

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

DEPARTMENT OF CIVIL ENGINEERING

(GEOTECHNICAL ENGINEERING DIVISION)



GUIDELINES FOR PREPARATION
OF
THESES/DISSERTATIONS/REPORTS
FOR
Ph.D. /M. Tech. /B. Tech. Students

PREAMBLE

A **thesis or dissertation** is a document submitted in support of candidature for an academic degree or professional qualification presenting the author's research and findings. In some contexts, the word "**Thesis**" or a cognate is used for part of a **Bachelor's or Master's course**, while "**Dissertation**" is normally applied to a **Doctorate**, while in other contexts, the reverse is true. The term "**Graduate Thesis**" is sometimes used to refer to both **Master's thesis and Doctoral Dissertations**. Dissertations and theses may be considered to be grey literature.

While utmost attention must be paid to the content of the thesis/dissertation (hereinafter called the '**thesis**'), which is being submitted in partial fulfillment of the requirements of the respective degree, it is imperative that a standard format be prescribed. The same format shall also be followed in preparation of the final soft copies to be submitted to the Library in future.

Guidelines for Preparation of Theses/Dissertations/Reports

Organization of the Thesis/Dissertation/Report

This thesis shall be presented in a number of chapters, starting with Introduction and ending with Summary and Conclusions. Each of the other chapters will have a precise title reflecting the contents of the chapter. A chapter can be subdivided into *sections, subsections and sub subsection* so as to present the content discretely and with due emphasis.

When the work comprises two or more mutually independent investigations, the thesis may be divided into two or more parts, each with an appropriate title. However, the numbering of chapters will be continuous right through, for example Part 1 may comprise Chapters 2 - 5, Part Two, Chapters 6 – 9 and so on.

- **Introduction**

The title of **Chapter 1** shall be Introduction. It shall justify and highlight the problem posed, define the topic and explain the aim and scope of the work presented in the thesis. It may also highlight the significant contributions from the investigation (sample of Chapter 1 given).

- **Literature Review**

This shall normally form **Chapter 2** and shall present a critical appraisal of the previous work published in the literature pertaining to the topic of the investigation. The extent and emphasis of the chapter shall depend on the nature of the investigation and literature survey done by the student.

- **Materials, Methodology and Testing Program**

This shall normally start from **Chapter 3** and shall present clearly the materials and testing methodology and equipments chosen for research work by the student. Any Fabrication work be clearly described, illustrated and designed suitably.

- **Report on Results & Discussions on the present investigation**

This shall normally start from **Chapter 4**. The reporting on the investigation shall be presented in one or more chapters with appropriate chapter titles. Following few points may be kept in mind while preparing report:

- Due importance shall be given to experimental setups, procedures adopted, techniques developed, methodologies developed and adopted.
- While important derivations/formulae should normally be presented in the text of these chapters, extensive and long treatments, copious details and tedious information, detailed results in tabular and graphical forms may be presented in Appendices. Representative data in table and figures may, however, be included in appropriate chapters.
- Figures and tables should be presented immediately following their first mention in the text. Short tables and figures (say, less than half the writing area of the page) should be presented within the text, while large table and figures may be presented on separate pages.
- Equations should form separate lines with appropriate paragraph separation above and below the equation line, with equation numbers flushed to the right.

- The discussion shall logically lead to inferences and conclusions as well as scope for possible further future work.

- **Summary and Conclusions**

This will be the final chapter of the thesis. A brief report of the work carried out shall form the first part of the Chapter. Conclusions derived from the logical analysis presented in the Results and Discussions Chapter shall be presented and clearly enumerated, each point stated separately. Scope for future work should be stated lucidly in the last part of the chapter.

- **Acknowledgements**

The acknowledgments by the candidate shall follow the citation of literature, signed by him/her, with date.

- **References (*Citations you referred in your study*)**

This should follow the Summary and Conclusions Chapter. The candidates shall follow the style of citation and style of listing in one of the standard journals in the subject area consistently throughout his/her thesis. However, the names of all the authors along with their initials and the full title of the article/monogram/book etc. have to be given in addition to the journals/publishers, volume, number, pages(s) and year of publication.

Citation from websites should include the names(s) of author(s) (including the initials), full title of the article, website reference and when last accessed. Reference to personal communications, similarly, shall include the author, title of the communication (if any) and date of receipt.

References are each numbered and ordered sequentially as they appear in the text, methods summary, tables, boxes, figure legends, online-only methods, extended data tables and extended data figure legends.

References are expressed either by a number in parenthesis or by Sir Name followed by Year of Publication such as [1], [2-5] or Burland (1990), Mir and Sridharan (2013), Sivakumar et al. (2004). Examples are:

Case-I: If References are expressed by a number in parenthesis in the text section such as:

For the past few decades, geosynthetics have successfully carved their way into Civil Engineering construction works. Their replacement of the conventional solutions has proved to be effective and economical [1-2].

The citations [1-2] are written in Reference as:

- [1]. Abdesssemmed M. Kenai S. and Bali A. (2015). Experimental and numerical analysis of the behavior of an airport pavement reinforced by geogrids. *Construction and Building Materials*, 94: 547–554.
- [2]. Dutta S., Padade A. H., Chaudhury N. N. and Mandal J. N. (2016). Design Charts for Flexible Airfield Pavement Based on Analytical Study. *Transportation Research Procedia*, 17(December 2014): 155–163.

Note: It may be noted that the title of a Journal or a Conference is written in Italic. However, the title of a Book, Ph.D. Thesis, M. Tech. Thesis, B. Tech Thesis and a Technical report is written in Italic.

Case-II: If References expressed by Sir Name followed by Year of Publication in the text section such as:

If single author is referred such as Burland (1990):

Burland J. B. (1990). On the compressibility and shear strength of natural soils. *Géotechnique* 40(3): 329-378.

If two authors are referred such as Mir and Sridharan (2013):

Mir B. A. and Sridharan A. (2013). Physical and compaction behaviour of clay soil-fly ash mixtures. *Journal of Geotechnical and geological Engineering*, 31(4): 1059-1072.

If more than Two authors are referred such as Sivakumar et al. (2004):

Sivakumar V., McKelvey D., Graham J. and Hughes D. (2004). Triaxial tests on model sand columns in clay. *Canadian Geotechnical Journal* 41: 299–312 (2004).

• **Appendix**

Detailed information, lengthy derivations, raw experimental observations etc. are to be presented in the separate appendices, which shall be numbered in Roman Capitals (e.g. “Appendix IV”). Since reference can be drawn to published/unpublished literature in the appendices these should precede the “References” section.

• **Publications by the candidate**

Articles, technical notes etc. on the topic of the thesis published by the candidate may be separately listed after the literature cited. This may also be included in the contents. The candidates may also include reprints of his/her publications after the literature citation.

THESIS FORMAT

1. Paper Quality

The thesis shall be printed/xeroxed on white bond paper, whiteness 95% or above, weight 70 gram or more per square meter.

2. Paper Size

The size of the paper shall be standard A 4; height 297 mm, width 210 mm.

3. Type Setting, Text Processing and Printing

The text shall be printed employing LaserJet printer, the text having been processed using a standard text processor. **The standard font shall be Times New Roman of 12 pts with 1.5 line spacing.**

4. Page Format

The Printed Sheets shall have the following written area and margins:

- Top Margin 15 mm, if header is used. When header is not used, the top margin shall be 30 mm.
- Left margin 25mm
- Right margin 20mm
- Bottom Margin 15 mm

- Footer 5 mm
- Foot Separation 10 mm
- Text Height 245 mm
- Text Width 160 mm

In case of double sided printing, for odd number page:

- Left Margin 30mm
- Right Margin 20 mm

In case of double sided printing, for even numbered page:

- Left Margin 20mm
- Right Margin 30mm

5. Pagination

Page numbering in the text of the thesis shall be Arabic/Hindu numerals at the center of the footer. But when the candidate opts for header style the page number shall appear at the right and left top corner for the odd and even number pages, respectively.

Page number “1” for the first page of the Introduction chapter shall not appear in print; only the second page will bear the number “2”.

The subsequent chapters shall begin on a fresh page (fresh odd number page in case of double sided printing). When header style is chosen the first page of each chapter will not have the header and the page number shall be printed at the center of the footer.

Pagination for pages before the Introduction chapter shall be in lower case Roman numerals, e.g., “i, ii, iii, iv”.

6. Header

When the header style is chosen, the header can have the Chapter number and Section number (e.g., Chapter 2, Section 3) on even numbered page headers and Chapter title or Section title on the odd numbered page header.

7. Paragraph format

Vertical space between paragraphs shall be about 1.5 line spacing. The first line of each paragraph should normally be indented by five characters or 12mm. A candidate may, however, choose not to indent if (s) he has provided sufficient paragraph separation.

A paragraph should normally comprise more than one line. A single line of a paragraph shall not be left at the top or bottom of a page (that is, no windows or orphans should be left). The word at the right end of the first line of a page or paragraph should, as far as possible, not be hyphenated.

8. Chapter and Section Format

- **Chapter**

Each chapter shall begin **on a fresh page** (odd number page in case of double sided printing) with **an additional top margin of about 75mm**. **Chapter number** (in Arabic/Hindu) and title shall be printed at the center of the page in 6mm (**font size: 18pt**) in bold face using both upper and lower case (all capitals or small capitals shall not be used). **A vertical gap of**

about 25mm shall be left between the Chapter number and Chapter title (font size: 14pt) lines and between chapter title line and the first paragraph.

- **Sections and Subsections (font size: 12pt)**

A chapter can be divided into Sections, Subsections and Sub-sub-Sections so as to present different concepts separately. Sections and subsections can be numbered using decimal points, e.g. 2.2 for the second section in Chapter 2 and 2.3.4 for the fourth Subsection in third Section of Chapter 2. Chapters, Sections and Subsections shall be included in the contents with page numbers flushed to the right. Further subsections need not be numbered or included in the contents.

The Section and Sub-Section titles along with their numbers in 5 and 4mm (16 and 14 pt) fonts, respectively, in bold face shall be flushed to the left (not centered) with 15 mm space above and below these lines.

In further subdivisions character size of 3 and 3.5 with bold face, small caps, all caps and italics may be used for the titles flushed left or centered. These shall not feature in the contents.

- **Table / Figure Format**

As far as possible tables and figures should be presented in portrait style. Small size table and figures (less than half of writing area of a page) should be incorporated within the text, while larger ones may be presented on separate pages. Table and figures shall be numbered chapter wise. For example, the fourth figure in chapter 5 will bear the number Fig. 5.4 or Fig 5.4.

Table number and title will be placed above the table while the figure number and caption will be located below the figure. Reference for Table and Figures reproduced from elsewhere shall be cited in the last and separate line in the table and figure caption, e.g. (after McGregor [12]).

9. Auxiliary Format

a. Binding

The evaluation copies of the thesis/dissertation/report may be spiral bound or soft bound. The final hard bound copies to be submitted after the viva-voce examination will be accepted during the submission of thesis/dissertation/report with the following colour specification:

1. Ph.D. Thesis: Maroon
2. M. Tech. Dissertation: Blue
3. B. Tech. Project Report: Black

- **Front Covers & Lettering**

The front covers shall contain the following details:

- **Full title of thesis in 18 point's size** font properly centered and positioned at the top.
- Full name of the candidate in **14 point's size** font properly centered at the middle of the page.

- A **40 mm dia. replica of the Institute emblem** followed by the name of department, name of the Institute and the year of submission, each in a separate line and properly centered and located at the bottom of page.
- Lettering-All lettering shall be **embossed** in Gold (background colour: Black for B. Tech; Blue for M. Tech and Maroon for Ph.D. only after approval from competent authority).

b. Bound back

The degree, the name of the candidate and the year of submission shall also be embossed on the bound (side) in gold.

c. Blank Sheets

In addition to the white sheets (binding requirement) two white sheets shall be put at the beginning and the end of the thesis.

d. Title Sheet

This shall be the first printed page of the thesis and shall contain the submission statement: the Thesis/Dissertation/project Report submitted in partial fulfillment of the requirements of the Degree, Ph.D./ M. Tech./ B. Tech., the name and Roll No. of the candidate, name(s) of the Supervisor and Co-supervisor(s) (if any), Department, Institute and year of submission. A Sample copy of the 'Title Sheet' is appended (**Specimen 'A'**).

e. Dedication Sheet (only for M. Tech. & Ph.D. Scholars)

If the candidate so desires(s) he may dedicate his/her thesis, which statement shall follow the title page. If included, this shall form the page 1 of the auxiliary sheets but shall not have a page number.

f. Approval Sheet

In the absence of a dedication sheet, this will form the first page and in that case shall not have a page number. Otherwise, this will bear the number two in Roman lower case "ii" at the center of the footer. The top line shall be:

1. **Thesis Approval** for Ph.D.
2. **Dissertation Approval** for M. Tech.
3. **Report Approval** for B. Tech. Projects, as the case may be.

The Approval Sheets are to be included only in the hard bound copies which are submitted after the successful Ph.D. viva voce examination. A sample copy of the Approval Sheet is appended (**Specimen `B'**)

g. Declaration

A declaration of Academic honesty and integrity is required to be included along with every thesis/dissertation/report after the approval sheet. The format of this declaration is given in **Specimen `C'** attached.

h. Abstract

The abstract shall highlight the important features of the thesis/dissertation/report and shall correspond to the electronic version to be submitted to the Library for inclusion in the website. The Abstract in the thesis, however, shall have two more parts, namely, the layout of the thesis giving a brief chapter-wise description of the work and the key words.

i. List of symbols and abbreviations

A complete and comprehensive list of all abbreviations, notations and nomenclature including Greek alphabets with subscripts and superscripts shall be provided after the list of tables and figures (As far as possible, generally accepted symbols and notation should be used).

Auxiliary page from dedication (if any) to abbreviations shall be numbered using Roman numerals in lower case, while the text starting from the Introduction shall be in Arabic/Hindu. (The first pages in the both the cases shall not bear a page number).

j. Acknowledgement

The Researcher should acknowledge the support received from various quarters during his/her research work in the form of “Acknowledgement”

k. Contents

The contents shall follow the Acknowledgement and shall enlist the titles of the chapters, section and subsection using decimal notation, as in the text, with corresponding page number against them, flushed to the right (**Specimen `D'**)

l. .List of Figures and Tables

Two separate lists of Figure captions and Table titles along with their numbers and corresponding page numbers against them shall follow the Contents.

NOTE: All the students are advised to complete Specimen `B' and Specimen `C' before submitting final dissertation copy to the Department and Supervisor

ORDER OF THESIS/REPORT CONTENTS

- 1. Title Sheet**
- 2. Dedication (only for M. Tech & Ph.D. Scholars)**
- 3. Approval Sheet**
- 4. Declaration**
- 5. Abstract**
- 6. List of symbols and abbreviations**
- 7. Acknowledgement**
- 8. Contents of the Project Report/Thesis/Dissertation**
- 9. List of figures**
- 10. List of Tables**

11. Appendix if any, shall be present at the end of the Project Report/Thesis/Dissertation after References

12. List of Publications

The tentative format of this order is given in Specimen `D' attached.

- NOTE:**
1. Further, all the research scholars/students may note that **no scanned data/table/figure** is allowed in the Thesis. Scanned figures should be edited properly with readable legend and axis titles.
 2. Furthermore, **figure captions** should be written below the figure as usual as text and not in the text box
 3. All the research scholars/students are advised to go through above guidelines carefully and prepare their dissertation/Thesis accordingly.

Specimen 'A': Title Sheet

[Title of Thesis (18 pt size)]

Submitted in partial fulfillment of the requirements
of the award of the degree of

**(Doctor of Philosophy/Master of Technology/
Bachelor of Technology)**

By

(Name of the Student)

(Roll No. _____)

Under Supervision of:

(Name of the Supervisor(s))



(Name of the Department/School/Interdisciplinary Programme)

NATIONAL INSTITUTE OF TECHNOLOGY SRINAGAR

(Year)

Specimen `B': Approval Sheet (font size: 14pt, however text below: 12pt)

This thesis/dissertation/report entitled (Title) by (Student's Name) under my guidance and supervision is approved for the degree of (Doctor of Philosophy/Master of Technology/ Bachelor of Technology). It is further certified that the work presented in this dissertation has not been submitted elsewhere for the award of the any degree.

Examiners

Supervisor (s)

Chairman/Head

Date : _____

Place : _____

Specimen `C' – Declaration (font size: 14pt, however text below: 12pt)

I hereby certify that the work which is being presented in the thesis entitled “_____” submitted by me (e.g. student) in partial fulfillment of the requirements for the award of the degree of M. Tech. (Geotechnical Engineering) submitted in the Department of Civil Engineering at National Institute of Technology Srinagar, J&K is an authentic record of my own work carried out during a period from July _____ to June _____ under the supervision of (**Supervisor’s name**), Deptt. of Civil Engg., NIT Srinagar. I declare that this written submission represents my ideas in my own words and where-in other’s ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. It is further certified that the work presented in this dissertation has not been submitted elsewhere for the award of the any degree.

(Roll No.)

(Signature & Name of the student)

Date: _____

Place: _____

This is to certify that the above statement made by the candidate is correct to the best of my/our knowledge

Signature of Supervisor

Signature of Co-Supervisor (if any)

The M. Tech Viva –Voce Examination of (Student’s name) has been held on _____ and accepted

Signature of External Examiner

Signature of H.O.D. (Civil Engineering Department)

Specimen 'A'
EXPERIMENTAL STUDY OF BEHAVIOR OF
GEOGRID REINFORCED
TWO LAYER FOUNDATION SYSTEM

A Dissertation

Submitted in Partial Fulfillment of the Requirements
for the Award of the Degree

of

MASTER OF TECHNOLOGY
IN
GEOTECHNICAL ENGINEERING

By

BASIT MAJID

Enroll No. GE 05/16

Under Supervision of

Prof. (Dr.) B. A. MIR



Department of Civil Engineering
NATIONAL INSTITUTE OF TECHNOLOGY
SRINAGAR

(2018)

Specimen 'D': CONTENTS

Note: Page numbering is tentative as an illustration. Actual page numbering depends on your data

Contents are also given tentatively and actual contents depends on your research work

<i>Dedication (only for M. Tech & Ph.D. Scholars)</i>	<i>ii</i>
<i>Approval Sheet</i>	<i>iii</i>
<i>Declaration</i>	<i>iv</i>
<i>Abstract</i>	<i>v</i>
<i>List of symbols and abbreviation</i>	<i>vi</i>
<i>Acknowledgement</i>	<i>viii</i>
<i>Contents</i>	<i>ix</i>
<i>List of Figures</i>	<i>xiii</i>
<i>List of Tables</i>	<i>xv</i>
Chapter-1: Introduction	1
1.1. General	1
1.2. Problem statement	3
1.3. Objectives of the study	3
1.4. Outline of the dissertation	4
Chapter-2: Literature Review	5
2.1. Introduction	5
2.2. Experimental Study	6
2.2.1. Footing on reinforced sandy soil	6
2.2.2. Footing on reinforced clayey soil	12
2.3. Bearing Capacity Failures in Homogeneous Soil	13

2.4. Experimental Study on Layered Soil	16
2.5. Analytical Study	19
2.5.1. Bearing capacity failures in reinforced soil	21
Chapter-3: Materials and Methodology	23
3.1. General	23
3.2. Materials Used	23
3.2.1. Soil	23
3.2.2. Geogrid	24
3.3. Method of Testing of Soils	25
3.3.1. Physical properties	25
3.3.1.1. <i>Specific gravity</i>	25
3.3.1.2. <i>Particle size distribution curve</i>	25
3.3.1.3 <i>Index properties/ Atterberg limits</i>	25
3.3.2. Engineering properties	26
3.3.2.1 <i>Compaction characteristics</i>	26
3.3.2.2 <i>Strength parameters</i>	26
3.4. Model Load Tests	27
Chapter-4: Results and Discussions	30
4.1. General	30
4.2. Geotechnical Characterization Results/ Properties	30
4.2.1. Physical properties	30
4.2.1.1 <i>Specific gravity</i>	30
4.2.1.2 <i>Particle size distribution</i>	30
4.2.1.3 <i>Index properties/ Atterberg limits</i>	32
4.2.2. Engineering properties	33

4.2.2.1	<i>Compaction characteristics of Bemina soil</i>	33
4.2.2.2	<i>Shear strength parameters of Bemina soil</i>	34
4.2.2.3	<i>Unconfined compression test</i>	35
4.3.	Discussion on Model Load Tests	40
4.3.1.	Effect of top layer thickness	40
4.3.2.	Effect of depth of top reinforcement layer	40
4.3.3.	Effect of Number of Reinforcement Layers	43
4.3.4.	Effect of vertical spacing of reinforcement layers	47
4.3.5.	Effect of width of reinforcement layers	47
4.3.5.	Effect of type of reinforcement	52
Chapter-5:	Conclusions and Future scope	54
5.1.	Conclusions	54
5.2.	Future scope	55
References		56
Appendix		60
List of Publication		65

Top margin: 15mm if header is used. When header is not used, the top margin: 30mm

[SAMPLE OF CHAPTER 1]

Additional margin between top margin & Chapter No. line: 75mm

Chapter 1 (18pt)

25mm

Introduction (14pt)

25mm

1.1. General (12pt)

Reinforced soil is a generic term that is applied to structures or systems constructed by placing reinforcing elements (e.g., steel strips, plastic grids, or geotextile sheets) in soil to provide improved tensile resistance. Reinforced soil structures are very cost-effective due to readily availability of the reinforcements which explains why the concept has emerged as one of the most exciting and innovative civil engineering technologies in recent times (Christopher et al. 1990). Reinforced soil foundations (RSFs) is one of the type which have been employed in engineering practice to increase the soil bearing capacity and to reduce the potential footing settlement. The concept of reinforced soil is based on the existence of tensile strength of reinforcement and soil-reinforcement interaction due to frictional, interlocking and adhesion properties. The reinforcing materials range from stiff metal to flexible geosynthetic materials and can be classified as either extensible reinforcements or inextensible reinforcements (McGown et al. 1978). The use of geosynthetic materials to improve the bearing capacity and settlement performance of shallow foundation has gained attention in the field of geotechnical engineering.

For the last three decades, several studies have been conducted based on the laboratory model and field tests, related to the beneficial effects of the geosynthetic materials, on the load bearing capacity of soils in the road pavements, shallow foundations, and slope stabilizations. The first systematic study to improve the bearing capacity of strip footing by using metallic strip was by Binquet and Lee (1975a,1975b). After Binquet and Lee's work, several studies have been conducted on the improvement of load bearing capacity of shallow foundations supported by sand

reinforced with various reinforcing materials such as geo-grids, geo-textile, fibers, metal strip, and geo-cell.

Nowadays use of geo-grid has increased due to its high tensile strength at low strain, open grid structure which causes bonding between geo-grid and foundation soil, long service life, light weight. High modulus polymer material like polyester and polyethylene can be used to manufacture the geo-grid. Geo-grid may be of two type i.e. bi-axial and uni-axial geo-grid depending upon the nature of manufacturing. The use of geo-grid could be particularly convenient when the mechanical characteristics of the soil beneath a foundation would suggest the designer in adopting an alternative solution, e.g. a deep foundation. Over the last decade, the use of geo-grids for soil reinforcement has increased greatly, primarily because geo-grids are dimensionally stable and combine features as high tensile modulus (low strain at high load), open grid structure, positive shear connection characteristics, light weight, and long service life. The open grid structure provides enhanced soil-reinforcement interaction (Albusoda and Hussein 2013). Providing the geo-grid in the foundation or pavement generally has three benefits:

- (i) It reduces the cost of construction material.
- (ii) Serviceability of the reinforced section is greater as compared to the unreinforced section.
- (iii) The shear stress reduces as we provide the geo-grid reinforcement due to increase in the internal angle of friction.

The bearing capacity of soil foundation system increases with the inclusion of reinforcing materials but there are other factors related to the configuration/layout of the system which affect the increase in the BCR like type of reinforcing materials, N (number of reinforcement layers), ratios of different parameters of reinforcing materials and foundations such as B (width of foundation), u/B (1st layer of reinforcement/width of foundation), h/B (the vertical spacing between consecutive reinforcement layers/width of foundation), b/B (the length of each reinforcement layer/ width of foundation), D/B (depth of foundation from ground level/width of foundation), type of soil, texture of soil, unit weight (or density) of soil etc.

Out of several studies, very few studies are available on the two-layer soils. Generally, all the studies are ultimately related to improvement in the bearing capacity of soil using reinforcing materials and related to the effect of various parameters on bearing capacity. The ratio of improvement in the bearing capacity can be expressed in a non-dimensional form as bearing capacity ratio (BCR) which is the ratio of bearing capacity of reinforced soil to bearing capacity of unreinforced soil. Geosynthetics have also been widely used as reinforcing materials in many

geotechnical engineering applications, such as mechanically stabilized earth (MSE) walls, slopes, embankments, pavements etc

1.2. Problem statement

Due to the scarcity of suitable construction sites, it has become necessary to construct on soil masses that were considered unsuitable for construction earlier. It is a risk to construct over such soils due to high compressibility, uneven settlement and low bearing capacity. Several types of ground improvement techniques involving stabilizing or reinforcing the soil are used to increase the bearing capacity and make these type of soils suitable for construction. Among the various techniques available for ground improvement, soil reinforcing has been emphasized by many researchers as an effective method. Historically, mankind has been using reinforcing techniques for a long time by making clay walls reinforced with bamboo or reed, but in the recent decades, geosynthetics have been adopted by engineers of the world as a soil reinforcing technique due to their ease of construction and cost efficiency. In the present study, the load settlement behavior of soft soil underlying a stiff soil is studied. This is the actual field condition which is simulated in the laboratory in the best possible way. The top soil is reinforced with geogrid and the improvement in the bearing capacity is evaluated. The improvement in bearing capacity is reported in terms bearing capacity ratio (BCR).

1.3. Objectives of the study

The main objective of the present work is to study the bearing capacity of two layer soil system reinforced with geogrids. The Detailed project work can be summarized as:

1. To determine the engineering properties of samples obtained at different depth.
2. To determine the bearing capacity of two layer soil system.
3. To determine the bearing capacity of two layer soil system with reinforcement in top layer.
4. To study the performance of footings for the different position of geo-grid layers.
5. To study the effect of various parameters on the bearing capacity of the two layer soil system.

1.4. Outline of the Dissertation

This dissertation is divided into five chapters. The following is a brief summary of the contents in each chapter.

Chapter 1: presents discussion about the foundation, problem-related to weak soil and soil reinforcement. Also, objectives and a brief description of work carried out have been discussed.

- Chapter 2: presents an extensive literature review related to experimental study, analytical study, and numerical analysis of reinforced soil foundation.
- Chapter 3: describes the materials used in this study and the experimental testing programs for model load tests.
- Chapter 4: presents full details of test results and discussion. The comparison of the results of this experimental study to the results of previous studies by different researchers is also provided in this chapter.
- Chapter 5: summarizes and concludes this research work and provides some suggestions for future research.

Note: Carefully check how to write citations/references in Reference section. For example, citations in Chapter-1 are given below (in alphabetical order):

References

Albusoda B. S. and Hussein R. S. (2013). Bearing capacity of Eccentricall loaded square foundation on compacted reinforced dune sand over gypseous soil. *Journal of Earth science and Geotechnical Engineering*, Vol 3, No. 4, pp 47-62.

Binquet J. and Lee K. L. (1975a). Bearing capacity tests on reinforced earth slabs. *Journal of Geotechnical Engineering Division*, ASCE, Vol. 101, No. 12, pp. 1241-1255.

Binquet J. and Lee K. L. (1975b). Bearing capacity analysis on reinforced earth slabs. *Journal of Geotechnical Engineering Division*, ASCE, Vol. 101, No. 12, pp. 1257-1276.

Christopher B. R., Gill S. A., Giroud J. P. and Juran I. (1990). Reinforced soil structures design and construction guidelines. Report No. FHWA-RO-89-043 PB91-1 912 69, Office of Engineering and Highway Operations, R&D Final Report Federal Highway Administration 6300 Georgetown Pike McLean, Virginia 22101-2296, USA.

McGown A. (1978). Effect of inclusion properties on the behavior of sand. *Geotechnique*, Vol 28, No. 3, pp 327-346.
