Graduate Program Review
Texas Tech University

Program Reviewed:  Department of Civil and Environmental Engineering

Onsite Review Date:  28 April 2015

Name of Reviewers

Internal:

- Kent Pearce, Professor and Department Chair, Department of Mathematics and Statistics, Texas Tech University, Lubbock, TX 79409
- James Yang, Associate Professor and Associate Department Chair, Department of Mechanical Engineering, Texas Tech University, Lubbock, TX 79409
- C Villalobos, Associate Professor, Department of Natural Resources Management, Texas Tech University, Lubbock, TX 79409

External:

- Neeraj Buch, Professor and Chairperson, Department of Civil and Environmental Engineering Michigan State University, East Lansing, MI 48824
- Shannon Bartelt-Hunt, Associate Professor, Department of Civil Engineering, University of Nebraska- Lincoln, NE 68588.

I. Academic Unit Description and Strategic Plan

Please evaluate the following by marking an X in one of the blanks for each item:

**Vision, Mission and Goals**

- X Excellent
- X Very Good
- Good
- Needs Improvement

**Strategic Plan**

- Excellent
- X Very Good
- Good
- Needs Improvement

Please comment on the positive components and suggested areas of improvement.

The department’s aspirational goal is to move into the top 50 programs in the nation. Based on the data provided in the self-study the department plans to grow the faculty size to 33, grow the research expenditure to $6 million/year and increase the PHD enrollment to 66. The department has a goal of increasing the faculty research expenditures to $180,000/year and research publications between 40-60/year.

Based on the meetings and review of faculty CVs it is clear that the quality of research and teaching is very good. The student morale is high and the students expressed satisfaction with their graduate experience at Texas Tech University. The strategic targets are achievable provided the department implements the recommendations stated in item VI of this report.
The goal of the department with respect to graduate education is to be ranked within the top 50 programs nationally. At a current ranking of 68 and because many CEE programs across the nations are also trying to achieve this same goal, their goal is a stretch goal, but it is realistic. Other stated goals for the graduate program are to grow the faculty to 33 T/TT faculty; $6 million in annual research expenditures; 66 PhD students and 100 refereed publications per year. Based on data provided, reaching these goals involves the addition of 4-5 faculty lines; increasing faculty research expenditures to $180,000 per year, increasing PhD students by approximately 30; and increasing publications by between 40-60 publications per year.

The strengths of the department lie in the quality of the existing faculty and students. After meeting with the faculty and reviewing their CVs, it is clear that the faculty are research active while maintaining a high level of instructional quality and service activities. The quality of the existing graduate student population appears to be very good, and the students we met (approximately 20 students from across the department) were engaged and generally very satisfied with their graduate experience. This is a significant strength of the department and the faculty members in the Department should be commended for their efforts in graduate student training and retention.

Despite these very positive components, the Department faces some challenges in meeting their strategic goals. These challenges will be described in more detail below, but in summary they include:

- The lack of a permanent chair, which has led to a slowing of faculty hiring in the department.
- A lack of teaching FTE, especially in the areas of structural engineering, water resources, transportation and geotechnical engineering. Due to a lack of teaching FTE and constraints on maximum class size, the faculty are unable to offer elective graduate courses on the schedule needed to maintain a vibrant and effective graduate program, especially at the PhD level.
- The need to renovate existing laboratory spaces for both graduate teaching and research
- The reliance on center funding for key staff positions such as lab technicians and grant management staff.
- The need to develop endowed funds to support graduate student fellowships

Hindrances for meeting strategic departmental goals include:

- The lack of commitment to hiring a permanent chair – thus, impeding the hiring of new faculty to fill vacancies
- The lack of available faculty is resulting in delayed course delivery of required doctoral curriculum courses
- The lack of teaching FTE and the lack of available faculty is resulting in teaching overloads for existing faculty – thus, constraining faculty time away from research

II. Program Curriculum

Please evaluate the following by marking an X in one of the blanks for each item:

Alignment of program with stated program and institutional goals and purposes

___ Excellent ___ X Very Good ___ Good ___ Needs Improvement

Curriculum development coordination and delivery
Program learning outcomes assessment

___ Excellent ___ Very Good ___ X _ Good ___ Needs Improvement

Program curriculum compared to peer programs

___ X Excellent ___ Very Good ___ Good ___ Needs Improvement

Please comment on the positive components and suggested areas of improvement.
Given the shortage of FTEs, the department has hired multiple instructors to meet the teaching demands of the undergraduate curriculum, however, the resources are approved on an annual basis and therefore the long term sustainability of the teaching resource is not guaranteed. It is recommended that the college provide funds to the department for multiple years to hire the instructors. These instructors will free up time for the tenure stream faculty to focus their attention on graduate courses and research.

The department offers MS and PhD degrees in Civil Engineering with specializations in environmental, geotechnical, structural, transportation and water resources engineering. The department also offers a 5 year BS/MS in environmental engineering. The department has recently merged with construction management and offers a certificate program in construction management, with discussions of expanding this to offer MS and PhD degrees as well. The curriculum plans provided by the department are consistent with other CEE departments across the country. There are no concerns with the curriculum, other than the need to offer more of the upper level MS/PhD courses that are on the books, but are not regularly offered due to constrains with teaching FTE and the need to deliver the undergraduate courses. The department teaches many undergraduate courses that are utilized as service courses by other departments, notably petroleum engineering and industrial engineering. The cap set by the college for 49 students per section imposes a limitation that requires faculty to teach more sections of these undergraduate courses, which limits their ability to offer graduate courses. The faculty in the department are largely already teaching an overload of 2 classes per semester, when the stated department goal is 2:1 for tenured research active faculty. Hiring new T/TT faculty will help in the long term, but because untenured faculty are only required to teach 1:1, the teaching relief that can be realized from hiring new faculty is 5+ years in the future.

To cover their undergraduate teaching requirements and allow T/TT faculty to teach the core graduate courses, the department has hired a set of instructors that teach approximately 4 courses per semester per instructor. The faculty expressed that there is uncertainty in their ability to hire these instructors as they don’t always have information on when the funds will be available until very close to the start of the fall semester. Also, the funds for these instructors are coming from unfilled T/TT faculty lines, and when those lines are filled, the funds for instructors will not be available, but the newly hired untenured faculty will not be able to fill the teaching duties of the instructors. We recommend that the college allow the department to hire instructors on a multiple-year basis (2 year rolling contract, at a minimum) to provide some ability for the department to plan ahead for the next academic year. These instructors teach a significant number of undergraduate courses and are critical to the department’s ability to successfully deliver their graduate curriculum. In addition, the addition of new T/TT lines
will also allow the department to offer more elective graduate courses on a more regular basis, which was cited by the students as being one limitation of their current graduate program.

-----------

The college-mandated cap of 49 students per section for all courses (including service courses such as statics, solids, dynamics and fluids – where effective instruction could be pedagogically realized and implemented in larger forums) is adversely impacting the ability of faculty to offer regular, consistent rotation of advanced graduate courses in which are prescribed in the doctoral program outlines.

III. Faculty Productivity

Please evaluate the following by marking an X in one of the blanks for each item:

Qualifications
___ Excellent ___ Very Good ___ Good ___ Needs Improvement

Publications
___ Excellent ___ Very Good ___ Good ___ Needs Improvement

Teaching Load
___ Excellent ___ Very Good ___ Good ___X Needs Improvement

External Grants
___ Excellent ___ Very Good ___ Good ___ Needs Improvement

Teaching Evaluations
___ Excellent ___ Very Good ___ Good ___ Needs Improvement

Professional Service
___ Excellent ___ Very Good ___ Good ___ Needs Improvement

Community Service
___ Excellent ___ Very Good ___ Good ___ Needs Improvement

Please comment on the positive components and suggested areas of improvement.

The faculty are actively engaged in all the three missions of the university-teaching, research and service. According to the self-study the faculty in the CEE department have a higher (2012 and 2013) average teaching load than the college average. This load needs to be reduced. This overload will adversely impact the research productivity of the faculty and meeting the stated goals of research expenditures, graduate students and journal articles.

-----------
In general, the faculty in the department are excellent and are involved actively in research, teaching and service. The review of graduate course evaluations indicates a high level of instruction and graduate student satisfaction with courses in the department, which speaks well of the faculty. Students also expressed strong opinions in our meeting that faculty are very engaged in graduate student mentoring. The teaching load of the faculty as rated as ‘needs improvement’ as many research active tenured faculty are teaching 2 courses per semester, when the departments stated goal is a teaching load of 3 courses per year. This teaching overload will negatively impact the faculty’s ability to conduct research, write peer-reviewed publications and submit additional grant applications. These research activities are necessary to meet the department’s stated goals of 100 peer reviewed publications, $6 million in extramural research funding and 66 PhD students.

IV. Students and Graduates

Please evaluate the following by marking an X in one of the blanks for each item:

**Time to degree**

__x_ Excellent     __x_ Very Good     ___ Good     ___ Needs Improvement

**Retention**

___ Excellent     __x_ Very Good     __x_ Good     ___ Needs Improvement

**Graduate rates**

___ Excellent     __x_ Very Good     ___ Good     ___ Needs Improvement

**Enrollment**

___ Excellent     ___ Very Good     __x_ Good     ___ Needs Improvement

**Demographics**

___ Excellent     __x_ Very Good     ___ Good     ___ Needs Improvement

**Number of degrees conferred annually**

___ Excellent     __x_ Very Good     ___ Good     ___ Needs Improvement

**Support Services**

__x_ Excellent     ___ Very Good     ___ Good     ___ Needs Improvement

**Job Placement**

___ Excellent     __x_ Very Good     ___ Good     ___ Needs Improvement

**Student/ Faculty Ratio**

___ Excellent     __x_ Very Good     ___ Good     ___ Needs Improvement

Please comment on the positive components and suggested areas of improvement

The self-study did not provide quantitative data on graduate rates and retention. However these issues were raised during the face to face meetings with the faculty and graduate students and no concerns were raised.
fact several faculty were singled out for their interest in graduate student success and the excellent mentoring they are providing the graduate students.

The growth of the graduate program may be hampered by the college required minimum stipend of $27,500/year with additional funding required for tuition. With decreasing funding levels across agencies, budgeting more than one student on proposals will become a challenge in the future. It is recommended that different stipend levels be considered for MS and PhD students to increase the number of PhD students in the department.

The time to achieve the degree for the MS and PhD in Civil Engineering are appropriate at <2 years and <5 years, respectively. The reported time to achieve the MS in Environmental Engineering is <1 year, but that number is cited as being erroneous. It appears as though the MS ENVE student achieve their degree in approximately 1 year, which is the planned time frame.

Quantitative data on retention of graduate students was not provided, but no graduate students expressed concerns regarding retention during the meeting, and the department maintains graduate advisors to assist non-thesis students. Thesis MS students and PhD students appear to be well-mentored by their graduate advisors. There are no concerns with retention.

No data was provided on graduation rates, however, because there are no concerns with retention or time to degree, it is assumed that graduation rates for the CEE graduate programs are high. Approximately 38 students graduated in 2013 between CIVE and ENVE graduate programs in the department.

In order to maintain current graduate student levels and achieve growth in the graduate program, the department needs to enroll more graduate students. Current data indicates that the department is moderately selective, admitting approximately 2/3 of the applicants to the program, however less than half of the admitted students are enrolling in courses as new graduate students. It appears as though a significant number of students are selecting another university for their graduate degree. Currently, the number of new admissions is not meeting the number of graduating students, indicating that the graduate program will shrink instead of grow. One concern that was identified during the external visit was the college minimum required stipend of $27,500 per year with additional funding required for tuition remission. With the university overhead rate of 49%, this makes the cost of a single graduate student to be approximately $60-65K per year. With funding levels capped (for example, in the environmental engineering program at NSF, annual grant amounts are capped at $110K), this makes hiring more than 1 student per year a challenge as the grant cannot support the student(s) in addition to materials and supplies and faculty summer salary. Based on the data provided in the self-study report, there seems to be a decreasing trend, or possibly a leveling off of new graduate students from 2011 through the present, despite generally consistent external funding during this period. The department needs to enroll more graduate students to meet their stated growth goals with a focus on both MS and PhD students. Some recommendations to achieve this include:

- Submission of more extramural proposals. Currently, the department submits approximately 2.5 proposals per T/TT faculty member. The number of extramural proposals submitted should be increased to the extent possible (3-5 per year).
• Recruitment of 150 hr MS students. The faculty in the department indicated that they have just developed curriculum for a 150 hr MS program in CIVE, similar to the existing ENVE BS/MS program. Advertising and recruiting for this program will allow them to retain their own undergraduates for a 1 year MS degree. Increasing the number of MS student is important to provide a student cohort for graduate courses and to increase overall graduate student enrollment.

• Increased emphasis on graduate student recruitment. The department did not appear to have a comprehensive recruitment plan. They face some challenges in keeping their own students as their own undergraduates are recruited by other state schools such as UT and A&M. However, TTU can develop their own set of feeder schools by looking at other four-year colleges within the state or region. They are clearly already doing a very good job with recruiting and retaining students without undergraduate CIVE degrees as a number of the students we spoke with during the meeting did not have an undergraduate engineering degree. The department should identify feeder schools and recruit from those schools to help ensure a consistent pool of applicants and continue their high level of support for students who need to take leveling classes prior to enrolling in graduate engineering courses.

• Development of $1,000 graduate scholarships. The department indicated that in the past, they could offer MS students a $1,000 scholarship, which would then allow them to pay in state tuition, which was a significant recruiting advantage. The department should engage in fundraising to create an endowed fund to allow them to offer these recruitment fellowships for MS students. Focusing on MS students as well as PhD students will allow them to increase their overall graduate student numbers. In addition, good quality MS students can serve as a pool of potential PhD students.

• Timing of GTA funding. The department expressed concerns that decisions regarding GTA funding from the college were not often made until very late in the summer, which does not allow them to recruit new graduate students as GTAs. Instead, they can only select GTAs from their existing student pool. The college should provide information on GTA funding as early as possible (January) so that the department can compete to recruit students in the March/April timeframe when other universities are making funding offers.

• Development of PhD fellowships. The department currently has no sources of fellowship funding for top PhD applicants. This should be developed to allow the department to recruit top students to TTU without the reliance on grant funding or GTA funding.

The gender demographics in the department are approximately 20% female in the CIVE graduate programs and approximately 50% female in the ENVE MS program. The CIVE graduate program is approximately 50% international students, and 50% domestic students with relatively few Black, Hispanic or Asian domestic students. The mix of international and domestic students is largely comparable to similar institutions. The department can work to improve gender and ethnic diversity in the department, although I find their current demographics to be similar to that of their peer institutions.

The department is conferring approximately 30-40 graduate degrees per year between CIVE and ENVE graduate programs. This is a very good number of degrees and is consistent with peer institutions to the best of my knowledge. As the graduate student population grows, this number will also rise.

Graduate students indicated that they felt very supported by staff within the department. This was expressed as a particular strength of the department, both in terms of administrative staff and research technician support. They also expressed that the college and university have sufficient resources on career development, teaching and other academic resources.
Based on the list of former students and their employers, there seem to be no issues with job placement after graduation.

The student to faculty ratio of 3.8:1 (84 graduate students to 22 faculty) in 2013 appears to be very good. Students appear to receive very good mentoring and advising based on the meeting with students. The student to faculty ratio may need to increase slightly to meet stated departmental goals (100 PhD students + 50 MS to 34 faculty). This would increase the ratio to 4 to 5 students: 1 faculty member.

---------

Interviewed students indicated:

- Variety of support from department and faculty for transferring students coming in from non-CEE background
- Need for more electives to be offered
- Concern about the availability of funding resources for student travel to and participation at conferences
- Classes in CEE not always available
- Seminars exist for some of the sub-disciplines (WR) but not for all of the sub-disciplines

V. Facilities and Resources

Please evaluate the following by marking an X in one of the blanks for each item:

**Facilities**

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Very Good</th>
<th>Good</th>
<th>Needs Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>___</td>
<td>___</td>
<td>___X</td>
<td></td>
</tr>
</tbody>
</table>

**Facility Support Resources**

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Very Good</th>
<th>Good</th>
<th>Needs Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>___</td>
<td>___</td>
<td>___X</td>
<td></td>
</tr>
</tbody>
</table>

**Financial Resources**

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Very Good</th>
<th>Good</th>
<th>Needs Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>___</td>
<td>___</td>
<td>___X</td>
<td></td>
</tr>
</tbody>
</table>

**Staff Resources**

<table>
<thead>
<tr>
<th>Excellent</th>
<th>Very Good</th>
<th>Good</th>
<th>Needs Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>___</td>
<td>___</td>
<td>___X</td>
<td></td>
</tr>
</tbody>
</table>

Please comment on the positive components and suggested areas of improvement

Based on the tour it was evident that there is adequate teaching laboratory space, however, the available space needs upgrading and repurposing to make it more usable. The lack of adequate storage space was brought up both for the environmental and civil engineering laboratories. Given that most of the laboratories are located in the basement it was noted that transporting material in and out the laboratory is challenging. The laboratory equipment also needs upgrades. The challenge is the funding source for this upgrade. One source of funding could be the engineering fee and make the equipment available for undergraduate and graduate teaching laboratories.
The laboratory technicians were very willing to work with the graduate students and appeared to be very knowledgably about the equipment and instrumentation needed for both teaching and research.

The department has adequate space in terms of square footage of laboratories. Unfortunately much of the laboratory space is in need of major renovations to continue to be functional. The addition of lab spaces being renovated for Dr. Reible will partially help the environmental and water resources faculty, but facilities for the structures, geotechnical and transportation faculty as well as the existing environmental engineering and water resources labs need to be updated. Issues observed in the environmental/water resources labs included: a lack of storage space, which can lead to safety concerns, very old benchtops, insufficient bench space and sample prep spaces and fume hoods in need of replacement. On the ‘dry side’ (structures, geotechnical and transportation), many of these same issues appeared to exist.

The technicians in the department are excellent and showed a strong desire to support graduate and undergraduate education. They were also very cognizant of laboratory safety issues and are proactive about ensuring a safe laboratory environment. They had a very positive attitude and are essential to the research productivity of the department. One concern related to this is that the water resources lab technician is funded from the water resources center, and if that funding source is not available, the department would need to pick up this salary. The insecurity of this funding situation is the reason staff resources are marked as very good instead of excellent.

There appear to be adequate spaces for graduate student offices and computers are provided to all students.

Another concern is the lack of funds available to replace equipment for either graduate teaching or research. The only current source of funding for equipment appears to be faculty start-up and research grants. It is very difficult if not impossible to request significant resources for routinely-used equipment on extramurally funded grants. Routinely-used equipment is also very hard to secure via external equipment funding mechanisms like the NSF MRI program. The department and college are encouraged to identify funding sources for routine equipment upgrades for graduate research and education. Some of this equipment can also be used for undergraduate education, which may open up alternative funding options within the university or college.

The computing equipment in the laboratory spaces is dated – some using OS systems which are two generations out of usage/support

VI. Overall Ranking

Please provide summative conclusions based on the overall review.

The attitude of the faculty, students and staff was very upbeat and are trying their best to meet the goals laid out by the college and the university administration. The faculty ratings in all three missions of the university range from very good to excellent and they need to be commended for that.

One of the stated goals is to improve the department’s ranking. This is a laudable goal however, this can only happen if (i) teaching and research laboratory is upgraded and renovated; (ii) the funding stream to support graduate
students and adjunct faculty are made available earlier in the year for better planning purposes; (iii) the open tenure stream positions are filled in the short-term.

Overall, I found that the CEE department at TTU is on the right track with respect to both graduate education and research. The goals to grow the department in terms of faculty, external dollars and students are credible. The faculty are productive in all areas of research, teaching and service and the greatest resource in the department is their excellent graduate student population. The main threats the department currently faces in expanding their graduate program and improving the quality of the program are the limitations in graduate course delivery due to course size limitations and pressures to offer undergraduate service courses to other departments; the lack of certainty associated with having an interim chair and the slow pace of faculty hiring; and the need to upgrade laboratory facilities for graduate education and research.

Please provide summative recommendations based on the overall review.

Based on the on-site visit and meetings with the various constituents the following recommendations are offered:

1. A permanent chairperson for the department should be selected as soon as possible.
2. Need to fill in the seven open tenure-stream positions to grow the research program, reduce the frequency of the offerings of graduate courses and assist with the growing undergraduate program.
3. The 49 student/section enrollment cap needs to be raised to reduce the number of sections for high enrollment courses (such as statics, solids, dynamics and fluids). This change will free up faculty time to engage in research and advising graduate students.
4. Investments need to be made in upgrading laboratory space. This can lead to more usable teaching space.
5. Resources available to support teaching assistants and adjuncts need to be made available in the year. The earlier timeline will assist in recruitment of graduate students and staffing of courses with adjuncts.
6. Recruit more students into the 150 credit hour MS program.
7. A college centric assistance with proposal processing and budget development will make the college even more competitive. The dependence on center resources is not a sustainable strategy.

1. Submission of more extramural proposals. Currently, the department submits approximately 2.5 proposals per T/TT faculty member. The number of extramural proposals should be increased to the extent possible (3-5 per year).
2. Recruitment of 150 hr MS students. The faculty in the department indicated that they have just developed curriculum for a 150 hr MS program in CIVE, similar to the existing ENVE BS/MS program. Advertising and recruiting for this program will allow them to retain their own undergraduates for a 1 year MS degree. Increasing the number of MS student is important to provide a student cohort for graduate courses and to increase overall graduate student enrollment.
3. Increased emphasis on graduate student recruitment. The department did not appear to have a comprehensive graduate recruitment plan. They face some challenges in keeping their own undergraduates as they are recruited by other state schools such as UT and A&M. However, TTU can develop their own set of feeder schools by looking at other four-year colleges within the state or region. They are clearly already doing a very good job with recruiting and retaining students without undergraduate CIVE degrees as a number of the students we spoke with during the meeting did not have an undergraduate engineering degree. The department should identify feeder schools and recruit from those schools to help ensure a consistently high quality pool of applicants and continue their high level of support for students who need to take leveling classes prior to enrolling in graduate engineering courses.

4. Development of $1,000 graduate scholarships. The department indicated that in the past, they could offer MS students a $1,000 scholarship, which would then allow them to pay instate tuition. The department should work to create an endowed fund to allow them to offer these recruitment fellowships for MS students.

5. Timing of GTA funding. The department expressed concerns that decisions regarding GTA funding were not often made until very late in the summer, which does not allow them to recruit graduate students as GTAs. Instead, they can only select GTAs from their existing student pool. The college should provide information on GTA funding as early as possible (January) so that the department can compete to recruit students in the March/April timeframe.

6. Development of PhD fellowships. The department currently has no sources of fellowship funding for top PhD applicants. This should be developed to allow the department to recruit top students to TTU without the reliance on grant funding or GTA funding.

----------

The college-mandated uniform expectation that every supported graduate student appointment be at the level of $27,500 for 12 months (both for MS students and PhD students) is hindering the department’s ability to grow its doctoral program – given fixed resources which the department has for graduate student support. The (optimal) professional degree for some of the CEE sub-disciplines is an MS degree. Having the flexibility to offer separate MS stipends and PhD stipends would allow the CEE to attract/support sufficient students for the critical masses which are needed in the MS professional programs and to release funds (tied up with supporting students in the MS professional programs) for attracting additional PhD students.