**SOIL MECHANICS CIVL2410**

**COMPUTING ASSIGNMENT 2017**

The assignment has two parts

1. Each tutorial group (see list below) is required to produce a spreadsheet that can use the method described in the notes to solve problems involving 1-D settlement calculation. This will be due before 9am Monday 9th October.

   For part 1 of this assignment a single electronic submission is required from each tutorial group (see list below). This should be emailed to david.airey@sydney.edu.au and should include the Group number in the subject. This may consist of several individual spreadsheets or a single group spreadsheet. This submission requirement is to encourage you to work cooperatively in your groups, however, if you wish to work individually, and submit an individual spreadsheet that is also acceptable.

   It is acceptable for every student in one group to have the same spreadsheet, but similar spreadsheets across more than one group will be considered to exceed the bounds of acceptable cooperation and will be penalised accordingly.

2. The spreadsheet will be used to solve a particular geotechnical problem (A to E below). Each student in the group will have a different problem. An individual report (hard copy) is required describing the results of your analyses. The report should be no more than 2 pages. It should contain a brief statement of the problem, present the key results (that is the effect of sub-layer thickness on settlement and differential settlement), and discuss these making reference to 1-D settlement theory.

   The report is due before midnight Sunday 15th October.

**Assessment**

Assessment will be 50% on the spreadsheet and 50% on its application and the report.

The following criteria will be applied

***1. Spreadsheet***

| | |
|---|---|
| 100% | General spreadsheet able to correctly solve settlement problems with a range of foundation shapes and loads as specified in self-explanatory input data. The spreadsheet will make use of macros and some visual basic programming |
| HD | General spreadsheet able to solve all individual problems and handle a range of foundation shapes and loads. The program will make use of macros, but may require some manual adjustment of the spreadsheet to cope with different foundation shapes and load histories. |
| D | Spreadsheet able to solve all problems and handle the range of boundary conditions and load histories, but requiring manual adjustment of spreadsheet to cope with different foundation shapes and loads. Limited use of macros to automate the spreadsheet. |
| CR | Spreadsheet capable of being adapted to solve all problems and handle the range of foundation shapes and loads. Some automation of spreadsheet, but requiring manual adjustment of spreadsheet to cope with different individual problems |
| P | Basic spreadsheet capable of solving 1-D settlement problems. Each individual problem will require substantial modification of the spreadsheet to cope with different geometry and loads |
| F | No spreadsheet produced or spreadsheet still requiring substantial work to solve the problems. |

***2. Report***

| | |
|---|---|
| HD | A concise, well presented report including relevant graphs and discussion showing a full understanding of the problem and your analyses |
| D | A good report including relevant graphs and discussion showing understanding of the problem and your analyses |
| CR | A report including relevant graphs and discussion showing broad understanding of the problem and your analyses but not of the detail |
| P | Poorly presented report but includes relevant graphs and discussion/ well presented report with rudimentary level of understanding |
| F | Poor report containing irrelevant information and demonstrating no understanding of the problem or the results of the analyses |

**Individual Projects**

For each project the aims are

- to show the effect that the sub-layer thickness has on the calculation of the settlement
- to determine the maximum differential settlement under the foundation
- to discuss the accuracy of the settlement calculations

To determine the initial void ratio assume $G_s = 2.65$. Assume also that settlements of any sand and gravel layers can be ignored

A. A square building (15 m × 15 m in plan) is to be constructed on a site where the soil profile consists of 3 m of clay with an over-consolidation ratio of 5 overlying a 5 m thick layer with an over-consolidation ratio of 1, which overlies rock. The soil properties are $C_c = 0.35$, $C_r = 0.07$ and $\gamma_{sat} = 20$ kN/m$^3$ for both clays, and the water table is 1 m below the soil surface. Determine the settlements when a stress of 100 kPa is applied by the building.

B. A building is to be constructed with a ring beam foundation on a site where the soil profile consists of 3 m of dense sand overlying a 5 m thick layer with an over-consolidation ratio of 1, which overlies rock. The soil properties of the clay are $C_c = 0.25$, $C_r = 0.05$, $\gamma_{sat} = 18$ kN/m$^3$, for the sand $\gamma_{sat} = 18$ kN/m$^3$, and the water table is 2 m below the soil surface. Determine the settlements when a stress of 100 kPa is applied by the building. Determine the differential settlement between the centre line of the ring beam and under the centre of loaded area of the beam. The inner and outer radii of the ring beam are 8 m and 12 m respectively

C. A rectangular building is to be constructed on a site where the soil profile consists of 5m of clay with an over-consolidation ratio varying linearly from 2 at the surface to 1 at 5 m, overlying a 7 m thick layer with an over-consolidation ratio of 2, which overlies rock. The soil properties are $C_c = 0.3$, $C_r = 0.08$ and $\gamma_{sat} = 20$ kN/m$^3$ for both clays, and the water table is 1 m below the soil surface. Determine the settlements when a stress of 125 kPa is applied by the building over an area of 12 m × 7 m on the soil surface.

D. Figure 1a shows the elevation of a site where a building applying a uniform stress of 100 kPa over a 12 m square foundation is to be demolished. An old brittle pipe carrying critical infrastructure lies 4 m beneath one edge of the building as shown in the plan view in Figure 1b. The soil profile consists of 2 m of dense gravel with $\gamma_{dry} = 17.2$ kN/m$^3$ which overlies a 6 m thick clay deposit. The water table is 2 m below the surface, level with the top of the clay layer. The clay layer has

properties $C_r = 0.04$, $C_c = 0.4$, OCR = 1, $\gamma_{sat} = 17.75$ kN/m$^3$. The clay is underlain by impermeable rigid rock. Determine the settlement of the pipe at points X and Y when the building is demolished and the stress of 100 kPa is removed. It may be assumed that the pipe moves with the surrounding soil.

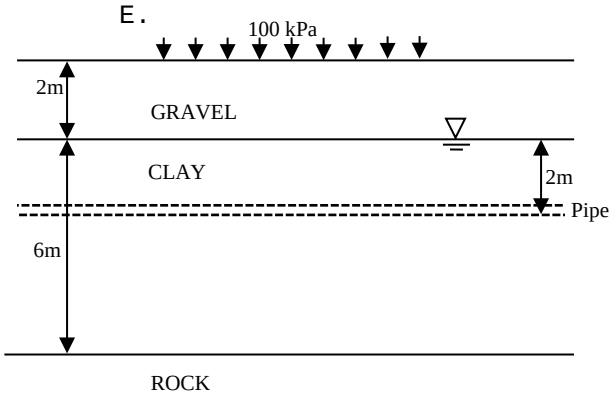


**Figure 1a Elevation**

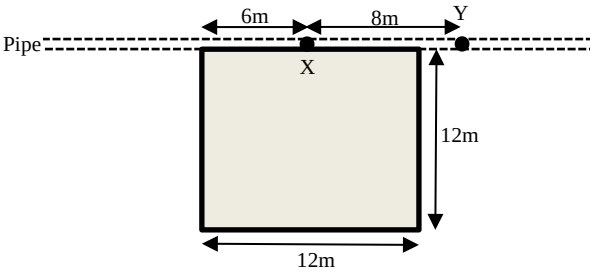


**Figure 1b Plan**

E. A circular grain silo is to be constructed on a site where the soil profile consists of 20m of clay overlying rock. The over-consolidation ratio varies linearly from 5 at the surface to 1 at the base of the clay layer. The clay properties are $C_c = 0.25$, $C_r = 0.04$ and $\gamma_{sat} = 18.5$ kN/m$^3$, and the water table is 1.5 m below the soil surface. Determine the settlements when a stress of 150 kPa is applied by the tank which is 12 m in diameter.

Note for the rectangular load the vertical stress change under a corner can be calculated from

$$\frac{p}{2\pi}\left[\tan^{-1}\left(\frac{l\,b}{z\,r_3}\right)+\frac{l\,b\,z}{r_3}\left(\frac{1}{r_1^2}+\frac{1}{r_2^2}\right)\right]$$

Where

$$r_1^2 = (l^2 + z^2)$$
$$r_2^2 = (b^2 + z^2)$$
$$r_3^2 = (l^2 + b^2 + z^2)$$

For the circular foundation off the centerline you will need to determine an equation to describe the response shown in the chart. This can be done by taking a few points and plotting a graph in Excel and using trendline options to give an equation.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | A | BUCHTA, MICHAEL | 12 | A | HASJIM, MATTHEW | 23 | A | DAWOD, MOHAMMAD |
| 1 | B | DEVARAPALLI, PRIYA | 12 | B | LAM, CHRIS | 23 | B | GANBAT, DISH |
| 1 | C | LIN, RAY | 12 | C | LU, TINGYU | 23 | C | PANASAMPON, CHAICHOTE |
| 1 | D | PINDORIA, ROHIT | 12 | D | NEVELL, THOMAS | 23 | D | VEKARIA, ROHAN |
| 1 | E | WANG, CAMILA | 12 | E | | 23 | E | ZOU, KEVIN |
| 2 | A | GROSS, AMANDA | 13 | A | BELL, WILLIAM | 24 | A | WILSON, MARYAM |
| 2 | B | KUA, JAY | 13 | B | NEWTON, JACOB | 24 | B | GUNNING, TOM |
| 2 | C | WADHWANA, DHANESH | 13 | C | SAVAS, NICHOLAS | 24 | C | ZHOU, PRISCILLA |
| 2 | D | WAIDYASEKARA, PASAN | 13 | D | YANG, ALEX | 24 | D | LEE, JUNG WOON JONATHAN |
| 2 | E | WARNER, JAMES | 13 | E | ZHU, DAMIAN | 24 | E | WANG, RYAN |
| 3 | A | CHEN, LEVIN | 14 | A | ELRICH, OMAR | 27 | A | AUNG, LU MIN |
| 3 | B | SHEN, JUNJIE | 14 | B | HODGKINSON, KIAH | 27 | B | GE, YONGXIN |
| 3 | C | NGO, ERIC | 14 | C | ZHU, JIAQI | 27 | C | QIU, YIPING |
| 3 | D | RAFFOUL, JOSEPH | 14 | D | SIFRI, ANDREW | 27 | D | TAO, MARGARET |
| 3 | E | | 14 | E | | 27 | E | TRUONG, BRUCE |
| 4 | A | CHEN, JACK | 15 | A | BROOKS, HAYDEN | 28 | A | GAO, MARTIN |
| 4 | B | COELHO, NATHAN | 15 | B | CHEN, XUYANG | 28 | B | HUANG, KAI |
| 4 | C | HO, DAVID | 15 | C | NICHOLAS, JOJO | 28 | C | KIM, WILLIAM |
| 4 | D | MEASDAY, MOLLY | 15 | D | SHENG, RUIHUA | 28 | D | LING, JOANNE |
| 4 | E | | 15 | E | WANG, MINGXIN | 28 | E | |
| 5 | A | FOSTER, LAURA | 16 | A | ANDERSON, STEPHEN | 29 | A | CHEN, LINJI |
| 5 | B | HARLOW, DIGBY | 16 | B | CAO, LILY | 29 | B | SONG, CHONGZHEN |
| 5 | C | VARSANI, PARTH DINESH | 16 | C | KELLY, DAVID | 29 | C | TAHIRI, MURTAZA |
| 5 | D | WANG, HAN | 16 | D | WENG, JING | 29 | D | YIN, YIREN |
| 5 | E | WU, DI | 16 | E | | 29 | E | ZHANG, SHARON |
| 6 | A | CHU, EDWIN | 17 | A | BANNAYAN, GEORGE | 30 | A | ALLAM, NOUR |
| 6 | B | HAN, SAM | 17 | B | LAU, ROCKY | 30 | B | JIN, XIEHAO |
| 6 | C | JIN, TONY | 17 | C | PENG, JINGHE | 30 | C | LI, MINGFENG LI |
| 6 | D | WISEMAN, CHARLIE | 17 | D | YANG, HANPEI | 30 | D | LIU, TONGYAO |
| 6 | E | YU, KAN | 17 | E | ZHENG, JOE | 30 | E | RICHARDSON, MAX |
| | | | | | | 30 | F | SIVAJI, ARAVINDD |
| 7 | A | AFSHAR, NATALIE | 18 | A | CHEN, HANCHI | 31 | A | KALUGAMPITIYA, NAVEEN |
| 7 | B | LAI, YUDAN | 18 | B | LEE, HIN TING | 31 | B | ZHU, DEREK |
| 7 | C | LAURENCE, LIZ | 18 | C | NAKHOUL, GHADI | 31 | C | VAUGHAN, SIONED |
| 7 | D | MIN, XINYU | 18 | D | PENG, JAREK | 31 | D | WALKER, DOMINIC |
| 7 | E | YANG, HAINI | 18 | E | SEE, SHERYN | 31 | E | YANG, ZIJIANG |
| 8 | A | KINGSFORD, CAROLINE | 19 | A | JIANG, XINYANG | 32 | A | LIU, JEFFREY |
| 8 | B | LI, CALVIN | 19 | B | YANG, XI | 32 | B | LEAVER, NICK |
| 8 | C | ROCHESTER, SAM | 19 | C | OEY, OLIVIA | 32 | C | XIA, CHENJIE |
| 8 | D | YANG, BETTY | 19 | D | ZAKI, KARIN | 32 | D | YEHIA, HASSAN |
| 8 | E | YUEN, KENNETH | 19 | E | | 32 | E | ZHANG, CASTIEL |
| 9 | A | ALSOP, CHRISTIAN | 20 | A | DAI, CATHY | 33 | A | AMAILEF, HAMZA |
| 9 | B | IE, YUVITA | 20 | B | PANG, FERNANDO | 33 | B | ZHOU, ALICE |
| 9 | C | LEE, GA YEE | 20 | C | REID, LACHLAN | 33 | C | LWIN, MAY |
| 9 | D | WIGMORE, JAMES | 20 | D | TCHARLASSIAN, GAREN | 33 | D | WU, LEO |
| 9 | E | TANG, ALICE | 20 | E | THANT NAY HSU, DANIEL | 33 | E | LAM, DANIEL |
| 11 | A | HARTNER, BRIANNA | 21 | A | EVANS-LIAUW, MIA | 34 | A | BRITTON-PURHONEN, ZARA |
| 11 | B | KORKMANN, BEN | 21 | B | JIN, LLOYD | 34 | B | ILIN, NIKITA |
| 11 | C | LI, CHENGJING | 21 | C | LANCASTER, JAMES | 34 | C | TU, JADE |
| 11 | D | YOUNG, MATTHEW | 21 | D | LOO, HAO JIE | 34 | D | ZHANG, HONGZE |
| 11 | E | HONG, CHRISTINA | 21 | E | ZHOU, XIAOLING | 34 | E | ZHOU, LINXIAO |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 37 | A | CHANG, ALBERT | 47 | A | MA, XIAO | 57 | A | WANG, JIAXIN |
| 37 | B | DANG, JASON | 47 | B | YU, WANLU YU | 57 | B | ZENG, ALEX |
| 37 | C | HENG, NERISSA | 47 | C | YANG, HARPER | 57 | C | NOURI, SAMI |
| 37 | D | JIANG, JONAS | 47 | D | FANG, YANG | 57 | D | O'NEIL, LIAM |
| 37 | E | TRAMONTE, LUCA | 47 | E | YONG DENG, AJANG | 57 | E | |
| 38 | A | BELL, JAMIKA | 48 | A | FANG, ARIA | 58 | A | CHEN, ANDY |
| 38 | B | CHEN, KYRIE | 48 | B | QIU, KENNY | 58 | B | CHEN, ZHENG |
| 38 | C | GUPTA, ANMOL GUPTA | 48 | C | ZHANG, BILLY | 58 | C | LI, RICHARD |
| 38 | D | MIU, TOM | 48 | D | JIA, ZHOU | 58 | D | ONG, JOLEEN ONG |
| 38 | E | ZHOU, DAN | 48 | E | | 58 | E | |
| 39 | A | AMMIT, LANGLEY | 49 | A | WANG, YUHANG | 61 | A | CAO, DONGFEI |
| 39 | B | LI, HANG | 49 | B | LI, STEVEN | 61 | B | FU, RAY |
| 39 | C | MASTROIANNI, ELYSSA | 49 | C | CAO, RONGXIANG | 61 | C | HO, SANDY |
| 39 | D | ZHU, JOEY | 49 | D | LIU, TONY | 61 | D | SINGH, YUVRAJ |
| 39 | E | WU, CHENGJUN | 49 | E | JIANG, YANG | 61 | E | WASSIF, CHRISTIAN |
| 40 | A | BANNON, BENJAMIN | 50 | A | BIAN, DANIEL | 62 | A | DENNING, ALEX |
| 40 | B | PEEK, AIDAN | 50 | B | WANG, ZAC | 62 | B | GAO, KEVIN |
| 40 | C | PODDAR, GAURAV | 50 | C | FENG, JIABIN | 62 | C | BAXTER, RYAN |
| 40 | D | PEEL, ISABELLA | 50 | D | GAO, CHRIS | 62 | D | YUE, RAY |
| 40 | E | STUNTZ, ELIOT | 50 | E | YI, ROY | 62 | E | GAO, PENGFEI |
| 40 | F | WAN, WINNIE | | | | | | |
| 41 | A | ANGGONO, RICKY JUNARDI | 51 | A | CHAU, XAVIER | 63 | A | LEE, JONATHAN |
| 41 | B | MATATIA, WILSON | 51 | B | HANRAHAN, CAITLIN | 63 | B | LIANG, LILY |
| 41 | C | PRIESTLEY, CATHERINE | 51 | C | WINDSOR, TOBY | 63 | C | PESCUD, WILLIAM |
| 41 | D | TAN, BENEDICT | 51 | D | ONG, MICHAEL | 63 | D | SOY, DARREN |
| 41 | E | THURECHT, KATHERINE | 51 | E | | 63 | E | |
| 42 | A | LI, ZERU | 52 | A | KRAJCIC, DJORDJE | 64 | A | TENG, HUALIN |
| 42 | B | FUNG, FREEMAN | 52 | B | NI, ZICHEN | 64 | B | LEERDAM, MICHAELA |
| 42 | C | GEBRAEEL, MARINA | 52 | C | SU, ALLEN | 64 | C | RUBBANI, ALISHBA |
| 42 | D | HUAN, XUEYI | 52 | D | DO, JOHN | 64 | D | CHEN, FRANKY |
| 42 | E | SUN, SUN JINGYI | 52 | E | QIN, SHAUN | 64 | E | CHALAK, EDWARD |
| 43 | A | CAO, LIZHEN | 53 | A | BHUTTA, ADIL | 65 | A | LI, MENG |
| 43 | B | CHEN, OLIVER | 53 | B | FISHER, LARA | 65 | B | LAU, EMILY |
| 43 | C | MYAT HSU MAY MAUNG, MYA | 53 | C | SHASHA, DANIEL | 65 | C | GHOBARY, ZAHRA |
| 43 | D | RADEMAKERS, SAM | 53 | D | MULLER, RICHARD | 65 | D | KNOTT, JUSTIN |
| 43 | E | WU, JANE | 53 | E | | 65 | E | WANGCHUK, ZIMBA |
| 44 | A | CAI, ZHENGYI | 54 | A | ACHJIAN, ANTHONY | 66 | A | BOWMAN, MACKENZIE |
| 44 | B | GUO, XIN | 54 | B | BOTROS, MATTHEW | 66 | B | CHOWDHURY, RAHMEE |
| 44 | C | KAN, ISAAC | 54 | C | CHENG, JUNDA | 66 | C | RATHI, VARSHA |
| 44 | D | TANG, JAY | 54 | D | ELSUSU, JUSTIN | 66 | D | WU, YONG |
| 44 | E | YESHI, SHONPA | 54 | E | PIROSCIA, VINCENT | 66 | E | CHEN, HAN |
| 45 | A | KIM, HYUNWOO | 55 | A | FORD, SARAH | 67 | A | SCARLET, SCARLET |
| 45 | B | NAZHA, JAD | 55 | B | XUE, ZHENSONG | 67 | B | WEHBE, MITCHELL |
| 45 | C | REN, ANDREW | 55 | C | LAU, FIONA | 67 | C | YUAN, WILLIAM |
| 45 | D | SHEN, JOSEPH SHEN | 55 | D | WOODLEY, LUCY | 67 | D | SINGH, SIM |
| 45 | E | TAN, DEREK | 55 | E | TAN, WILLARS | 67 | E | YAN, SUNYAO |
| 46 | A | KOU, XUANRUI | 56 | A | HU, ZEYU | 68 | A | HEDAYATI MAHDI ABADI, FLORA |
| 46 | B | LLOYD, MICHAEL | 56 | B | JOSHI, AISHWARYA | 68 | B | GOODALL, LAURA |
| 46 | C | SOLARI, ANTHONY | 56 | C | PEARCE, JORDAN | 68 | C | GOJKOVIC, IVAN |
| 46 | D | TA, SANDY | 56 | D | XU, WILLIAM | 68 | D | MARRIOTT, JORDAN |
| 46 | E | ZHENG, YIXUAN | 56 | E | YAO, DONGMING | 68 | E | FITZPATRICK, LUKE |
| | | | | | | 68 | F | BABANOUR, DAVID |

| | | | | |
|---|---|---|---|---|
| 69 | A | WONG, TOBY | | |
| 69 | B | LIN, KENNETH | | |
| 69 | C | MAZZUCCO, ADAM | | |
| 69 | D | PHAN, PETER | | |
| 69 | E | CHEN, ZIXUAN | | |
| 70 | A | JOSEPH, IMRAN | | |
| 70 | B | CRAVEN, TOM | | |
| 70 | C | JABBOUR, SEBASTIAN | | |
| 70 | D | GOMES, CHLEO GABRIELLE | | |
| 70 | E | | | |
| 71 | A | MERRIMAN, JAMES | | |
| 71 | B | HOANG, PHONG | | |
| 71 | C | WANG, RUBY | | |
| 71 | D | PENG, TIANMING | | |
| 71 | E | | | |
| 72 | A | KAWASHIMA, TAMIRU | | |
| 72 | B | BENNETT, LEWIS BENNETT | | |
| 72 | C | KIM, ERIC | | |
| 72 | D | NASSIF, ROY | | |
| 72 | E | FLOOD, TOM | | |
| 73 | A | XIA, YIWEI | | |
| 73 | B | ZHENG, YANG | | |
| 73 | C | HETHERINGTON, JAKE | | |
| 73 | D | TANG, TOM | | |
| 73 | E | | | |
| 75 | A | CHEN, DANA | | |
| 75 | B | DURSTON, MICHAELA | | |
| 75 | C | LAHOUD, ANDREW | | |
| 75 | D | STRANEY, CHRISTIANA | | |
| 75 | E | ZHU, ZEJING | | |
| 76 | A | RATHI, VAISHALI | | |
| 76 | B | TRIPP, ARTHUR | | |
| 76 | C | WANG, YUWEN | | |
| 76 | D | JOSHUA, KARL | | |
| 76 | E | HAN, ERIC | | |
| 76 | F | LI, JEFFREY | | |