS EXTERIOR INSULATION IS PRETTY EASY TO BEAT UP AND COMPROMISE WITHOUT A PROTECTIVE MATERIAL. MATERIAL CHOICES ARE LIMITED BECAUSE OF EXPOSRE TO SOIL+WATER. DETAIL OPTIONS AT PAGE BOTTOM.

3*UNDER SLAB_LIKELY NOT REQUIRED BUT POSSIBLY DESIREABLE. SEE TEMPERATURE DIFFERENTIAL CONDITONS.

4*UNPROTECTED FACES OF THE FOOTING_NO THERMAL BREAK THIS BOTTOM AND INSIDE FACE THIS SECTION AND REMAINS SUBJECT TO THERMAL TRANSFER.



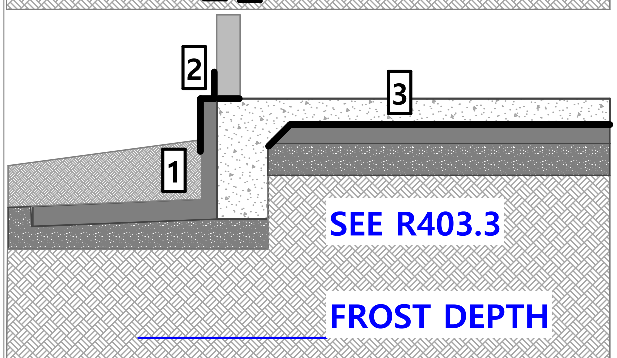
BETTER THERMAL PROTECTION

1*WRAPPED EXTERIOR INSULATION_THIS INSTALLATION ELIMINATES ANY COMPROMISED THERMAL TRANSFER THRU CONCRETE. PATIENCE REQUIRED IN PRE-INSTALLING THE FOAM AND GETTING/KEEPING THE JOINTS TIGHT. THE CONCRETE DEAD LOAD, WHEN POURED, WILL PUSH AND CHANGE THE GEOMETRY OF THE RIGID INSULATION POCKET AND SEPARATE JOINTS UNLESS THEY REST ON FIRM SOIL/FILL.

2*PROTECTING THE INSULATION_DITTO ABOVE

3*UNDER SLAB_RUNNING FULL UNDER SLAB INSULATION COUPLED WITH THIS FOUNDATION PROTECTION LEADS TO A MORE COMFORTABLE SLAB.

4*STRUCTURAL LOAD ON INSULATION_RIGID INSULATIONS HAVE A COMPRESSIVE STENGTH RATING IN PSI, WHICH WILL WANT TO BE RESEARCHED. AS A REFERENCE A 2000 PSF SOIL WILL WANT A 13.88 PSI FOAM TO KEEP PACE WITH ITS STRUCTURAL CAPACITY.



FROST PROTESTED SHALLOW FOUNDATION (FPSF)

1*EXTERIOR INSULATION_EXTENDS FROM TOP OF SLAB DOWN TO 12" MAX TO GRADE AND A MIN ADDITIONAL 12" BELOW GRADE AND THEN HOIZONTALLY UP TO A MAX OF 36" IN THE COLDEST ZONE. R VALUE BASED ON A LOACATIONS AIR FREEZING INDEX, (A TEMPERATURE RATING), PER CODE TABLE R403.3(1).

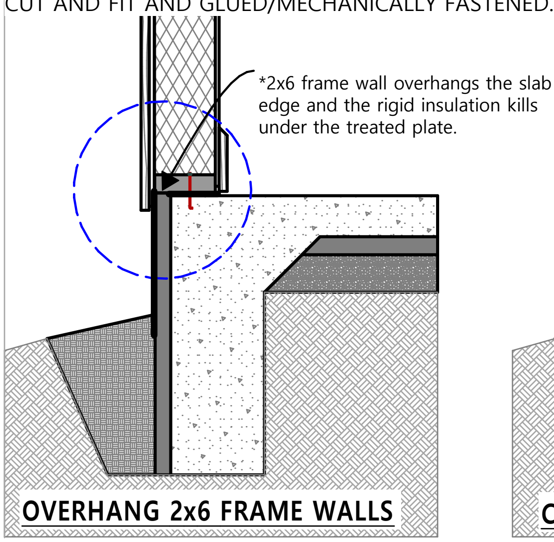
2*PROTECTING THE INSULATION_DITTO ABOVE

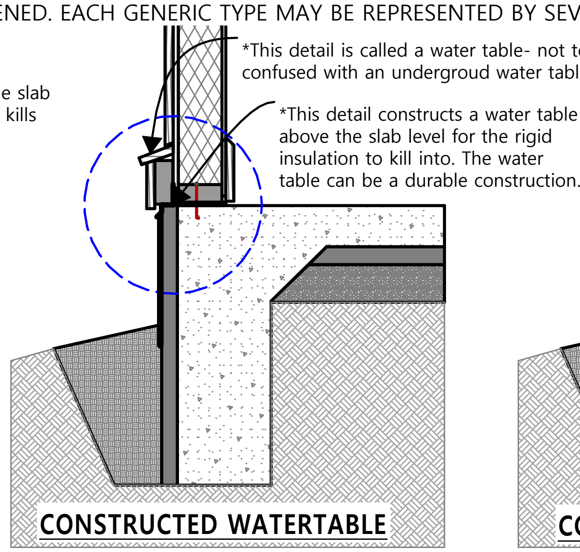
3*UNDER SLAB_IRONICALLY UNDER SLAB INSULATION CONTROLLING HEAT LOSS INTO THE GROUND, WILL REQUIRE MORE EXTERNAL INSULATION AS GROUND WILL REMAIN COLDER.

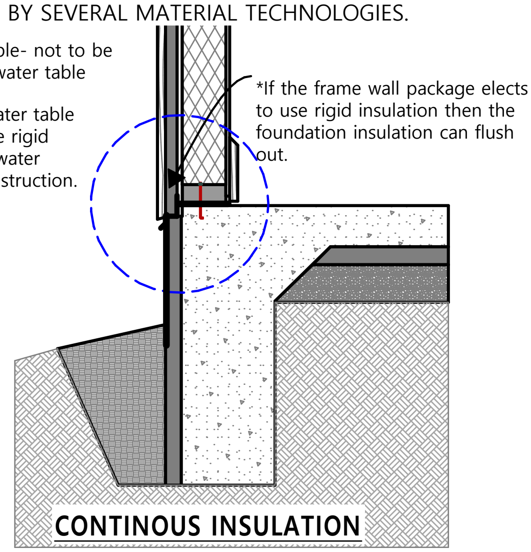
DETAILS

***PHYSICALLY PROTECTING THE EXTERIOR RIGID INSULATION ABOVE GRADE**_OFTEN- IN TYPICAL ILLUSTRATIONS LIKE THE ABOVE- THE RIGID INSULATION IS SHOWN CHAMFERED, ONLY BECAUSE WHEN EXPOSED AS SHOWN A HARD CORNER IS YET MORE VULNERABLE TO PHYSICAL DAMAGE. THE DETAILS BELOW ALL REMOVE THAT VULNERABILITY.

***PROTECTIVE (INSULATION) COVERING CHOICES**_TROWEL OR BRUSH APPLIED STUCCO TYPE FINISHES, METAL FLASHING, NON ROT SHEETGOODS CUT AND FIT AND GLUED/MECHANICALLY FASTENED. EACH GENERIC TYPE MAY BE REPRESENTED BY SEVERAL MATERIAL TECHNOLOGIES.

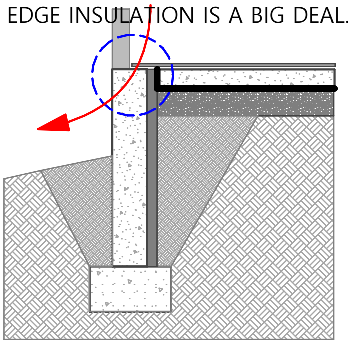






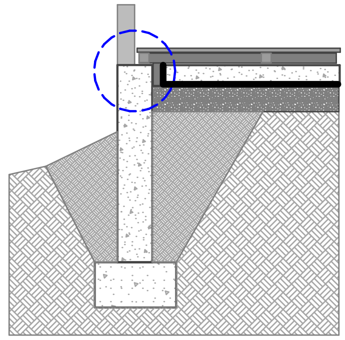
STEM WALL FOUNDATION GENERIC CONDITIONS

***THE EDGE**_THE ACHILLES HEEL OF THIS OTHERWISE SIMPLE AND FLEXIBLE FOUNDATION SYSTEM IS THE SLAB EDGE/FOUNDATION LEDGE DETAIL. THE GREAT BENEFIT IS THE LEDGE AS A SUPPORT VEHICLE FOR THE SLAB. THE ADDITIONAL BENEFIT IS IT PROVIDES A PLACE TO PUT A THERMAL BREAK BETWEEN THE FOUNDATION (EXTERIOR) AND THE SLAB (INTERIOR). (THE INTEGRAL FOUNDATION DOES NOT PROVIDE THIS OPPORTUNITY). THE LIMITATION IS THE INSULATION THICKNESS THAT CAN BE WORKED INTO THIS SLIGHTLY COMPLICATED DETAIL. IN COLDER ZONES THE SLAB EDGE INSULATION IS A BIG DEAL.



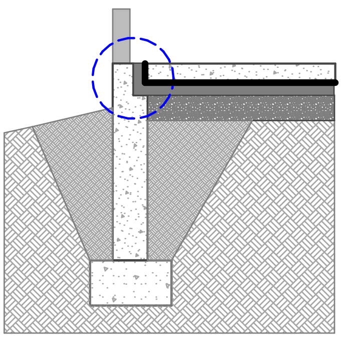
NO SLAB LEDGE

***CARE**_IF SOIL COMPACTION AND OR REINFORCEMENT ASSURES NO DROP IN THE SLAB THEN SLAB EDGE INSULATION CAN RUN STRAIGHT UP.
***FLOORING**_THIS OBVOUSLY PUTS THE INSULATION FARTHER INTO THE SPACE AND WOULD WANT TO BE COVERED WITH A FLOORING THAT WOULD RESIST ECHOING ANY CRACKING AT THAT JUNCTURE.



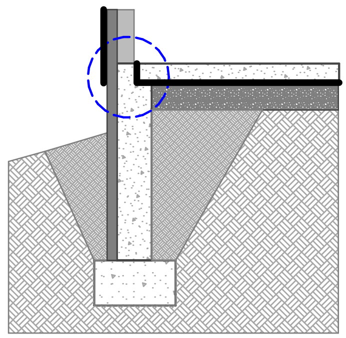
ALL ABOVE THE SLAB

***ABOVE SLAB**_RIGID INSULATION WITH FURRING STRIPS AND A FLOOR SHEATHING ABOVE THE SLAB ALLOWS ANY FLOORING TYPE SELECTION.
***WOOD FLOORING**_IF REAL WOOD FLOORING IS DESIRED THIS IS A VIABLE OPTION. THE WOOD SHOULD BE PUT UP ON SLEEPERS ANYWAY-SO MATCH THE SLEEPER HEIGHT TO THE DESIRED RIGID INSULATION THICKNESS.



EDGE & SLAB

***SUPPORT LEDGE**_SUPPORTING THE SLAB EDGE IS STRUCTURALLY PRECAUTIONARY. GETTING AMPLE (REMAINING) WALL THICKNESS, INSULATION THICKNESS, AND SUPPORT WIDTH IS A DIMNESIONAL CHALLENGE. WHEN ALL IS ACHIEVED IT IS A GOOD DETAIL. SEE OPTIONS BELOW.



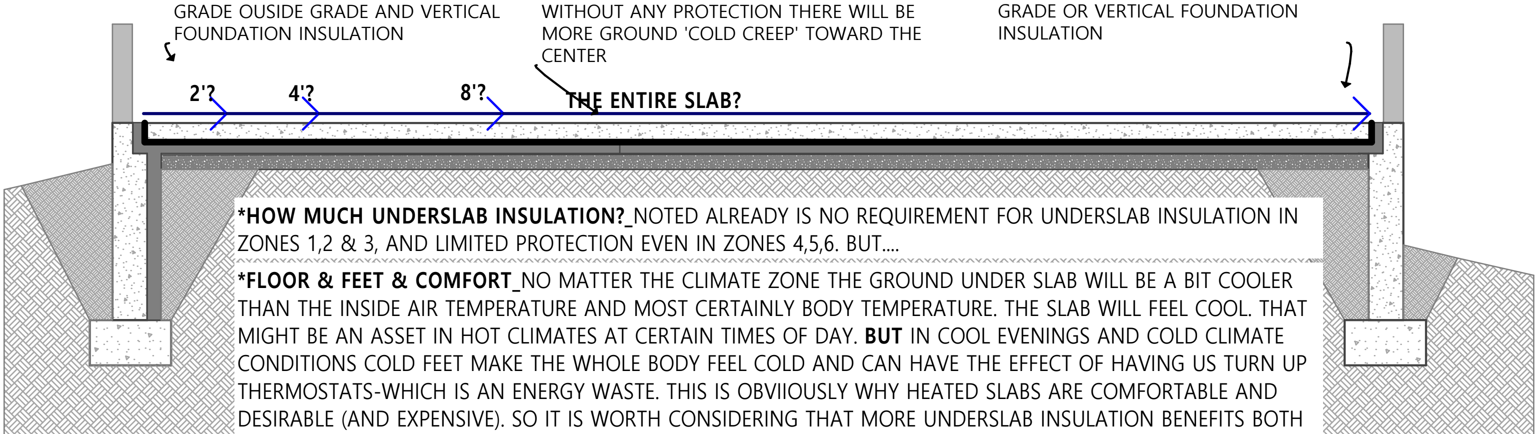
EXTERIOR INSULATION

***CONTINUOUS**_IF EXTERIOR INSULATION IS PLANNED TO SHEATH THE STRUCTURE THEN EXTENDING THAT DOWN TO THE FOOTING ON THE OUTSIDE MAKES SENSE. IT PROVIDES A COMPLETE/TIGHT 'SEAL' AND AN EASIER DETAIL AT THE BASE. THIS IS A GOOD COLD CLIMATE CANDIDATE.

GROUND TEMPERATURE HERE IS BETTER PROTECTED WITH HIGHER GRADE OUSIDE GRADE AND VERTICAL FOUNDATION INSULATION

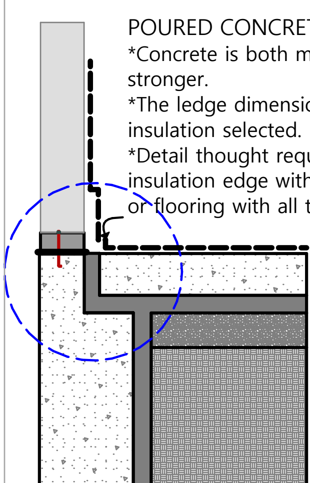
GROUND TEMPERATURE AT CENTER SLAB WILL BE EFFECTED BY THE PERIMETER PROTECTION. WITHOUT ANY PROTECTION THERE WILL BE MORE GROUND 'COLD CREEP' TOWARD THE CENTER

GROUND TEMPERATURE HERE IS NOT PROTECTED EITHER BY EXTERIOR GRADE OR VERTICAL FOUNDATION INSULATION

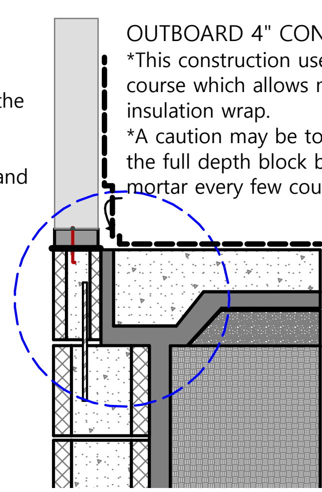


***HOW MUCH UNDERSLAB INSULATION?**_NOTED ALREADY IS NO REQUIREMENT FOR UNDERSLAB INSULATION IN ZONES 1,2 & 3, AND LIMITED PROTECTION EVEN IN ZONES 4,5,6. BUT....

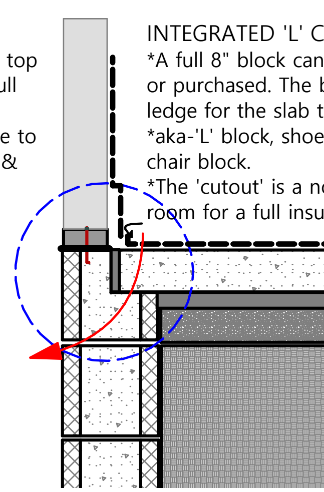
***FLOOR & FEET & COMFORT**_NO MATTER THE CLIMATE ZONE THE GROUND UNDER SLAB WILL BE A BIT COOLER THAN THE INSIDE AIR TEMPERATURE AND MOST CERTAINLY BODY TEMPERATURE. THE SLAB WILL FEEL COOL. THAT MIGHT BE AN ASSET IN HOT CLIMATES AT CERTAIN TIMES OF DAY. **BUT** IN COOL EVENINGS AND COLD CLIMATE CONDITIONS COLD FEET MAKE THE WHOLE BODY FEEL COLD AND CAN HAVE THE EFFECT OF HAVING US TURN UP THERMOSTATS-WHICH IS AN ENERGY WASTE. THIS IS OBVIIOUSLY WHY HEATED SLABS ARE COMFORTABLE AND DESIRABLE (AND EXPENSIVE). SO IT IS WORTH CONSIDERING THAT MORE UNDERSLAB INSULATION BENEFITS BOTH COMFORT AND ENERGY CONSUMPTION.



POURED CONCRETE
*Concrete is both more flexible and stronger.
*The ledge dimension can be catered to the insulation selected.
*Detail thought required to cover up the insulation edge with base and base cap, and or flooring with all these details.



OUTBOARD 4" CONCRETE BLOCK
*This construction uses a 4" wide block top course which allows more room for a full insulation wrap.
*A caution may be to tie this top course to the full depth block below with #4 bar & mortar every few courses horizontally



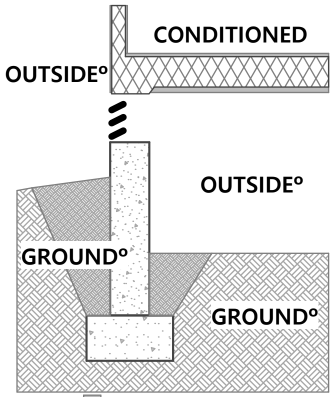
INTEGRATED 'L' CONCRETE BLOCK
*A full 8" block can be field cut (labor cost) or purchased. The block shape creates a ledge for the slab to nestle in.
*aka-'L' block, shoe block, header block, chair block.
*The 'cutout' is a nominal 4" x 4" so the room for a full insulation wrap is not there.

***2 APPLICABLE NOTES ALL 3 DETAILS**_A FOUNDATION WIDTH OF 10" OR 12" OBVIOUSLY GIVES THIS DETAIL MORE ROOM TO WORK, AND A 2X6 FRAME WALL HAS MORE 'COVER' POTENTIAL OVER THE EXPOSED INSULATION AT THE SLAB PLANE.

INSULATING THE VENTED+CONDITIONED CRAWL SPACE FOUNDATION

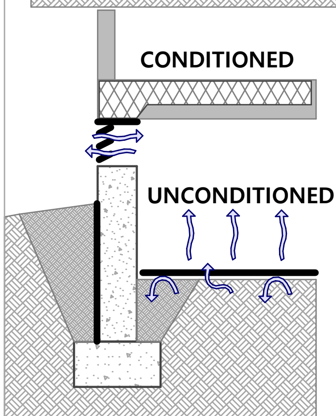
***COMPARISON**_THIS PROJECT'S DEFAULT IS THE CONDITIONED CRAWL SPACE FOR REASONS SUMMARIZED BELOW. THERE ARE PROJECT SPECIFIC INSTANCES WHERE THE VENTED-OR OPEN-CRAWL OR PIER FOUNDATION MAY MAKE SENSE. DITTO WHERE THE UNVENTED (AKA 'SEALED' OR 'CLOSED' CRAWL) MAY MAKE SENSE. PLEASE NOTE SECTION R408.3 MAY VARY A LOT, BASED ON STATE BY STATE EDITING.

VENTED CRAWL SPACE R408.1 R408.2 ✗



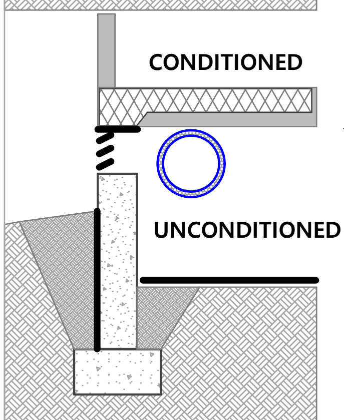
THERMAL PROTECTION

*A VENTED CRAWL SPACE IS NOT PROTECTED THERMALLY. IT BECOMES THE OUTSIDE TEMPERATURE ALBEIT WITHOUT THE EFFECTS OF SUN AND WIND. THE INSULATION RESPONSIBILITY IS IN THE FLOOR PLANE. A FRAME FLOOR WITH BRIDGING/BRACING, PLUMBING AND ELECTRIC RUNNING AROUND, IS AND ALWAYS HAS BEEN HARD TO INSULATE WELL. A SPECIAL CONSTRUCTION APPROACH CAN ACCOMPLISH THIS BUT TAKES MORE CARE AND MONEY THAN CONVENTIONAL CONSTRUCTION.



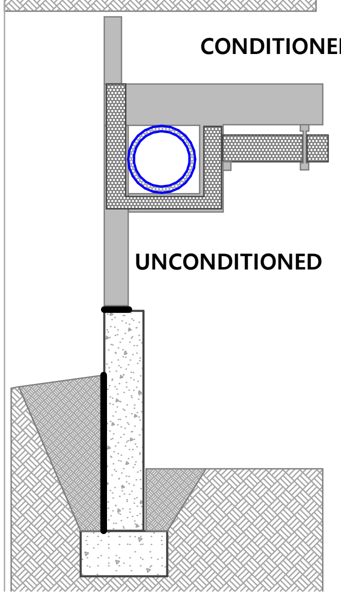
MOISTURE PROTECTION

*THE VENTED CRAWL IS A LITTLE OF A MIXED BAG. A VAPOR RETARDER ON THE GROUND PLANE IS REQUIRED BUT IS NOT REQUIRED TO BE SEALED. HUMIDITY FROM WET GROUND IS THEREFORE CONTROLLED BUT NOT PREVENTED. WALL VENTS ARE REQUIRED TO CAUSE AIR CHANGES. AN OPTION SET EXISTS FOR BOTH RETARDER AND VENTS. BOTTOM LINE THOUGH, IS THIS SYSTEM DOES NOT MANAGE HUMIDITY, MOLD, MILDEW.



INEFFICIENT HVAC

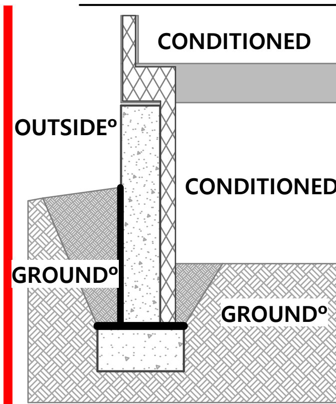
*THE LARGEST SINGLE LIABILITY TO THE VENTED CRAWL SPACE IS WHEN THE HVAC DUCTWORK OPERATES IN THIS SPACE. THE INSULATION REQUIRED AROUND DUCTWORK IS MINIMAL. THE HEATING CYCLE IS PUSHING WARM AIR WITH THE DUCTWORK SITTING IS A COLD ENVIRONMENT. THE COOLING CYCLE IS PUSHING COOL AIR WITH DUCTWORK SITTING IN A WARM AND HUMID ENVIRONMENT. EXTREMELY INEFFICIENT.



VENTED (TALL) CRAWL

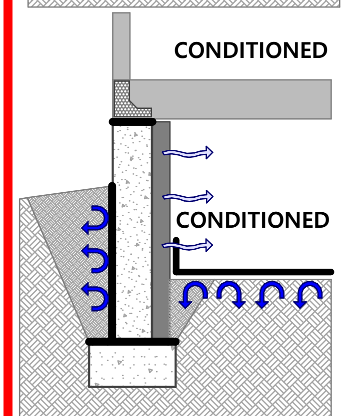
*THE REQUIREMENTS ARE NO DIFFERENT AND THE SAME THERMAL AND MOISTURE LIABILITIES EXIST IN THE TALL CRAWL. BECAUSE WORKING HEIGHT IS MORE GENEROUS THE SPECIAL CONSTRUCTION NOTED ABOVE BECOMES EASIER TO EXECUTE.ONE APPROACH IS TO CAREFULLY LAYOUT AND NOTE ON PLANS THE ELECTRICAL, PLUMBING AND HVAC SYSTEMS AND KEEP THEM TIGHT UP IN THE FLOOR. THEN DROP A COMPLETELY UNINTERUPTED INSULATION PLANE BELOW THE STRUCTURAL FLOOR PLANE. THERE ARE A FEW WAYS TO DO THAT, ALL PESKY. AIR HANDLER AND DUCT LOCATIONS ARE ALL PART OF THE DESIGN PROBLEM.

CONDITIONED CRAWL SPACE check R408.3 ✓



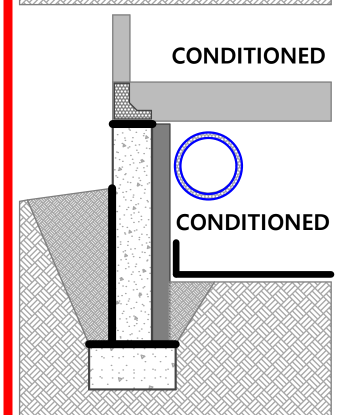
THERMAL PROTECTION

*CONTINUOUS INSULATION PLANE AS SHOWN. A FEW TECHNIQUES EXIST FOR INSULATING THE FOUNDATION WALLS. THE NET RESEULT IS TO ENABLE THE CRAWL TO BE CONDITIONED FULLY OR TEMPERED TO WITHIN A FEW DEGREES OF THE LIVING SPACES ABOVE. THE FRAME FLOOR IS RELIEVED OF ITS ALWAYS COMPROMISED INSULATION RESPONSIBILTIES.



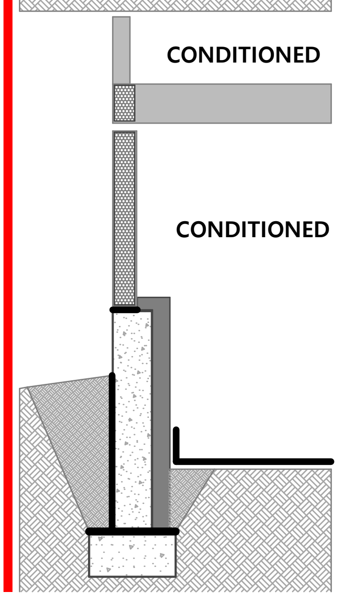
MOISTURE PROTECTION

*THE CLOSED CRAWL IS SEALED-TIGHTLY. THE GROUND BARRIER IS LAPPED, TAPED, AND TAKEN MIN 6" UP WALLS AND PIERS-AND ALSO TAPED. THE WALL INSULATION IS BEST WITH CLOSED CELL FOAM BOARDS OR SPRAY. DUCTWORK(SEE BELOW), THE WOOD FLOOR, ANY MECHANICAL EQUIP OR STORAGE ITEMS ARE IN A CONTROLLED ENVIRONMENT.



EFFICIENT HVAC!

*THE CLOSED CRAWL HOLDS A TEMPERATURE JUST A FEW DEGREES DIFFERENT THAN THE CONDITIONED SPACE ABOVE. THE DUCTWORK DELIVERING HEATING AND COOLING IS IN THE CONTROLLED ENVIRONMENT AND OPERATES EFFICIENTLY.THE SPACE IS 'TEMPERED' AND FREE FROM MOLD/MILDEW, AND BAD OUTSIDE AIR.



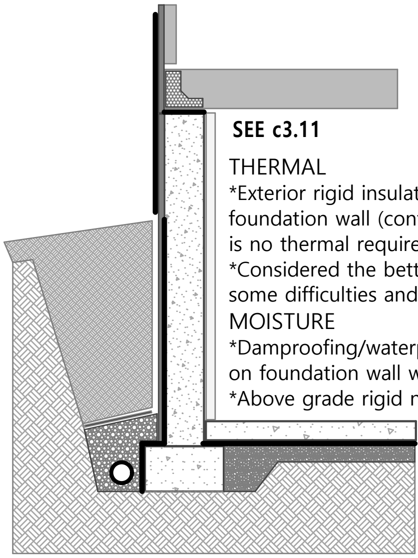
CLOSED (TALL) CRAWL

*THE ONLY CONSTRUCTION DISTINCTION IN THE TALL CRAWL WOULD BE THE FRAME WALLS WITH THEM BEING INSULATED WITH CAVITY INSULATION. THE SPACE IS 'SEALED' AND CLOSED THE SAME AS ANY CLOSED CRAWL.

*TREATING A LARGER VOLUME THIS WAY BECOMES MORE EXPENSIVE AND AT SOME POINT BEGS THE QUESTION IF THIS SHOULD BECOME HABITABLE USEFUL FINISHED SPACE WITH THE ADDITION OF SOME EXCAVATION AND A CONCRETE FLOOR.

INSULATING THE BASEMENT FOUNDATION

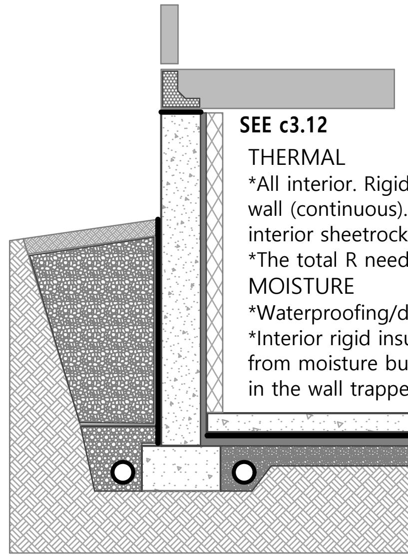
***APPROACHES**_SOME QUICK SECTIONS BELOW POINT OUT BASIC CHARACTERISTEICS AND HIGHLIGHTS ONLY FOR COMMON FOUNDATION CONSTRUCTIONS. FOUNDATION DRAIN SYSTEM AND UNDERSLAB DRAINABLE BASE AND VAPOR BARRIER SHOW ALL SECTIONS.



SEE c3.11

THERMAL
*Exterior rigid insulation direct against foundation wall (continuous). If r value met there is no thermal requirement on the inside wall.
*Considered the better solution but comes with some difficulties and costs.
MOISTURE
*Dampproofing/waterproofing below grade best if on foundation wall with rigid on top of that.
*Above grade rigid need exterior protection

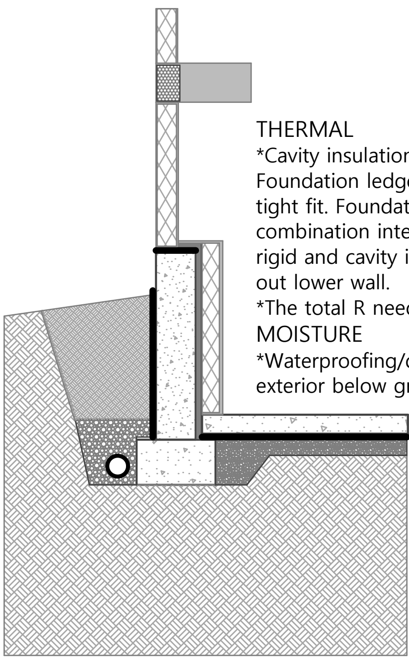
FULL CONCRETE WALL (SIMILAR CONCRETE BLOCK)



SEE c3.12

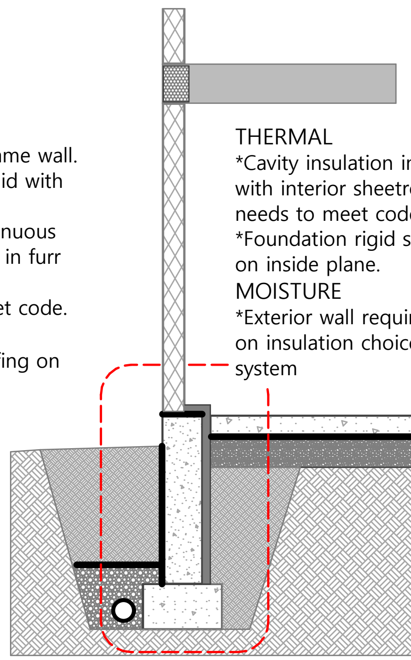
THERMAL
*All interior. Rigid insulation direct against foundation wall (continuous). Cavity insulation in 2x frame wall with interior sheetrock.
*The total R needs to meet code.
MOISTURE
*Waterproofing/dampproofing on exterior below grade
*Interior rigid insulation protects the interior wall cavity from moisture but at the same time can keep moisture in the wall trapped.

FULL CONCRETE WALL (SIMILAR CONCRETE BLOCK)



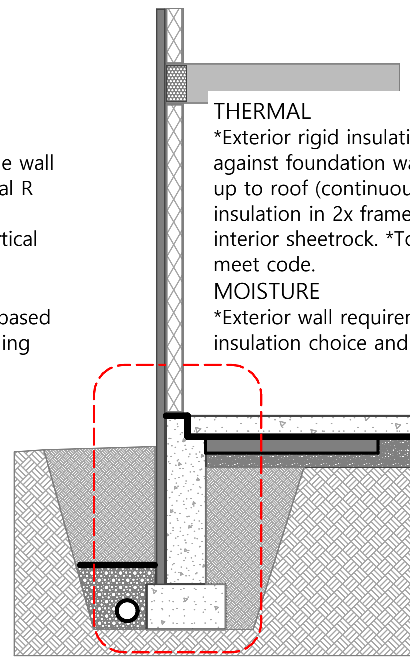
THERMAL
*Cavity insulation in 2x frame wall. Foundation ledge uses rigid with tight fit. Foundation wall combination interior continuous rigid and cavity insulation in furr out lower wall.
*The total R needs to meet code.
MOISTURE
*Waterproofing/dampproofing on exterior below grade

BASEMENT DAYLIGHT WALL



THERMAL
*Cavity insulation in 2x frame wall with interior sheetrock. *Total R needs to meet code.
*Foundation rigid shows vertical on inside plane.
MOISTURE
*Exterior wall requirements based on insulation choice and siding system

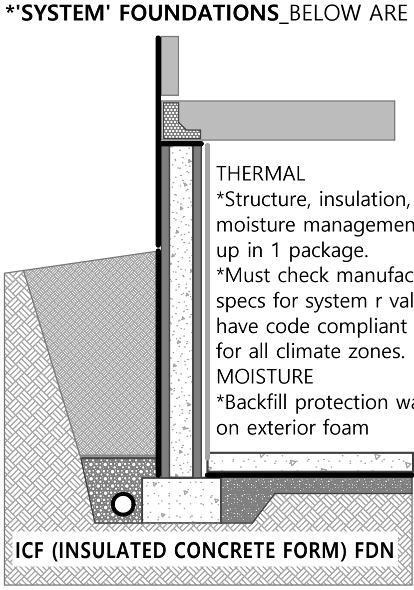
BASEMENT WALKOUT WALL



THERMAL
*Exterior rigid insulation direct against foundation wall, frame wall, up to roof (continuous). Cavity insulation in 2x frame wall with interior sheetrock. *Total R needs to meet code.
MOISTURE
*Exterior wall requirements based on insulation choice and siding system

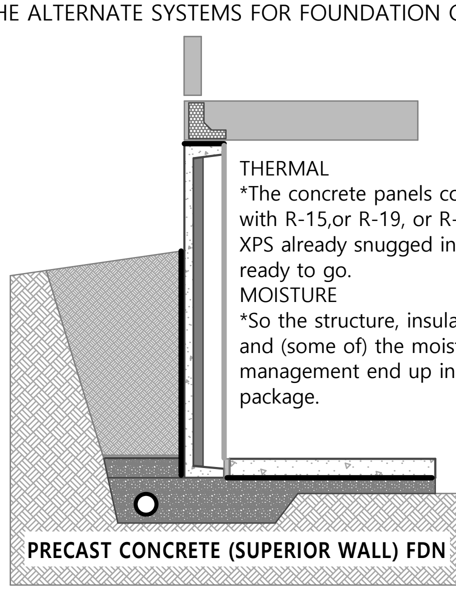
BASEMENT WALKOUT WALL

***'SYSTEM' FOUNDATIONS**_BELOW ARE 3 OF THE ALTERNATE SYSTEMS FOR FOUNDATION CONSTRUCTION. INFORMATION READILY AVAILABLE.



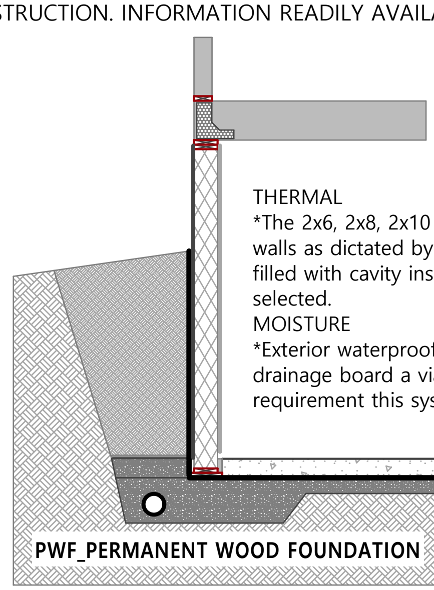
THERMAL
*Structure, insulation, and moisture management end up in 1 package.
*Must check manufacturers specs for system r value. All have code compliant systems for all climate zones.
MOISTURE
*Backfill protection wanted on exterior foam

ICF (INSULATED CONCRETE FORM) FDN



THERMAL
*The concrete panels come with R-15,or R-19, or R-21 XPS already snugged in & ready to go.
MOISTURE
*So the structure, insulation, and (some of) the moisture management end up in 1 package.

PRECAST CONCRETE (SUPERIOR WALL) FDN

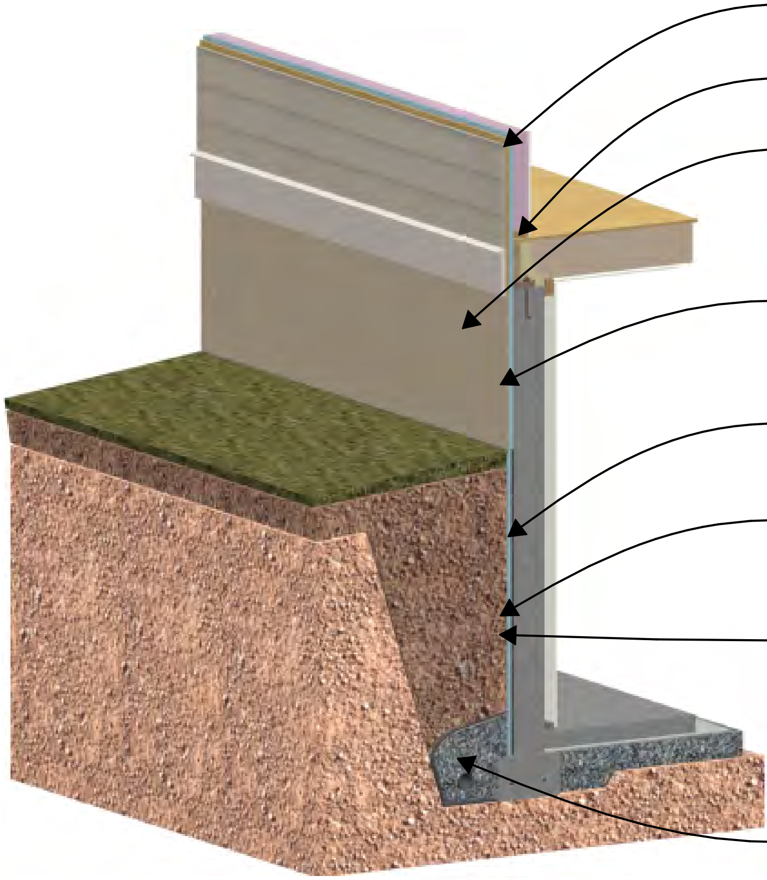


THERMAL
*The 2x6, 2x8, 2x10 frame walls as dictated by structure filled with cavity insulation as selected.
MOISTURE
*Exterior waterproofing and drainage board a viable requirement this system

PWF_PERMANENT WOOD FOUNDATION

FOUNDATION PROTECTIONS c3.11
SAMPLE BASEMENT SECTION 1

***THIS SAMPLE SECTION**_NOT POSSIBLE TO ADDRESS ALL SECTION POSSIBILITIES. THIS SECTION SHOWS EXTERIOR INSULATION R-10 CONTINUOUS APPLICABLE CLIMATE ZONE 1,2,3,4(EXCEPT MARINE). TYPE I, TYPE II SOILS.



EXTERIOR NOTATIONS

*EXTERIOR INSULATION_relieves the requirement for the frame wall cavity insulation. 2x4 frame walls become energy viable.

*BAND INSULATION_spray foam a good choice this potentially leaky condition.

*EXTERIOR FOUNDATION INSULATION ABOVE GRADE _rigid insulation above grade needs to be thermally tight and taped or sealed, needs a protective coating, and wants a more attractive look than insulation board. There are a bunch of options on the market specific to this condition and requirement.

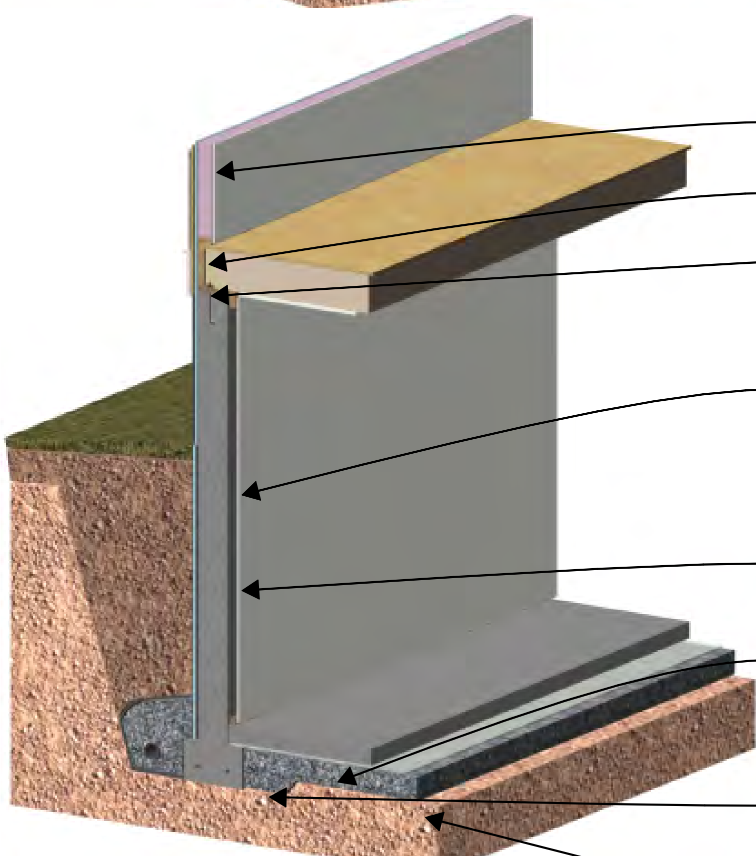
*GRADE LINE_setting/marking an accurate final grade line on the foundation wall is an important one. In a lot of construction situations materials and systems want to join at the grade line. The early applied dampproofing/waterproofing line is one of them.

*EXTERIOR WATERPROOFING BELOW GRADE _considered wise to dampproof/waterproof directly on the foundation wall and place the rigid on top of that.

*EXTERIOR FOUNDATION INSULATION BELOW GRADE _rigid placed on top of the dampproofing/waterproofing. Fastening options exist. Backfilling wants to be careful to avoid beating up and compromising the thermal barrier plane.

*DRAINAGE PLANE IDEA_water wants to drain freely to the drain tile. This is an important judgement decision. Drainable backfill (good), gravel backfill (better), a drainage board/drainage plane on the foundation wall outermost surface further facilitates moving water down the wall to the drain. Maybe not recommended- but some might install a quality drain board and backfill with whatever spoils are on site.

*DRAIN_this section showing the wrap technique for the drain tile. The drain tile must be protected from silt/fine soil which will compromise the drain's effectiveness.



INTERIOR NOTATIONS

*EXTERIOR INSULATION_relieves the requirement for the frame wall cavity insulation. 2x4 frame walls become energy viable.

*BAND INSULATION_spray foam a good choice this potentially leaky condition.

*SEALED (AND ANCHORED) PLATE_2x6 plate typical. If in contact with masonry, treated plate required, or install on sill seal, or both. Sill seal easily rolls out and offers moisture protection, and functions as an air infiltration barrier to this condition.

*INTERIOR WALLS_when the exterior rigid insulation meets code requirements there is no requirement to insulate or finish these interior basement walls. And in theroy they stay condensation free. The adequate exterior insulation should keep the interior foundation wall warm enough to avoid all moisture/condensation potential.

*IF_these basement walls are to be finished with sheetrock and a frame out or furring system is to be installed regardless, it becomes wise to add cavity insulation because of its cost/value.

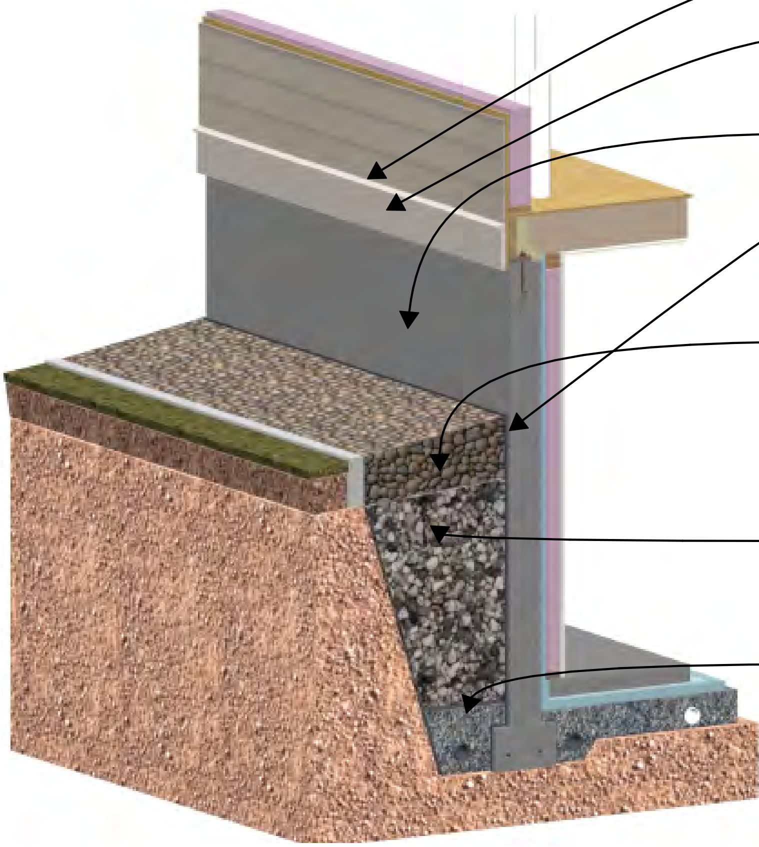
*UNDER SLAB INSULATION_not required when grade is more than 1 foot above the footing. but underslab insulation is always a comfort benefit. remember the soil temperature below the slab is always cooler than the air temperature inside and the slab will want to assume that cooler temperature-unless it is insulated.

*DRAIN_this section assumes interior water collection not required. that requirement usually restricted to high water table/saturated soil conditons.

*SLAB PREP_vapor barrier and 4" sub base typical

FOUNDATION PROTECTIONS c3.12
SAMPLE BASEMENT SECTION 2

***THIS SAMPLE SECTION**_NOT POSSIBLE TO ADDRESS ALL SECTION POSSIBILITIES. THIS SECTION SHOWS INTERIOR INSULATION ONLY, A POTENTIALLY WET SOIL CONDITION AND SOIL GASSES.



EXTERIOR NOTATIONS

*WATER TABLE DRIP_gets water to drip freely to the ground plane. Helps avoid water and staining/discoloration on material below it.

*WATER TABLE BOARD_is mostly a design/visual tool. It gives an entire siding package a more substantial look. Depth as selected. Always non rot.

*SURFACE MATERIAL_none really needed. A parge coat or a textured (masonry) paint may be used for cosmetic purposes.

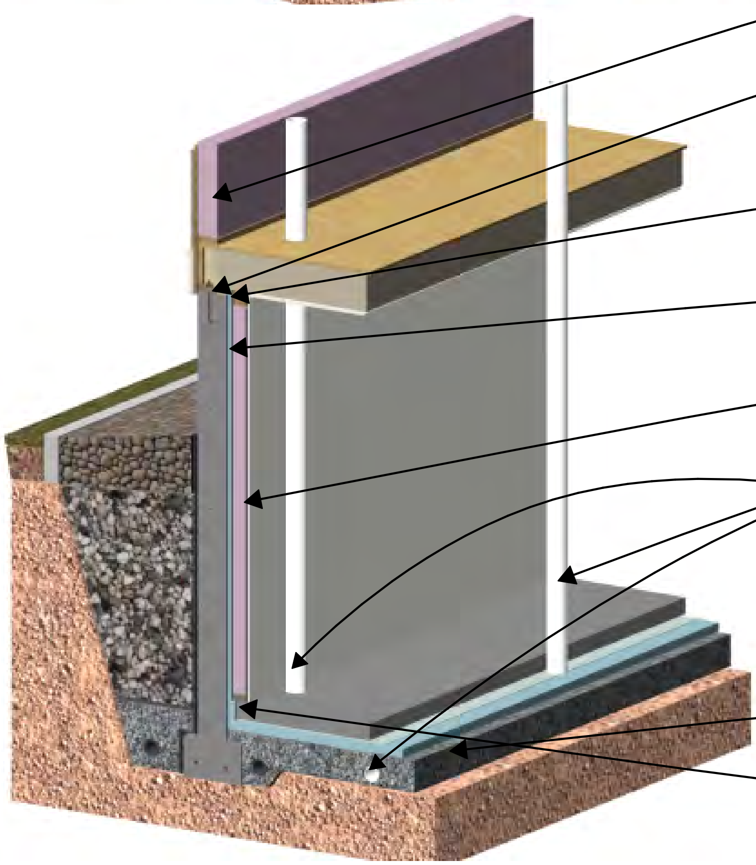
*FOUNDATION FINISH BELOW GRADE_damproofing or waterproofing required by code.

*BACKFILLING MATERIALS_sections shows 3 materials to illustrate 3 functions.

*TOP BACKFILL MATERIAL_planting in 12" soil with a mulch bed is the commom against the house treatment. Soil (fines/silt) will work its way down thru the backfill, as may root structures. Termites are given a home. An alternative solution is make that last layer washed gravel. No soil, no mud splash. Easy to blow out or rake leaves. No termites. Place the planting beds just a bit further out away from the foundation/drainage system.

*BULK BACKFILL MATERIAL_this definitely wants to be drainable to encouge any/all water to get to the drain and not hang around putting pressure on the wall. The same universal gravel used for the drain zone can be used, keeping things simple and effective.

*FOUNDATION DRAIN MATERIAL_drainable gravel with 2"below drain and 6" above with landscape fabric filter to ensure no small stuff gets to the drain tile. If soil backfill is used this is a high probability. With gravel fill above this is a much lower probability



INTERIOR NOTATIONS

*INSULATION AT BAND_spray foam seems the best option here to fill all nooks and crannies and tighten up this leaky zone.

*SEALED (AND ANCHORED) PLATE_2x6 plate typical. If in contact with masonry, treated plate required, or install on sill seal, or both. Sill seal easily rolls out and offers, moisture protection, and functions as an air infiltration barrier to this condition.

*INTERIOR RIGID RETURN TO PLATE_another juncture gap that need insulation fill. Rigid or spray foam better than fiberglass this application.

*INTERIOR RIGID AT WALL_rigid semi impermeable a good choice to establish a continuous basement wall r value and give moisture protection to frame wall inside.

*FRAME WALL_snugged up to the rigid continuous. R-11 up to R-21 cavity possible in a 2x4 or 2x6 set to take sheetrock for a finished space.

*SOIL GAS_the vapor barrier will hold radon or other soil generated gases under it. A means of escape is wanted. A vertical pipe running from sub base thru roof is that escape. The drainable sub base should be (about) 40% void and can pass that gas along to the vertical escape. A fan assist (above) will assure exit. An under grade pipe system to the vertical escape will move more gas. Note alternate vertical pipe connecting with a perimeter drain line (if one exists).

*VAPOR BARRIER_required for soil gas entrapment and to eliminate water/water vapor entering slab.

*THERMAL BREAK_setting a perimeter band at interior wall perimeter as a slab leveling target is an option. If/when a thermal bereak is of value recovery board or xps rigid are options. In this below grade situation the thermal break is not reequired.

appendix f
AF 103.6 Passive subslab depressurization system

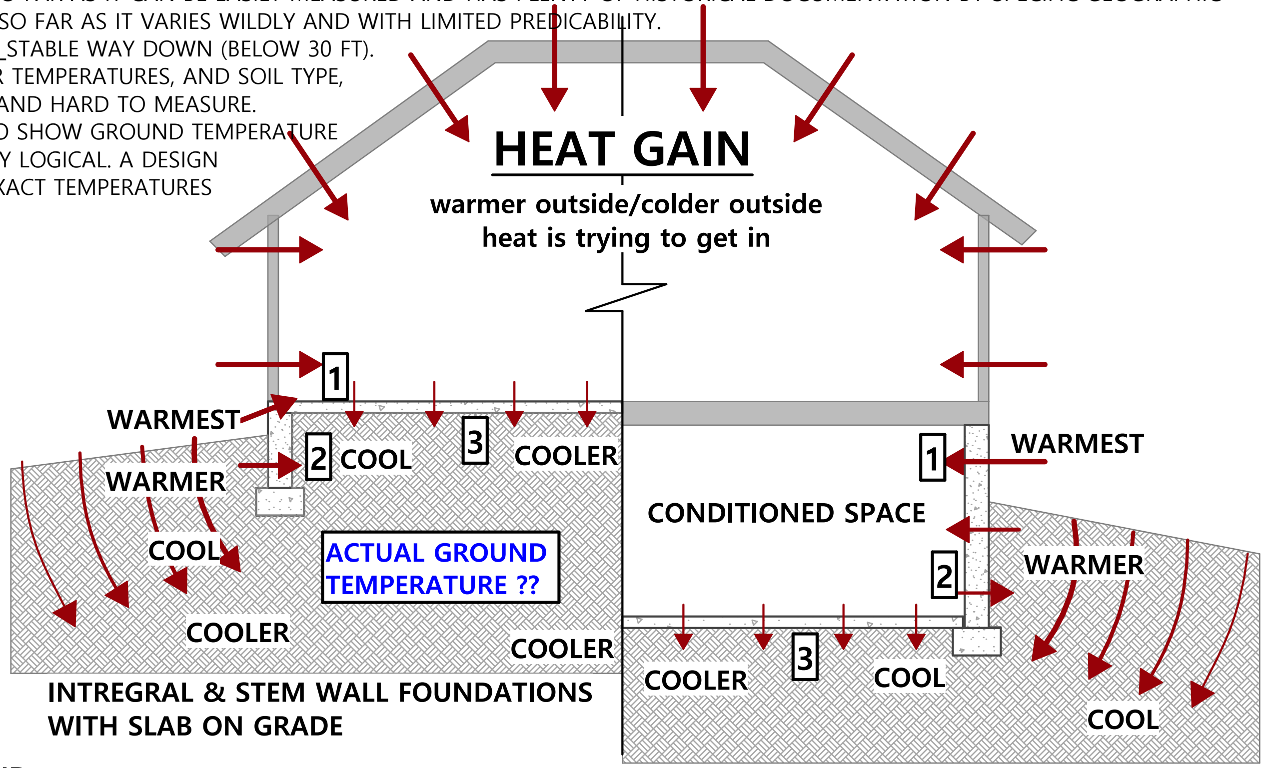
HOT TO COLD

***ABOVE GRADE**_ILLUSTRATIONS BELOW INTENDED TO GRAPHICALLY SHOW THE HOT TO COLD TRANSFER THAT JUST IS. THIS OCCURS ABOVE AND BELOW GRADE. BECAUSE TEMPERATURES ARE TRYING TO EQUALIZE- EVEN A 1 DEGREE SEPARATION WILL GENERATE TRANSFER.

***INSIDE AIR.**_SIMPLE BECAUSE THERE IS A COMFORT STANDARD. THIS PROJECT USES 70^{O} DURING THE HEATING CYCLE, AND 75^{O} DURING THE COOLING CYCLE. AN INDIVIDUAL MAY SET THOSE AS PREFERRED,

***OUTSIDE AIR.**_SIMPLE IN SO FAR AS IT CAN BE EASILY MEASURED AND HAS PLENTY OF HISTORICAL DOCUMENTATION BY SPECIFIC GEOGRAPHIC LOCATION. NOT SIMPLE IN SO FAR AS IT VARIES WILDLY AND WITH LIMITED PREDICABILITY.

***GROUND TEMPERATURES**_STABLE WAY DOWN (BELOW 30 FT). OTHERWISE SUBJECT TO AIR TEMPERATURES, AND SOIL TYPE, AND MOISTURE CONTENT, AND HARD TO MEASURE. ILLUSTRATION INTENDED TO SHOW GROUND TEMPERATURE TRAVEL WHICH IS PERFECTLY LOGICAL. A DESIGN LIMITATION IS KNOWING EXACT TEMPERATURES IN THE GROUND.



INTREGRAL & STEM WALL FOUNDATIONS WITH SLAB ON GRADE

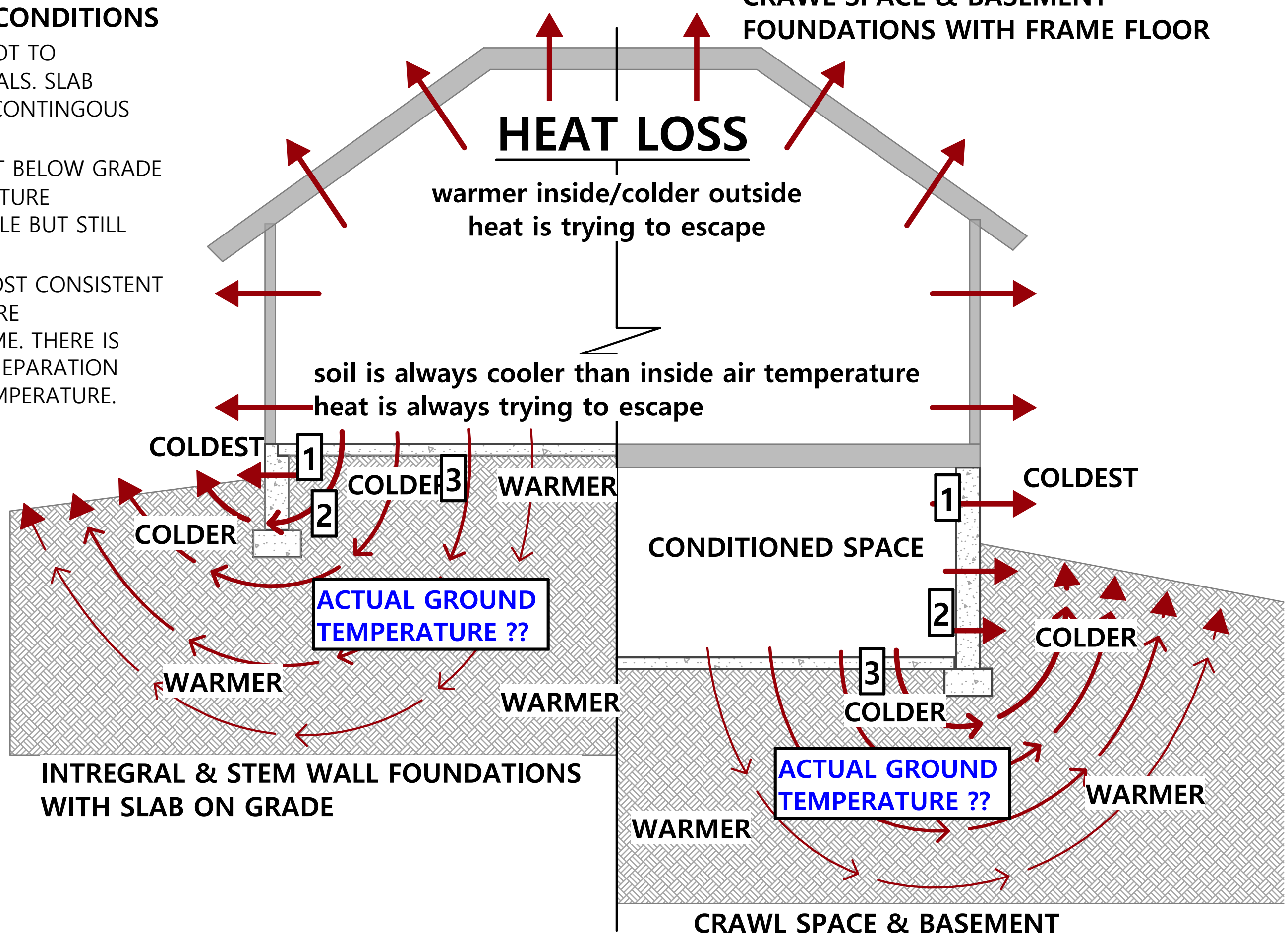
CRAWL SPACE & BASEMENT FOUNDATIONS WITH FRAME FLOOR

1,2,3 LOGIC OF GROUND TEMPERATURE ALL CONDITIONS

1.MOST VULNERABLE SPOT TO TEMPRATURE DIFFERENTIALS. SLAB AND FOUNDATION ARE CONTINGOUS WITH THE OUTSIDE AIR.

2.LESS VULNERABLE SPOT BELOW GRADE AS IN GROUND TEMPERATURE WILL BE LESS MORE STABLE BUT STILL SUBJECT TO CHANGE.

3.LEAST VULNERABLE/MOST CONSISTENT AS GROUND TEMPERATURE CHANGES TAKE THEIR TIME. THERE IS SIMPLY MORE GROUND SEPARATION TO THAT CAUSAL AIR TEMPERATURE.



INTREGRAL & STEM WALL FOUNDATIONS WITH SLAB ON GRADE

CRAWL SPACE & BASEMENT FOUNDATIONS WITH FRAME FLOOR

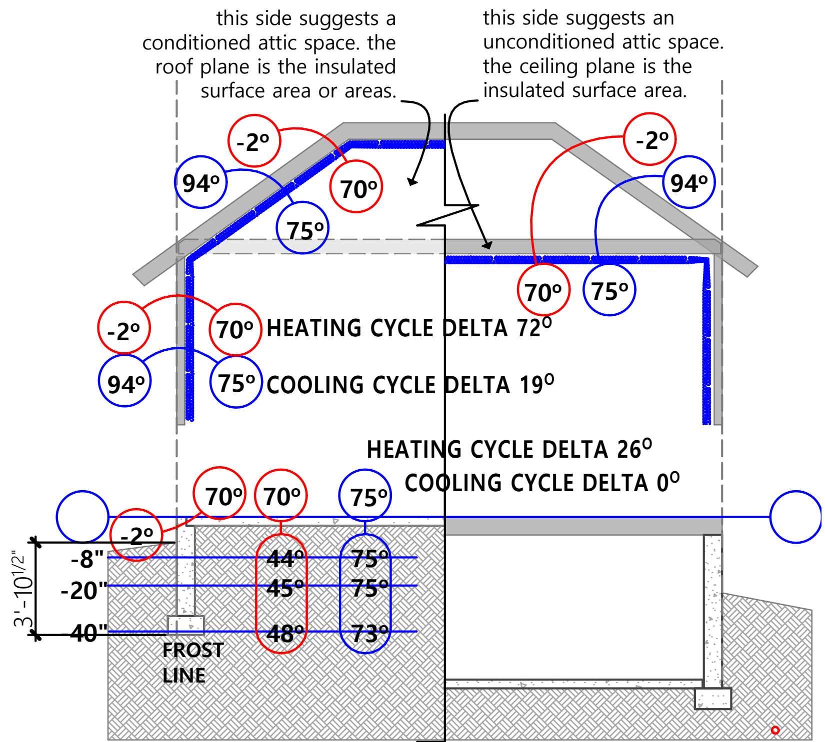
THERMAL ENVELOPE DESIGN

***THERMAL ENVELOPE_**THE THERMAL ENVELOPE IS DEFINED BY THE CONTINUOUS SURFACES WHERE THE INSIDE CONDITIONED SPACE MEETS THE OUTSIDE SPACE-AND OR- ANY UNCONDITIONED SPACE-AND OR- THE GROUND.
***TEMPERATURE DIFFERENTIALS AND AREA_**THE UNAVOIDABLE TEMPERATURE DIFFERENTIAL OCCURS OVER AN AREA OF BUILDING-WALL, ROOF, AND FLOOR. THE MORE AREA THE GREATER THE POTENTIAL HEAT GAIN OR HEAT LOSS.
***INSULATION_**IS USED TO SLOW DOWN THAT TRANSFER. THE SLOWER THE TRANSFER THE LESS CONDITIONING (HEATING AND COOLING) IS REQUIRED AND THEREFORE THE LESS ENERGY CONSUMED. AND GREATER COMFORT REALIZED.
***THE CHALLENGE_**IS TO SELECT THE RIGHT AMOUNT OF INSULATION IN ANY AND ALL SPECIFIC LOCATIONS IN WALL, ROOF, AND FLOOR, TO BEST SLOW DOWN THAT TRANSFER.
***THE GENERIC AND REVEALING DESIGN EQUATION_**TEMPERATURE DIFFERENTIAL TIMES SURFACE AREA DIVIDED BY INSULATION SLOW DOWN RATE EQUALS THE HEAT FLOW (GAIN OR LOSS). THIS IS APPLICABLE TO ANY WALL, ROOF, FLOOR AREA. THE TEMPERATURE DIFFERENTIALS WE USE FOR THIS DESIGN IS ESTABLISHED BY CODE AND LOCATION. THE (MANY) SURFACE AREA(S) NEEDS TO BE CALCULATED USING ONE'S HOME DESIGN. THE INSULATION SLOW DOWN RATE, IN OTHER TERMS, THE **R** (RESISTANCE) VALUE OF THE CONSTRUCTION ASSEMBLY, IS A CHOICE THAT DETERMINES THE HEAT FLOW AND ITS REQUIRED ENERGY AND ENERGY COST. THERE IS A DYNAMIC BETWEEN THE INVESTMENT IN THAT **R** AND ENERGY AND COMFORT.

surface area x delta Temperature / Resistance = heat flow

QUANTIFYING TEMPERATURE DIFFERENTIALS-

***NOTE_**THIS EXPLANATION IS PRINCIPLE AND NOT INTENDED TO FOLLOW CODE OR MANUAL 'J' TO THE LETTER.
***DESIGN INTERIOR TEMPERATURES_** COMMON AND REASONABLE ARE THE INTERIOR DESIRED TEMPERATURES OF 70^{O} FOR THE HEATING CYCLE, AND 75^{O} FOR THE COOLING CYCLE.
***DESIGN EXTERIOR TEMPERATURES_**WHERE AS REAL EXTERIOR TEMPERATURES VARY A BUNCH CODE SETS DESIGN TEMPERATURES AT THE 99TH PERCENTILE OF WINTER/SUMMER TEMPERATURES. SO 1% OF THE TIME HOT AND COLD MAY SLIP OUTSIDE THESE DESIGN PARAMETERS. THESE ARE CHARTED ACROSS THE COUNTRY IN THE CODE REQUIRED DESIGN MANUAL 'J'. TEMPERATURES SHOWN ARE FOR LINCOLN, NE (PRETTY MUCH CENTER OF THE LOWER 48).
DESIGN IN GROUND TEMPERATURES_**GROUND TEMPERATURES SHOWN ARE FROM THE CHARTED DATA FROM A NRCS TEMPERATURE STATION NEAR LINCOLN NE.



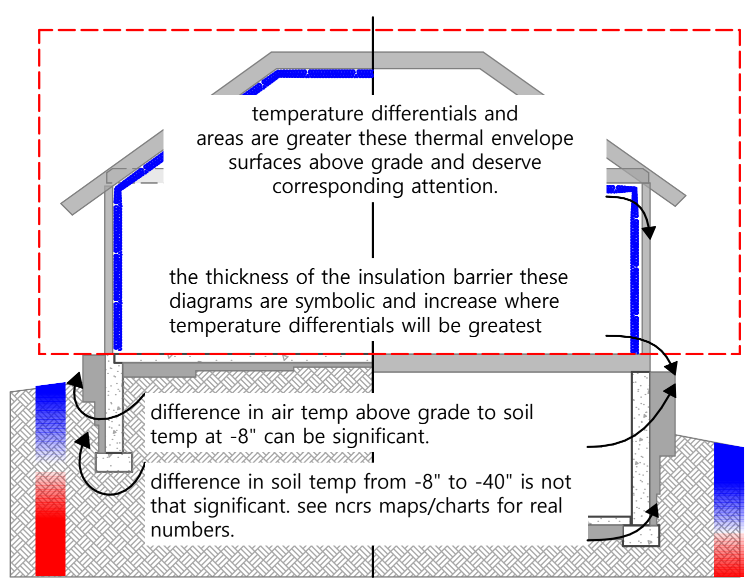
NOTE ACTUAL LOAD CALC EXERCISES ARE IN CHAPTER c9 THERMAL ENVELOPE

*****DATA**

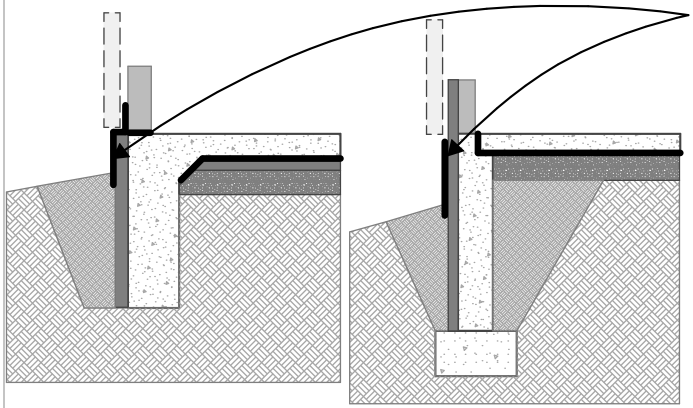
*THESE IN GROUND TEMPERATURES HAVE BEEN INCLUDED TO CONTINUE TO MAKE THE POINT ABOUT TEMPERATURE DIFFERENTIALS. IN GROUND SOIL TEMPERATURES (AND MOISTURE CONTENT) AT -2",-4",-8",-20", -40" ARE MONITORED DAILY , RECORDED AND PUBLICLY AVAILABLE. THE NATURAL RESOURCES CONSERVATION SERVICE (NRCS) IS PART OF THE USDA, AND HAS SITES NATIONWIDE THAT MONITOR AND MAKE AVAILABLE THIS DATA AS WELL AS AIR TEMPERATURES. ALTHOUGH CREATED FOR THE AGRICULTURAL WORLD, DATA MAY BE INTERSTING/USEFUL.

COMMON SENSE UNDERGROUND THINKING

***c3.13_**HEAT LOSS IS THE LARGER AND THEREFORE CONTROLLING TEMPERATURE DIFFERENTIAL. HEAT LOSS FROM THE SLAB 'DOWN AND OVER' TO THE COLDER OUTSIDE AIR BECOMES THE DESIGN PROBLEM. THE OUTSIDE PERIMETER OF THE FLOOR AREA, AND THE UPPER PORTION OF THE FOUNDATION WALL ARE SUBJECT TO THE GREATER TEMPERATURE DIFFERENTIALS.
***SLAB EDGE_**IS PERHAPS THE MOST VULNERABLE SPECIFIC SPOT AS THERE IS NEVER ANY INSULATING GROUND COVER THERE-AIR TEMPERATURE ONLY.
***INSULATING THE WALL, OR THE SLAB_**INSULATING THE FOUNDATION WALL WILL KEEP GROUND TEMPERATURES UNDER THE SLAB WARMER, AND THERFORE LIMIT HEAT LOSS THRU THE SLAB. INSULATING BELOW THE SLAB MORE DIRECTLY RESISTS LOSS THRU THE SLAB. THE CODE CALLS FOR THE SAME **R** AND WIDTH WHICHEVER METHOD IS USED.
***CONSIDER_**GIVEN THE SAME AMOUNT OF INSULATION DOLLARS, INSULATING THE FOUNDATION WALL IS MORE OFTEN MORE EFFECTIVE. IF NOT FOR THAT COST OF RIGID INSULATION IT WOULD BE BEST TO INSULATE BOTH. INSULATING UNDER THE SLAB (THE WHOLE SLAB) WILL RESULT IN A WARMER, MORE COMFORTABLE SLAB. IT ALSO WILL RETAIN SUN GENERATED RADIANT HEAT GAIN MORE EFFECTIVELY. AND IF A HEATED SLAB IS CONSIDERED THE UNDERSLAB AREA MUST BE INSULATED.

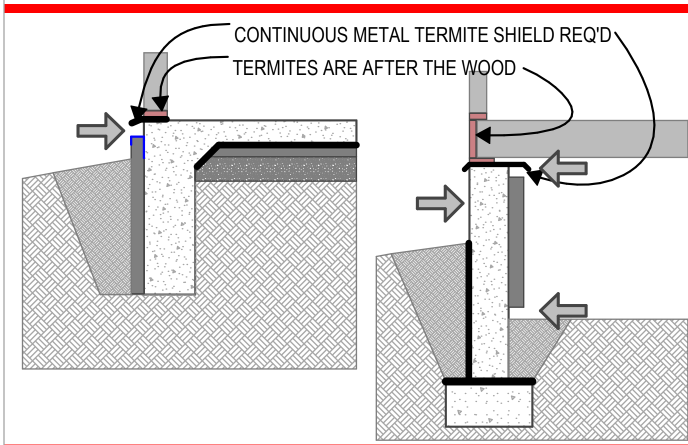


FOUNDATION PROTECTIONS c3.15
SOME CONDITIONS, EXCEPTIONS



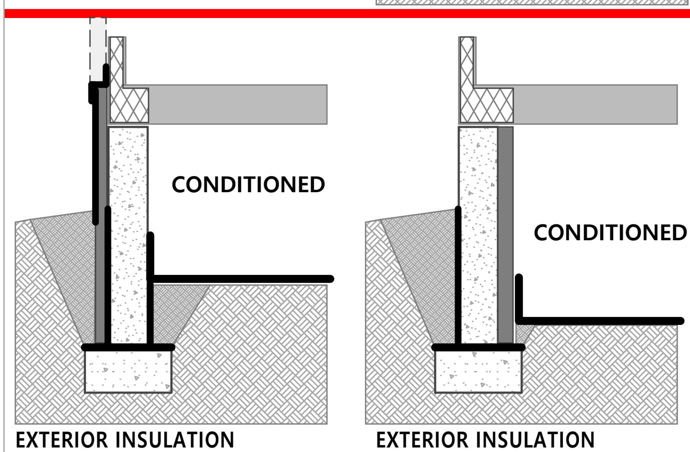
PROTECTING RIGID INSULATION ABOVE GRADE

*CODE_A DISTANCE SEPARATION OF 6" OR 8"IS REQUIRED BETWEEN GRADE AND SIDING/TRIM OR FRAME WALL. SO THAT MIN DISTANCE(AT LEAST) IS ALWAYS EXPOSED TO GENERAL WEAR & TEAR. PROTECTION TYPES NOTED BELOW. RESEARCH NEEDED.
***STUCCO LIKE PRODUCTS**_RANGE OF 'GOOP' PRODUCTS FOR BRUSH, ROLL, SPRAY, TROWEL APPLICATION. A USUALLY APPLICABLE RULE IS THICKER IS TOUGHER. OR CONSIDER A MESH APPLICATION (SYNTHETIC OR TRADITIONAL STUCCO) WHICH OFFERS IMPACT RESISTANCE. ALSO REQUIRES SEVERAL STEPS TO COMPLETE A SYSTEM.
***SHEETGOOD PRODUCTS**_ CEMENT BACKER BOARD, TREATED PLYWOOD ARE TOUGH NON ROT SHEETGOODS THAT WILL WANT A COSMETIC/AESTHETIC FINISH.
***PREFINISHED+APPLIED**_ROLLED PREFINISHED 'SKINS' LIKE GROUNDBREAKER BY NUDO.
***PREFINISHED RIGID INSULATION**_PROTECTIVE COATING IS ON THE RIGID.
***WARNING**_READ INSTALLATION GUIDES CAREFULLY. DIFFERENT PRODUCTS SUIT DIFFERENT CONDITIONS AND **GEOMETRIES.** IN PRINCIPLE BRUSH/TROWEL/SPRAY FINISHES ARE THE MORE FLEXIBLE AND FORGIVING WITH MORE CORNERS AND A MORE COMPLEX GEOMETRY.



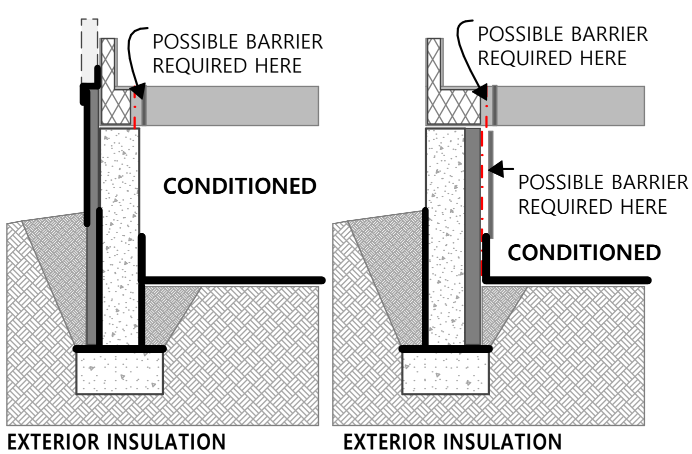
TERMITE INSPECTIONS

***CODE**_IN TERMITE SENSITIVE AREAS (d2.13) AN INSPECTION GAP OR GAPS MAY BE REQUIRED INTENDED TO SPOT TERMITE PRESENCE/ACTIVITY. TERMITES WILL BORE UP THRU RIGID INSULATION WITHOUT ANY VISIBLE TRACE.
***BORATE**_IS USED AS A WOOD FRAME SPRAY TERMITE PROTECTION, AND IT IS USED IN SOME RIGID INSULATIONS FOR THIS CONDITION. MENTIONED BECAUSE IT IS NATURAL, AND ENVRONMENT AND HUMAN FRIENDLY INSECT DETERENT.
***THE ENERGY DEVIL**_THESE GAPS PREVENT A COMPLETE AND TIGHT ENERGY SEAL. HOW BIG A PROBLEM IS A CONDITION OF CLIMATE ZONE AND GAP WIDTH(S). SOME HAVE ATTEMPTED TAPED RIGID 'FLAPS' TO CLOSE THAT MORE COMPROMISING TOP PERIMETER GAP.
***ALTERNATIVES**_LOCAL AUTHORITES MAY EXEMPT THE VISUAL INSPECTION GAPS IF OTHER PRECAUTIONS ARE IN PLACE, SUCH AS ANNUAL INSPECTIONS AND APPROPRIATE REMEDIES BY PROFESSIONALS.



CONDITIONED CRAWL INSULATION

***EXTERIOR GENERAL**_SIMILAR TO THE BASEMENT INSULATION DISCUSSION, EXTERIOR RIGID IS A FINE OPTION. THE CAUTION IS CUTTING OFF **ALL** AVENUES WHERE DELTA 'T'/WATER/MOISTURE CAN MIGRATE THROUGH THE MASONRY/CONCRETE FOUNDATION AND SHOW UP ON THE INSIDE.
***EXTERIOR CHALLENGES**_ONE HAS TO THINK ABOUT THIS ENTIRE PERIMETER INCLUDING GARAGE AND PORCH CONNECTIONS TO THE CRAWL SPACE.
***INTERIOR GENERAL**_RETROFIT PROJECTS ALMOST ALWAYS PLACE INSULATION ON THE INTERIOR, WHICH IS A BIG REASON WE SEE IT THERE A LOT. INSIDE IS ALSO A PROTECTED ENVIRONMENT- SO SOME EXTERIOR CHALLENGES APPLYING AND MAINTAINING RIGID INSULATION DO NOT EXIST.
***INTERIOR CHALLENGES**_AS WITH THE CONDITIONED BASEMENT IT IS WISE TO OFFER THE OPPORTUNITY FOR THE INTERIOR ASSEMBLY TO DRY TO THE INSIDE. BUT SEE BELOW BECAUSE THE FOAMS NEED TO BE FIRE PROTECTED. SO THAT IS AN INHERENT (ALBEIT NOT A DEAL BREAKER) CONDITION.



PROTECTING FOAM INSULATION SECTION R316

***DANGER**_FOAM PRODUCTS ANYWHERE IN A HOME PRESENT A FIRE DANGER. IGNITION, RAPID FLAME AND SMOKE SPREAD, SERIOUS AND DEADLY OFF GASSING.
***CODE**_SECTION R316 ENCOMPASES ALL FOAM PLASTIC. SECTION R316.4 DEFINES THE 'THERMAL BARRIER' FOAM PLASTIC NEEDS. SECTION R316.5.4 DEALS SPECIFICALLY WITH CRAWL SPACES AND THE SLIGHTLY LESS PROTECTIVE 'IGNITION BARRIERS' THE FOAM PLASTIS NEEDS. THE CRAWL SPACE MUST BE NONHABITABLE SPACE AND ACCESSIBLE FROM THE OUTSIDE ONLY.
***PRESCRIBED IGNITION BARRIERS**_ARE SPECIFICALLY CODE LISTED. THESE CAN BE USED WITHOUT SPECIFIC LOCAL APPROVAL.
***NOTE ON SPRAY FOAM AND SPRAY THERMAL BARRIER**_WHEN SPARY FOAM IS USED IN THE FRAMING BAND, THEN USING SAME FOR THE WALLS- AND THEN SPRAYING INTUMESCENT PAINT OVER ALL FOAM BECOMES A 2 STEP OPERATION FOR INSULATING AND THERMAL PROTECTIONS. CHECK IF PAINT IS LOCALLY APPROVED.
***NOTE ON THERMAX**_THERMAX IS THE ALUMINUM FACED POLYISO BOARD THAT IS GENERALLY APPROVED AS A 1 STEP INSULATION/IGNITION BARRIER. ONE LIABILITY IS IT WILL NOT DRY TO THE INSIDE BECAUSE OF THE ALUMINUM FACING (INWARDS). IN SOME CLIMATES THIS IS NOT A PROBLEM, AND IN SOME IT COULD BE A PROBLEM.
***AVAILABLE SYSTEMS**_OTHER METHODS/TECHNIQUES ARE USED FOR CLOSED CRAWL. KNOW THE CONCERNS AND ASK QUESTIONS.