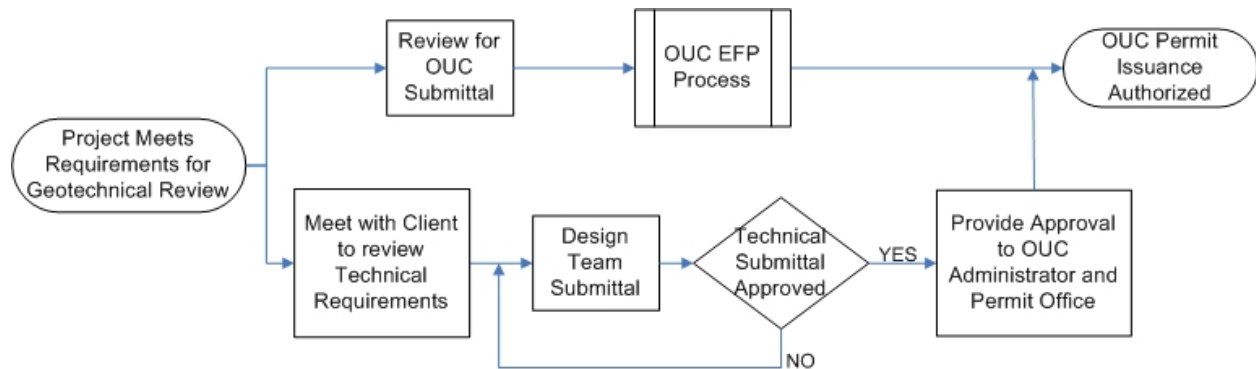


3.3.6 Geotechnical Review

Private and public developments that have excavations, foundations or earth retention systems that are equal to or greater than 12 feet below adjacent (existing) Public Way grade and/or excavations deeper than 4 feet that extend beyond the development’s property lines and into the Public Way require a geotechnical review. The two departments who may perform the geotechnical review within the City are the Department of Buildings (DOB) and CDOT.



For a building project, the owner must go through DOB to obtain a building permit, which includes a caisson-only or foundation permit for construction of all geotechnical elements on the project. This DOB foundation review is either performed in-house for general geotechnical elements or is given to an external peer reviewer for earth retention system design. Alternately, the owner of the project may go through Developer Services for the DOB foundation review.

For any infrastructure project, bridges, roadways, tunnels, etc., CDOT manages the project and performs the review using a CDOT external reviewer for technical design issues.

The design review follows the Geotechnical Review Checklist shown in [Appendix D](#). A geotechnical report, stamped by a Professional Engineer licensed in the State of Illinois, with site specific soil borings and appropriate in situ and laboratory testing, is required. All earth retention (temporary and/or permanent) and foundation design must be stamped by a Structural Engineer licensed in the State of Illinois. Slope stability and excavation drawings may be stamped by a Professional Engineer licensed in the State of Illinois. Slopes that are at or less than 1.5H:1V may require slope stability analysis by CDOT; slopes that are steeper than 1.5H:1V must include slope stability analysis.



Appendix D Geotechnical Review Checklist

Private and Public Developments which have excavations, foundations or earth retention system that are equal to or greater than 12 feet below adjacent (existing) grade and/or excavations deeper than 4 feet that extend beyond the development's property lines and into the Public Way require a geotechnical review. The following is a partial list of items that require geotechnical review:

- Deep foundation members such as caissons, drilled shafts to rock, H-piles, pipe piles, auger-cast piles, micropiles, timber piles, stone columns
- Underpinning elements such as micropiles, hydraulically pushed piers, helical piers and any other form of underpinning.
- Footing or matt foundations (deep excavation because of poor soils and/or because of proposed basements)
- Earth Retention System include but are not limited to steel sheet piling, soldier pile and lagging, slurry walls, secant pile walls, ground improvement for earth retention, rings and lagging, timber sheeting, timber boards and lagging, trench boxes or equivalent shoring systems.
- Elevator pits
- Elevator with hydraulic pistons
- New pits or excavations within the basement of an existing building
- Backfilling and/or restoration of vaulted sidewalks (Note: this is a special case whereby **any** depth applies)

For a building project, contact the Department of Buildings (DOB) (312-742-6084) to start the building or foundation permit process which will include OUC. For non-building infrastructure projects, bridges, roadways, utilities, tunnels, etc., contact the OUC (312-742-3130) to start the geotechnical review. The geotechnical review is concurrent with the OUC EFP process and the geotechnical approval is required for OUC to issue permit issuance authorized. The geotechnical calculations are not required prior to OUC EFP submittal.

The CDOT Geotechnical Reviewer will schedule an Intake Meeting to review process and assist the Permittee as needed. It is the responsibility of the Designer to complete and submit this checklist along with all required drawings and calculations for Geotechnical Review.

In addition to the requirements on the **Plan Preparation Checklist (Appendix D)**, the drawing set shall include the items shown in this document, if applicable, including but not limited to the areas to be excavated and/or the areas where earth retention is required, clearly indicated on Excavation (EX) and/or Earth Retention System (ERS) plans. Earth retention system design (if applicable) will be included as part of the review process along with drawings, geotechnical and structural calculations and installation sequence. Foundation bearing capacity calculations, settlement, (total and differential) calculations and testing procedures (if applicable) must be provided. Monitoring by a licensed surveyor during construction may be required for the protection of adjacent public property and will be outlined as needed by CDOT upon final approval.

**Appendix D
Geotechnical Review Checklist**



1.0 GEOTECHNICAL REPORT

1.	Include written report, boring logs and location plan.	
2.	Provide top of boring elevation tied to Chicago City Datum (CCD)	
3.	Adequate number of borings to cover the entire building site (a minimum of two borings for the first 10,000 square feet of the building footprint and one boring for every 10,000 square feet thereafter, or fraction thereof)	
4.	Adequate depth of boring is required to be a minimum dimension below bearing elevation either two times the footing width for spread footings or two times the maximum bell diameter for caissons (drilled shafts)	
5.	Log shall show ground water levels, Standard Penetration test values (N), Unconfined Compressive Strength values (Q _u), Water Content values, and Soil Classification by strata	
6.	Pressuremeter tests for bearing capacities greater than 21 ksf (minimum two borings)	
7.	Vane Shear tests (recommended) in soft clays for Earth Retention System (ERS) design and/or to check for caisson squeeze (minimum of two borings)	

2.0 DRAWINGS

2.1a COVER SHEET

1.	Complete sheet index block in the lower right-hand corner with the project OUC Number (initial submittal (20## - #####), project name, and sheet numbers.	
2.	Show title information in the top center of the sheet and include: Project route number, common name, street name, Location of improvement, and Type of improvement.	
3.	Show the graphic scales used on plans & profiles in the lower left-hand side of the sheet.	
4.	Provide a project layout map at bottom center of the sheet. Include on the map: Location of project, and north arrow, Beginning and end stations, Important intermediate stations, Prominent features, Names for special features, Route and street names, scale of location map, and Equation stations.	
5.	Provide the project gross and net lengths immediately below the layout map. Only include the mainline distances. Do not include length of intersection improvements.	
6.	Include the designer (company) name or Agency name. The drawings must be sealed, signed and dated by a Professional Engineer or Structural Engineer licensed in the State of Illinois, depending on the project scope of work.	
7.	Show the information for C.U.A.N. on the lower left hand side of the cover sheet.	
8.	Show the legend for symbols denoting existing and proposed features.	

Appendix D
Geotechnical Review Checklist



2.1b INDEX OF SHEETS, HIGHWAY STANDARDS, AND PLANS NOTES

1.	Completely fill out the sheet index (Can be placed on cover sheet).	
2.	Provide a list of all <i>IDOT Highway Standards</i> necessary to construct the project. Also, include the revision number (Can be placed on cover sheet).	
3.	Include all applicable general plan notes (Can be placed on cover sheet).	

2.2 SITE PLANS

1.	Locate column lines/work from property lines in N-S and E-W directions.	
2.	Locate property lines from cross street right-of-way (ROW) lines	
3.	Indicate elevations in CCD	
4.	Show existing grades	

2.3 PLAT SURVEY

1.	Must provide ALTA survey dated within the last 180 days or else update is required	
2.	Show existing utilities (gas, water, sewer, electric, telecom, freight tunnels, etc.) or provide a separate utility plan (see Civil Plans and Details below)	
3.	Utility information shall be obtained through an OUC Information Retrieval (IR).	
4.	Show existing grades, streets, alleys and sidewalks, etc.	
5.	Are any property vacations required?	

2.4 ARCHITECTURAL FLOOR PLANS, BUILDING SECTIONS, AND ELEVATIONS

(if applicable)

1.	Show property lines, column lines, floor elevations and pit elevations	
2.	Elevator pistons located from column tiles.	
3.	Correlate building datum to CCD on sheets	

2.5 STRUCTURAL FLOOR PLANS, FOUNDATION PLAN, CAISSON/PLAN PILE

(if applicable)

1.	Same as Architectural plus	
2.	Show all adjacent buildings/structures on plans with sections	
3.	Show encroachments of any components beyond property line on plan with sections (caps, grade beams, caisson shafts and bells, piles, etc.)	
4.	Dimension of encroachments beyond property lines (caisson bells must include over dig.)	
5.	Encroachments may require City Council approval. Verify	
6.	Caisson and/or pile details with bearing elevation and bearing capacity	
7.	Spread footing and/or matt details with bearing elevation and bearing capacity	

**Appendix D
Geotechnical Review Checklist**



2.6 CIVIL PLAN AND DETAILS

1.	Show location of new sidewalks, driveways, alleys, curb and gutters, street pavements/drop-off lanes	
2.	Pavement Details (Appendix A)	
3.	New plumbing lines, structures and service connections	
4.	Dimension all sewer and water connections to nearest cross street right-of-way line	
5.	Show storm water retention structures with locations, depth and typical sections	
6.	Existing utility plan if not shown on Plat of Survey (see Item 2.3 for details)	

2.7 PLUMBING DRAWINGS (if applicable)

1.	Street names, property lines; all underground utility plans (underground, basement, first floor)	
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2.8 LANDSCAPING DRAWINGS (if applicable)

1.	Landscaping plans and details	
2.	Planting/species list	

2.9 EARTH RETENTION SYSTEM/EXCAVATION DRAWINGS

1.	Property lines and column lines	
2.	Earth retention components and Open Cut slopes with locations from property lines	
3.	Dimension of encroachments beyond property lines	
4.	Dimension all sewer and water connections to nearest cross street right-of-way line	
5.	Encroachments may require City Council approval. Verify	
6.	Adjacent structures, existing utilities and excavation limits	
7.	Typical section on all sides showing all conditions – Include existing grades, bottom of excavation, excavation slopes, top and lower tip elevations of earth retention, bottom of adjacent foundation (underpinning required?) and utilities	

2.10 LOGISTIC PLANS: SIGNED BY CDOT DIVISION OF PERMITS

1.	Property lines, streets, sidewalks and alleys (including utility poles)	
2.	Utility lines (including sewer, water, electric and gas)	
3.	Portion of street, alley and sidewalks to be closed	
4.	Fences, barricades and pedestrian canopies (existing and proposed) with location dimensions	
5.	Typical section along each side	

3.0 FOUNDATION DESIGN CALCULATIONS AND INSTALLATION PROCEDURES

Upon completion of OUC EFP Submittal, the Permittee shall submit design calculations required by CDOT Geotechnical Reviewer. Hand calculations are required; computer output is not accepted. A general listing of typical calculations is provided below for reference; additional calculations may be required on an individual project/site specific basis. Additional requirements specific to soil testing and analysis as well as foundation load testing and design parameters may be found in the Chicago Building Code, Chapter 18 – Soils and Foundations.

- A. Foundation Design Calculations and Construction Procedures
 - A1. Foundation Bearing capacity – Hand calculations for all types of foundations used: Shallow (footing, mats, etc.); deep (caisson, piles); and/or combination
 - A2. Foundation Structural capacities of steel piles (12 ksi max. per Chicago Building Code)
 - A3. Settlement – Total and differential settlements
 - A4. Installation Procedures – Caissons, Drilled Shafts, Piles
 - A5. Load test procedures – Caissons, Drilled Shafts, Piles

- B. Underpinning of Existing Building
 - B1. Structural capacity of underpinning piles
 - B2. Underpinning pier (pile) static capacity
 - B3. Design of underpinning brackets
 - B4. Analysis to determine if adjacent existing footing/walls are capable of withstanding anticipated pressures/stress
 - B5. Underpinning installation procedure
- C. Adjacent Structure Analysis and Protection
 - C1. Existing footing/wall sub-grade bearing capacity/stability analysis for reduced factors of safety because of removal of soil surcharge above existing footings
 - C2. Global Stability Analysis

4.0 EARTH RETENTION CALCULATIONS AND INSTALLATION PROCEDURES

4-1. Common Items

The following items are to be included with all earth retention (ERS) submittals. All ERS drawings and calculations to be sealed and signed by Structural Engineer licensed in the State of Illinois.

- A. Hand calculations are required; computer output is not accepted.
- B. Boring logs, field/lab test data and Final Site (Project) Specific Geotechnical Report.
- C. List all design assumptions used in the calculations, as they are introduced in sequence of computations.
- D. Provide copies of relevant pages of references used in the calculations. These include all graphs, charts, or tables used in the analysis or design.
- E. Provide copies of catalogue cuts, tables of material properties used in the structural calculations.

Appendix D Geotechnical Review Checklist



- F. All submittals must begin with a sketch and/or listing of soil layering, soil parameters, and design water level assumed in the calculations. Specific borings which were used in establishing the design conditions should be identified by boring numbers as given on the logs.
- G. Calculations should show cross-sections giving design elevations for:
 - i. Top and toe of the wall
 - ii. Existing surrounding ground
 - iii. Bottom of the excavation
 - iv. Existing adjacent foundations within the zone of influence
 - v. Cut slopes and set-backs
 - vi. Water elevation
- H. All formulas must be listed, as they are being used in the various parts of the calculations.
- I. Include all calculation steps that are a normal part of an actual hand solution whether or not a computer-assisted analysis/design was used. Do not submit recopied computer output as hand calculation.
- J. Construction surcharge should be actual conditions planned by the contractor (crane loading included) or minimum traffic surcharge of 240 psf uniformly distributed vertical load.
- K. ERS drawings must include plan views and cross-sections which are consistent with the final design options, eliminating alternatives. Sufficient cross-sections must be provided to show top of grade, cutback slopes, adjacent buildings, sidewalks, alleys, and roadways, as well as utilities with the zone of influence (within 2.5 times the excavation depth from grade).
- L. A Groundwater Control Plan and dewatering calculations prepared by an Illinois registered PE must be submitted for review in all cases where well/wellpoints and/or dewatering are necessary to maintain a dry, stable excavation.
- M. ERS drawings must include Sequencing of work from pot-holing for foundations and pre-trenching for earth retention to backfilling of area to adjacent (proposed) street grade. Include step by step procedures regarding installation of bracing and removal of bracing per the staged excavation design calculations. All items in the construction procedure shall correspond to items checked in the ERS design.

4-2. Earth Retention System (ERS) Items – General

The ERS submitted must include calculations for the design of all vertical wall components and for all bracing components. For example, depending the system selected, this may include design for:

- Sheet piles, soldier piles and lagging, secant piles, slurry walls, etc.
- Walers, struts, rakers, kicker blocks, anchors, and temporary earth berms.
- Utility supports for existing infrastructure.
- Use of proprietary systems, such as trench boxes or slide rail shoring, requires that a structural engineer licensed in the state of Illinois confirm that the systems components are satisfactory for site-specific conditions. Manufacturers or suppliers cut sheets must be submitted, listing serial numbers of frames or boxes proposed for use on the project.

4-3. Items Specific to Cantilever Wall Analysis/Design

In addition to Common Items and ERS Items - General, the following must be included as part of the submitted.

- A. Provide a step-wise calculation of lateral pressure distribution. Calculate pressures at every change of state of the problem, e.g. stratum boundaries excavation depth, brace or anchor level, adjacent foundation load as it varies with depth.
- B. Plot lateral pressures on diagram to reasonable size for illustration. Split diagram into sensible triangular and rectangular units; identify units by letter or number for use in moment equations. Account for all components of load: soil, water, and surcharge.
- C. In cases where a theoretical negative or small positive active earth pressures are predicted through clay strata, a minimum active earth pressure of $0.25\gamma_z$ should be substituted, where γ_z is the total overburden pressure at depth z .
- D. Provide moment calculations based on above pressure diagram, solving for wall embedment depth required for rotational equilibrium ($SF=1.0$) about the toe. Show intermediate steps, reducing moment expression to its final form for solution. Find zero shear, maximum moment, to size sheeting.
- E. Provide additional embedment length to establish safety factor or margin of safety vs. rotational failure about the toe. Any of the generally recognized methods of determining design embedment depth may be used. However, a minimum safety factor of 1.5 vs. ultimate passive resistance is required in all cases.
- F. Provide analysis of structural wall deflection and ground deformation required to mobilize passive resistance. The support assumption for structural deflection should be consistent with figure 6.1 of the U.S. Army Corps of Engineers EM 1110-2504 "Design of Sheet Piles Walls". The transition/rotation of the soil/wall system can be estimated roughly from NAVFAC DM 7.2-6.2, based on soil type.
- G. A check of base stability or overall (global) stability should be made using generally accepted methods. The minimum allowable factor of safety is 1.5.

4-4. Items Specific to Single Level Braced or Anchored Walls

In addition to Common Items and ERS Items - General, the following must be included.

- A. The free-earth support method should be used as the basis of design. No moment reduction due to flexibility of the wall should be assumed.
- B. Provide calculations to show the wall embedment depth required for rotational equilibrium about the brace or anchor level (SF=1.0 condition). Provide additional embedment length required for safety factor as in cantilever case.
- C. Provide strut or anchor load calculations by taking moment about toe. Size sheeting as a beam with above system of forces applied.
- D. Bracing Calculations.

4-5. Items Specific to Walls with Two or more Levels of Bracing

In addition to Common Items and ERS Items - General, the following must be included.

- A. Provide analyses for cantilever and single brace stages, strut removal, and final depth of excavation stages.
- B. Use generally recognized apparent earth pressure envelopes for determining multi-tier strut loads, do not reduce strut or anchor loads to account for temporary conditions.
- C. Provide base stability analysis for full and partial depth of cut, as needed to final critical correlation. Minimum required safety factor is 1.5.
- D. An estimate of adjacent ground movement should be made (Clough's method or alternate) accounting for stiffness of proposed wall used safety factor vs. basal heave.
- E. When analyzing overall stability of the execution, do not include friction between the wall and retained soil as contributing to stability of the system.
- F. Provide design for all bracing component (walers, struts, rakers, etc.)

4-6. Bracing

In addition to Common Items and ERS Items and appropriate bracing analysis, the following must be included.

- A. Ground Anchor (tieback) design shall include un-bonded and bonded length calculation and related sketch; testing procedures (proof, performance and creep), production anchor procedure.
- B. Provide design of all bracing components (walers, struts, rakers, etc.). If friction along the wall/soil interface is considered, do not reduce load on the walers by more than 20% of the waler load per linear foot as an allowance for friction.
- C. Structural design: stiffeners, connections, support brackets. Check compact and non-compact sections.