c2 COVERS LOAD BEARING CONDITIONS INTEGRAL IN MANY CONCRETE FLOORS. THIS CHAPTER ADDRESSES THE CONCRETE SLAB AS A FLOOR AND PAVING SURFACE ONLY.

SLAB SUMMARY

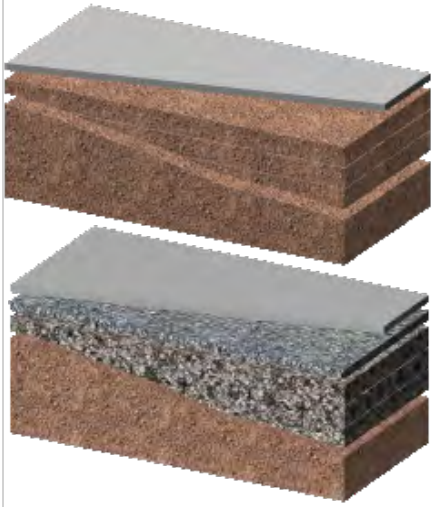
CONCRETE & CODE

***MINIMAL SPECIFICATIONS**_THE CODE CHART BELOW OUTLINES MINIMUM PSI VALUES FOR THE DESIGNATED USES FOR CONCRETE. THE WEATHERING POTENTIAL PER THE NATIONAL MAP MAY INFLUENCE THAT REQUIRED STRENGTH SOME.

***THE CONCRETE MIX**_BEYOND THIS SIMPLE COMPRESSIVE STRENGTH PSI REQUIREMENT THERE MAY BE OTHER IMPORTANT CONDITIONS SUGGESTING THE BETTER/BEST CONCRETE MIX FOR A GIVEN POUR AND WEATHER CONDITION. THE PSI RATING IN AND OF ITSELF IS NOT OFTEN THE MOST IMPORTANT CONSIDERATION AS THAT STRENGTH USUALLY EXCEEDS WHAT IS REQUIRED. THE BETTER MIX MAY BE BASED TEMPERATURE, WORKABILITY, HARDNESS (OR OTHER) RELATED CONCERN THAT COULD INCIDENTALLY EFFECT THE PSI RATING. GOOD INSTALLERS AND CONCRETE VENDORS WILL KNOW AND ADVISE.

TABLE R402.2 MINIMUM SPECIFIED COMPRESSIVE STRENGTH OF CONCRETE

TYPE OR LOCATION OF CONCRETE CONSTRUCTION	MINIMUM SPECIFIED COMPRESSIVE STRENGTH[a] (f'_c)		
	Weathering Potential[b]		
	Negligible	Moderate	Severe
Basement walls, foundations and other concrete not exposed to the weather	2,500	2,500	2,500[c]
Basement slabs and interior slabs on grade, except garage floor slabs	2,500	2,500	2,500[c]
Basement walls, foundation walls, exterior walls and other vertical concrete work exposed to the weather	2,500	3,000[d]	3,000[d]
Porches, carport slabs and steps exposed to the weather, and garage floor slabs	2,500	3,000[d, e, f]	3,500[d, e, f]

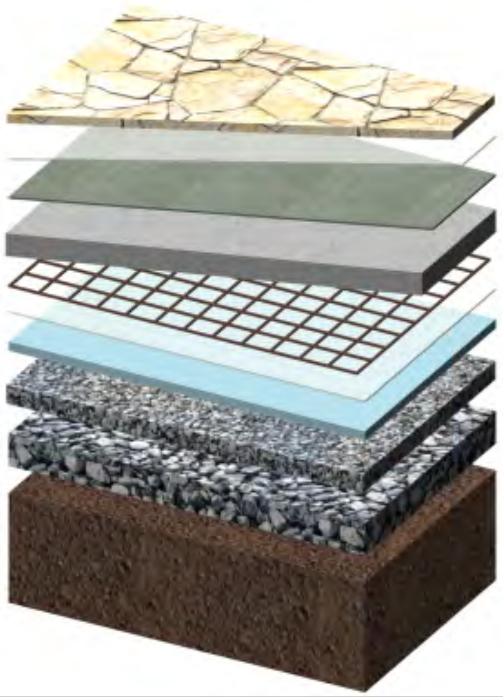


THE BASIC SLAB

***THE LAST WORD ON SOIL**_EXCAVATION/DRAINAGE/FOOTINGS/FOUNDATION WALLS AND **SLABS** ARE ALL DESIGN DEPENDENT ON SOIL TYPE. GROUP I SOILS WILL DRAIN AND COMPACT WELL. SOME GROUP II & ALL GROUP III SOILS DO NOT DRAIN OR COMPACT AS WELL. IT WOULD BE GREAT IF SOILS WERE UNQUESTIONABLY ONE OR THE OTHER, AND EASY FOR EVERYONE TO IDENTIFY, MAKE DESIGN DECISIONS, AND MOVE ON. BUT AS HAS BEEN NOTED, SOILS CAN BE TOUGH TO SUSSINCTLY IDENTIFY, CAN BE MIXED & LAYERED.

***BASIC SLAB ON GROUP I SOILS**_GROUP I SOILS ARE GRANULAR, DRAIN WELL, AND HAVE PREDICTABLE BEARING CAPACITY. SLABS CAN BE POURED DIRECTLY ON THE SOIL. THE SAME SOIL CAN BE USED AS STRUCTURAL FILL.

***BASIC SLAB ON GROUP II AND GROUP III SOILS**_GROUP II AND III SOILS ARE MORE OF A MIXED BAG AND NEED A MORE CAREFUL EXAMINATION. ALL SOFT SOIL NEEDS TO BE REMOVED. SAME SITE SOIL MAY NOT BE SUITABLE AS STRUCTURAL FILL, AND A MORE GRANUALAR SOIL OR GRAVEL BROUGHT IN FOR STRUCTURAL FILL. A GRAVEL SUB BASE AND A VAPOR BARRIER WILL BE REQUIRED.



THE COMPLEX SLAB-A LA CARTE CHOICES TO SOLVE PROBLEMS

***ILLUSTRATION**_IF ONE UNDERSTANDS THE PURPOSE OF EACH THESE LAYERS THEN THEIR JUDICIOUS SELECTION FOR A GIVEN SLAB CONDITION IS POSSIBLE. IT IS DIFFICULT, AND LIKELY MISLEADING TO ATTEMPT TO ILLUSTRATE AN IDEAL SLAB DETAIL FOR EACH USE AND CONDITION, IF ONLY FOR A SITE'S SOIL CONDITIONS AND SURFACE FINISH CHOICES.

***USES**_SIDEWALK/DRIVEWAY/PATIO/PORCH/GARAGE AND INTERIOR SLABS WILL HAVE DIFFERENT REQUIREMENTS AND DIFFERENT FINISHES DESIRED.

***APPLIED COVERINGS**_ THINK AHEAD. CONCRETE POUR/PROCESS MAY BE EFFECTED.

***SURFACE SEALING**_SEALING WILL PREVENT/DETER WATER ABSORPTION/STAINING, AND MANAGE DUST. SMART MOVE ON MANY TO MOST SLABS.

***INTEGRAL FINISH**_THINK AHEAD. CONCRETE POUR/PROCESS MAY BE EFFECTED

***THE SLAB**_PSI & AIR ENTRAINMENT PER CODE IS USUALLY FINE. IT IS THE MIXING/INSTALLATION/CURING THAT REQUIRES DILIGENCE.

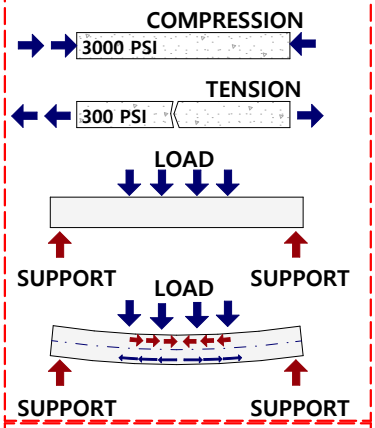
***REINFORCEMENT**_FOR STRUCTURAL AND OR SHRINKAGE MANAGEMENT. NOT NECESSARILY OF ANY VALUE IF GRADE PREP IS GOOD AND OTHER SHRINKAGE STRATEGIES ARE EMPLOYED. IF NOT INSTALLED CORRECTLY-TOTALLY WORTHLESS.

***VAPOR BARRIER**_KEEPS MOISTURE/VAPOR BELOW THE SLAB. HIGHLY RECOMMENDED FOR ALL CONDITIONED SPACES AND FREQUENTLY GARAGES/ENCLOSED SPACES WITH SLABS. NOT DESIRED IN EXTERIOR WEATHER EXPOSED INSTALLATIONS.

***INSULATION**_RIGID INSULATION PER CODE OR BETTER UNDER CONDITIONED SPACES, AND ALWAYS WITH HEATED SLABS.

***BASE/SUBBASE/STRUCTURAL FILL/GRADE**_GET IT CORRECTLY PREPARED. THE 2 BASIC REQUIREMENTS BELOW SLAB ARE MEETING OR EXCEEDING UNIFORM BEARING REQUIREMENTS AND PROVIDING A WATER MIGRATION INTERUPTION WHERE APPROPRIATE.

BASIC STRUCTURAL CONCEPTS FOR THE SLAB

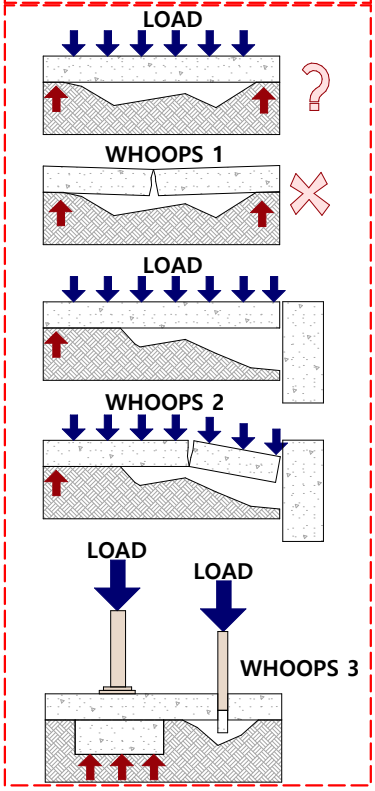


A GENERAL CONCRETE (AND MASONRY) PERFORMANCE RULE

***COMMON CHARACTERISTICS AS INTRODUCED CHAPTER 2**_MASONRY PRODUCTS INCLUDING CONCRETE, CONCRETE BLOCK, MORTAR, AND PARGES ARE SOME MIXTURE OF A GRAVEL, & OR SAND, WATER AND A BINDING AGENT (PORTLAND CEMENT). THEY ARE MIXED, PLACED, AND THEY HARDEN INTO A SOLID MATERIAL. AS A MATERIAL GROUP THEY ARE MUCH STRONGER IN COMPRESSION AND GENERALLY WEAK IN TENSION.

***THE SLAB**_ WHEN FULLY AND UNIFORMLY SUPPORTED A CONCRETE SLAB'S COMPRESSIVE STRENGTH IS ALL THAT IS CALLED FOR. WHEN NOT ADEQUATELY AND UNIFORMLY SUPPORTED INCREASED TENSILE STRENGTH IS CALLED FOR AND THE SLAB NEEDS SOME 'REINFORCEMENT' HELP.

* **STRENGTH**_TYPICAL COMPRESSIVE STRENGTHS RANGE FROM 2500 PSI TO 5000 PSI WITH 3000 PSI BEING THE MORE UNIVERSAL 'GO TO' MIX. THE TENSILE STRENGTH IS LIMITED IN CONCRETE. THE RULE OF THUMB PUTS IT AT 10% OF THE COMPRESSIVE STRENGTH. A CONCRETE'S TENSIL STRENGTH IS NOT CONSIDERED IN CONCRETE STRUCTURAL ENGINEERING, BUT IT DOES GIVE THE CONCRETE SOME AMOUT OF 'FLEX'.



LOADING ON CONCRETE FLATWORK

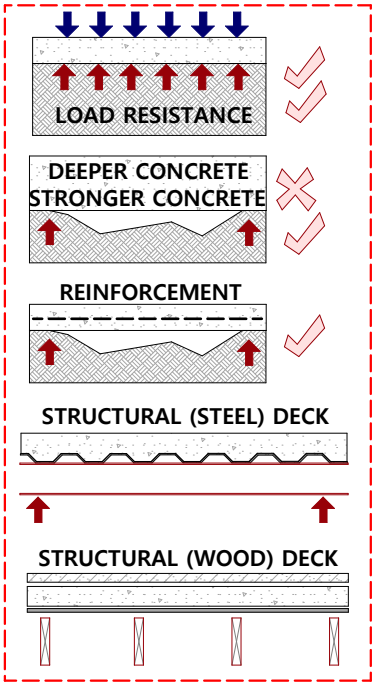
***FLATWORK/SLABS/ ARE FLOORS**_SO CODE COMPLIANT FLOOR LIVE AND DEAD LOADS ARE APPLICABLE. 40# LIVE LOAD FOR LIVING SPACES, 50# LIVE LOAD FOR GARAGES. DEAD LOAD IS BASED ON THICKNESS AND UNIT WEIGHT. CONCRETE CAN WEIGH FROM 110 PCF TO 150 PCF BASED ON WHATS IN THE MIX AND WHETHER IT IS REINFORCED OR NOT. THAT IS A BIG DIFFERENCE -AND POINTS TO THE CHOICES INHERENT IS DESIGNING/SELECTING A CONCRETE MIX. THE LIGHTER WEIGHT CONCRETES ARE PURPOSEFULLY MIXED TO BE LIGHTWEIGHT WHEN THEY ARE PLACED ON STEEL DECKS AND OR IN ABOVE GRADE INSTALLATIONS WHERE UNNECESSARY WEIGHT IS A LIABILITY. THE TYPICAL RESIDENTIAL SLAB ON GRADE WOULD AVERAGE MAYBE 145 PCF OR 48.33 PSF FOR A 4" SLAB.

***CONCENTRATED LOADING**_WHEN LOADING IS GATHERED AND DISTRIBUTED BY WALLS OR POSTSOF SOME KIND IT IS USUAL THAT A SLAB WILL NEED THICKENING AND REINFORCEMENT AND BECOMES KNOWN AS A THICKENED SLAB OR INTEGRAL FOOTING, AND IS DESIGNED TO MANAGE WHATEVER SPECIIFC LOADS ARE BEING IMPOSED. THESE CONDITIONS ARE NOTED/EXPLAINED IN c2.

***WHOOPS 1 FAILURE IN TENSION**_SLAB HAVING TO BE SUPPORTED INCONSISTENTLY IN A CONVENTIONAL BEAM LIKE CONDITION AND FAILING IN TENSION AT THE BOTTOM OF THE SLAB.

***WHOOPS 2 FAILURE IN TENSION**_DIAGRAM MIMICING A PERIMETER CONDITION WITH A SLAB NOT BEING SUPPORTED BY THE WALL, AND RELYING ON SOIL BEARING, WHICH IS INADEQAUTE. THE SLAB IS NECESSARILY 'CANTILEVERED', AND FAILS IN TENSION AT THE TOP OF THE SLAB. THE CANTILEVER CONDITION IS A KIND OF UPSIDE DOWN BEAM WHERE THE TENSION OCCURS ON THE TOP AND THE COMPRESSION ON THE BOTTOM. AS ILLUSTRATED IN A NUMBER OF PLACES THIS CONSTRUCTION GUIDE, THIS CONDITION IS A CONSTANT WITH STEM WALLS AND SLABS. PROPER SOIL PREP IS ESSENTIAL BELT AND REINFORCEMENT TIES BETWEEN WALL AND SLAB IS THE COMFORTING SUSPENDERS.

***WHOOPS 3 FAILURE IN SHEAR**_PUNCH THRU CAN HAPPEN IN CONCRETE WHEN LARGER LOADING IS DISTRIBUTED OVER A SMALL AREA (LIKE POKING A STICK IN THE GROUND). A REALLY BIG LOAD ON A SMALL STEEL COLUMN WITH SMALL BEARING PLATE COULD THEORETICALLY CAUSE THIS BUT THAT SAME LOAD WOULD DEMAND A DEEPER FOOTING UNDER THAT SLAB MITIGATING ANY DANGER. THE ILLUSTRATION WITH BEARING PLATE SHOWN A FOOTING BENEATH THE SLAB.



CHOICES IN SUPPORTING CONCRETE SLABS

***SOLUTION #1 FOR SLABS ON GRADE IS PREP THE SOIL**_WITH UNIFORM AND SUFFICIENT BEARING CAPACITY A SLAB IS SERVING AS A DIRECT AND UNIFORM LOAD DISTRIBUTOR TO THE SOIL, AND IS CALLED ON TO FUNCTION IN COMPRESSION ONLY. IF CONDITIONS REQUIRE ADDITIONAL/OTHER SUPPORT.....

***DEEPER AND STONGER CONCRETE**_THAT TENSILE STRENGTH IS INCREASED BOTH WITH MORE DEPTH AND A STRONGER CONCRETE. BUT IT IS LIMITED, AND UNIVERSALLY RECOGNIZED AS NOT BEING COST EFFICIENT AS A STRUCTURAL SOLUTION. IF SOIL IS UNIFORMLY A LITTLE 'SURFACE SOFT' , MAYBE FROM AN UNSCHEDULED RAIN, DEEPER POUR MAY BE ADVISED TO PROMISE A MINIMUM THICKNESS OF 3 1/2" AS CODE REQUIRED.

***REINFORCE THE CONCRETE**_REINFORCEMENT IS STRUCTURALLY AND ECONOMICALLY THE BETTER WAY TO INCREASE THE SPANNING 'BEAM' POTENTIAL WITH CONCRETE. ALSO PRETTY FLEXIBLE. SPANNING THESE MINI VOIDS AS DIAGRAMED, IS THE CONCERN IN PRINCIPLE, THEN THINK OF THE ENTIRE SLAB REINFORCED IN BOTH DIRECTIONS GIVING IT THE CAPABILITY OF REMAINING RIGID WITH UNPREDICTABLE (HIGH) SUPPORT POINTS SCATTERED ABOUT THE SLAB AREA. ALSO BEWARE OF MOSTLY EXTERIOR SITUATIONS WHERE (WATER) CAN UNDERMINE A SLAB BASE OVER TIME AND CREATE/LEAVE UNINTENDED VOIDS.

***THE STEEL SUPPORT DECK**_THE STEEL SUPPORT DECK IS ANOTHER APPROACH. THERE ARE 2 STRUCTURAL FORMATS TO THE STEEL DECK. ONE IS AS **THE** SUPPORT INSTRUMENT (IN TENSION AS STEEL DOES SO WELL) WITH DEAD CONCRETE SITTING ON TOP FUNCTIONING IN COMPRESSION ONLY. THE OTHER IS DECK AS FORM-SUPPORTED TEMPORARILY UNDERNEATH-ON TOP OF WHICH CONCRETE AND REINFORCEMENT ARE INSTALLED TOGETHER. THE CONCRETE AND STEEL BECOME THE STRUCTURE WHEN CURED, AND SUPPORTS CAN BE REMOVED.

***THE WOOD SUPPORT DECK**_WITH PROPER PRECAUTIONS A SLAB CAN BE POURED ON TOP OF A FRAME DECK. THE PLYWOOD FLOOR BECOMES THE BOTTOM FORM. THE INITIAL CONCERN IS FOR THE WOOD CONSTRUCTION TO BE STIFF/RIGID/STRONG ENOUGH TO AVOID DEFLECTIONS THAT MIGHT ENCOURAGE CONCRETE CRACKING. SEE ADDITIONAL NOTES NEXT PAGE.

STRUCTURAL ASSISTANCE FOR THE SLAB

REINFORCEMENT_WELDED WIRE MESH

REINFORCEMENT_LIGHT BARS EACH WAY

STEEL REINFORCING (AND ITS CONTROVERSIES)

***WELDED WIRE**_WELDED WIRE MESH (WWM) OR WELDED WIRE FABRIC (WWF) IS STEEL WIRE PREASSEMBLED INTO GRID SIZES OF 6"X6" & 4"X4", WITH TYPICAL STEEL GUAGES OF 10,8,6,4. (1/8" UP TO 1/4" +/-). IT COMES IN (FLAT) SHEETS OR (NOT FLAT) ROLLS.

***REINFORCING BAR**_#3 (3/8"), AND #4 (1/2") BAR ARE TYPICAL AND PLACED ON SITE INTO GRIDS AS SPECIFIED. 24" X 24" IS COMMON.

***STRUCTURAL FUNCTION**_ WHEN EITHER REINFORCEMENT IS CAREFULLY PLACED BELOW MIDPOINT IN THE SLAB POUR IT CAN PROVIDE TENSILE ASSISTANCE TO THE CONCRETE, AND BRIDGE OR SPAN MODERATE VOIDS.

***SHRINKAGE/CRACK MANAGEMENT**_WHEN EITHER REINFORCEMENT IS CAREFULLY PLACED JUST ABOVE MIDPOINT IN THE SLAB IT WILL FUNCTION IN LIMITING SHRINKAGE MOVEMENT AND MECHANICALLY HOLDING THE CONCRETE TOGETHER. THE UPPER PORTION OF A SLAB IS MORE PRONE TO SHRINKAGE, SO REINFORCING HIGHER IN THE SLAB MAKES MORE SENSE.

***COVER**_ALL STEEL REINFORCEMENT IN CONCRETE REQUIRES 'COVER' WHICH IS A MINIMUM DIMENSION WITHIN THE POUR-FROM THE FACE OF A POUR- FOR IT TO DO ITS JOB. IN THESE RELATIVELY THIN FLOOR SLABS 1 1/2" COVER IS MINIMUM ACCEPTED. SO THE STRUCTURAL FUNCTION WOULD WANT THE STEEL 1 1/2" FROM BOTTOM OF POUR, AND THE SHRINKAGE STEEL 1 1/2" FROM THE TOP. MANY SIMPLIFY AND SAY HOLD THE STEEL IN THE MIDDLE.

***SUPER SLABS**_A THICK ENOUGH SLAB, SAY 6", CAN HAVE THE HEAVIER STRUCTURAL RE-BAR IN THE BOTTOM OF A SLAB, AND THE SHRINKAGE WWM STEEL IN THE TOP PORTION OF THE SLAB.

***INSTALLATION**_GETTING THESE OPTIONS ON THE GROUND PLANE BEFORE THE POUR IS EASY ENOUGH. GETTING THEM PROPERLY POSITIONED IN THE SLAB POUR IS NOT. READ UP ON THIS. IF IT NOT IN THE RIGHT PLACE IT NOT ONLY WILL NOT DO THE INTENDED JOB, BUT WILL COMPROMISE THE SLAB.

***THE BIG CONSIDERATION**_THIS STEEL IS NOT AN AUTOMATIC FIX FOR BAD SOIL. IF BAD SOIL UNDER A HOUSE CANNOT BE REMEDIED WITH STRUCTURAL FILL THEN CONSIDERING CRAWL SPACE CONSTRUCTION AND FRAME FLOOR MAY WELL BE WISE. BAD SOIL UNDER GARAGES AND PORCHES, BECAUSE OF THEIR SMALLER SIZE, HAVE A BETTER SHOT AT BEING MANAGED WITH A SERIOUS STRUCTURAL SLAB, AND CONSEQUENCES ARE NOT AS DIRE.

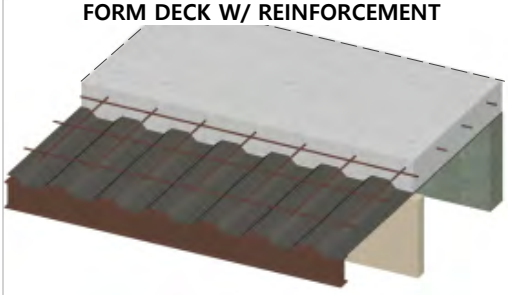
STRUCTURAL DECK

SHORTER SPAN STRUCTURED DECKS

***STEEL STRUCTURAL DECK**_THESE DECKS NEED TO BE SUPPORTED AT EACH END. FOUNDATION WALLS, AND SMALL STEEL BEAMS ARE TYPICAL. THE SUPPORT AND PERIMETER DETAILS NEED TO BE THOUGHT OUT. THE STEEL DECK IS THE 'TENSILE' STRUCTURE. THE CONCRETE IS RELIEVED OF THAT REQUIREMENT & DOES ITS JOB IN COMPRESSION. THE SLAB IS POURED ON TOP OF THE DECK & FINISHED/PITCHED AS REQ'D. DECK SPANS WILL VARY BASED ON THE DECK & DECK GUAGE. A COMMON INSTALLATION IS A 22 GA DECK SPANNING 5' +/-. DECK SPANS OF 6' AND 7' ARE ALSO REASONABLE AND REPRESENT A TYPICAL RANGE OF FRONT PORCH DEPTHS.

***MOSTLY PORCH APPLICATIONS_[6.10]** A GOOD CHOICE WHERE A SPANNED DECK WOULD BE MORE ECONOMICAL THAN A LOT OF FILL, AND A PERMANENT NON ROT DECK CONSTRUCTION IS DESIRED. PORCHES GET WET. ALSO A GOOD CHOICE WHEN A HEAVY HARD SURFACE (EG FLAGSTONE) IS DESIRED, AND A 'STIFF' FLOOR CONSTRUCTION IS IN ORDER.

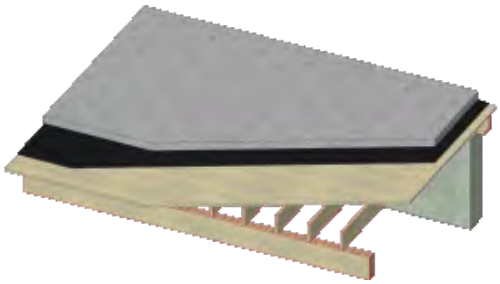
FORM DECK W/ REINFORCEMENT



LONGER SPAN STRUCTURED DECKS

***STEEL 'FORM' DECK**_THIS APPROACH USES THE DECK AS A FORM FOR A STRUCTURED CONCRETE 2 WAY SLAB. SIMILARLY WALL AND OR STEEL BEAM SUPPORTS ARE NEEDED TO CARRY THE 2 WAY SLAB (TO THE EFFECTIVE SPAN LENGTHS THE SLAB HAS BEEN DESIGNED FOR), AND PERIMETER DETAILING THOUGHT OUT. THE FORM DECK NEEDS TEMPORARY INTERMEDIATE SUPPORTS UNTIL THE STEEL REINFORCED SLAB IS POURED AND SET. TEMPORARY SUPPORTS ARE THEN REMOVED. SLABS DO NEED TO BE THICKER TO ACCOMODATE BOTH THE REINFORCEMENT AND THE ADDITIONAL HT REQUIRED FOR THE SLAB PITCH. (THE WHOLE STEEL STRUCTURE CAN BE PITCHED

***PORCHES AND GARAGES**_LARGER PORCHES CAN BE CANDIDATES FOR THIS TECHNIQUE. SO ARE GARAGES THAT MAY OTHERWISE DEMAND A MOUNTAIN OF FILL. GENERALLY FEWER AND LARGER STRUCTURAL MEMBERS ARE EMPLOYED. ENGINEERING REQUIRED.



WOOD STRUCTURED DECKS

***WOOD DECK**_CONCRETE IS POURED ON TOP OF A WOOD FRAME DECK. IT ADDS (ABOUT) 45 PSF** TO THE DEAD LOAD. AS NOTED THE GENERAL CONCERN IS ENOUGH STIFFNESS IN THE WOOD STRUCTURE TO ELIMINATE DEFECTIONS/MOVEMENT THAT WILL ENCOURAGE CONCRETE CRACKING.

***EXTERIOR PORCHES**_EXTERIOR PORCHES MAY BE AN APPLICATION WHEN FLAGSTONE (THICKER REAL STONE) IS THE DESIRED FINISH, OR MAYBE A SPECIAL CONCRETE FINISHED SURFACE INSTEAD OF A LIGHTER WEIGHT DECKING. ON TOP OF STRUCTURAL STIFFNESS DEMANDED, WATER MANAGEMENT IS **THE** BIG DEAL.

***INTERIOR THERMAL MASS**_ANOTHER PERFECTLY VIABLE APPLICATION OF A SLAB POURED ON A WOOD FRAME FLOOR CONSTRUCTION IS TO CREATE THE INTERNAL THERMAL MASS NEEDED FOR PASSIVE SOLAR APPLICATIONS. PRETTY SIMPLE AND NO WATER TO DEAL WITH.

THE INEVITABLE SHRINKING SLAB

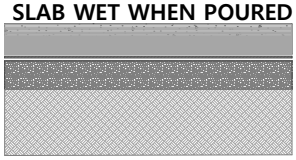
THE ART AND THE SCIENCE OF CONCRETE? CONCRETE IS ALIVE

***THE BAKING ANALOGY**_MEASURING, MIXING, SEQUENCE, TIMING, TEMPERATURE CONTROL ALL HAVE TO BE PRETTY ACCURATELY EXECUTED FOR THE CAKE TO COME OUT PERFECTLY. THE BAKER HAS THE GOOD FORTUNE OF DOING THIS INSIDE A CONTROLLED KITCHEN ENVIRONMENT. THE CONCRETE PROCESS IS SIMILAR-INGREDIENTS HAVE TO BE SELECTED/PROPORTIONED/MIXED/SEQUENCED/AND THEN DELIVERED AND INSTALLED IN AN IMPOSSIBLE TO CONTROL EXTERIOR ENVIRONMENT. IT BAKING TIME IS IN RAIN, WIND, SUN, FREEZING & HOTTER THAN BLAZES TEMPERATURES. IT IS A TALL ORDER.

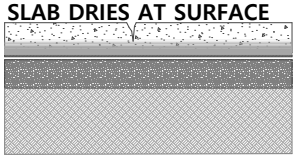
***THE SLAB**_SIMPLE CONCRETE IS TRICKY. SLAB INSTALLATIONS ARE THE TRICKIEST BECAUSE OF THEIR EXPANSIVE SURFACE AREAS BEING EXPOSED TO THOSE VARYING BAKING CONDITIONS, AND THE FACT THEY ARE SO VISIBLE. SELDOM ARE SLABS A 'NO BRAINER'. THIS SLAB SUMMARY DOES NOT MAKE ANY EFFORT TO INVESTIGATE THE **MANY** CONCRETE INSTALLATION COMPLEXITIES BUT WILL OUTLINE THE EVERYDAY COMMON SLAB SLAB CRACKS. ONE GENERAL REFERENCE THAT DOES A GOOD JOB EXPLAINING TECHNICAL STUFF IN LAYMAN'S TERMS IS THE CONCRETE NETWORK (www.concretenetwork.com).

AIR TEMPERATURES & MOISTURE DOES IT AGAIN

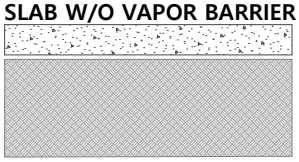
SLAB WET WHEN POURED



SLAB DRIES AT SURFACE



SLAB W/O VAPOR BARRIER



***WET TO DRY**_ ANY CONCRETE MIX HAS A BUNCH OF WATER IN IT. A GOOD PORTION OF THAT WATER WORKS (HYDRATES) WITH THE CEMENT IN MAKING THE CONCRETE WHAT IT IS. BUT EXCESS WATER NEEDS TO EVAPORATE, AND IT (USUALLY) TRAVELS UP TO THE TOP SURFACE TO DO SO. WHEN IT EVAPORATES AT THE SURFACE, THAT VOLUME IS CONSEQUENTLY REDUCED, SHRINKAGE NATURALLY OCCURS, SO CRACKS SHOW UP.

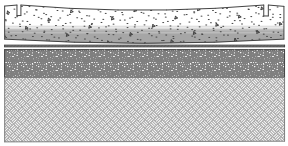
***CONCERNS ABOUT SHRINKAGE**_SOME SHRINKAGE CRACKS ARE INEVITABLE. SHRINKAGE CRACKS ARE NOT TYPICALLY A STRUCTURAL ISSUE, AND STABILIZE AFTER FULL CURING. HELPING THE SLAB DECIDE WHERE TO CRACK IS THE ROLE OF CONCRETE JOINT MANAGEMENT.

***SHRINKAGE CURLING**_THAT SAME SURFACE DRYING/SHRINKING THAT FACILITATES CRACKING MAY ALSO INDUCE SOME 'CURLING'-PARTICULARLY IF THE MIX RESISTS CRACKING. THE SURFACE SHRINKING HAS TO CAUSE SOME CHANGE/MOVEMENT. THINK OF THE DAMP SPONGE LEFT TO DRY ON THE COOL(ER) GRANITE COUNTER. THAT UPPER SURFACE IN CONTACT WITH THE AIR WILL DRY FIRST/SHRINK/ & CURL. IT WILL CURL & NOT CRACK BECAUSE A SPONGE HAS 'FLEX' CHARACTERISTICS.

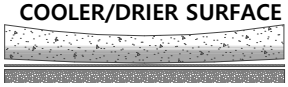
***TEMPERATURE & MOISTURE CURLING**_CHANGES IN TEMPERATURE & MOISTURE (HUMIDITY MOSTLY) CAN COMBINE TO CURL A SLAB UP OR DOWN. THIS PHENOMENON IS TRUE WITH ANY 'FLAT' BUILDING PRODUCT. IT IS ILLUSTRATED DRAMATICALLY WITH 4'X8' SHEETS OF VIRTUALLY ANY BUILDING PRODUCT THAT ARE ALMOST NEVER COMPLETELY FLAT. THIS IS ALWAYS A CONDITION OF EXPANSION/CONTRACTION AS A FUNCTION TEMPERATURE AND MOISTURE BEING INCREMENTALLY DIFFERENT ON EACH SIDE OF THE SHEET.

***THE VAPOR BARRIER/CATCH 22**_THE VAPOR BARRIER THAT IS CRITICAL IN ANY MOSIT SOIL CONDITION TO HOLDING MOISTURE IN THE GROUND AND NOT LETTING IT RISE INTO INTERIOR SPACE, IS ALSO RESPONSIBLE FOR REQUIREING A NEWLY POURED SLAB TO DRY IN ONE DIRECTION ((UP) AND EXACERBATE THE CRACKING SITUATION. THE SLAB NOT REQUIRING A VAPOR BARRIER-ON TYPE I SOILS-HAS A BETTER CHANCE OF DRYING IN 2 DIRECTIONS AND LIMITING THE CRACK POTENTIAL.

SHRINKAGE CURLING



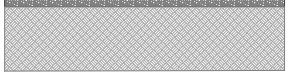
COOLER/DRIER SURFACE

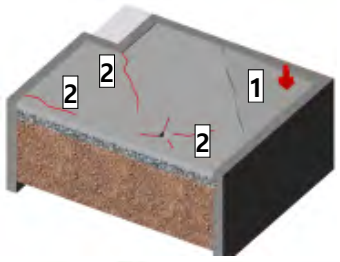


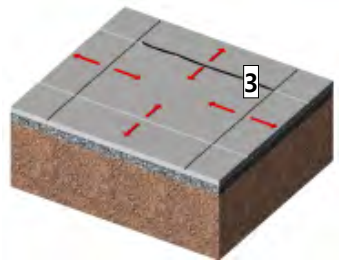
WARMER/WETTER SURFACE

WARMER/WETTER SURFACE

COOLER/DRIER SURFACE





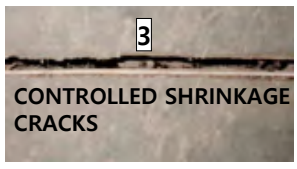


STRUCTURAL CRACKS (AND OR) SHRINKAGE CRACKS

1*STRUCTURAL FAILURE_IDENTIFIED BY THE SIZE (GAP) OF THE CRACK. LOGIC SAYS THE CAUSE WOULD BE AN UNINTENDED LOAD BEING PUT ON THE SLAB, OR A FAILURE OF SOIL BELOW THE SLAB. THIS LOCATION (1) GIVES SHOWS THE PROBLEM OF AN EXCAVATED CORNER NOT BEING BACKFILLED PROPERLY AND SETTLING. THIS IS AN INSTANCE WHERE A PERIMETER SUPPORT LEDGE AND/OR REBAR IN WALL BENT INTO THE SLAB WOULD MANAGE THE 'DROP' PROBLEM. WITHOUT THAT STRUCTURAL BACKUP A SLAB CORNER LIKE THIS COULD SLOWLY DROP BIT BY BIT.

2*SHRINKAGE CRACK(S)_ARE SMALLER AND MAY SHOW UP ANYWHERE (RANDOM). THERE ARE A FEW PLACES-MOST NOTABLE ANY 'INSIDE' CORNERS-WHERE THEY ARE MOST SUBJECT TO SHOWING UP. HOWEVER THEY CAN SHOW UP ANYWHERE WHICH IS WHY THEY ARE LITERALLY CALLED 'RANDOM'. IF THEIR PRESENCE IS ANTICIPATED AS A VISUAL DISTURBANCE THEN ONE NEEDS TO UNDERSTAND THEM & DESIGN A CONTROL STRATEGY.

3*CONTROL_THERE ARE GENERALLY ACCEPTED STRATEGIES FOR MANAGING THESE CRACKS. THE GENERAL CONCEPT IS ENCOURAGING THE CRACKS TO OCCUR IN PRE-DESIGNATED PLACES. NEXT PAGE.....



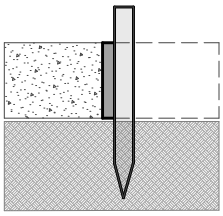
SHRINKAGE MANAGEMENT

A COUPLE BASICS ON THE MIX

***CEMENT**_THE CODE CHART BELOW OUTLINES MINIMUM PSI VALUES FOR CONCRETE USE CONDITIONS. THE WEATHERING POTENTIAL IS ESSENTIALLY THE FREEZE/THAW LIKELYHOOD/FREQUENCY. THE FOOTNOTES (NOT SHOWING) SPECIFY AN AIR ENTRAINMENT REQUIREMENT IN
***WATER**_ADDITION TO THE PSI. AIR ENTRAINMENT REFERS TO & QUANTIFIES BY PERCENTAGE OF VOLUME THE AIR (POCKETS OR BUBBLES) WITHIN THE CONCRETE THAT ALLOW SPACE FOR ANY WATER/MOISTURE WITHIN THE SLAB TO EXPAND INTO WHEN FREEZING. WITHOUT THE AIR POCKETS
***AGRREGATES**_THAT FREEZING WATER WOULD WANT TO PUSH/CRACK THE SLAB ITSELF. AIR ENTRAINMENT IS ACHIEVED WITH A SPECIFIC
***AIR ENTRAINMENT**_ADMIXTURE. IT ALSO PROVIDES A VERY VALUABLE ADDITIONAL ASSET OF IMPROVING WORKABILITY.
***WORKABILITY**_THE RATIO OF THE ESSENTIAL CEMENT/SAND/AGGREGATE AND WATER COMPONENTS EFFECT THE CONCRETE STRENGTH AND WORKABILITY IS OFTEN THE MORE IMPORTANT ISSUE, AND CAN CERTAINLY BE A BIT TOUCHY. EXPERIENCE WORKING WITH CONCRETE CANNOT BE UNDERESTIMATED.

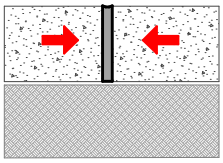
TYPICAL RESIDENTIAL CONCRETE 'JOINTS'

***MANAGING THE CONCRETE MOVEMENT**_THESE BELOW COMMON JOINTS HELP MANAGE CONCRETE PLACEMENT, PERFORMANCE, AND SHRINKAGE CRACKS. THE BELOW ARE THE EVERYDAY RESIDENTIAL TECHNIQUES.



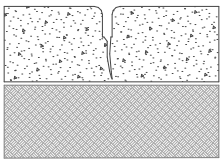

THE CONSTRUCTION JOINT

***THE DEFINITION**_TERM DESCRIBING A STOPPING PLACE (FORM) IN A POUR. A SUBSEQUENT POUR WILL ABUTT THIS. THE FORM USED NEEDS TO BE FIXED INTO THE GROUND. THIS SITUATION IS SOMETIMES A FINISHING/TIMING TACTIC, OR END OF DAY, OR THE CONCRETE TRUCK RUNS OUT OF MATERIAL.....



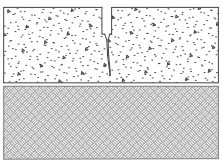

THE ISOLATION JOINT

***THE DEFINITION**_ISOLATES PORTIONS OF A SLAB SO EACH 'FLOATS' OR IS PHYSICALLY INDEPENDENT. THE JOINT MATERIAL (CHEAPEST IN ASPHALT IMPREGNATED FIBRE BOARD) IS AS DEEP AS THE CONCRETE THEREBY SEPARATES THE POUR. THE 1/2" (+/-) MATERIAL IS COMPRESSIBLE SO IT WILL GIVE A BIT AS/IF THE CONCRETE EXPANDS.
***WHY**_IF ANY DIFFERENTIAL MOVEMENT IS ANTICIPATED THE ISOLATION JOIST WILL PERMIT INDEPENDENT MOVEMENT.



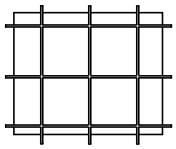

A GROOVED CONTROL JOINT

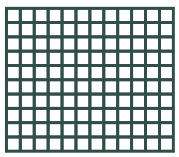
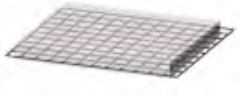
***THE DEFINITION**_THE CONTROL JOINTS ARE NOT FULL DEPTH, AND ARE FOR SHRINKAGE MANAGEMENT. THE RULE OF THUMB DEPTH IS 25% OR 1" FOR A NOMINAL SLAB.
***THE TOOL**_A GROOVING TOOL FINISHES OFF THIS JOINT, AND IS ROUNDED AND MORE VISUALLY PRONOUNCED THAN THE SAWCUT. MORE OFTEN USED ON EXPOSED EXTERIOR WORK (DRIVEWAYS/SIDEWALKS/PATIOS) AND CAN INTRODUCE DESIGNED PATTERNS.




A SAWCUT CONTROL JOINT

***THE DEFINITION**_THE SAWCUT IS SIMILARLY 25% OF THE SLAB DEPTH AND DONE AFTER THE SLAB IS SET BUT STILL 'GREEN'. THERE ARE A COUPLE OF TECHNIQUES AND PIECES OF EQUIPMENT FOR THIS. TIIMING IS IMPORTANT OR BLOW OUT/ CHIPPING BECOMES AN ISSUE. KNOW YOUR EXACT LAYOUT WELL AHEAD OF TIME.
***NOTE**_THE STRESS CRACKING THIS PHOTO IS SUGGESTING SOME 'CURLING' IN EACH OF THESE SAW CUT SEGMENTS.



REINFORCEMENT (AND SHRINKAGE CONTROL) OPTIONS

***THE IDEA**_ANY THING PLACED WITHIN A CONCRETE POUR WILL MECHANICALLY BE GRABBED BY THE CONCRETE AS IT SETS UP AND WILL THEREFORE ACT AS A 'BINDER'. AS THE CONCRETE DRIES AND SHRINKS, OR WITH ONGOING TEMPERATURE AND MOISTURE CONTENT CHANGES, THAT 'BINDER' WILL MECHANICALLY HOLD THE CONCRETE TOGETHER. THE ACKNOWLEDGED EFFECT OF ALL THESE BINDING METHODS RELATIVE TO SHRINKING IS TO CONTROL THE SIZE AND NUMBER OF CRACKS (MORE SMALLER CRACKS). THEY CANNOT REALLY ALTER THE TOTAL SHRINKAGE (PERCENTAGE) BECAUSE THEY CANNOT CONTROL THE WATER VOLUME LEAVING THE MIX.
***REBAR**_CAN ALSO PERFORM A STRUCTURAL FUNCTION, AS WELL AS SHRINKAGE MANAGEMENT. CAREFUL POSITIONING PER THE INTENDED PURPOSE IS VERY IMPORTANT.
***WWM**_DITTO. THE MESH IS YET HARDER TO KEEP IN PROPER POSITION BECAUSE ONE CANNOT AVOID STEPPING ON IT, AND ONE CANNOT AVOID STANDING/MOVING ON THE MESH WHILE INSTALLING.
***FIBERS**_SYNTHETIC OR STEEL FIBERS CAN BE ADDED TO THE CONCRETE MIX. THE MIXING DISTRIBUTES THEM (THEORETICALLY) UNIFORMLY GIVING THEM THE POSITIONING TO CONTROL SHRINKAGE UNIFORMLY THROUGHOUT THE POUR. THIS DOES ELIMINATE THE DIFFICULT ISSUE OF GETTING STEEL REINFORCEMENT PLACED CORRECTLY. FIBERS ARE NOT CONSIDERED A STRUCTURAL BENEFIT, AND ARE VISIBLY AND TEXTURALLY EVIDENT AT THE TOP SURFACE MAKING SOME INTEGRAL FINISHES DIFFICULT. THIS CONCEPT OF THE MECHANICAL BINDER GOES WAY BACK-ADDING HORSE HAIR TO THE MUD-AND IS A GOOD ONE TO REMEMBER CONCEPTUALLY.

PLANNING FOR CONCRETE JOINTS

SAMPLE PLAN BELOW SAME AS STEM WALL SLAB ON GRADE

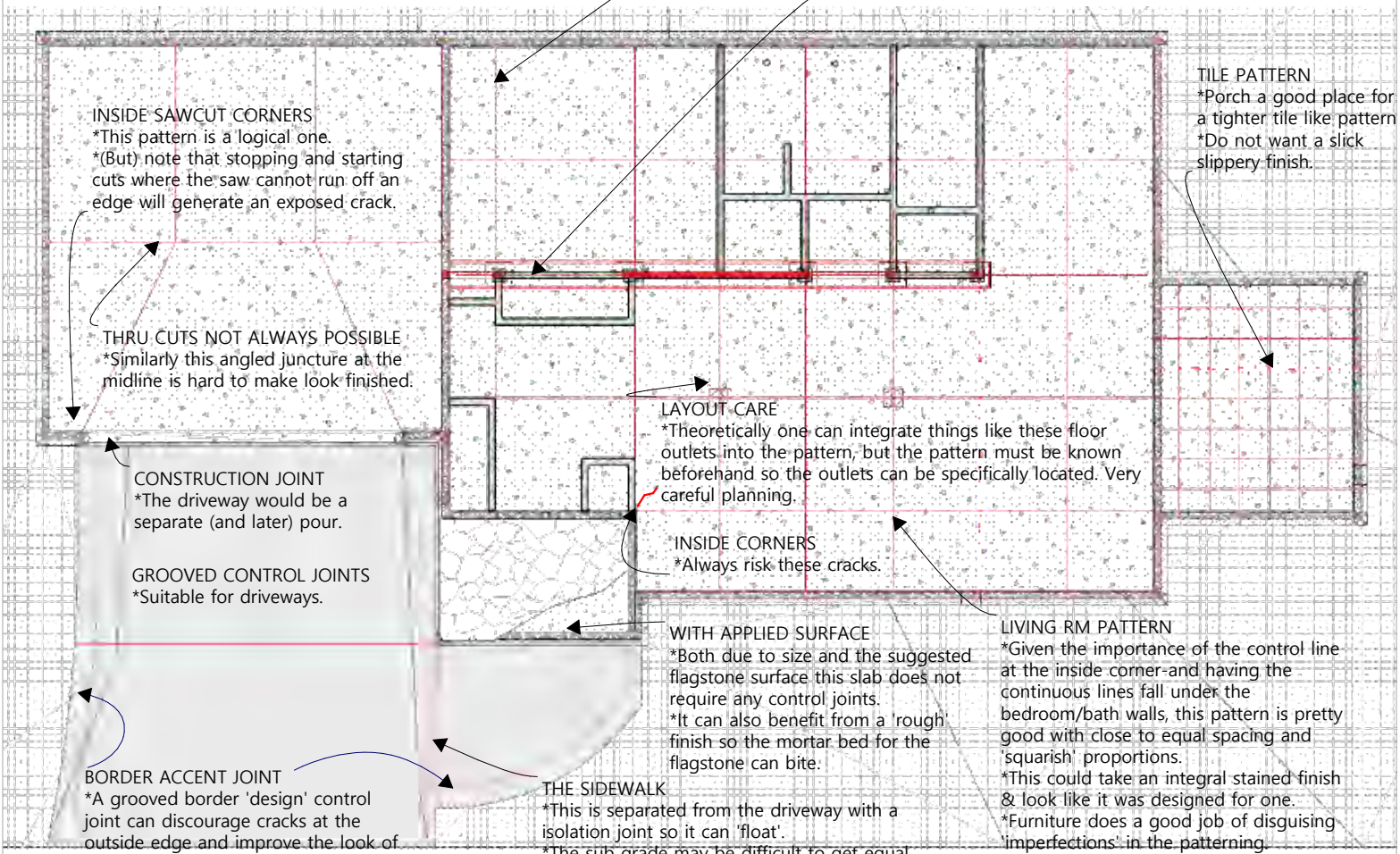
*ILLUSTRATING CONCRETE JOINTS ASSUMING EXPOSED CONCRETE FLOORS IN GARAGE, HOUSE, AND PORCH BASED ON STEM WALL SLAB ON GRADE DESIGN PLAN [c1.5,c1.6].

RULES OF THUMB FOR CONTROL JOINTS

*SPACING AT 24-36 TIMES THE SLAB THICKNESS OR 8' TO 12' MAX FOR 4" THICK SLAB
*ANY TIGHTER SPACING FOR A DESIGN PATTERN IS FINE
*CONTINUOUS CUTS ALWAYS BEST
*SQUARE GEOMETRY IS BETTER FOR GETTING THE CRACKS TO HOUSE THEMSELVES IN THE CUTS
*WORK OFF INSIDE CORNERS
*UNDER WALLS IF POSSIBLE

OUT OF PATTERN
*These 2 control lines are out of pattern in the bedroom. The bed will disguise this.
*They continue from their foyer location where they follow the inside corner & under wall rules.

ISOLATION JOINT
*See[c1.5, c1.6]. there is a grade beam with piers down this wall centerline. An isolation joint following this grade beam would allow some movement without cracking the slab in all directions.



INSIDE SAWCUT CORNERS
*This pattern is a logical one.
*(But) note that stopping and starting cuts where the saw cannot run off an edge will generate an exposed crack.

THRU CUTS NOT ALWAYS POSSIBLE
*Similarly this angled juncture at the midline is hard to make look finished.

CONSTRUCTION JOINT
*The driveway would be a separate (and later) pour.

GROOVED CONTROL JOINTS
*Suitable for driveways.

TILE PATTERN
*Porch a good place for a tighter tile like pattern
*Do not want a slick slippery finish.

LAYOUT CARE
*Theoretically one can integrate things like these floor outlets into the pattern, but the pattern must be known beforehand so the outlets can be specifically located. Very careful planning.

INSIDE CORNERS
*Always risk these cracks.

WITH APPLIED SURFACE
*Both due to size and the suggested flagstone surface this slab does not require any control joints.
*It can also benefit from a 'rough' finish so the mortar bed for the flagstone can bite.

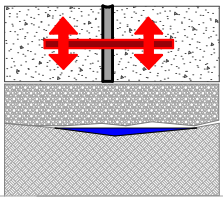
LIVING RM PATTERN
*Given the importance of the control line at the inside corner-and having the continuous lines fall under the bedroom/bath walls, this pattern is pretty good with close to equal spacing and 'squarish' proportions.
*This could take an integral stained finish & look like it was designed for one.
*Furniture does a good job of disguising 'imperfections' in the patterning.

BORDER ACCENT JOINT
*A grooved border 'design' control joint can discourage cracks at the outside edge and improve the look of a concrete walk or driveway. Looks particularly good on curved shapes.

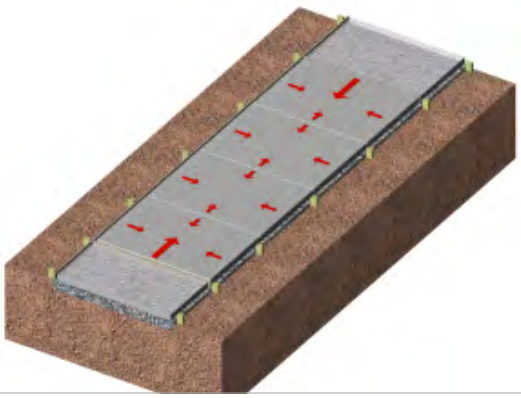
THE SIDEWALK
*This is separated from the driveway with a isolation joint so it can 'float'.
*The sub grade may be difficult to get equal compaction with the driveway so it could be subject to settling differently than the driveway.
*So another place to consider steel dowels.

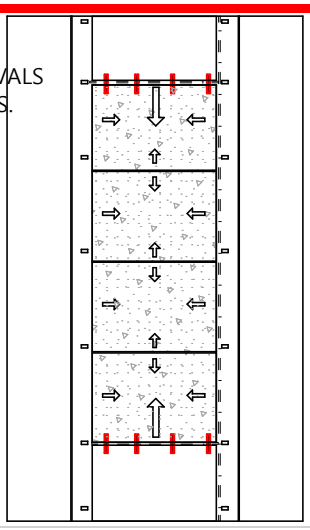
SIDEWALK MAKES 2 POINTS

*EXTERIOR SLABS WITHOUT PERIMETER DRAINED FOUNDATION SYSTEMS ARE SUBJECT TO WATER MOVEMENT/SOIL EROSION OVER TIME UNDER THE SLAB CONSTRUCTION. ONCE WATER FINDS A PATH OF LESSER RESISTANCE IT WILL CONTINUE TO USE THAT ROUTE AND MOVE SMALLER SOIL PARTICLE ALONG WITH IT UNTIL VOIDS ARE CREATED- AND STRUCTURAL CRACKS IN CONCRETE SHOW UP.
*STEEL DOWELLING IS A NOT VERY COMPLICATED WAY TO KEEP 2 SLAB SECTIONS MOSTLY TOGETHER.



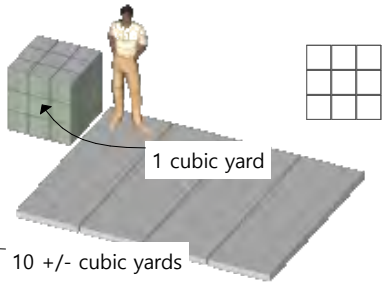
*SIDEWALK SHOWING SEVERAL SECTIONS SEPARATED WITH GROOVED ISOLATION JOISTS AT 3' TO 5' INTERVALS AND CONSTRUCTION JOINTS AT 12' TO 20' INTERVALS.

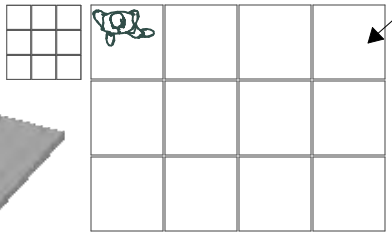




CONCRETE VOLUME AND DELIVERY

***UNIT OF MEASUREMENT**_IS THE CUBIC YARD, aka 'A YARD'. WHETHER FOOTING, WALL, OR SLAB, THIS CUBIC VOLUME IS HOW IT IS QUANTIFIED. CUBIC VOLUME IS WIDE x DEPTH x HEIGHT, OR X x Y x Z. THERE ARE 27 CUBIC FEET IN 1 CUBIC YARD.
***THE CONCRETE TRUCK**_IS SEEN ALL OVER. IT IS DELIVERING AND MIXING AT THE SAME TIME. IT HOLDS ABOUT 10 CUBIC YARDS (9 MAY MORE OFTEN BE QUOTED). IF REGULAR CONCRETE IS BEING DELIVERED AT 145 PCF THEN THE TRUCK LOAD (EXCLUDING THE TRUCK) IS 145 x 27 x 10 or 39,150 lbs OR 20 TONS. SO WATCH OUT.



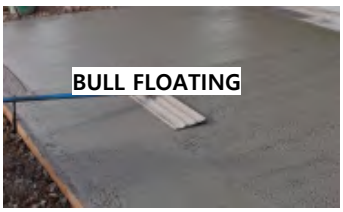


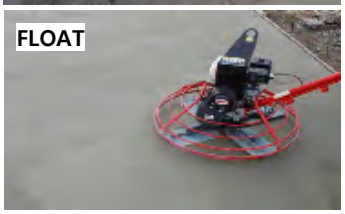
CUBIC YARD
*Is 3'x3'x3' or 27 cubic feet
*1 cubic yard considered in 4" depth per a typical slab is 12 layers of 3'x3' area or 12x9 sf or 108 sf.
*1 concrete truck delivering 10 cubic yards equates to a slab area 1080 sf or 30'x36'

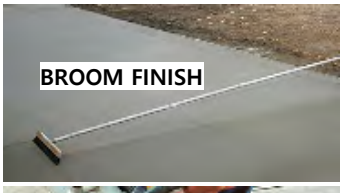
INSTALLATION PLANNING

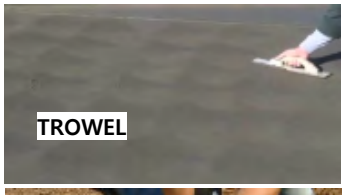
***CONCRETE SLAB STRATEGY**_WHAT IS INTERESTING, CHALLENGING AND DIFFERENT ABOUT THIS CONCRETE SLAB EVENT IS THAT IS HAS A LIFE OF ITS OWN THAT INSTALLERS HAVE TO UNDERSTAND AND RESPOND TO. INSTALLERS HAVE TO DO THE RIGHT THING AT THE RIGHT TIME. MANY/MOST OTHER BUILDING PROCESSES/MATERIALS ARE STATIC IN NATURE AND GIVE INSTALLERS TIME AS NEEDED TO THINK/ALTER/FIX. TO GET THIS IT MAY BE HELPFUL TO WATCH A FEW YOUTUBE VIDEOS TO SEE THIS HAPPEN IN TIME. RECOGNIZING THE LIVE NATURE OF THIS MAY INFLUENCE ONES APPROACH. BELOW IMAGES INTENDED TO SHOW THAT SEVERAL THINGS HAVE TO BE ORCHESTRATED WITHIN A TIME FRAME.

PUMP PLACEMENT
*Note man's feet (almost) fit within the reinforcement grid. No value when too low in the pour.
*Also note underslab heating, and the psfd insulation surrounding the forms. Cold weather site.









GENERAL SLAB INSTALLATION SEQUENCE

***MOVING CONCRETE INTO PLACE**_IF THE CONCRETE TRUCK CAN GET CLOSE ENOUGH TO THE POUR LOCATION THE CONVENTIONAL GRAVITY DELIVERY CHUTE IS USED. IF IT CANNOT GET CLOSE ENOUGH THEN AN ALTERNATE MEANS IS REQUIRED. PUMPING THE CONCRETE OR A MUCH SMALLER CAPACITY 'BUGGY' DELIVERY ARE REQUIRED. VOLUME OF A POUR, AND TIME ARE ISSUES.
***PLACEMENT**_FORMS (BOUNDARIES) ARE SET & LEVELED, BASE PREP ALL SET. CONCRETE IS PLACED (BY CHUTE, PUMP OR BUGGY) AND DISTRIBUTED UNIFORMLY. POCKETS UNDER THE SURFACE ARE ELIMINATED THROUGH ONE METHOD OR ANOTHER OF 'VIBRATION'.
***LEVELING**_INITIAL LEVELING IS ACCOMPLISHED WITH 'SCREEDING' AND THE FIRST PASS AT FLOATING. LEVEL CHECK AT THE INTERIOR OF THE POUR REQUIRED.
***WAITING**_THE AGGREGATE NEEDS TO 'SETTLE AND WATER RISE TO THE TOP.
***EDGING, GROOVING (EXTERIOR SLABS)**_PERIMETER EDGING AND CONTROL JOINT GROOVING DONE WHILE THE CONCRETE IS STILL PRETTY WET & WORKABLE.
***FLOATING**_WITH HAND OR POWER TOOLS THIS IS FURTHER LEVELNG AND SMOOTHING PROCESS. MANY SLABS NEED GO NO FURTHER WITH FINISH. EXTERIOR SLABS MAY WELL WANT A BROOM FINISH APPLIED AT THIS POINT.
***TROWELING**_WITH HAND OR POWER TOOLS THIS IS A YET FURTHER SURFACE SMOOTHING PROCEDURE ONE WANTS IF THE CONCRETE IS TO HAVE AN EXPOSED 'SLICK' SURFACE.
***SAWCUT CONTROL JOINTS**_TIMING IMPORTANT. OFTEN, BUT NOT ALWAYS A NEXT DAY OPERATION.
*****CURING**_IS THE TIME THE CEMENT & WATER NEED TO DO THEIR CHEMICAL THING RESULTING IN CONCRETE STRUCTURAL AND SURFACE STRENGTH. IT IS IMPORTANT TO CONTROL THE TEMPERATURE/HUMIDITY TO LET THIS (HYDRATION) HAPPEN SUCCESSFULLY. 3 TO 14 DAYS IS THE FREQUENTLY STATED TIME RANGE. RESEARCH THIS BEFORE COMMITTING TO A CURE & SEAL PROCESS. THE FULL 'STRUCTURAL' CURING TAKES LONGER- ABOUT A MONTH FOR A SLAB.

CONCRETE SLAB FINISH OPTIONS

INTEGRAL CHOICES ARE MANY-SOME REQUIRE RESEARCH

***CONCEPT**_THERE IS A REAL INTRIGUE TO INTEGRAL FINISHES BOTH FROM A DESIGN AND A SUSTAINABLE STANDPOINT. THE DESIGN OPPORTUNITIES ARE VAST. **HOWEVER**, AS WITH THIS WHOLE SLAB ON GRADE ADVENTURE-SOME SEEMINGLY SIMPLE APPLICATIONS ARE NOT SO SIMPLE AND CAN BE PRICEY. THERE IS A LOT OF OPPORTUNITY FOR SCREW UPS- AND MOST SCREW UPS WITH CONCRETE ARE HARD TO IMPOSSIBLE TO FIX. RESEARCH & BEWARE. CHECK INSTALLERS PREVIOUS INSTALLATIONS IF POSSIBLE AND ESTABLISH A QUALITY STANDARD.

CONCRETE TEXTURAL FINISHES

***OVERVIEW**_RECOGNIZING THAT CONCRETE HAS A BRIEF TIME WHILE IT IS SETTING UP WHEN THE SURFACE IS SOFT ENOUGH TO TAKE A TEXTURE, AND FIRM ENOUGH TO HOLD THAT TEXTURE. THAT TEXTURE CAN BE IMPOSED WITH TOOLS, SUCH AS TROWEL, BROOM, OR REALLY ANY DEVICE THAT CAN EFFECT A PATTERN IN THE CONCRETE. CONVERSELY THE CONCRETE IN THAT STATE CAN BE POLISHED WITH ALL TEXTURE BEING REMOVED. TIMING AND WORK ACCESS TO THE ENTIRE SURFACE AREA NEEDS CONSIDERATION.

PRE POUR INTEGRAL FINISHES

***OVERVIEW**_THE IDEA HERE IS TO MIX SOMETHING INTO THE CONCRETE BEFORE POURING IT-HENCE TRUELY INTEGRAL. UNIFORMITY IN COLOR OR TEXTURE IS GENERALLY MORE GUARANTEED. BUT 'BATCHES' FROM THE CONCRETE TRUCK CAN/WILL VARY A BIT. NOTE THE AGGREGATE MIXES SOMETIMES NEED POWER WASHING OR SAND BLASTING TO FULLY EXPOSE THE AGGREGATE.

***COLOR**
***AGGREGATES**

POST POUR INTEGRAL FINISHES

***OVERVEW**_VARIETY OF FINISHES INTEGRATED INTO THE CONCRETE THE POUR. TECHNIQUE AND TIMING VARY A GOOD DEAL. AND REQUIRE EXPERIENCE TO PULL OFF CORRECTLY. NO ROOM FOR EXPERIMENTATION OR ERROR WITH ANY OF THESE.

***STAMPING**
***CASTING TEXTURE**
***CASTING COLOR**
***CASTING SALT**
***WATER BASED STAINING**
***ACID STAINING**

"COMPOUND" INTEGRAL FINISHES

***OVERVIEW**_SUGGESTING HERE THAT MORE THAN ONE OF THESE MEANS TO EFFECT THE VISUAL/TEXTURAL CONCRETE FINISH CAN BE IMPLETEMNTED.

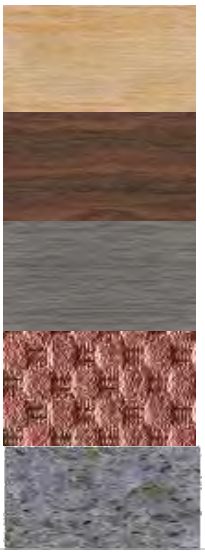
***MULTPLE TEXTURES**
***STAINING+POLISHING**
***AGGREGATES+POLISHING**

APPLIED FLOORING-RISING MOISTURE IS A CAVEAT TO ALL POSSIBLE SELECTIONS

***GENERAL**_c4.9 DISCUSSES MOISTURE (RISING) IN THE SLAB AND FLOORING. ALL THE APPLIED FLOORING SYSTEMS HAVE SOME LEVEL OF MOISTURE TOLERANCE, FROM VERY LOW, TO VERY HIGH. KNOWING THE MOISTURE CONDITION ANY FLOORING IS GOING TO HAVE TO LIVE IN IS CRITICAL TO A BETTER DECISION. IT IS UNFORTUNATELY ANOTHER SKETCHY SITUATION WITH NO WAY TO FORMALLY VERIFY.

***APPLIED** _BECAUSE THESE FLOORINGS ARE APPLIED (AND NOT INTEGRATED) THEY ARE INTERFACING WITH BOTH MOISTURE AND CHEMICALS THE SLAB PRODUCES.

***SLABS DESIGNATED FOR APPLIED FINISHES**_WHEN APPLIED FINISHES ARE USED THE SLAB FINISHING REQUIREMENTS CAN BE LIGHTENED. CRACKING, AND GENERAL CONSTRUCTION CRAP LIKE PAINT OVERSPRAY, GET COVERED UP. A CONSISTENT/LEVEL CONCRETE SURFACE IS REQUIRED BUT THE COSMETICS DO NOT MATTER MUCH.



APPPLIED FINISH FLOORINGS

***OVERVIEW**_FOR SOME A CONCRETE FLOOR, DESPITE THE MANY INTETESTING FINISHES NOTED ABOVE, JUST DOESN'T FEEL RIGHT OR COMFORTABLE, OR WARM ENOUGH. MOST CONVENTIONAL FINISHES CAN BE INSTALLED OVER CONCRETE AND ARE NOT NECESSARILY MORE EXPENSIVE. THESE ARE THE FINISHES THAT WANT SERIOUS MOISTURE INVESTIGATION.

***REAL HARDWOOD**
***ENGINEERED 'REAL' WOOD**
***LAMINATE FLOORING**
***CARPET**
***VINYL SHEETGOODS**
***VINYL TILES+PLANKS**

APPLIED 'MASONRY' FLOORING

***OVERVIEW**_ALL OPTIONS INSTALL SIMPLY AND EASILY ON A SLAB. AND AN INCREDIBLE DESIGN SELECTION EXISTS. THESE SELECTIONS USUALLY ARE **NOT** SO MOISTURE SENSITIVE.

***CERAMIC+PORCELAIN TILE**
***GRANITE AND MARBLE TILE**
***SLATE+STONE**

APPLIED LIQUID FLOORING

***OVERVIEW**_TECHNICALLY A VARIED SELECTION SET WITH THE LIQUID APPLICATION BEING THE COMMON DENOMINATOR. ALL HAVE A CHEMISTRY TO THEM, AND AN INSTALLTION TIMING AND SEQUENCE SET OF RULES THAT NEED TO BE OBEYED.

***SEALERS**
***SOLID COLOR PAINTS**
***EPOXIES**
***EPOXY BASED PEBBLE/TERRAZZO FINSIHES**

SLABS AND PERMEANCE

(3)PERM RATING LANGUAGES

***VAPOR IMPERMEABLE**_0.1 OR LESS
***VAPOR SEMI-IMPERMEABLE**_>0.1 TO 1.0
***VAPOR SEMI-PERMEABLE**_>1.0 TO 10
***VAPOR PERMEABLE**_>10

***CLASS I**_0.1 OR LESS
***CLASS II**_>0.1 TO 1.0
***CLASS III**_>1.0 TO 10

***VAPOR BARRIER**_0.1 OR LESS
***VAPOR RETARDER**_>0.1 TO 10

MATERIAL RATINGS

***ALUMINUM FOIL**_0.0 (FOR REFERENCE)

SLAB ASSEMBLY

***2"RIGID XPS INSULATION**_0.55 (SEMI-IMPERMEABLE)
***6 MIL POLYETHYLENE SHEETS**_0.06
***10 MIL POLYETHYLENE SHEETS**_0.02-0.04
***15 MIL POLYETHYLENE SHEETS**_0.015 (ALL IMPERMEABLE)
***4" CONCRETE SLAB**_.4-.8 (PERMEABLE)

THE PERM LANGUAGE

***PERMS**_A MEASUREMENT OF WATER VAPOR PERMEABILITY. A MEASUREMENT OF HOW READILY WATER VAPOR CAN PASS THRU A MATERIAL. THERE IS A STANDARD TEST PERFORMED TO DETERMINE THAT RATE.

***RATING SYSTEM TERMS**_THERE ARE A FEW TERMS USED TO DESCRIBE THE SAME PERM RATING (UNFORTUNATELY). THE NUMBERS ARE WHAT COUNT. THE VAPOR IMPERMEABLE/VAPOR SEMI-IMPERMEABLE/VAPOR SEMI-PERMEABLE , AND VAPOR PERMEABLE IS THE BETTER DESCRIPTIVE LANGUAGE. CLASS I, II, III SHARE THE IDENTICAL RATING PARAMETERS, AND ARE USED IN THE CODE. THE VAPOR BARRIER, VAPOR RETARDER LANGUAGE WAS USED PREVIOUSLY IN THE CODE TO DISTINGUISH EFFECTIVENESS, AND IS COMMONLY USED IN GENERAL CONSTRUCTION CONVERSATION. A BARRIER MEANS 'NO GO", A RETARDER MEANS "GO SLOW". A VAPOR RETARDER COULD BE VAPOR SEMI-IMPERMEABLE(CLASS II) OR SEMI-PERMEABLE(CLASS III).

***THE WHOLE HOUSE**_ALL SURFACES OF THE THERMAL ENVELOPE PLAY A ROLE IN KEEPING WATER OUT AND MANAGING VAPOR. VAPOR MANAGEMENT IS BY FAR THE TRICKIER PROBLEM BECAUSE ITS PRESENCE AND BEHAVIOR IS ALWAYS CHANGING. PERM RATINGS HELP A LOT IN PROBLEM SOLVING MATERIAL SELECTIONS.

***THE JOB AT THE SLAB**_EXCESSIVE VAPOR ENTERING THRU THE SLAB CAN BE A HUMIDITY ISSUE (DAMP, SMELLY, MOLD, MILDEW) AND A PROBLEM FOR SOME APPLIED FLOORING PRODUCTS. WOOD PRODUCTS LIKE TO SWELL (AND THEN SHRINK) WITH CHANGING VAPOR , AND LESS PERMEABLE SURFACES WANT TO BLISTER OR BALOON OR 'POP' WITH VAPOR PUSHING FROM BELOW. THE ACI DOCUMENT NOTED BELOW DESCRIBES MORE COMPLETELY THE FLOORING AND INDOOR AIR QUALITY CONCERNS.

***PERMEANCE THINKING**_IF A VAPOR TRANSMISSION RATE IS ACCEPTABLE IN A SLAB AS TESTED (SEE BELOW) THEN LOGIC SAYS A FLOORING PRODUCT WITH EQUAL OR GREATER PERMEABILITY WILL BE FINE AS IT CANNOT TRAP ANYTHING.

MOISTURE IN THE SLAB

***MOISTURE TESTING**_THE BOTTOM LINE IS THAT WATER AND VAPOR CONTROL PRECAUTIONS ARE TAKEN OR NOT, A SLAB SHOULD BE TESTED FOR MOISTURE AFTER IT HAS PASSED THRU THE TIME-DRYING AND SPACE CONDITIONING. AN APPLIED FLOORING MIGHT BE SELECTED TO AVOID PROBLEMS, OR MIGHT BE SELECTED BECAUSE ITS APPLICATION, IF DONE CORRECTLY, MIGHT REMEDY A VAPOR INTRUSION PROBLEM.

***COMPATABILITY**_THIS IS ANOTHER OF CONSTRUCTIONS PANDORA'S BOX PROBLEMS. KEEP IN MIND THIS FLOORING COMPATIBILITY WITH CONCRETE MOISTURE IS A HUGE HUGE DEAL IN SQUARE FEET AND DOLLARS, SO A LOT OF PEOPLE ARE IN THE GAME MAKING NOISE.

***MOISTURE TESTING METHODS**_ONE OBJECTIVE BUT UNFORTUNATELY DENSE DOCUMENT (ACI 301.2R-06) IS BY IS THE AMERICAN CONCRETE INSTITUTE. THEY ARE NOT SELLING ANYTHING.. JUST SCANNING IT HAS VALUE. ANOTHER THOUGHT IS TO READ THRU THE 3 ESTABLISHED ASTM TESTING PROCEDURES AS THEY HOLD INSIGHTS INTO THE NATURE OF THIS MOISTURE SITUATION.

***WHY NOT**_THE PLASTIC SHEET TEST (ASTM F4263) IS SO SIMPLE THERE IS NO REASON NOT TO DO IT. THE BAD RAP IS THAT IT ONLY INDICATES SURFACE MOISTURE IN THE SLAB. BUT IF ONE RUNS SEVERAL TO MANY TEST PATCHES AND EXTENDS THE TIME DURATION SEQUENTIALLY OUT OVER MANY DAYS IT IS LOGICAL SOMETHING CAN BE LEARNED. IF ONE HAS THE TIME ACTUAL FLOORING SAMLPLES CAN BE PLACED ON THE SLAB TO SEE HOW/IF MOISTURE COLLECTS OR IF THE (PERMEANCE) OF THE FLOORING ALLOW ENOUGH BREATHING TO AVOID ANY COLLECTION.

***3 ASTM TESTS**_ALL THREE ARE ON SITE RELATIVELY SIMPLE TESTS CAPABLE OF EXECUTION BY DIY[ER], FLOORING SUBCONTRACTOR.
#1_Plastic Sheet Test (ASTM D 4263) **#2**_Anhydrous Calcium Chloride Test (ASTM F 1896) **#3**_Relative Humidity Test Using Probes (ASTM F 2170)

***MOISTURE METERS**_ EXIST IN A COUPLE OF DIFFERENT FORMS (AND PRICE POINTS). AND SOME HAVE ADDED VALUE FOR CHECKING WOOD MOISTURE. LIKE THE PLASTIC SHEET TEST, THESE MAY NOT REPRESENT THOROUGH/HIGH SCIENCE TESTING, BUT STILL HAVE INFORMATION VALUE. AT WORST THEY ARE AN ALERT INFORMING WHEN CONCRETE (OR WOOD) IS TOO WET AND SOME ACTION IS NEEDED.

***FLOORING WARRANTIES**_ FINISH FLOORING PRODUCTS FOR INSTALLATION ON SLABS MIGHT SPEC HOW LONG A SLAB NEED TO BE INSIDE CONDITIONED SPACE BEFORE WARRANTIES ARE HONORED.