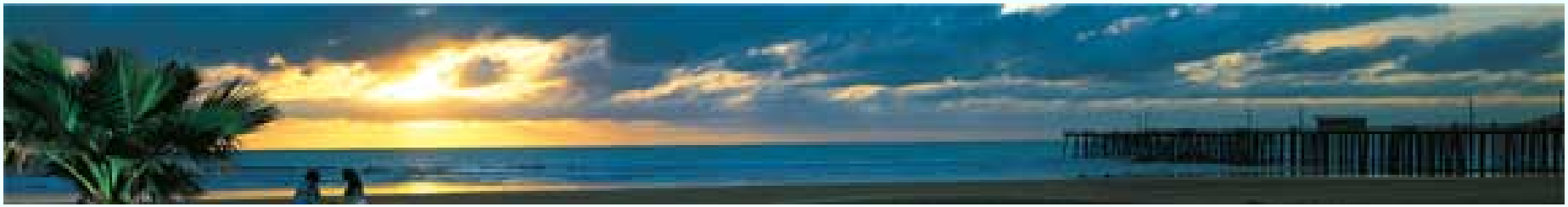
# SEAOSC Dinner

## June 4, 2008

# Cal Poly Architectural Engineering Program


**Allen C. Estes**

**Professor and Head**

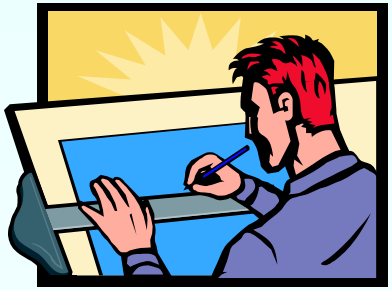



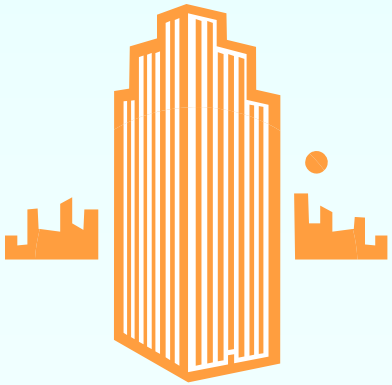
# The faculty sends their greetings

# Department Head

# ARCE Program

- Only 17 accredited Architectural Engineering programs in the country
- What is Architectural Engineering?
- Cal Poly has intense emphasis on building structures
- Located in College of Architecture and Environmental Design

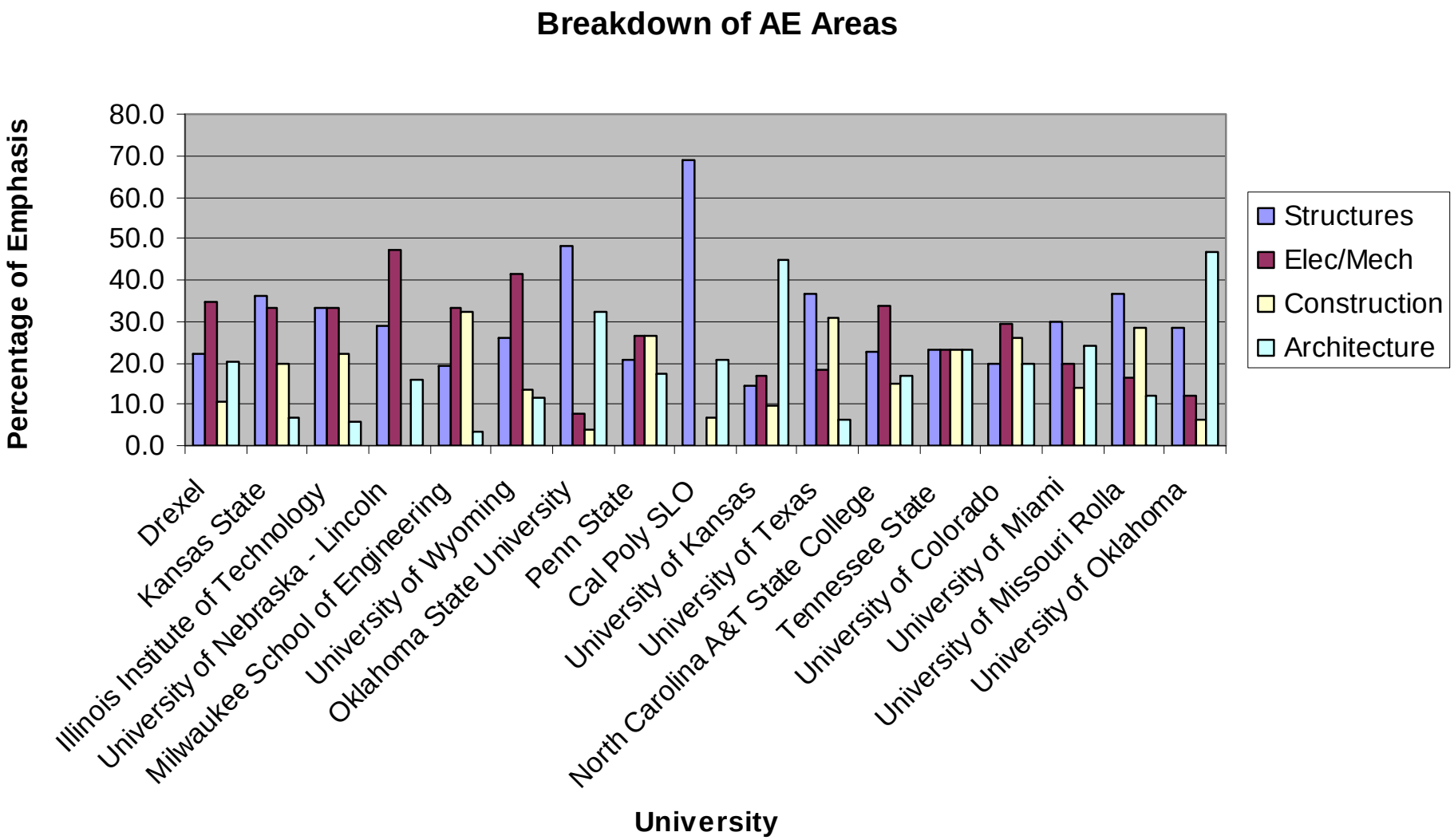




# AE Programs

| University | Length (Years) | Semester or Quarter | Credit Hours | Equiv.Sem. Hours |
|---|---|---|---|---|
| Drexel | 5 | Quarter | 200 | 133 |
| Kansas State | 5 | Semester | 158 | 158 |
| Illinois Institute of Technology | 4 | Semester | 136 | 136 |
| University of Nebraska | 4 | Semester | 126 | 126 |
| Milwaukee School of Engineering | 4 | Quarter | 197 | 131 |
| University of Wyoming | 4 | Semester | 132 | 132 |
| Oklahoma State University | 5 | Semester | 160 | 160 |
| Penn State | 5 | Semester | 160 | 160 |
| Cal Poly SLO | 4 | Quarter | 203 | 135 |
| University of Kansas | 5 | Semester | 165 | 165 |
| University of Texas | 4 | Semester | 126 | 126 |
| North Carolina A&T State College | 4 | Semester | 128 | 128 |
| Tennessee State | 4 | Semester | 126 | 126 |
| University of Colorado | 4 | Semester | 128 | 128 |
| University of Miami | 4 | Semester | 129 | 129 |
| University of Missouri Rolla | 4 | Semester | 128 | 128 |
| University of Oklahoma | 4 | Semester | 128 | 128 |

# AE Topics


Breakdown of AE Areas
Percentage of Emphasis
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Structures
Elec/Mech
Construction
Architecture
Drexel
Kansas State
Illinois Institute of Technology
University of Nebraska - Lincoln
Milwaukee School of Engineering
University of Wyoming
Oklahoma State University
Penn State
Cal Poly SLO
University of Kansas
University of Texas
North Carolina A&T State College
Tennessee State
University of Colorado
University of Miami
University of Missouri Rolla
University of Oklahoma
University

# Agenda

- What makes us special?
- Major curriculum assessment
  - The future of engineering education
  - Constraints imposed from outside sources
  - Current ARCE curriculum
  - Some areas for change

# What makes us special?

- High quality students

# What makes us special?

- Focus on Undergraduates
- Emphasis on teaching

# What makes us special?

- Small classes
- Student-Faculty Interaction

# What makes us special?

- Dual track faculty
  - Researcher
  - Practitioner

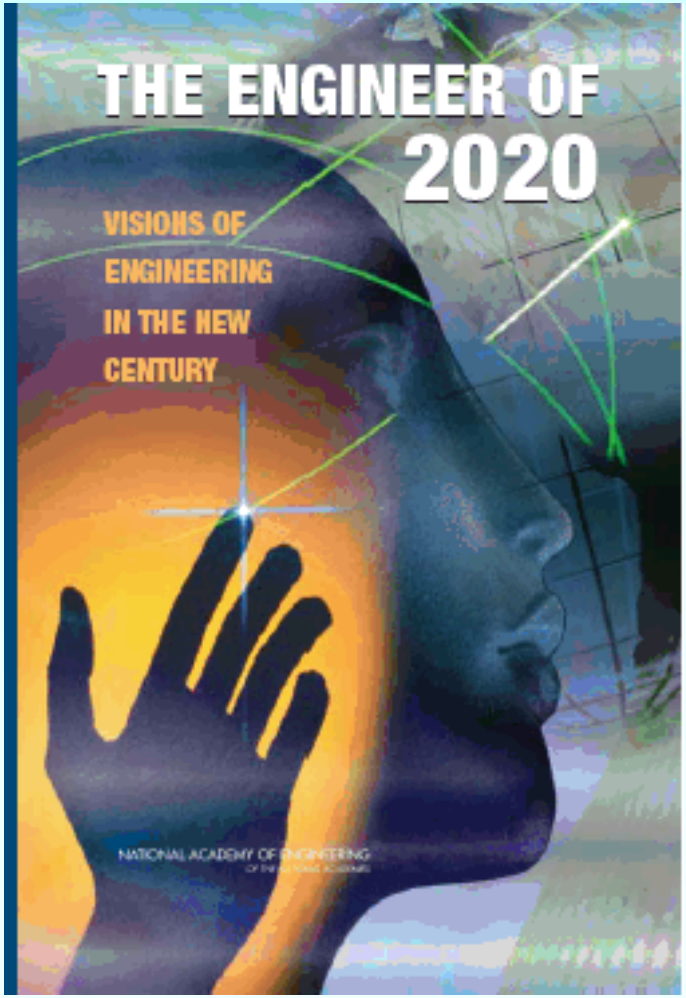
# What makes us special?

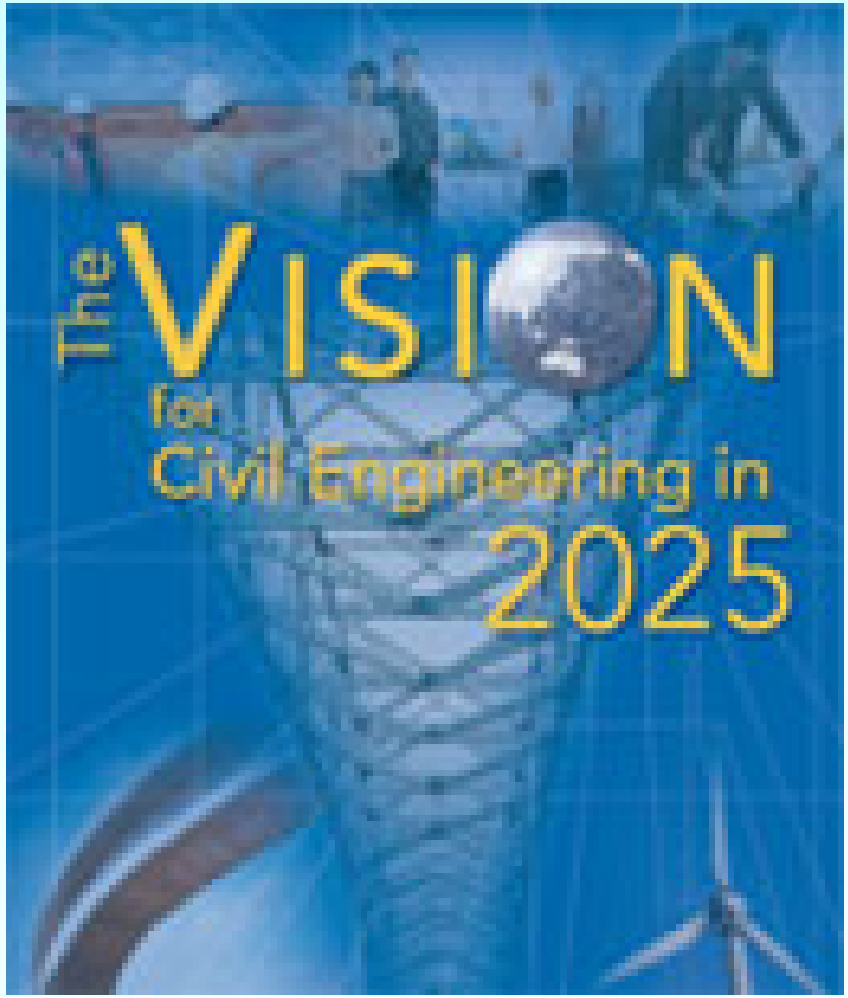
- Practical hands-on approach
- Real world emphasis

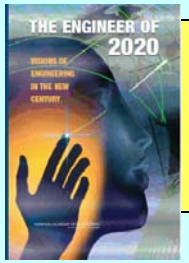
# What makes us special?

- Partnership with industry
- Most intense undergraduate structures program in the country

# What does the future look like?

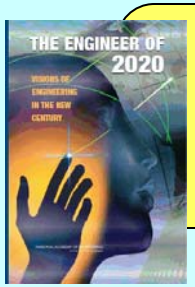





# Engineer of 2020

- Technological problems will be interconnected and interdisciplinary
- Technology and engineering knowledge will grow most in the areas of bioengineering, biotechnology, nanotechnology, information technology, and large scale systems integration
- Engineers need a stronger sense of how technology and public policy interact
- Engineers need a larger role in political decision making
- Attributes of an engineers are strong analytical skills, practical ingenuity, creativity, communication skills, business and management skills, leadership abilities, and high ethical standards
- Engineers must be dynamic, flexible, agile, able to learn new concepts
- Continue to learn over a lifetime

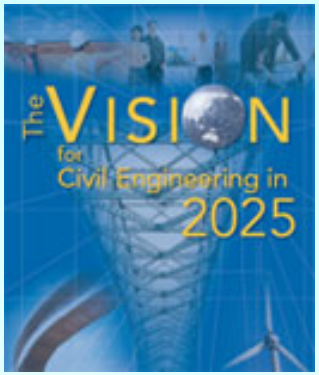



# Engineer of 2020: Implications for Education

- Integrate math and science with engineering; teach engineering early
- Minimize required number of core courses
- Feature electives in non-technical subjects
- Define breadth in terms of thought processes that facilitate learning how to learn
- Move from a sequential to a holistic curriculum
- Recognize that fundamental courses may change as technology evolves
- Four year undergraduate engineering degree is insufficient

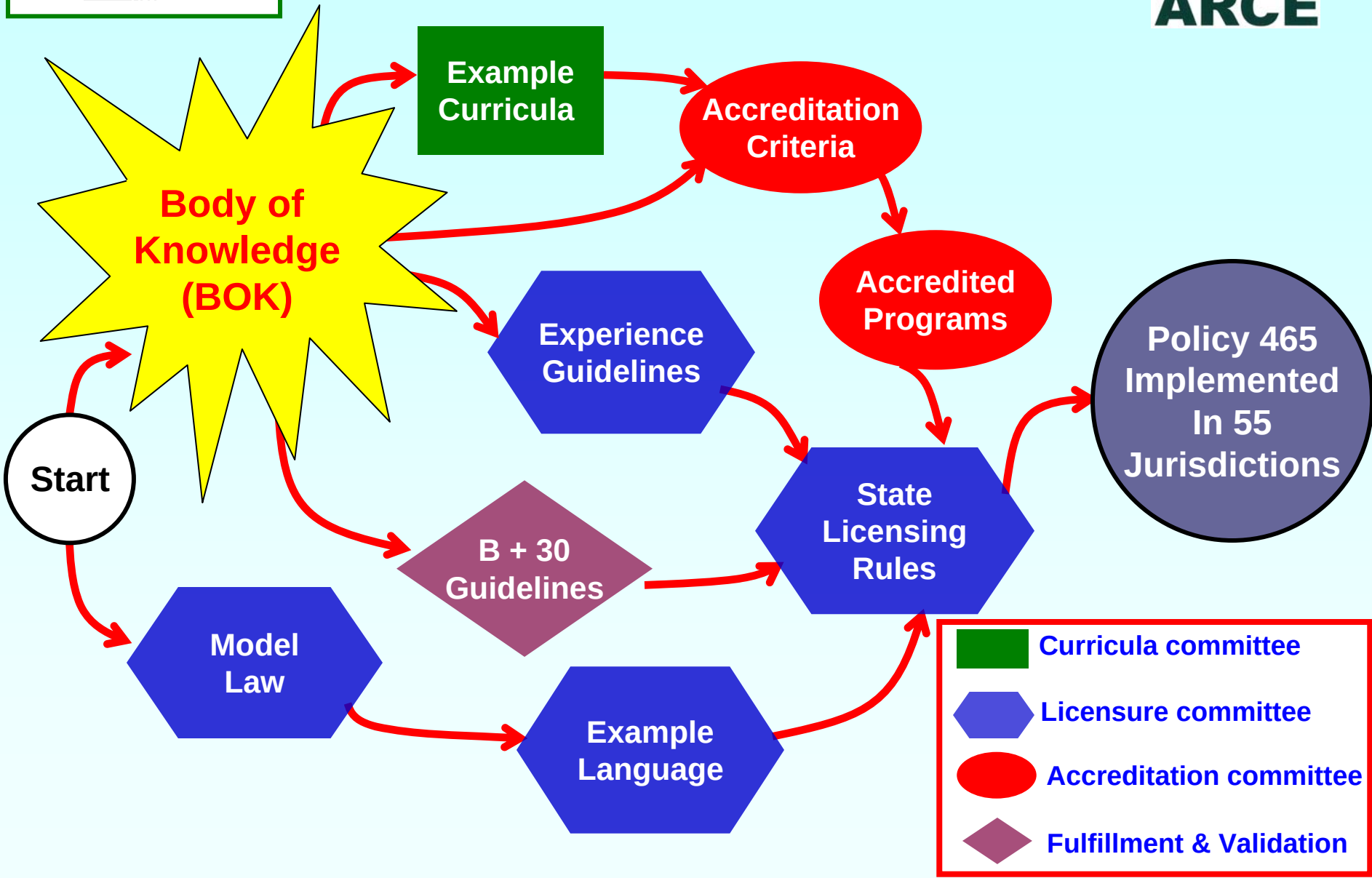
# Vision for Civil Engineering in 2025

**Civil engineers serve competently, collaboratively, and ethically as master:**

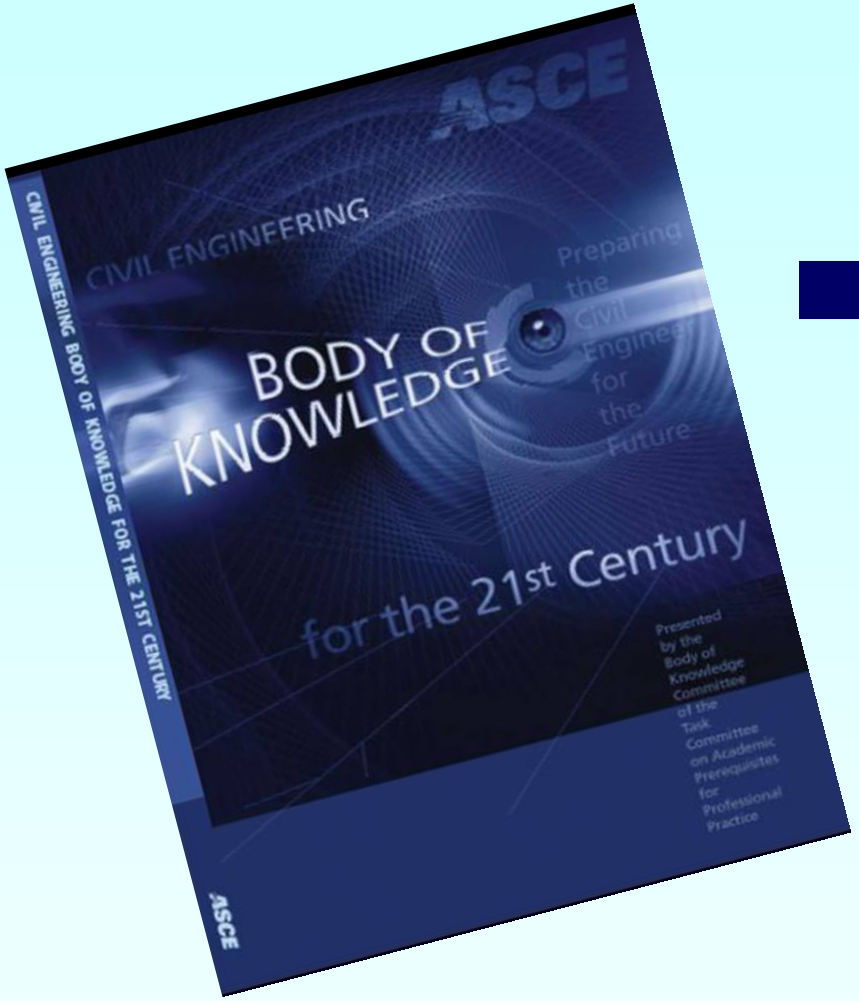



- **planners, designers, constructors, and operators of the built environment;**
- **stewards of the natural environment and its resources;**
- **innovators and integrators of ideas and technology;**
- **managers of risk and uncertainty; and**
- **leaders in shaping public environmental and infrastructure policy.**

# ASCE Policy 465



***Knowledge, skills,*** **and** ***attitudes*** **necessary to <u>enter</u> the practice of civil engineering at the professional level.**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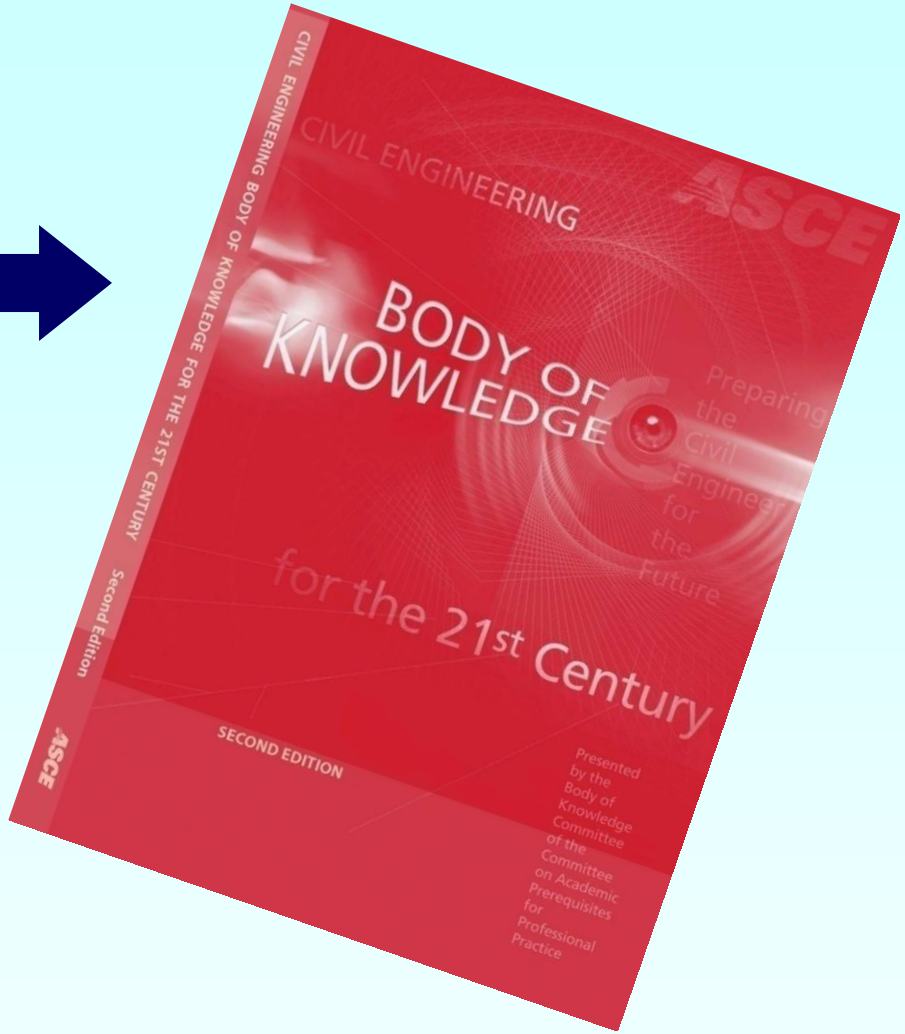
Preparing the Civil Engineer for the Future
for the 21st Century
Presented by the Body of Knowledge Committee of the Task Committee on Academic Prerequisites for Professional Practice
CIVIL ENGINEERING BODY OF KNOWLEDGE FOR THE 21ST CENTURY
ASCE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ASCE

# Civil Engineering Body of Knowledge

| TECHNICAL | PROFESSIONAL |
| --- | --- |
| Technical core | Inter-disciplinary teams |
| Experimentation | Professional & ethical standards |
| Design | Communication |
| Engineering problems | Impact of engineering |
| Engineering tools | Life-long learning |
| Specialized area of civil engineering | Contemporary issues |
| | Business & public policy |
| Project management, construction, and asset mgmt. | Leadership |

# Body of Knowledge II

## *Foundational*

1. Mathematics
2. Natural sciences
3. Humanities
4. Social sciences

## *Technical*

5. Materials science
6. Mechanics
7. Experiments
8. Problem recognition & solving
9. Design
10. Sustainability
11. Contemporary issues & historical perspectives
12. Risk & uncertainty
13. Project management
14. Breadth in CE areas
15. Technical specialization

## *Professional*

16. Communication
17. Public policy
18. Business & public administration
19. Globalization
20. Leadership
21. Teamwork
22. Attitudes
23. Lifelong learning
24. Professional & ethical responsibility

# Program Objectives

- Able to determine and advance in a career path primarily in structural engineering or a building industry field.
- Able to attain a graduate degree.
- Engaged in lifelong learning.
- Able to meet increasing professional demands to communicate effectively.

# Program Outcomes

- Apply knowledge of mathematics, science and engineering to building structures.
- Design and conduct experiments, analyze and interpret data.
- An ability to design a building system, component, or process to meet desired needs within realistic constraints such as regulatory, economic, environmental, social, political, ethical, health and safety, constructability, and sustainability.

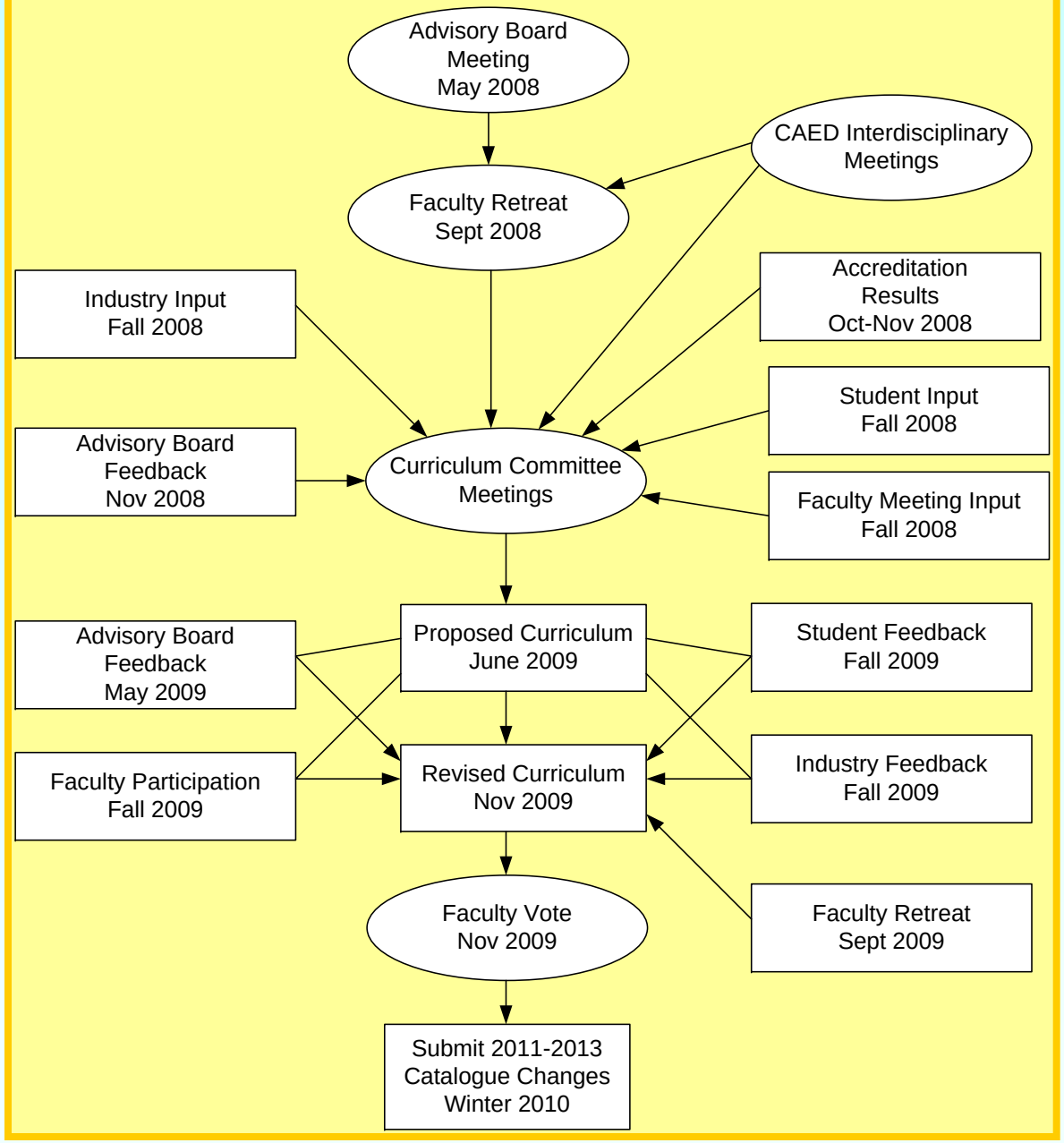
# Program Outcomes

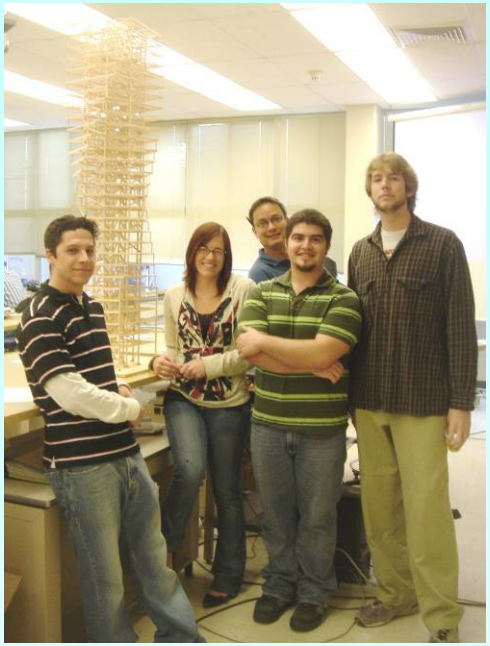
- Function on interdisciplinary teams for the design and construction of buildings.
- Identify, formulate and solve structural engineering problems.
- Understand professional and ethical responsibility.
- An ability to communicate effectively
- Understand the impact of engineering solutions in a global and societal context.

# Program Outcomes

- Ability to engage in life-long learning.
- A knowledge of how the built environment is related to contemporary issues.
- An ability to use the techniques, skills and tools necessary for structural engineering practice.
- A basic proficiency in construction and constructability issues in buildings

# Proposed Curriculum Assessment Process



# ARCE Advisory Board

# Cal Poly ARCE Program

- First Year
  - Math
  - Physics
  - Intro to Engineering
  - Architecture

- Second Year
  - Math/Chemistry
  - Construction
  - Structures I/II
  - Architecture

44 Units Gen. Edu.

- Commo.
- Humanities
- Social Sci

- Third Year
  - Structural Analysis
  - Steel Design
  - Timber Design
  - Soil Mechanics
  - Structural Systems

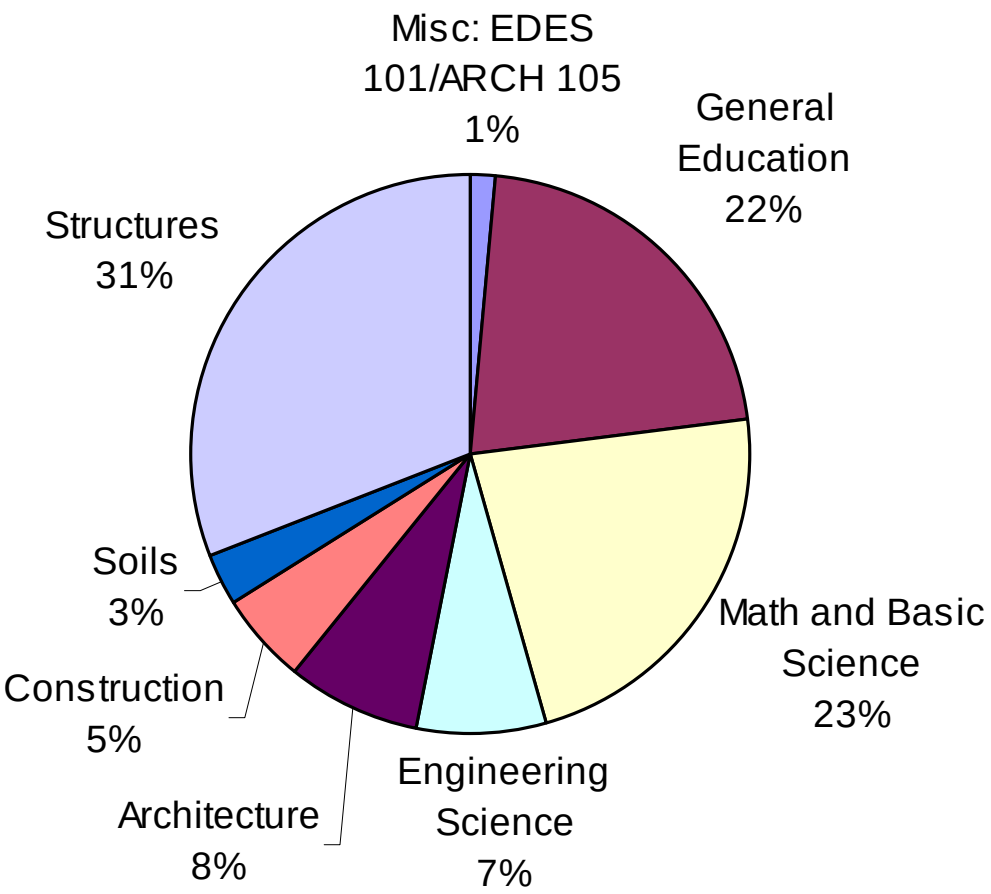
- Fourth Year
  - Timber/Masonry
  - Seismic
  - Concrete
  - Tech. Electives
  - Senior Project

**204 Credit Hours**

# Curriculum Analysis

| Cal Poly ARCE Program | Units |
|---|---|
| Misc: EDES 101/ARCH 105 | 3 |
| General Education | 40 |
| Math and Basic Science | 51 |
| Engineering Science | 14 |
| Architecture | 16 |
| Construction | 11 |
| Soils | 6 |
| **Structures** | |
| Structural Design | 23 |
| Structural Analysis | 26 |
| Computer Lab | 5 |
| Advanced Electives | 6 |
| Senior Project | 3 |
| **Total** | **204** |

# Curriculum Analysis



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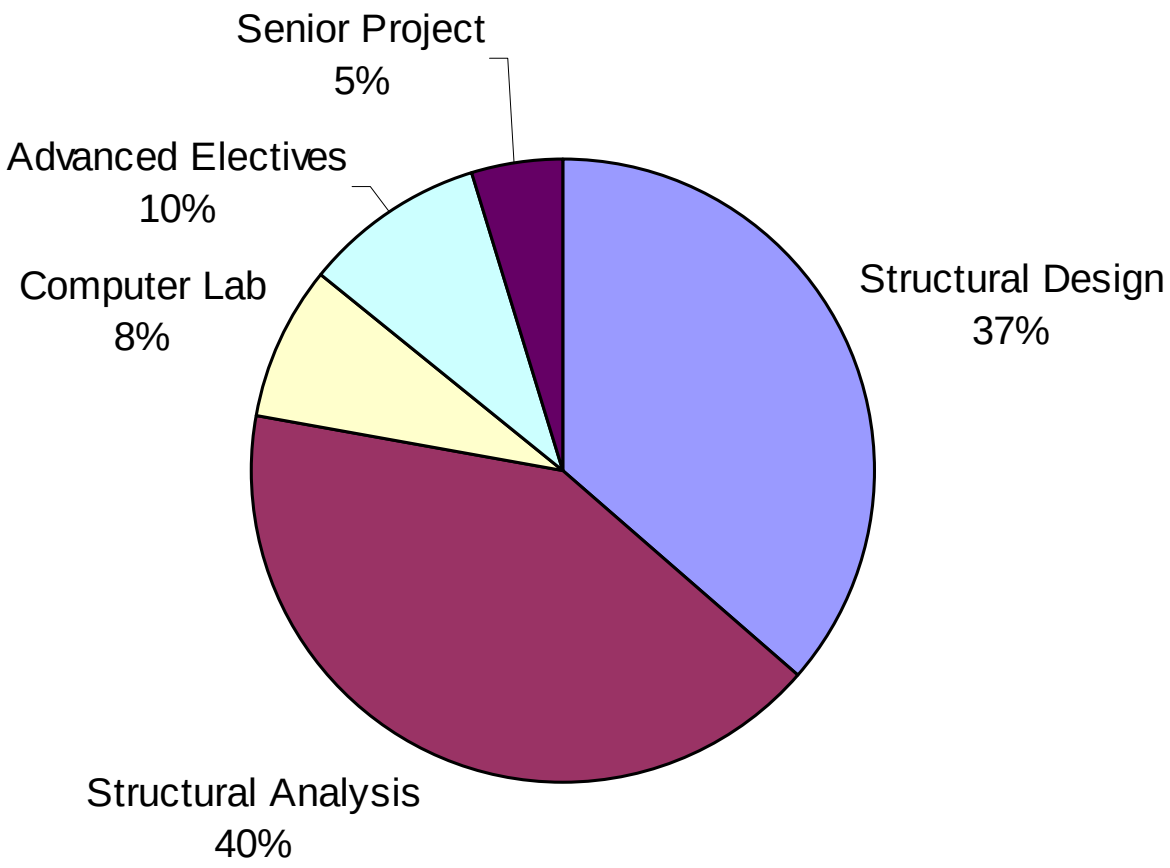


# General Education

| | General Education | |
|---|---|---|
| A | **Communication** | |
| A1 | Writing-Exposition | 4 |
| A2 | Oral Communication | 4 |
| A3 | Reasoning | 4 |
| C | **Arts and Humanities** | |
| C1 | Literature | 4 |
| C2 | Philosophy | 4 |
| C4 | Upper Division Elective | 4 |
| D/E | **Social and Individual** | |
| D1 | American Experience | 4 |
| D2 | Political Economy | 4 |
| D3 | Comparative Social Institutions | 4 |
| D4 | Self Development | 4 |
| | **Total** | **40** |

# Math and Science

| | Math and Basic Science | |
|---|---|---|
| MATH 141 | Calculus I | 4 |
| MATH 142 | Calculus II | 4 |
| MATH 143 | Calculus III | 4 |
| MATH 241 | Calculus IV | 4 |
| MATH 244 | Differential Equations | 4 |
| STAT 321 | Probability and Statistics | 4 |
| CSC 341 | Numerical Methods | 4 |
| GEOL 201 | Physical Geology | 3 |
| PHYS 141 | General Physics I | 4 |
| PHYS 132 | General Physics I | 4 |
| PHYS 133 | General Physics I | 4 |
| CHEM 124 | General Chemistry | 4 |
| B2 | **Life Science Elective** | 4 |
| | **Total** | **51** |

# Engineering Science

| | Engineering Science | |
|---|---|---|
| ME 341 | Fluid Mechanics | 3 |
| ME 302 | Thermodynamics | 3 |
| EE 201 | Electric Circuit Theory | 3 |
| ARCE 225 | Dynamics | 3 |
| CSC 231 | Computer Science | 2 |
| | **Total** | **14** |

| | Architecture | |
|---|---|---|
| ARCH 121 | Design & Drawing 1.1 | 3 |
| ARCH 122 | Design & Drawing 1.2 | 3 |
| ARCH 123 | Design & Drawing 1.3 | 3 |
| ARCH 221 | Architectural Design Fundamentals 2.1 | 3 |
| ARCH 217/2 | History of World Architecture | 4 |
| | **Total** | **16** |

# Construction

| | Construction | |
|---|---|---|
| ARCH 106 | Materials of Construction | 2 |
| CM 211 | Construction Drawings & Specifications | 4 |
| CM 332 | Evaluation of Cost Alternatives | 3 |
| BRAE 237 | Introduction to Engineering Surveying | 2 |
| | **Total** | **11** |

| | Soils | |
|---|---|---|
| ARCE 421 | Soil Mechanics | 3 |
| ARCE 422 | Foundation Design | 3 |
| | **Total** | **6** |

# Structural Analysis

| | Structural Analysis | |
|---|---|---|
| ARCE 211 | Structures I | 3 |
| ARCE 212 | Structures II | 3 |
| ARCE 223 | Mechanics of Structural Members | 4 |
| ARCE 227 | Structures III | 2 |
| ARCE 302 | Structural Analysis | 4 |
| ARCE 306 | Matrix Analysis of Structures | 3 |
| ARCE 412 | Dynamics of Framed Structures | 3 |
| ARCE 483 | Seismic Analysis and Design | 4 |
| | **Total** | **26** |

| | Computer Lab | |
|---|---|---|
| ARCE 257 | Structural CAD for Building Design | 2 |
| ARCE 351 | Structural Computing Analysis I | 1 |
| ARCE 352 | Structural Computing Analysis II | 1 |
| ARCE 353 | Structural Computing Analysis III | 1 |
| | **Total** | **5** |

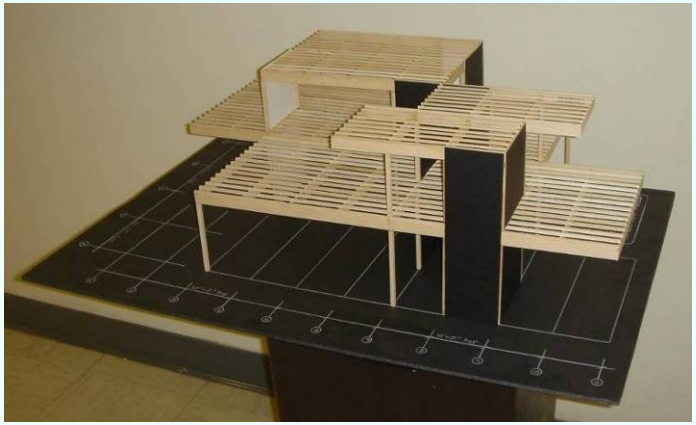
# Structural Design

| | | |
|---|---|---|
| | **Structural Design** | |
| ARCE 371 | Structural Systems Laboratory | 3 |
| ARCE 303 | Steel Design I | 3 |
| ARCE 372 | Steel Structures Design Laboratory | 3 |
| ARCE 304 | Timber Design | 3 |
| ARCE 305 | Masonry Design | 2 |
| ARCE 451 | Timber and Masonry Structures Design Laboratory | 3 |
| ARCE 444 | Reinforced Concrete Laboratory | 3 |
| ARCE 452 | Concrete Structures Design Laboratory | 3 |
| | **Total** | **23** |

| | | |
|---|---|---|
| | Senior Project | |
| ARCE 453 | Senior Project Laboratory | 3 |

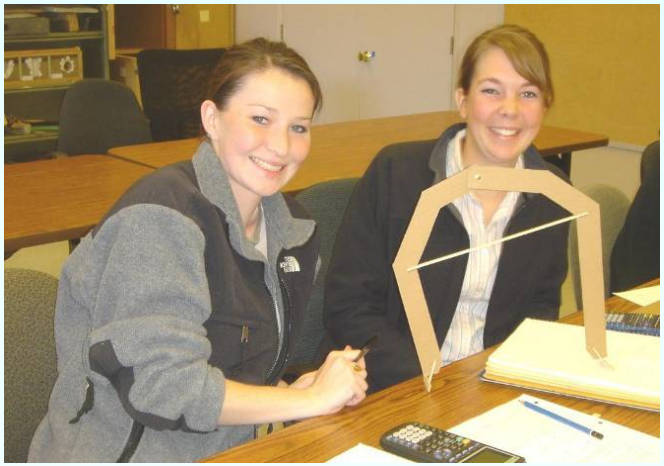
# Advanced Electives

| | Advanced Electives - Choose 2 | |
|---|---|---|
| ARCE 403 | Advanced Steel Structures Laboratory | 3 |
| ARCE 423 | Advanced Foundation Design | 3 |
| ARCE 445 | Prestressed Concrete Design Laboratory | 3 |
| ARCE 446 | Advanced Structural Systems Laboratory | 3 |
| ARCE 447 | Advanced Reinforced Concrete Laboratory | 3 |
| ARCE 448 | Seismic Rehabilitation Laboratory | 3 |
| | **Total** | **6** |



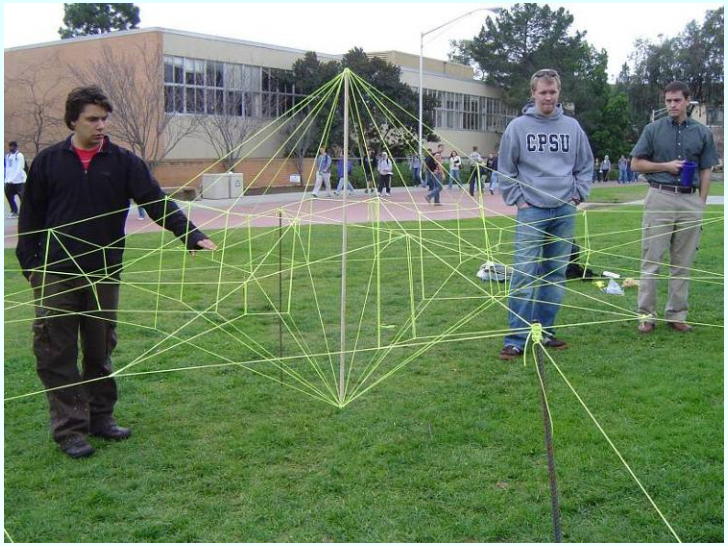
# Curriculum Assessment

- Too complex and inflexible
- Need upper level interdisciplinary experience
- Incorporate newest advancements (codes, technologies)
- Probability and Statistics
- Professional practice seminar

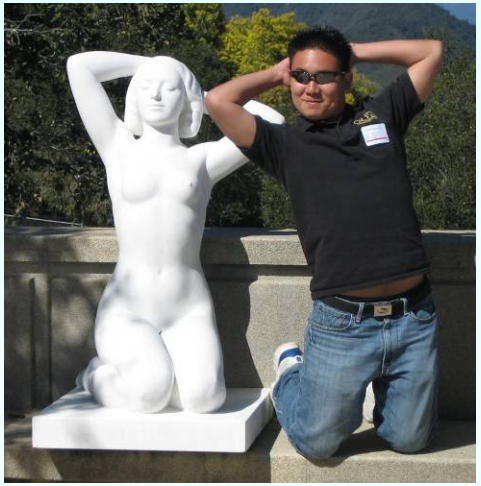


# Curriculum Assessment

- Opportunity for international exchanges
- Credit for internships
- Cross-listing with Civil Engineering
- Need more CM courses
- Freshman ARCE courses

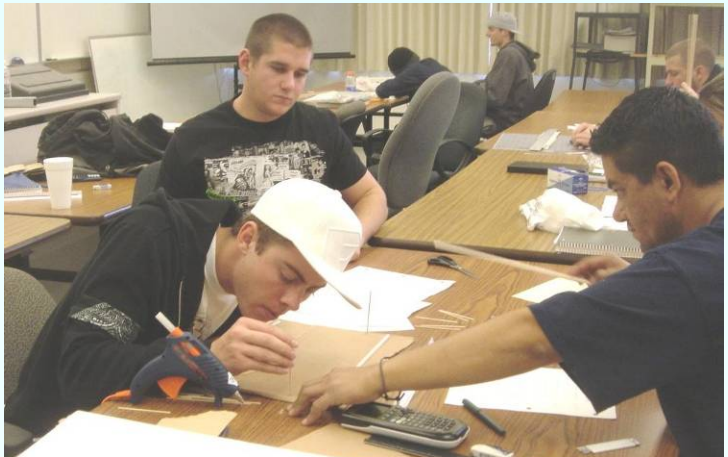


# SEAOC Student Chapter



# Other Activities

- Master's Program
  - One year program
  - Practical focus
  - Master's project
- Accreditation Visit
- 60th Anniversary Celebration
- Upgrade of Facilities and Resources



# Questions?

# Cal Poly Architectural Engineering Program