


Curriculum Reform Needs for Civil Engineering Education in the USA

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An aerial photograph of a city, likely Rome, showing a dense cluster of buildings with terracotta roofs. In the background, a large, prominent dome with a lantern on top is visible, characteristic of St. Peter's Basilica. The text is overlaid on this image.

**MANY CONFERENCES, WORKSHOPS,
AND SCHOLARLY PAPERS PRESENTED
OVER THE LAST 20- 30 YEARS SUGGEST
DISSATISFACTION WITH PRESENT
ENGINEERING EDUCATION**



**THERE IS A BELIEF
THAT
UNIVERSITIES DO A GOOD JOB AT:
TEACHING BASIC SCIENCE &
ENGINEERING THEORY, AT FORMING
RESEARCHERS & ACADEMICS**

**BUT NOT AT EDUCATING ENGINEERS
FOR ENGINEERING PRACTICE**



BORDOGNA (1998)

**saw the Civil Engineer of the 21st century as
*the MASTER INTEGRATOR***

**PRESENT CURRICULA DO NOT PREPARE
STUDENTS FOR THIS ROLE!**



The Engineering Dean's Council and Corporate Roundtable (1994) recommended that universities expose engineering students to:

- **Fundamentals of science**
- **Engineering Disciplines**
- **The broad world of practical engineering**
- **Teamwork**
- **Communication Skills**
- **Leadership**

A wide-angle, high-angle photograph of Reliant Stadium, an American football stadium. The stadium is mostly empty, with rows of red seats visible. The green field is in the foreground, with the word "HOUSTON" visible on the yard lines. The stadium's roof structure is a complex, white, lattice-like design. The text "RELIANT STADIUM" is visible on a sign in the background.

WHAT THEY REALLY WANT

IS

NEW RENNAISSANCE ENGINEERS



Characteristics of Renaissance Engineers

- **Breadth of knowledge and interests**
- **Familiarity with the latest technologies and understanding of the relation to classical work**
- **Concern and appreciation for all aspects of engineering and the built environment**

ENGINEERING EDUCATION IN THE U.S.

BEFORE SPUTNIK

- **Emphasis on Professional /Practical Courses**
- **All Professors had Practical Experience**
- **American Engineers known as Doers**

ENGINEERING EDUCATION IN THE U.S.

AFTER SPUTNIK

- **Emphasis on Basic and Engineering Science**
- **More theoretical courses at the expense of practice**
- **Reduced Laboratory work**
- **Reduced Design /Construction Content**

SOME PROBLEMS WITH PRESENT ENGINEERING CURRICULA IN THE U.S.

- **Lack of continuity/coordination in coursework**
- **Excessive emphasis on theory**
- **Lack of practical examples and real cases**
- **Lack of open ended problems**
- **Fragmentation of analysis/design/construction**
- **Students do not acquire intuitive feeling/understanding of real behavior**

EDUCATIONAL INITIATIVES

- **ASCE CONFERENCES/SESSIONS**
- **NSF INITIATIVES/COALITIONS**
- **NAE STUDY**
- **ABET 2000**
- **ASCE BOK**

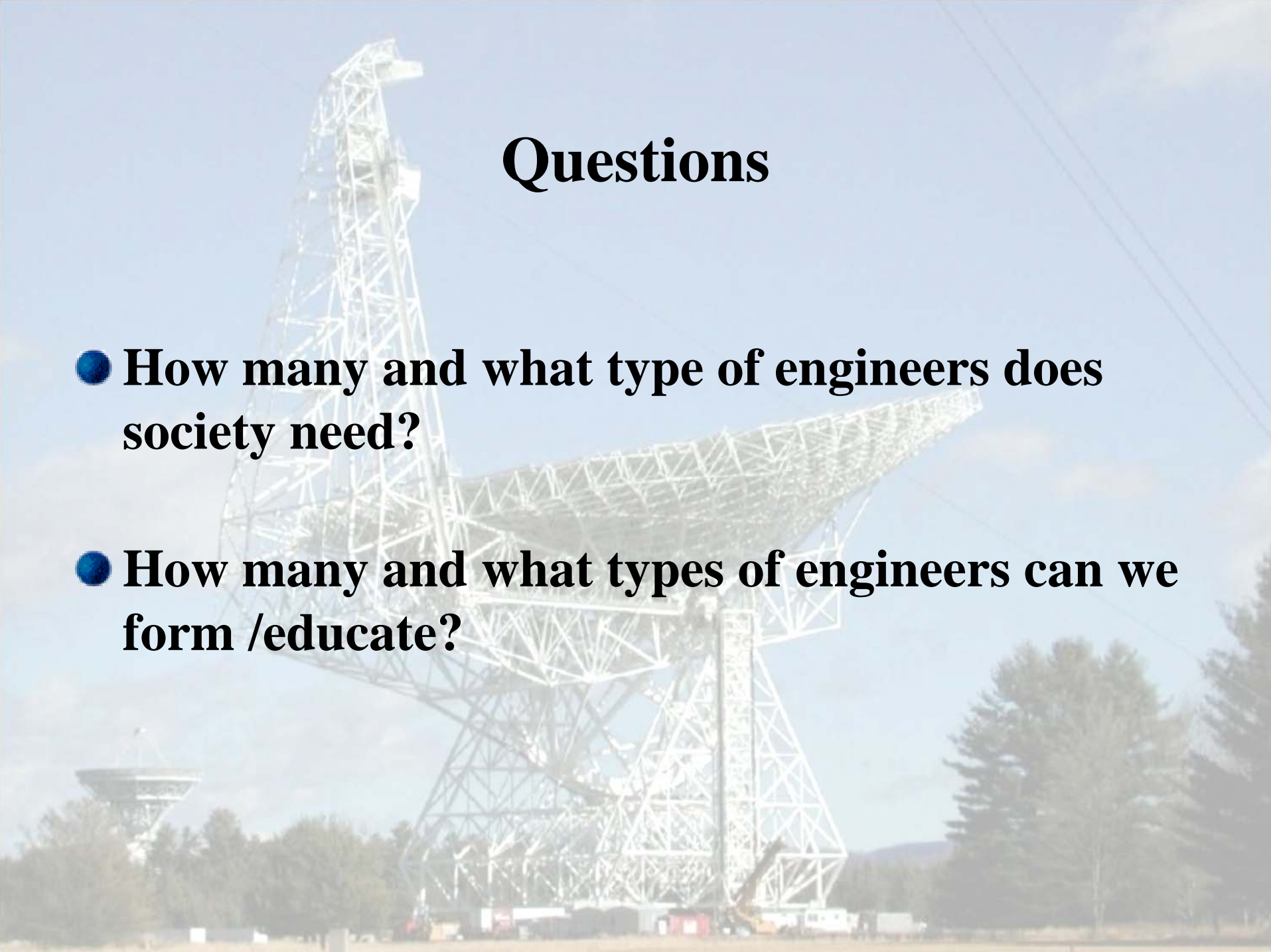
DESIRED CURRICULUM TOPICS

The background of the slide features a faded image of a suspension bridge with two large stone towers and a multi-story building with windows on the right side.

- **Programming/Planning of Facilities**
- **Public Sector Issues**
- **General Facility Design**
- **Construction Planning/Execution**
- **Performance Monitoring**
- **Retrofit, Rehabilitation**

Questions

- **How many and what type of engineers does society need?**
- **How many and what types of engineers can we form /educate?**



Types of Engineers

The background of the slide is a faded, high-angle photograph of a large offshore oil rig. The rig's complex steel framework, including various towers, cranes, and walkways, is visible against a hazy, greyish-blue sky and sea. The overall tone is industrial and technical.

- **Researchers**
- **Global Megaproject Managers**
- **Facility Designers/Builders/Operators**
- **Regular Designers**
- **Regular Builders**

ADDITIONAL QUESTIONS

The background of the slide is a photograph of the Golden Gate Bridge in San Francisco, California. The bridge's iconic orange-red towers and suspension cables are visible against a clear blue sky. The bridge spans across a body of water, with the water's surface showing some ripples and a small wake. The overall scene is bright and clear.

- **Can we form the desired types of engineers in 4/5 years?**
- **How much will they learn in school and how much in practice?**
- **Should the undergraduate/graduate curriculum be the same for all types of engineers?**

SUGGESTED IMMEDIATE ACTIONS

An aerial photograph of the Florence Cathedral (Duomo) in Italy, showing its iconic terracotta dome and the surrounding city of Florence. The image is slightly faded to serve as a background for the text.

- **Incorporate Real Cases in Coursework**
- **Integrate planning/Design/Construction/Operation**
- **Use Visual Design/Construction Lab**
- **Collaborate with Professional Engineers**

DESIGN/CONSTRUCTION INTEGRATION

- **MUST COMBINE DESIGN OF STRUCTURES, FOUNDATIONS, OTHER SUBSYSTEMS**
- **MUST INCLUDE CONSTRUCTION PLANNING THROUGHOUT DESIGN**
- **VIRTUAL CONSTRUCTION MODELLING ALLOWS 3 SPACE DIMENSIONS + TIME LEADING TO DYNAMIC MODELING**

VIRTUAL DESIGN/CONSTRUCTION LABORATORY

- **COMPUTERIZED 3-D VIRTUAL REALITY IS THE TECHNOLOGY THAT BRUNELLESCHI WOULD USE TODAY**
- **SUCCESSFUL CONSTRUCTION ENGINEERS ARE VISUALLY ORIENTED ; BUT ENGINEERING EDUCATION IS PROBABLY ONLY REACHING ONE SIDE OF STUDENT BRAIN**
- **MUST REPLACE 2-D DRAFTING & SCHEDULING WITH 3-D DESIGN USING SOLID MODELS & TIMED CONSTRUCTION SIMULATION**

CLOSURE

- **EDUCATING CIVIL ENGINEERS FOR SUCCESS IN THE 21ST CENTURY WILL REQUIRE SIGNIFICANT CHANGES IN THE U.S. APPROACH**
- **FOUR YEARS (120-128) DEGREE HOURS ARE INSUFFICIENT**
- **COURSES MUST INVOLVE REAL CASE STUDIES**
- **PRACTITIONERS MUST BE WILLING COLLABORATORS IN THE NEEDED CHANGES**