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Inaugural Lecture

Concrete: Friend or Foe

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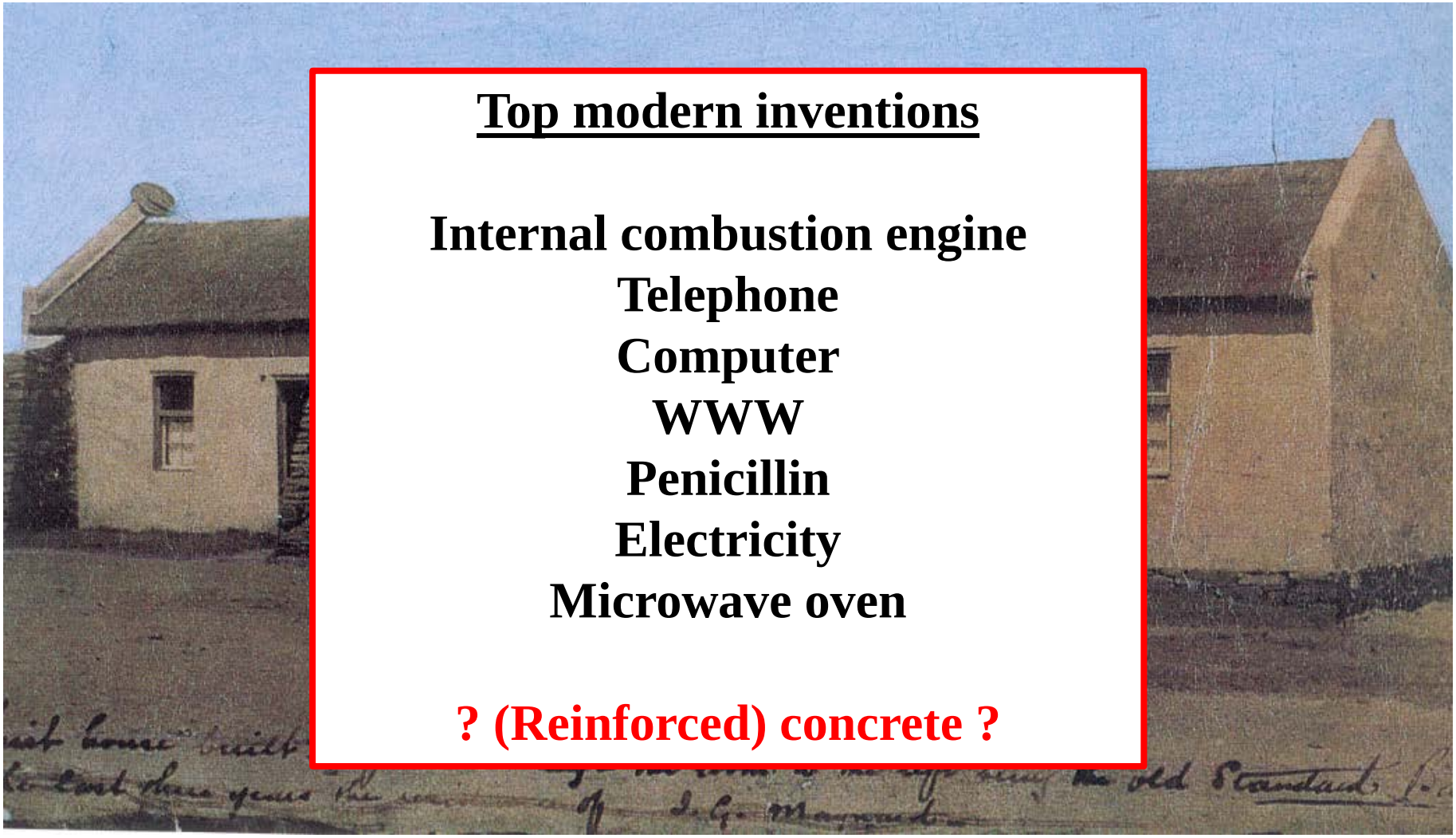
Department of Civil Engineering



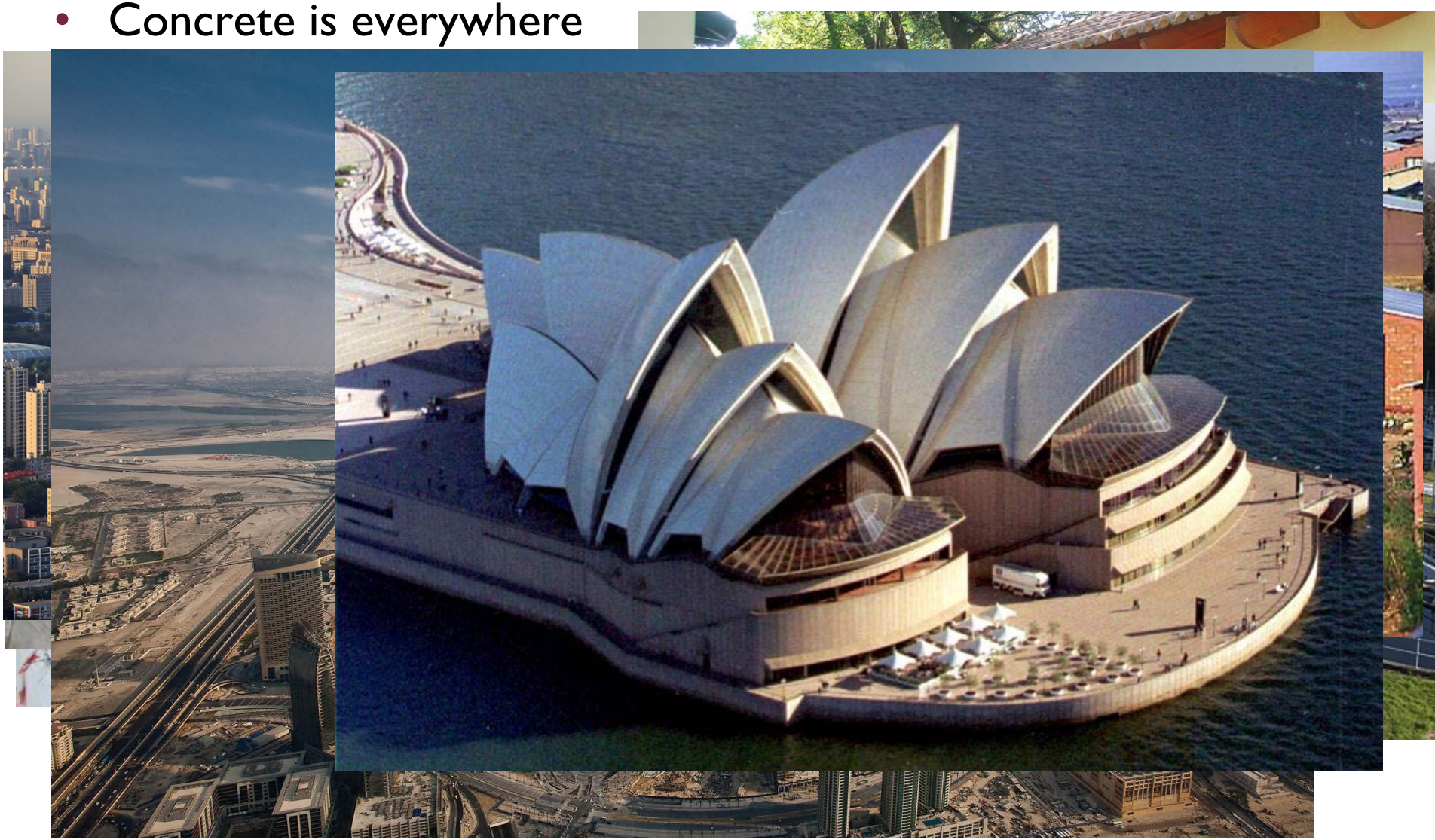
Top modern inventions

Internal combustion engine
Telephone
Computer
WWW
Penicillin
Electricity
Microwave oven

? (Reinforced) concrete ?

Introduction

- Concrete is everywhere



Introduction

Why is concrete so popular?

Relatively cheap

Robust

Easy to use

Become rock-like material

Can last for decades

Relative easy design guidelines

Introduction

- Concrete is winning solution!
- What is the environmental impact?

Introduction

- Cement production produces 5 – 7 % of world CO_{2e} emissions
- Can grow to 10 % by 2050

CPT Frankfurt return

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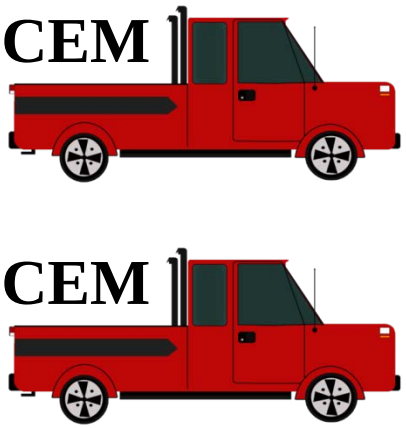

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Around 4.6 billion tonnes of cement produced in 2016

4 600 000 000 000 kg cement

CONCRETE:

Friend or Foe?

Cement manufacturing

Cement manufacturing

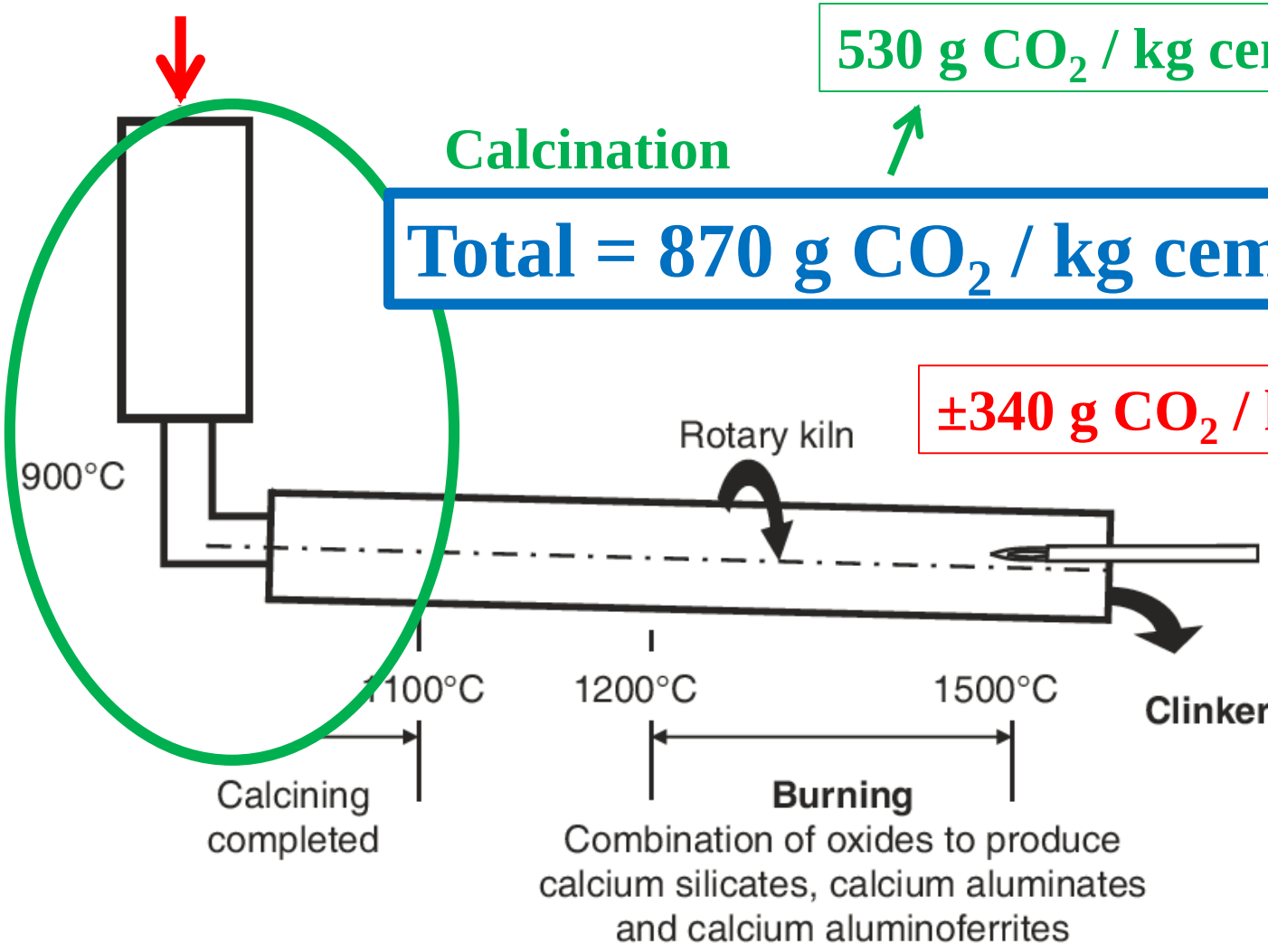
Limestone and shale/clay

530 g CO_2 / kg cement

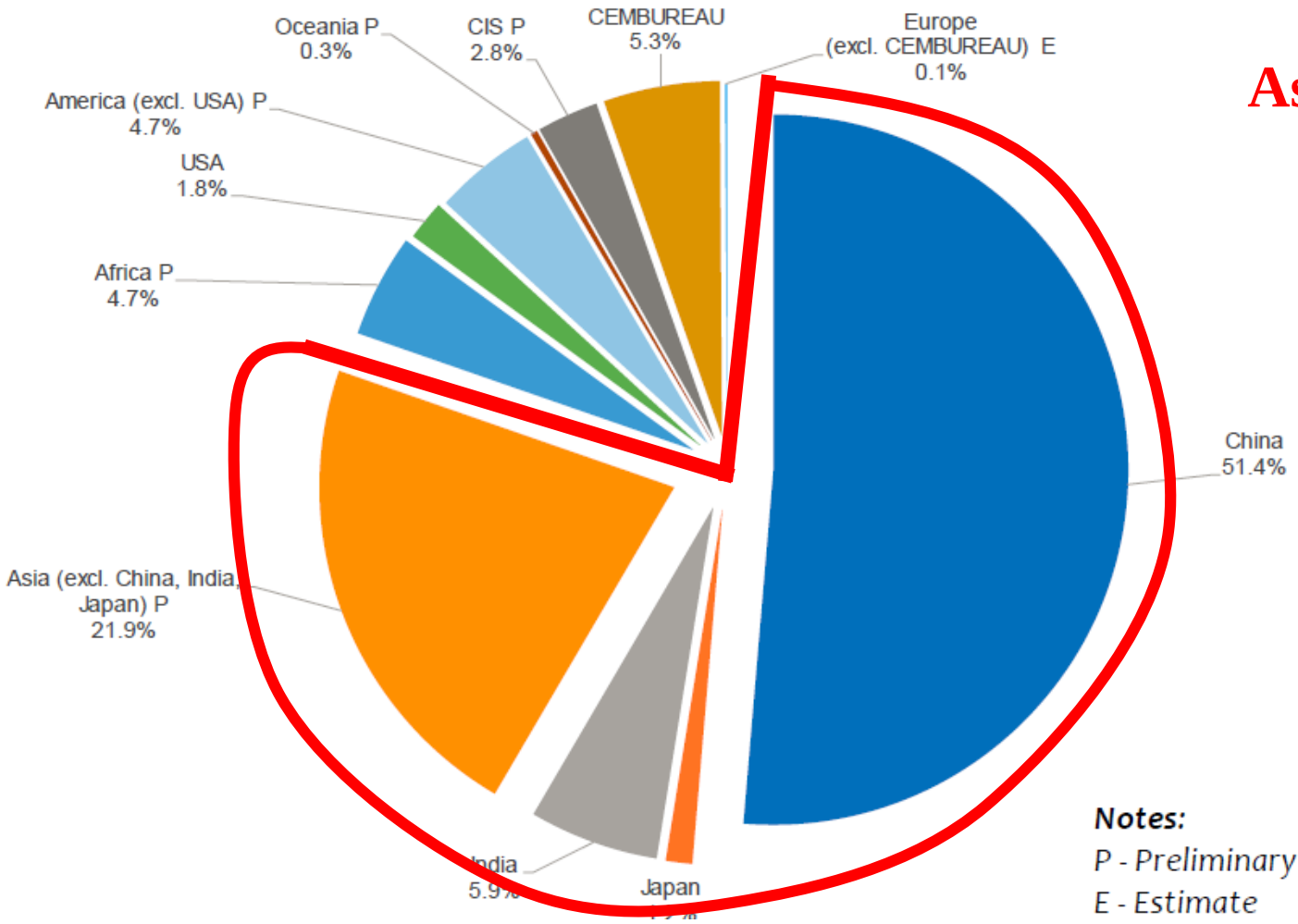
Calcination

Total = 870 g CO_2 / kg cement

±340 g CO_2 / kg cement



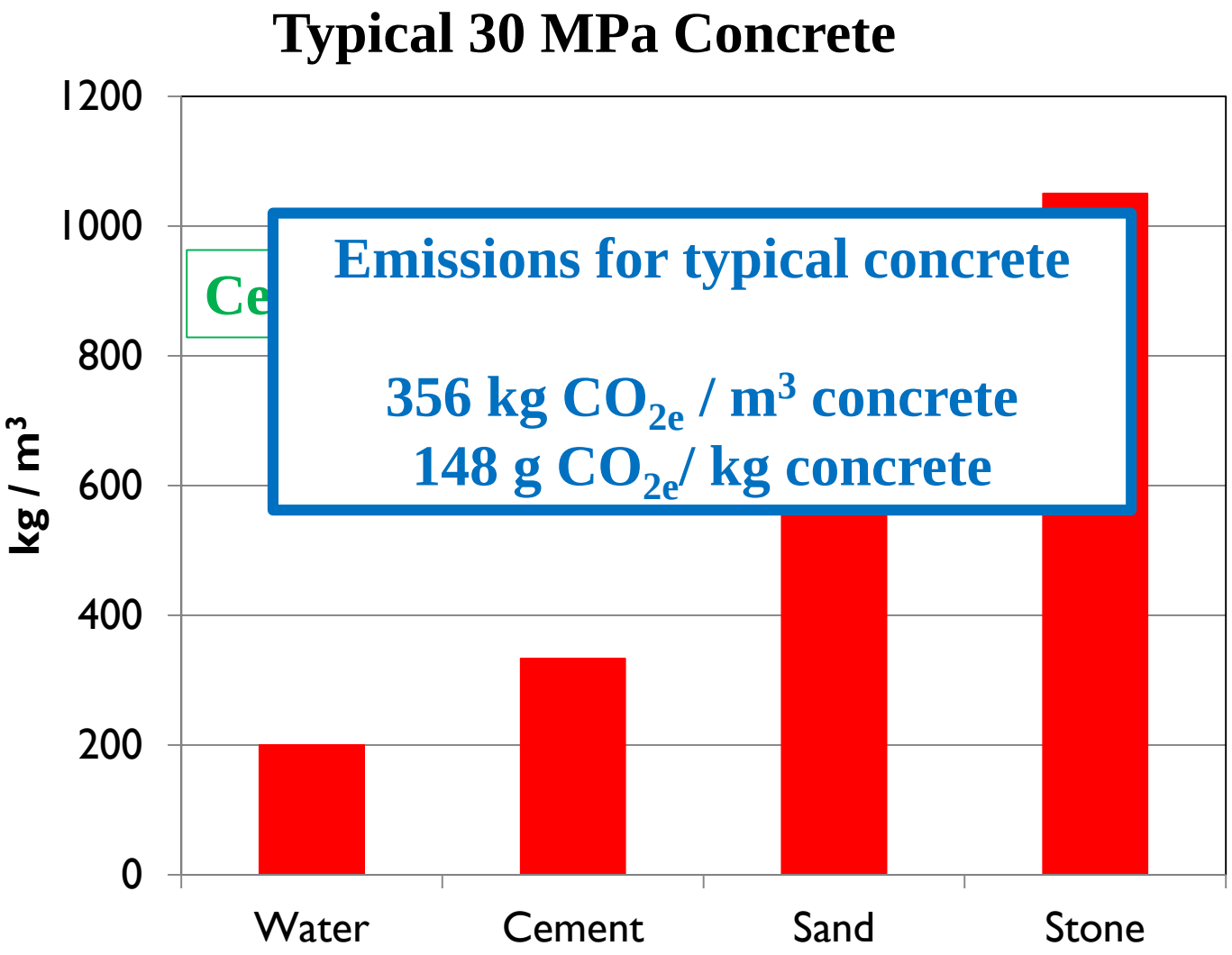
Cement Production 2016: 4.6 Billion Tonnes



Asia = 80.4%


CEMENT

Concrete


Typical 30 MPa Concrete
1200
1000
800
600
400
200
0
kg / m³
Ce
Emissions for typical concrete
356 kg CO2e / m³ concrete
148 g CO2e/ kg concrete
Water
Cement
Sand
Stone

Solutions to Reduce Impact of Concrete

Solutions to reduce impact of concrete:

1. Blend/extend cement with SCMs
2. Optimise mix designs
3. Improve durability
4. Implement advanced/unconventional uses of concrete

5. New material/concept to revolutionise construction industry

1. Using SCMs

- Cement can be blended with SCM (Supplementary Cementitous Materials)
- Waste materials from other industries

Fly ash from coal power plants

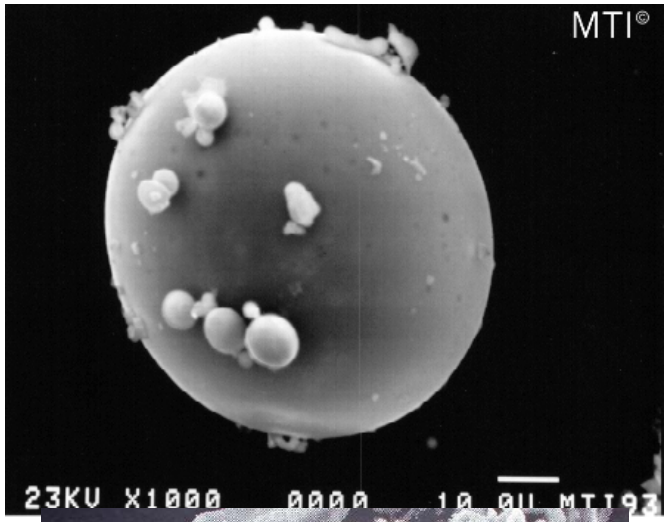
SiO_2 ; Al_2O_3

Slag from steel plants

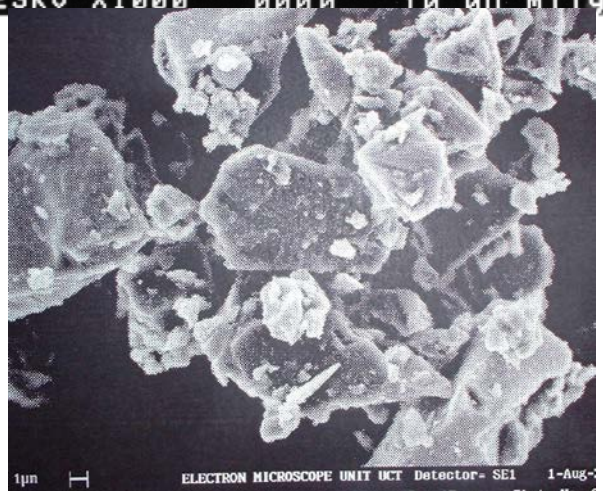
SiO_2 ; CaO ; Al_2O_3 ; MgO

Miracle materials!

- 30 % replacement of cement with fly ash, or
- 50+ % replacement of cement with slag

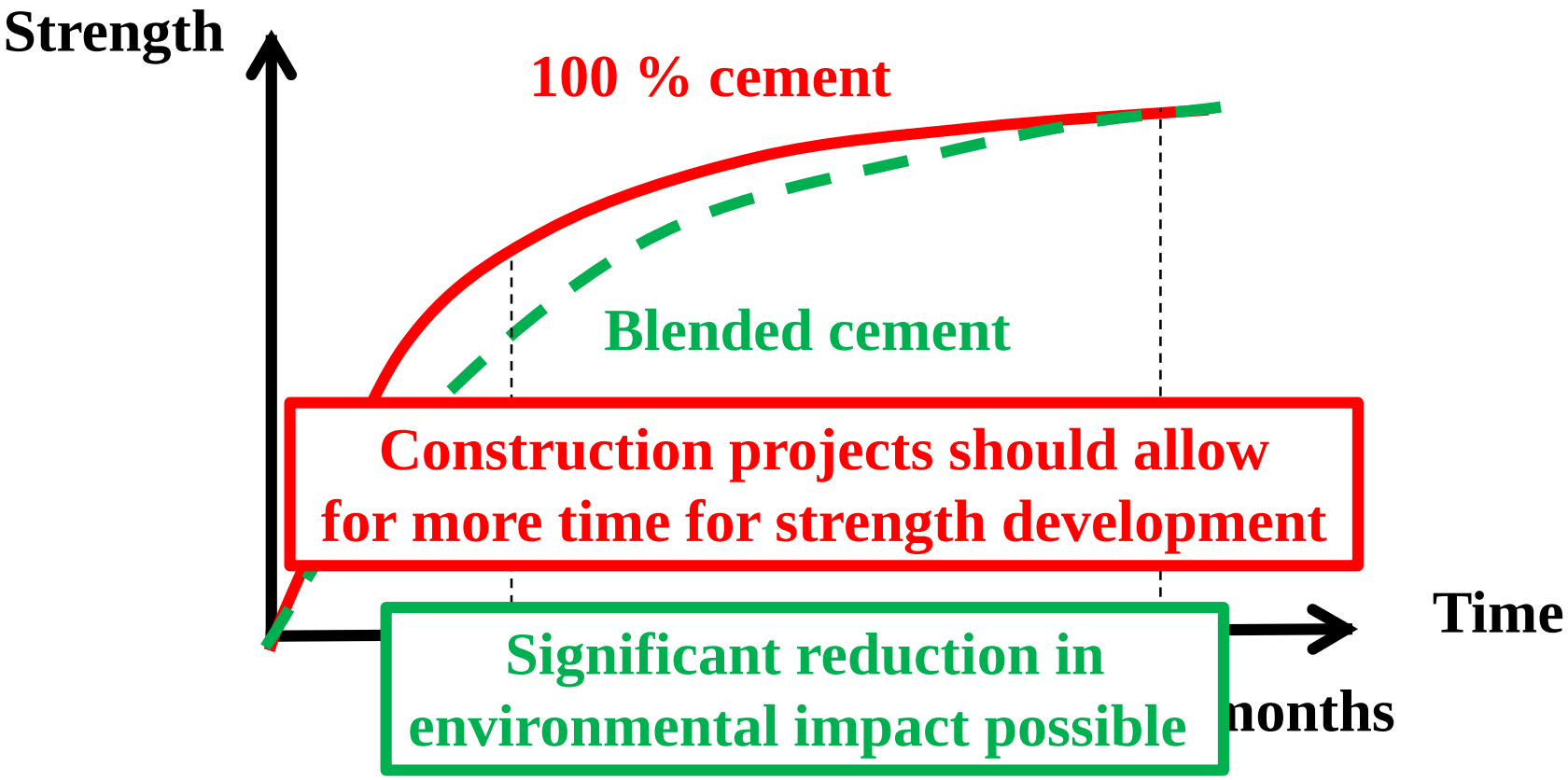


- Same strength concrete
- Improved durability
- Improved flowability (fly ash)
- More economical



Significant reduction in environmental impact possible

SCM = Slower strength development

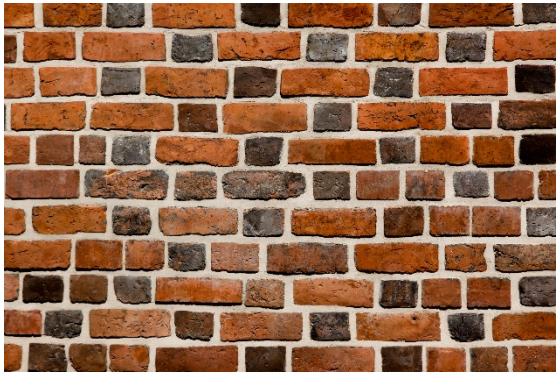


1. Using SCM

Other materials that can be used as SCM:

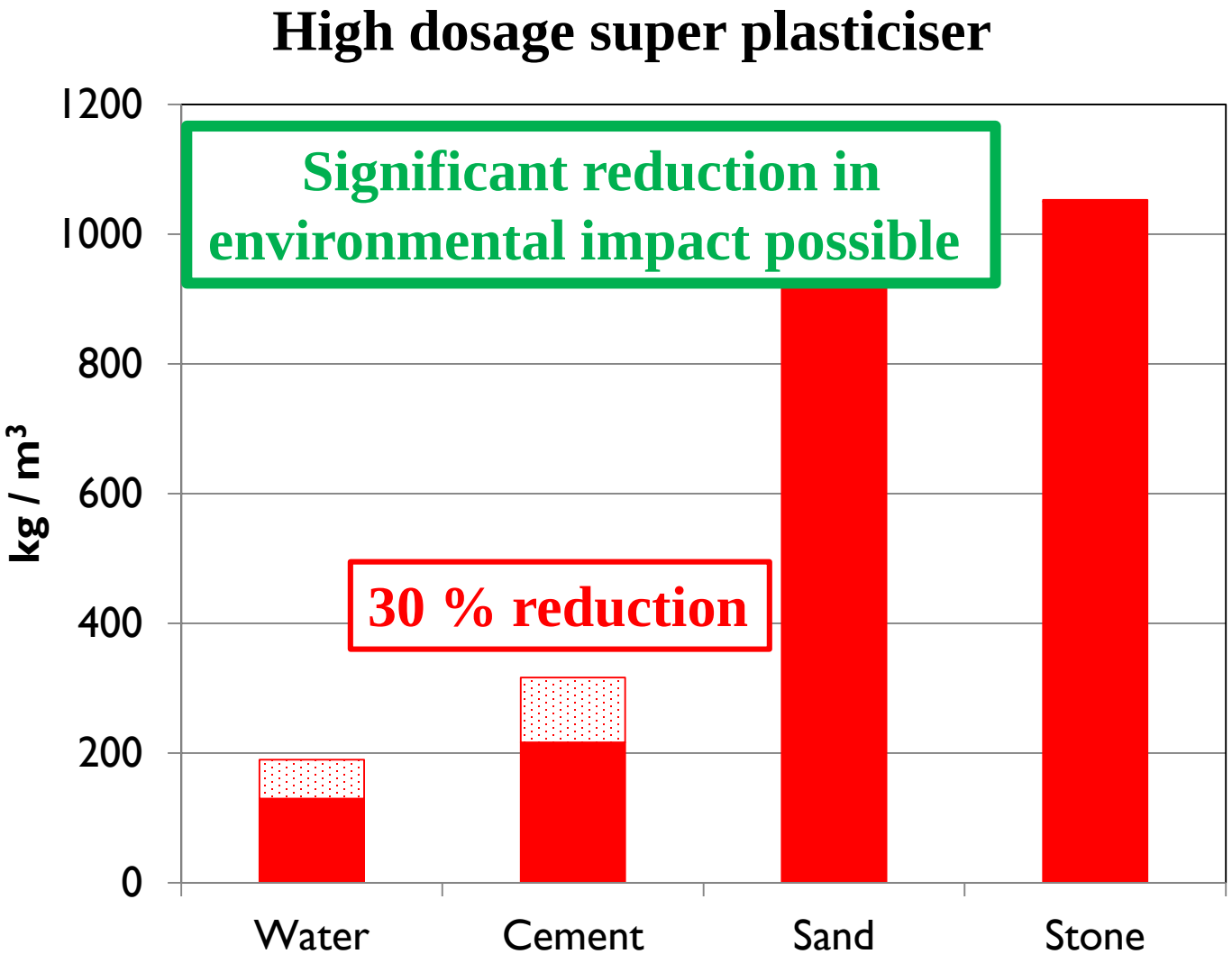
- Glass

- Clay bricks



- Ceramic tiles

2. Optimising Mix Designs



3. Durability

- Consider the complete life span using Life Cycle Analyses
- The longer the structure lasts, the less the environmental impact

5. New Material/Concept

New material/concept to revolutionise construction industry

Google ✗

ScienceDirect ✗


BACK
TO THE FUTURE

Concluding Remarks

- **Society simple cannot function without concrete!**

- Significant scope for reduction of environmental impact over next 50 years

- The answer: waste materials

Concluding Remarks

Role players:

- Construction Industry
- Government
- Manufacturers
- End-users
- Universities and Research Institutes

Universities should expose **future engineers** to new **technology**, but, more importantly, universities should teach students the **skills** to **investigate, understand and implement new technologies** that have not even been developed yet.

Universities should lead with new technology

CONCRETE:

Friend or Foe?

FRIEND!

But we have to change the way we work with concrete