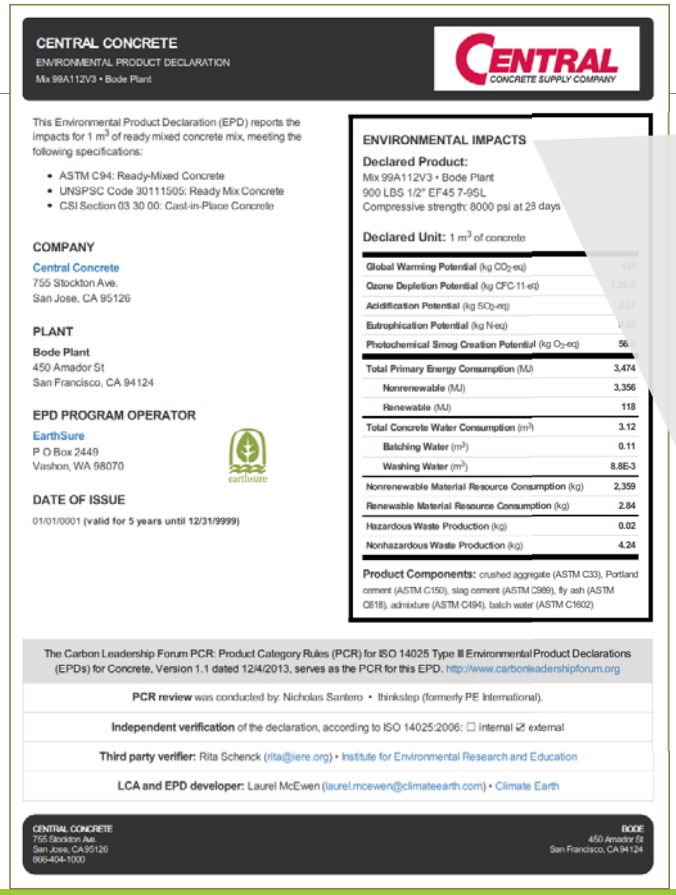
Low Carbon Footprint Concrete Solutions and Implementation

SDC TECHNOLOGY FORUM 45

LA JOLLA, CA

FEBRUARY 13-15, 2019

EPD (Environmental Product Declaration)



CENTRAL CONCRETE
ENVIRONMENTAL PRODUCT DECLARATION
Mix 99A112V3 • Bode Plant

This Environmental Product Declaration (EPD) reports the impacts for 1 m^3 of ready mixed concrete mix, meeting the following specifications:

- ASTM C94: Ready-Mixed Concrete
- UNSPSC Code 30111505: Ready Mix Concrete
- CSI Section 03 30 00: Cast-in-Place Concrete

COMPANY
Central Concrete
755 Stockton Ave.
San Jose, CA 95126

PLANT
Bode Plant
450 Amador St
San Francisco, CA 94124

EPD PROGRAM OPERATOR
EarthSure
P O Box 2449
Vashon, WA 98070

DATE OF ISSUE
01/01/0001 (valid for 5 years until 12/31/9999)

ENVIRONMENTAL IMPACTS
Declared Product:
Mix 99A112V3 • Bode Plant
900 LBS 1/2" EF45 7-9SL
Compressive strength: 8000 psi at 28 days

Declared Unit: 1 m^3 of concrete

Global Warming Potential (kg CO_2-eq)	435
Ozone Depletion Potential (kg CFC-11-eq)	1.2E-5
Acidification Potential (kg SO_2-eq)	2.37
Eutrophication Potential (kg N-eq)	0.56
Photochemical Smog Creation Potential (kg O_3-eq)	56.
Total Primary Energy Consumption (MJ)	3,474
Nonrenewable (MJ)	3,356
Renewable (MJ)	118
Total Concrete Water Consumption (m^3)	3.12
Batching Water (m^3)	0.11
Washing Water (m^3)	8.8E-3
Nonrenewable Material Resource Consumption (kg)	2,359
Renewable Material Resource Consumption (kg)	2.84
Hazardous Waste Production (kg)	0.02
Nonhazardous Waste Production (kg)	4.24

Product Components: crushed aggregate (ASTM C33), Portland cement (ASTM C150), slag cement (ASTM C989), fly ash (ASTM C618), admixture (ASTM C494), batch water (ASTM C1602)

The Carbon Leadership Forum PCR: Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPDs) for Concrete, Version 1.1 dated 12/4/2013, serves as the PCR for this EPD. http://www.carbonleadershipforum.org

PCR review was conducted by: Nicholas Santero • thinkstep (formerly PE International).

Independent verification of the declaration, according to ISO 14025:2006: ☐ internal ☑ external

Third party verifier: Rita Schenck (rita@iere.org) • Institute for Environmental Research and Education

LCA and EPD developer: Laurel McEwen (laurel.mcewen@climateearth.com) • Climate Earth

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450 Amador St
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GWP

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Embodied Carbon Reduction Methods

- Cement replacement
- Recycled aggregate
- Cement reduction
- Carbon sequestration
- Geopolymer or alternate cements
- Extending service life

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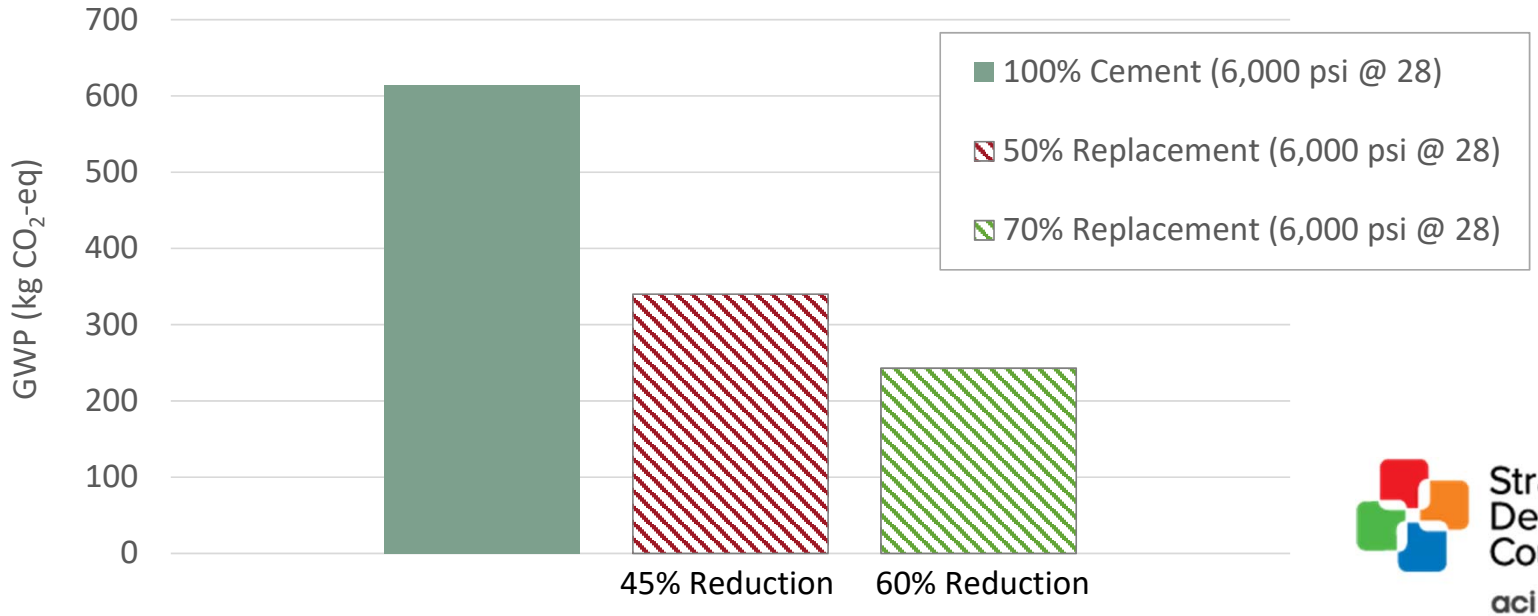
Cement Replacement

- Most significant impact for GWP reduction



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Cement Replacement

- Most significant impact for GWP reduction
- Strong history of use
  - Slag, fly ash, metakaolin, silica fume, natural pozzolan, limestone
- Newer options
  - Glass pozzolan
  - Proprietary mineral blends
- Performance advantages

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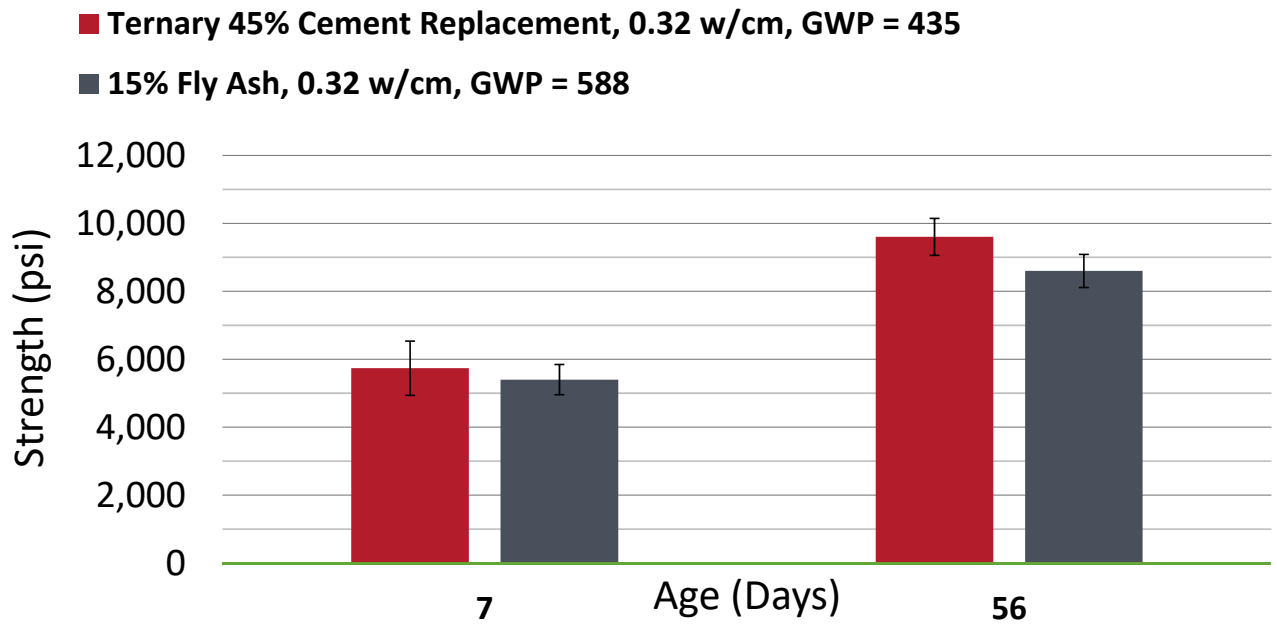
Cement Replacement

25% reduction of GWP
12% higher strength

- Performance advantages: compressive strength



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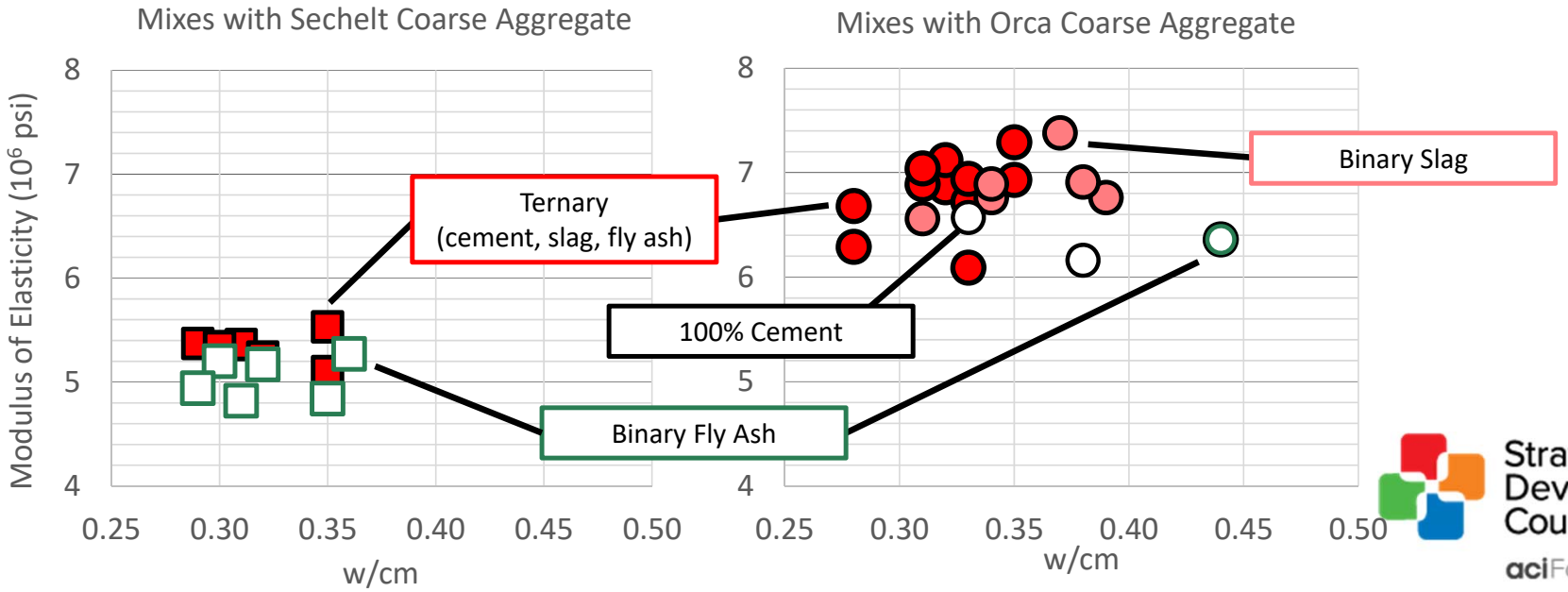
Cement Replacement

Data trends suggest higher elastic modulus with slag

- Performance advantages: elastic modulus



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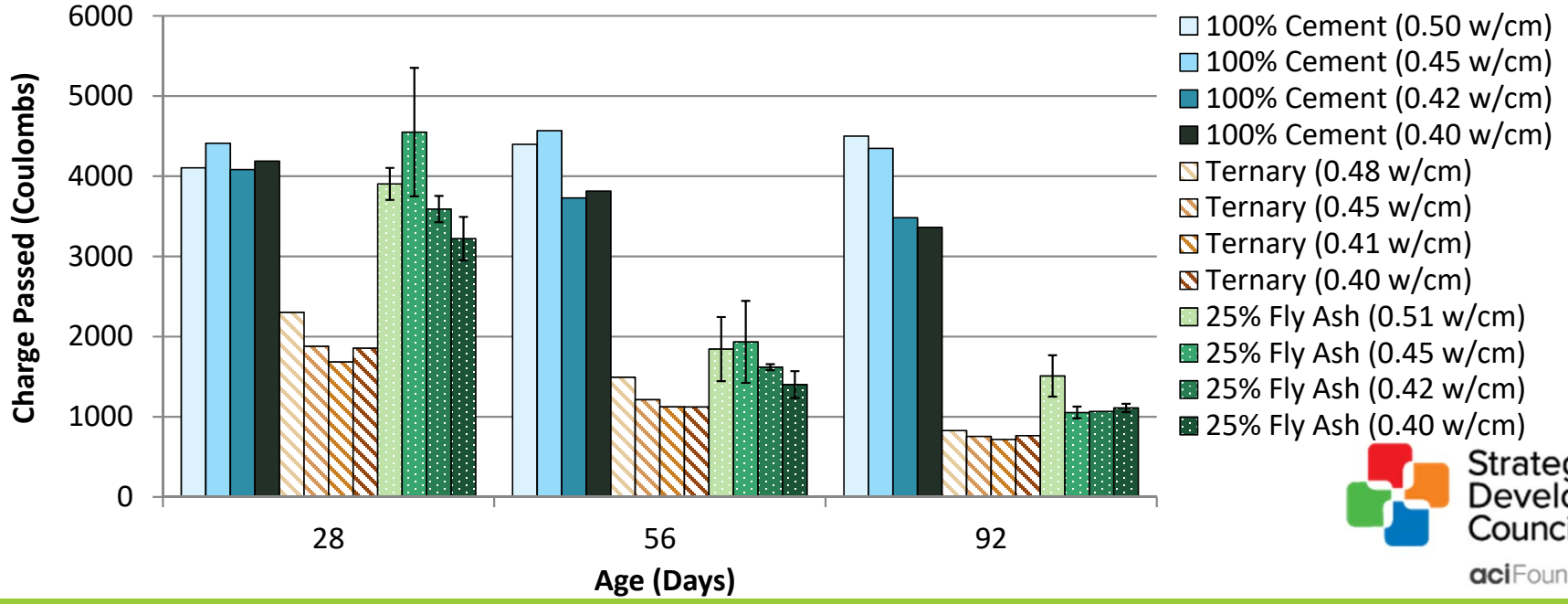
Cement Replacement

Data show more significant reduction in permeability with SCMs than w/cm

Performance advantages: permeability



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Recycled Aggregate

- Significant opportunity for reducing discarded waste and depletion of natural materials
  - Industry average: 5% of concrete returned for disposal
- Quality control and predictability are critical
  - Targeted applications
  - Blend with natural aggregate
  - ACI 555 – Concrete with Recycled Materials

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Cement Reduction

GWP reduction (%) ≈ cement reduction (%)

- Strength boosting admixtures
- High performance aggregate
- Injection of CO_2 into fresh concrete during batching

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Carbon Sequestration

- Injection of CO_2 into fresh mix during batching
- Curing with CO_2
- Calcium carbonate coating on aggregates

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Geopolymers

- Currently used in Europe, Australia, etc.
- ACI committee 242, Alternative Cements
  - ITG-10R: Practitioner's Guide for Alternative Cements

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Extending Service Life

- Not necessarily a reduction of embodied carbon, but improves value of concrete as structural material and efficiency of embodied carbon
  - Self-healing concrete
  - Fibers
  - Admixtures

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Collaboration for Implementation

Ready-mixed producer can be helpful contributor to the design team

- Important to have contractor input
- Insure sustainability goals are achieved without negatively impacting placement, finishing, architectural goals, and schedule

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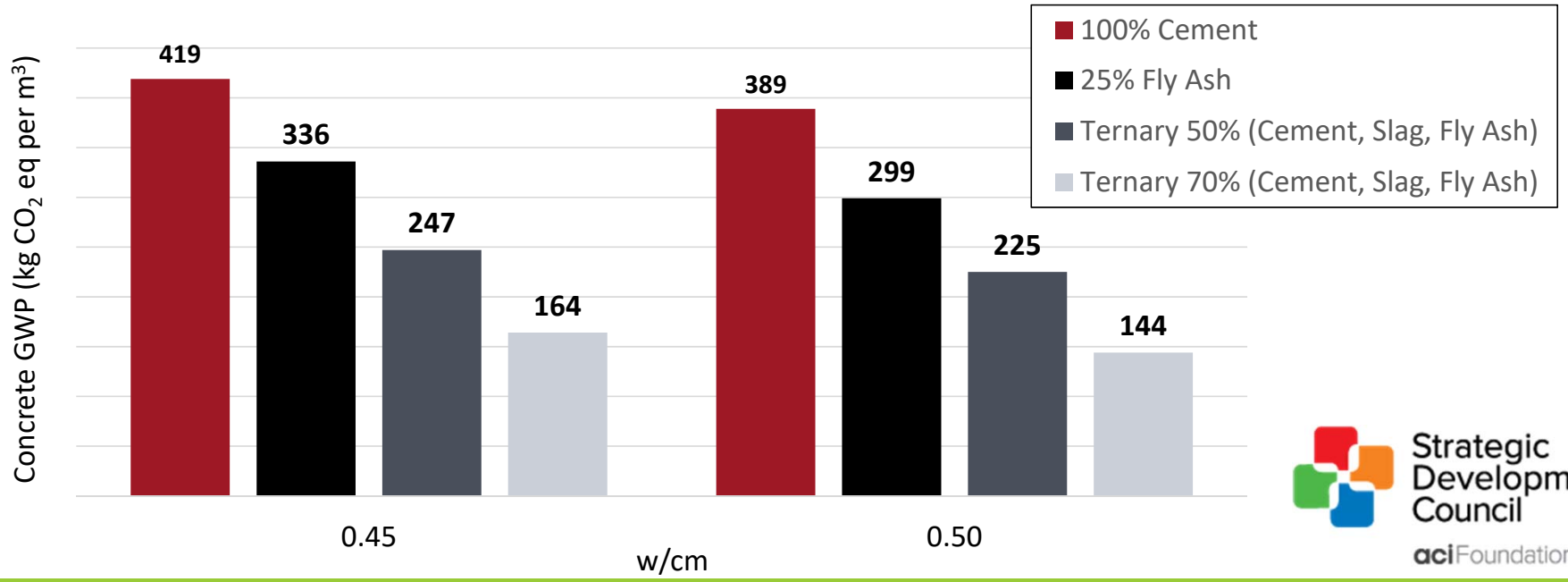
Specifications

Effect of cement replacement and w/cm on GWP



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Specifications

- Specify w/cm only when required by exposure class
- Specify design strength (f'_c) at age later than 28 days, where possible
- Maturity testing to maximize cement replacement for high-early strength mixes

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Thank you!

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