# ISAP TC APE
# Working Group 2
# Cold Recycling of RA(P)


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&
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**Feedback to ISAP TC APE at TRB**
**12th January 2014**


Stellenbosch
THE SOUTH AFRICAN NATIONAL ROADS AGENCY LTD

# Purpose of ISAP WG2

- Global interface for needs analysis regarding cold recycling
- Coordinate research by sharing findings, identifying needs and technical solutions
- Promote CR technology by:
  - Coordinate publications, guidelines, specifications
  - Create a database of research/ project data
  - Gather & share info on enviro & sustainability

# ISAP WG2 Members 2013


**TOTAL = 36**

# WG2 Membership = 36

| Continent | Members | Countries |
|---|---|---|
| Africa | 3 | 1 |
| Asia | 10 | 2 |
| Australasia | 3 | 2 |
| EU | 15 | 5 |
| North America | 3 | 1 |
| South America | 2 | 1 |

# Focus of WG2 discussions

- Research focus areas (Global)
  - Laboratory
  - Field (APT and LTPP)
- Key findings and developments
  - Mix design
  - Structural design
  - Specifications
- Publications, documents and manuals

# Activities of WG2 in 2013
## Meet at Conferences

- Key Notes on CR: AAPA, NZIHT, RIOH
- Planned workshop at 7PMTC Pavement Maintenance Technology Congress in Shenzhen, China arranged by RIOH in November 2013 – instead, recycling theme was integrated into proceedings

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**ISAP Technical Committee APE**
**Asphalt Pavements and Environment**

## WG2 - Cold Recycling of RAP

May xx[th], 2013

**RE: State of the Art on Mix Design of Cold Recycled Mixtures with RAP**
**Call for Contributions**

Dear Colleague,

The Working Group 2 on Cold Recycling of RAP of ISAP TC on Asphalt P
working on the preparation of a State of the Art Report on the proc
mixtures (mixes stabilized with either bitumen emulsion o
the mix design procedures (standard procedures a
types of applications and all possible co
filler and high amount of active f
polymer-modified bitu
materials with h
Only
ording to the
the report.
a way that will make a logical and
on, some independent reviewers will undertake the
. Each author of the contributions will be explicitly
e of the Art Report.
outions to apetg2.cr.star@gmail.com. The deadline for submission is the
, 2013.
format that you have to follow is provided as attachment.

Please don't hesitate to contact us to have more information and/or clarifications.

We are looking forward to receive your contribution.

Best regards.

| ***Kim Jenkins*** | ***Alessandro Marradi*** | ***Manfred Partl*** | ***Gabriele Tebaldi*** |
|---|---|---|---|
| *Chairman of WG2 on Cold Recycling of ISAP TC on Asphalt Pavements and Environment* | *Secretary of WG2 on Cold Recycling of ISAP TC on Asphalt Pavements and Environment* | *Chairman of ISAP TC on Asphalt Pavements and Environment* | *Secretary of ISAP TC on Asphalt Pavements and Environment* |

**State-of-the-Art-Report STAR on Mix Design for Cold Recycling**

# Activities of WG2 in 2013
## STAR – Mix Design for CR

- Global = Sum of different continents
- Synthesis of mix design methods
- Fundamental: cold recycling, high RAP%
- Variables
  - Active filler type & % (none, lime, cem, FA..)
  - Binder types (foam vs emulsion; modified?)
  - Mix preparation, conditioning and testing
- Deadline Sep 2013 extended to mid 2014

# Activities of WG2 in 2013

## STAR – Mix Design for CR

## Submissions to date

- Italy (Ancona) – M Bocci and A Grilli
- USA (FHWA) – W Lee
- UK (Nottingham) – K Kuna G Airey N Thom
- South Africa (draft) – K Jenkins D Collings and A Lynch

# Trial Section R35 South Africa 2012 – 2013 (Lynch & Jenkins)

**Southbound Lane**

| | | km 5.5 | km 5.833 | km 6.166 | km 6.5 | km 6.85 | km 7.2 | km 7.55 | km 7.9 | km 8.25 | km 8.6 | km 8.95 | km 9.3 | km 9.65 | km 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 45 mm Asphalt | | Cape Seal | | | | | | | | | | | |
| Layer design properties | | G1 (1) | G1 (2) | G1 (3) | | | | | | | | | | | |
| | | 200 mm C3-1 subbase | 200 mm C3-2 subbase | 200 mm C3-3 subbase | 200 mm C3-1 base | 200 mm C3-2 base | 175 mm BSM Emulsion | 200 mm BSM Emulsion | 175 mm BSM Emulsion | 200 mm BSM Emulsion | 175 mm BSM Foam | 200 mm BSM Foam | 175 mm BSM Foam | 200 mm BSM Foam | |
| % by mass content | Cement | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | |
| | Lime | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Residual Bitumen | 0 | 0 | 0 | 0 | 0 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | |

**Base binder**

Gran | Cem | Emulsion | Foam

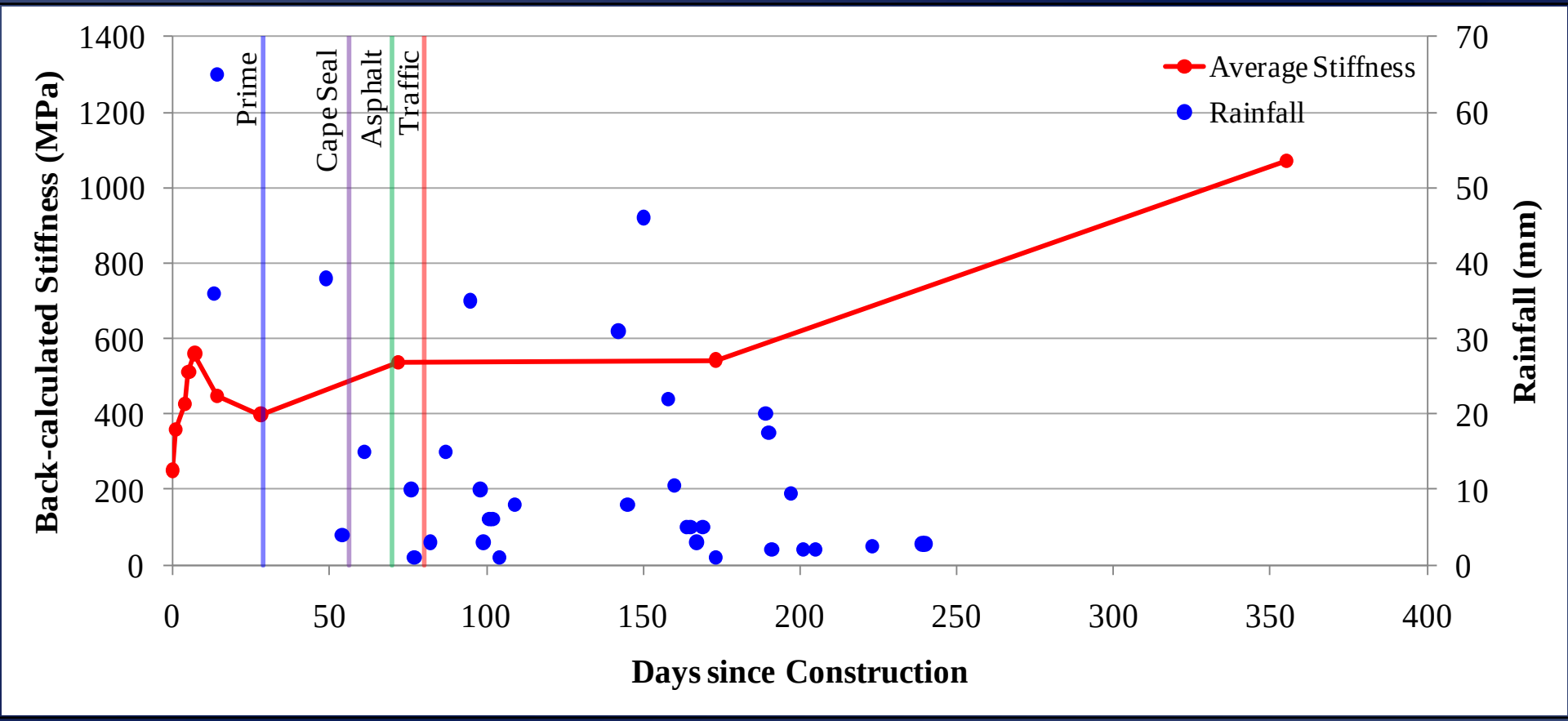
**Northbound Lane**

| | | km 5.5 | km 5.925 | km 6.5 | km 6.85 | km 7.2 | km 7.55 | km 7.9 | km 8.25 | km 8.6 | km 8.95 | km 9.3 | km 9.65 | km 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 45 mm Asphalt | | Cape Seal | | | | | | | | | | |
| Layer design properties | | G1 (1) | G1 (2) | | | | | | | | | | | |
| | | 200 mm C3-1 subbase | 200 mm C3-2 subbase | 200 mm C3-1 base | 200 mm BSM Emulsion | 175 mm BSM Emulsion | 200 mm BSM Emulsion | 175 mm BSM Emulsion | 200 mm BSM Emulsion | 175 mm BSM Foam | 200 mm BSM Foam | 175 mm BSM Foam | 200 mm BSM Foam | |
| % by mass content | Cement | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 2 | |
| | Lime | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Residual Bitumen | 0 | 0 | 0 | 0.9 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | |

**Variables:**

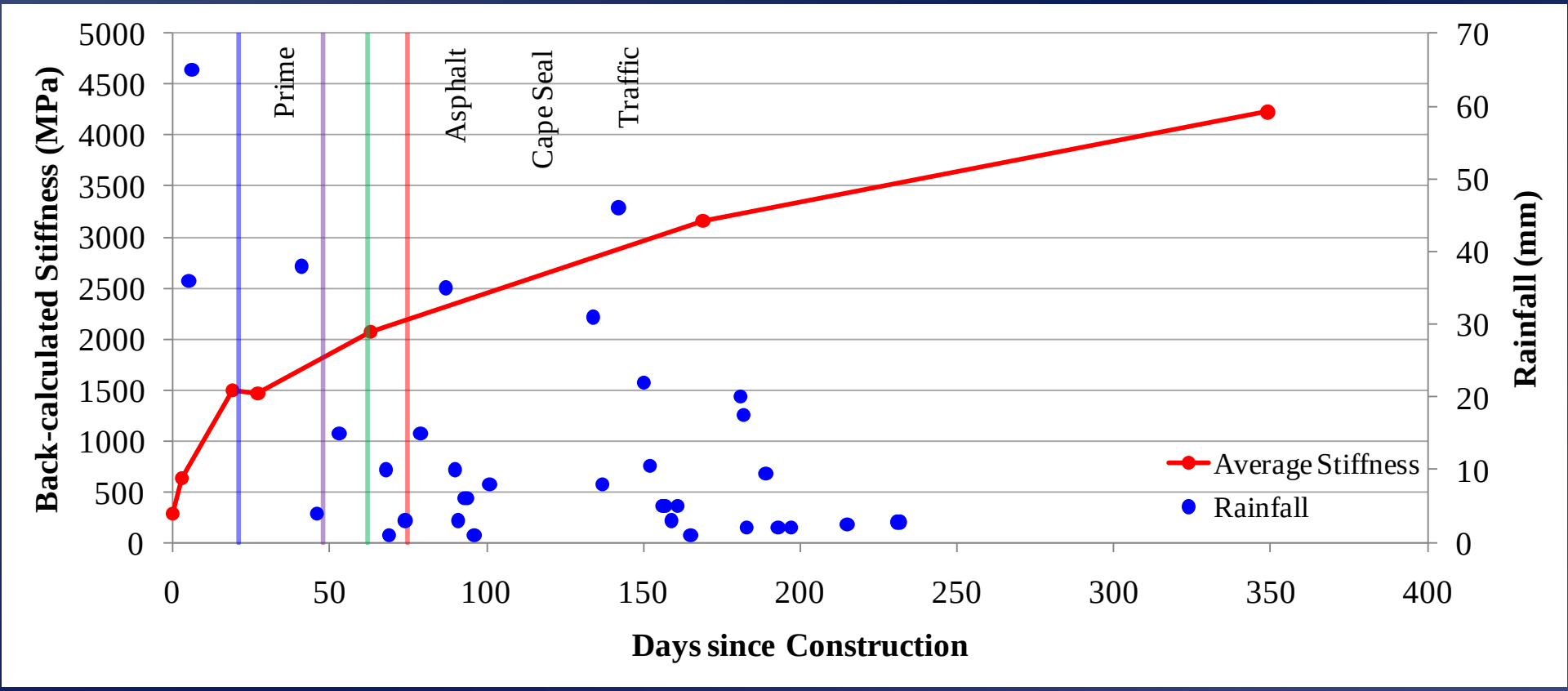
1. Base Binder
2. Base thickness
3. Surfacing
4. Active filler type & %
5. Traffic
6. Emulsion %

# 200mm BSM Foam (2.4%b, 1%c) NB



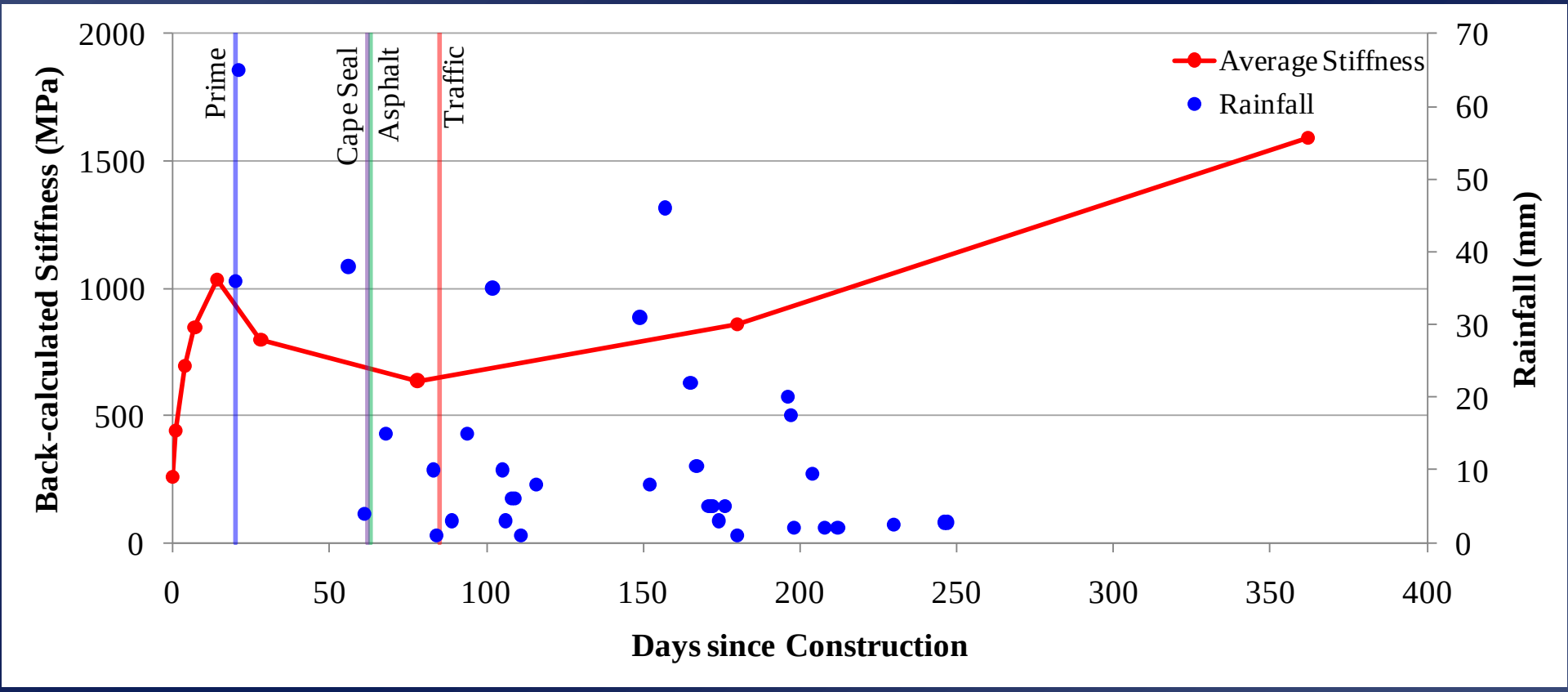

(Lynch & Jenkins)

# 175mm BSM Foam (2.4%b, 2%c) NB



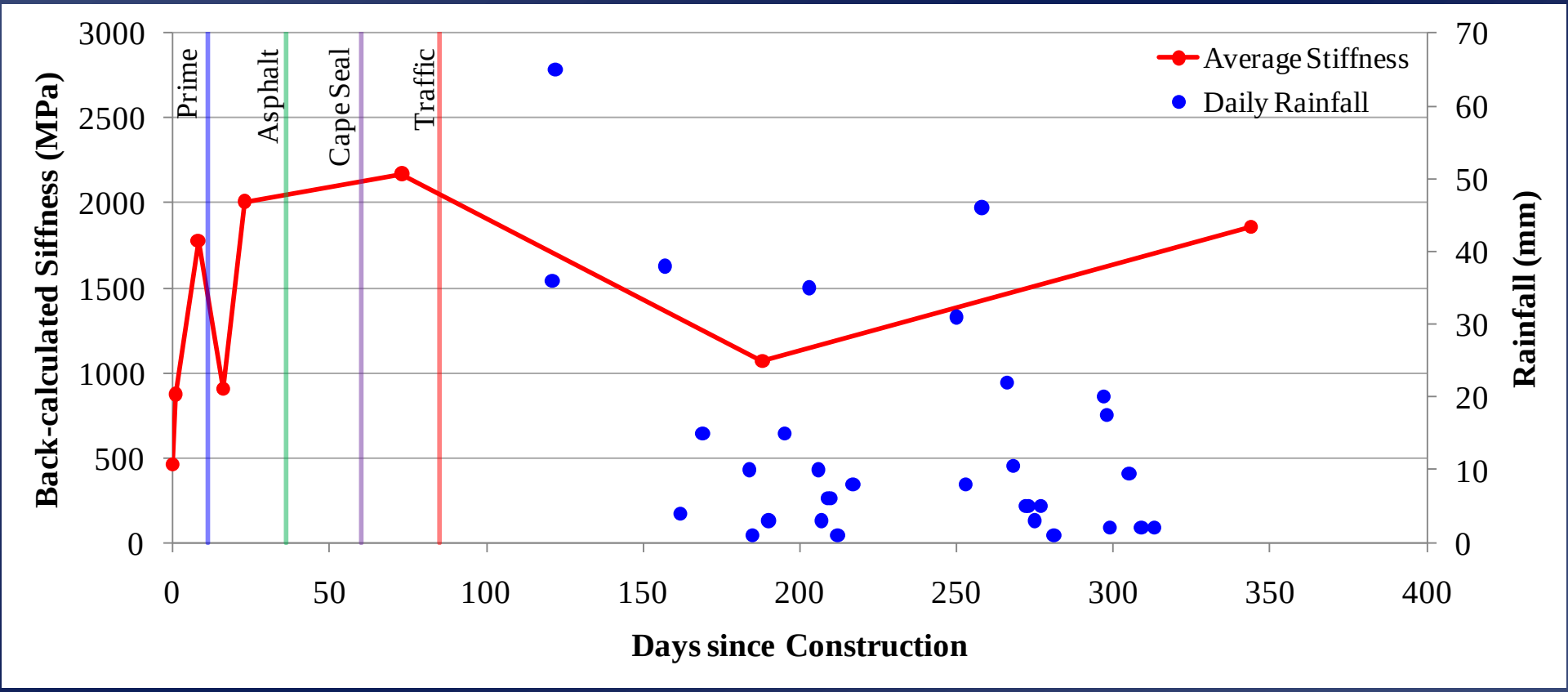

(Lynch & Jenkins)

# 200mm BSM Emulsion (2.4%b, 1%c) NB



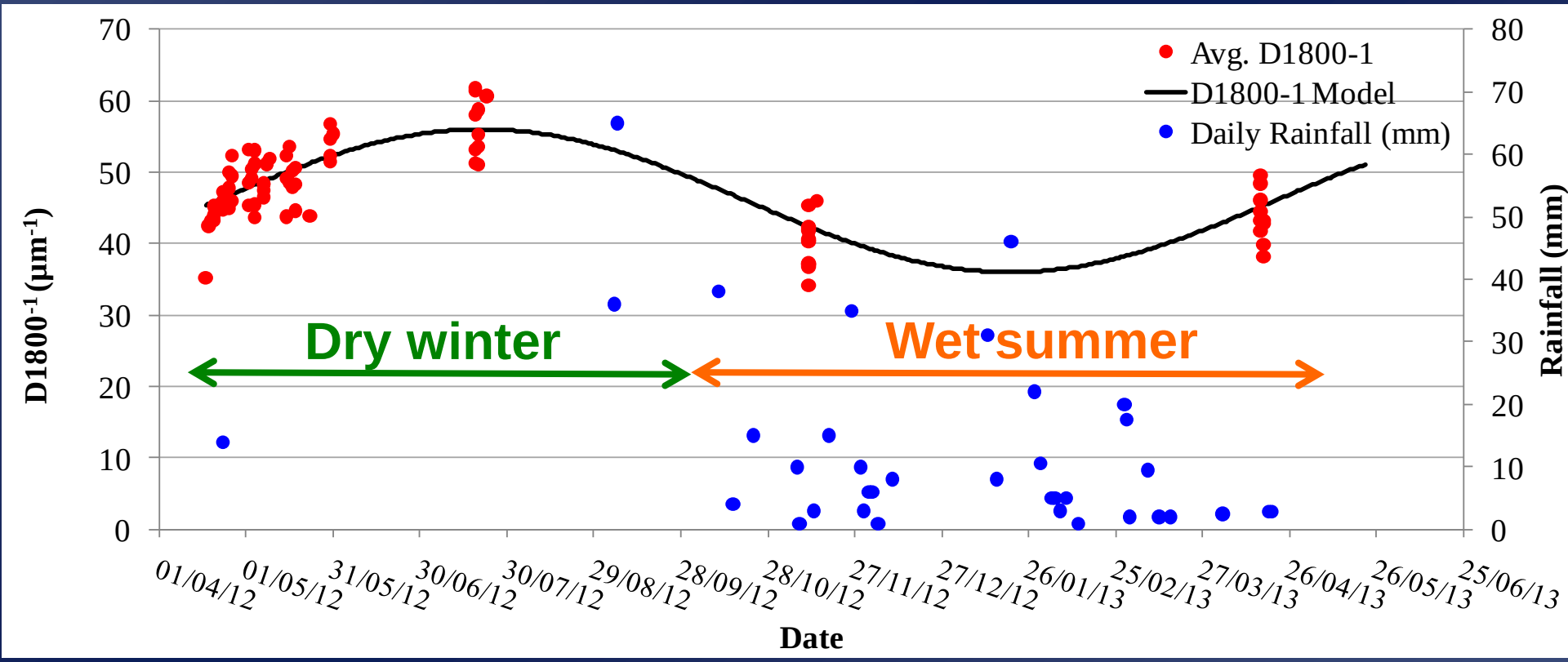

(Lynch & Jenkins)

# 200mm BSM Emulsion (2.4%b, 2%c) SB

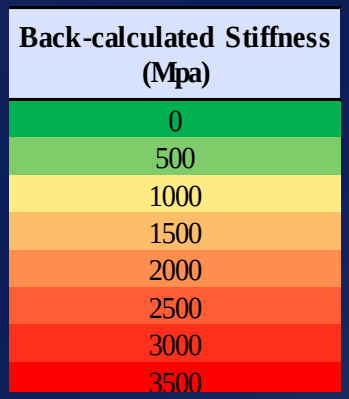



(Lynch & Jenkins)

# Seasonal stiffness variation



# 200mm Cemented (2%c, 1%l) NB



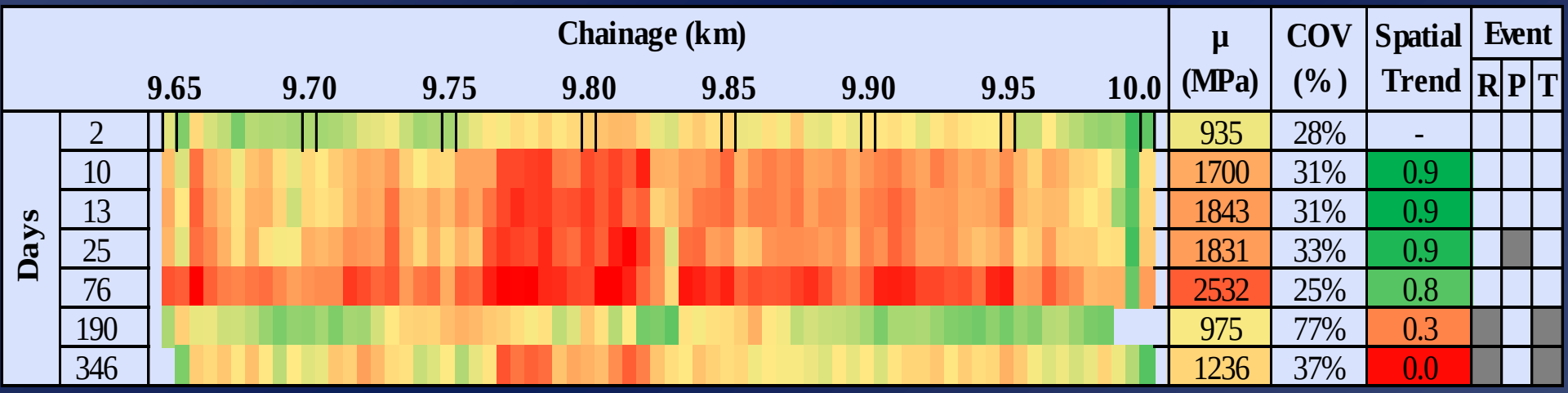

| Days | Chainage (km) 6.50 6.55 6.60 6.65 6.70 6.75 6.80 6.85 | μ (MPa) | COV (%) | Spatial Trend | Event R | Event P | Event T |
|---|---|---|---|---|---|---|---|
| 0 | | 202 | 15% | - | | | |
| 1 | | 349 | 21% | 0.5 | | | |
| 2 | | 527 | 25% | 0.6 | | | |
| 3 | | 638 | 31% | 0.7 | | | |
| 6 | | 888 | 39% | 0.7 | | | |
| 7 | | 884 | 38% | 0.8 | | | |
| 15 | | 1344 | 40% | 0.8 | | | |
| 28 | | 1647 | 35% | 0.8 | | | |
| 93 | | 1017 | 36% | 0.7 | | | |
| 208 | | 1239 | 38% | 0.4 | | | |
| 365 | | 1377 | 38% | 0.5 | | | |

## Spatial and Temporal Variation

(Lynch & Jenkins)

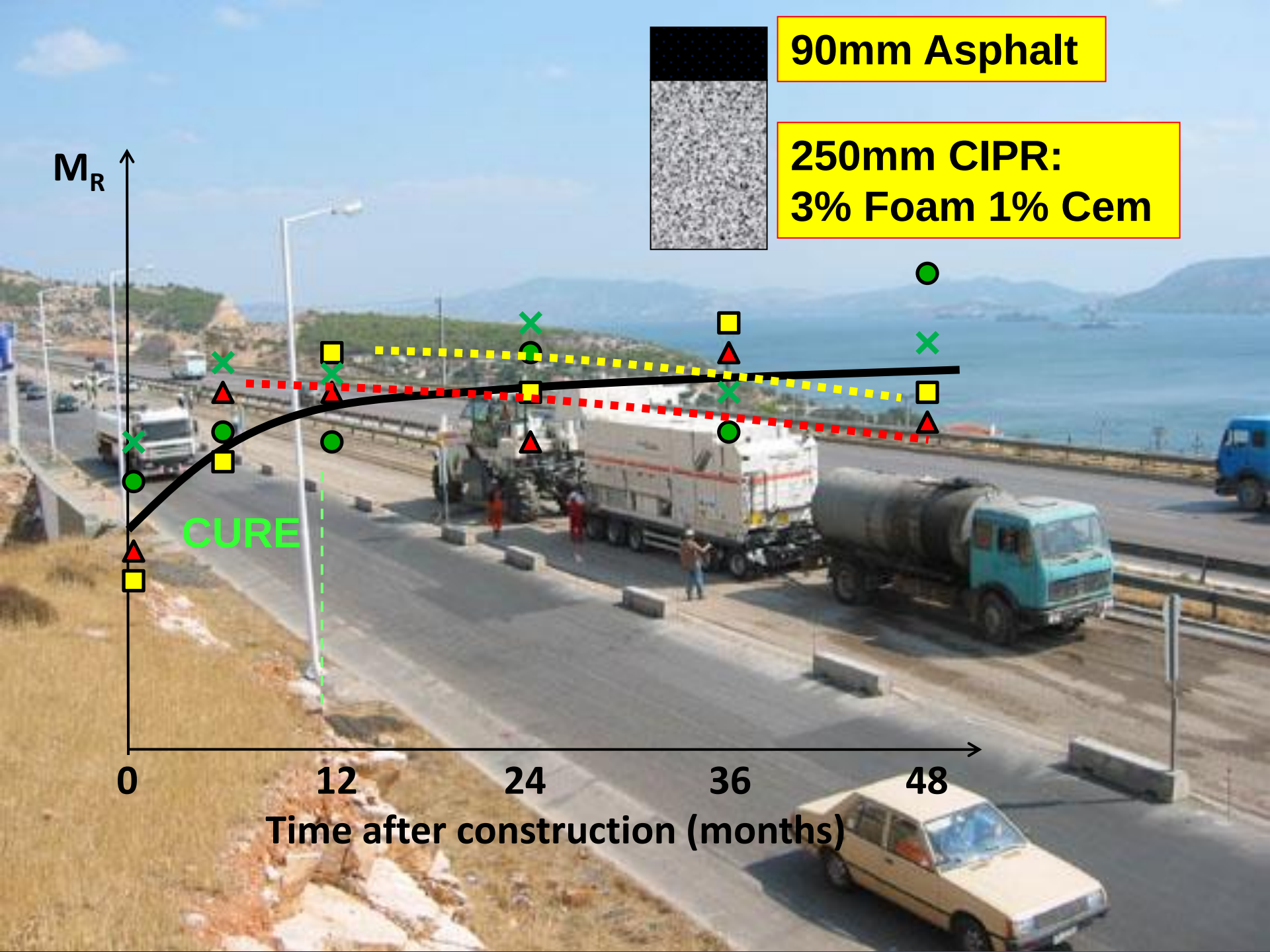
# 200mm BSM foam (2.4%b, 2%c) NB

| Back-calculated Stiffness (Mpa) |
|---|
| 0 |
| 500 |
| 1000 |
| 1500 |
| 2000 |
| 2500 |
| 3000 |
| 3500 |

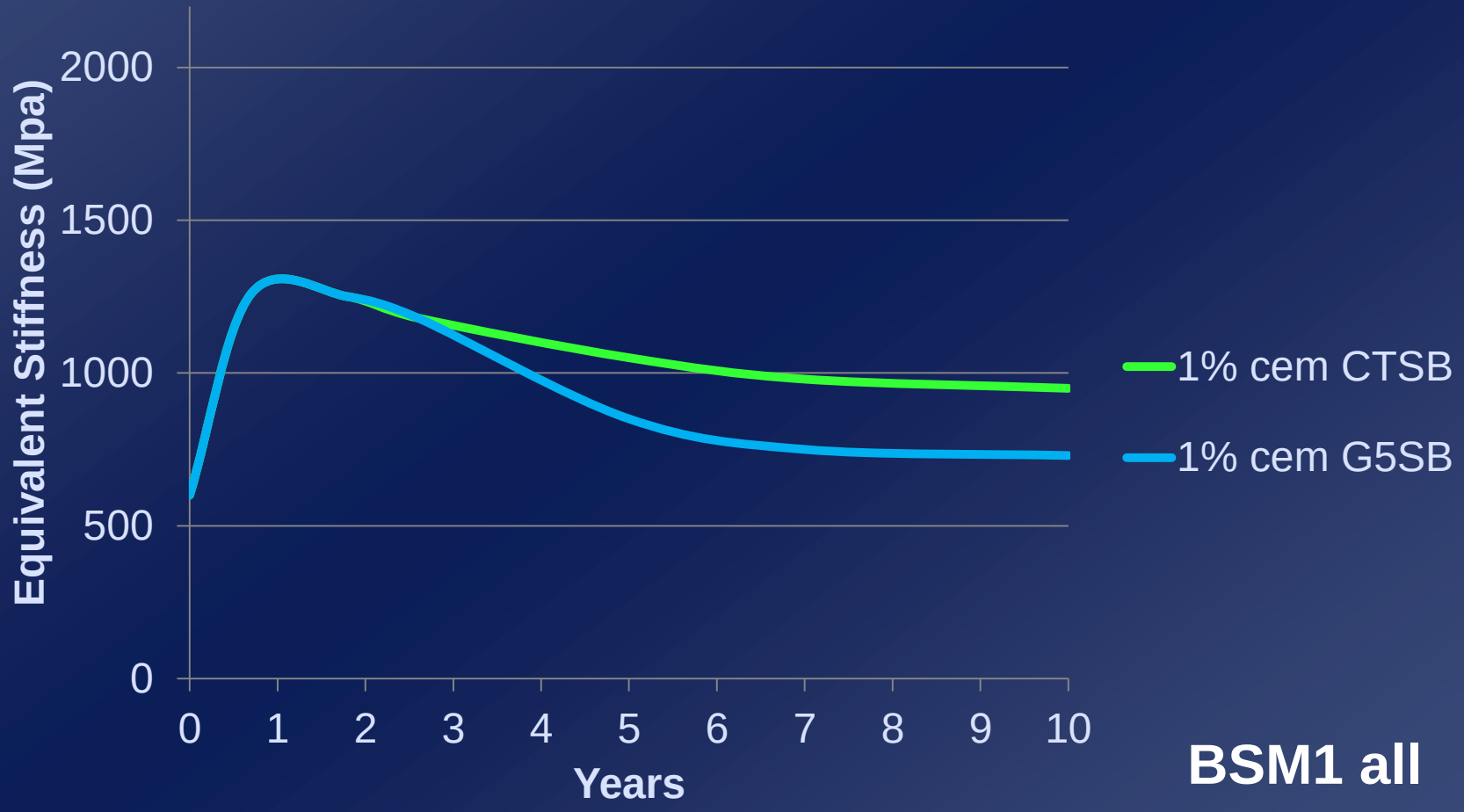



| Days | μ (MPa) | COV (%) | Spatial Trend | Event R | Event P | Event T |
|---|---|---|---|---|---|---|
| 2 | 935 | 28% | - | | | |
| 10 | 1700 | 31% | 0.9 | | | |
| 13 | 1843 | 31% | 0.9 | | | |
| 25 | 1831 | 33% | 0.9 | | | |
| 76 | 2532 | 25% | 0.8 | | | |
| 190 | 975 | 77% | 0.3 | | | |
| 346 | 1236 | 37% | 0.0 | | | |

(Lynch & Jenkins)


90mm Asphalt
250mm CIPR:
3% Foam 1% Cem
$M_R$
CURE
0
12
24
36
48
Time after construction (months)

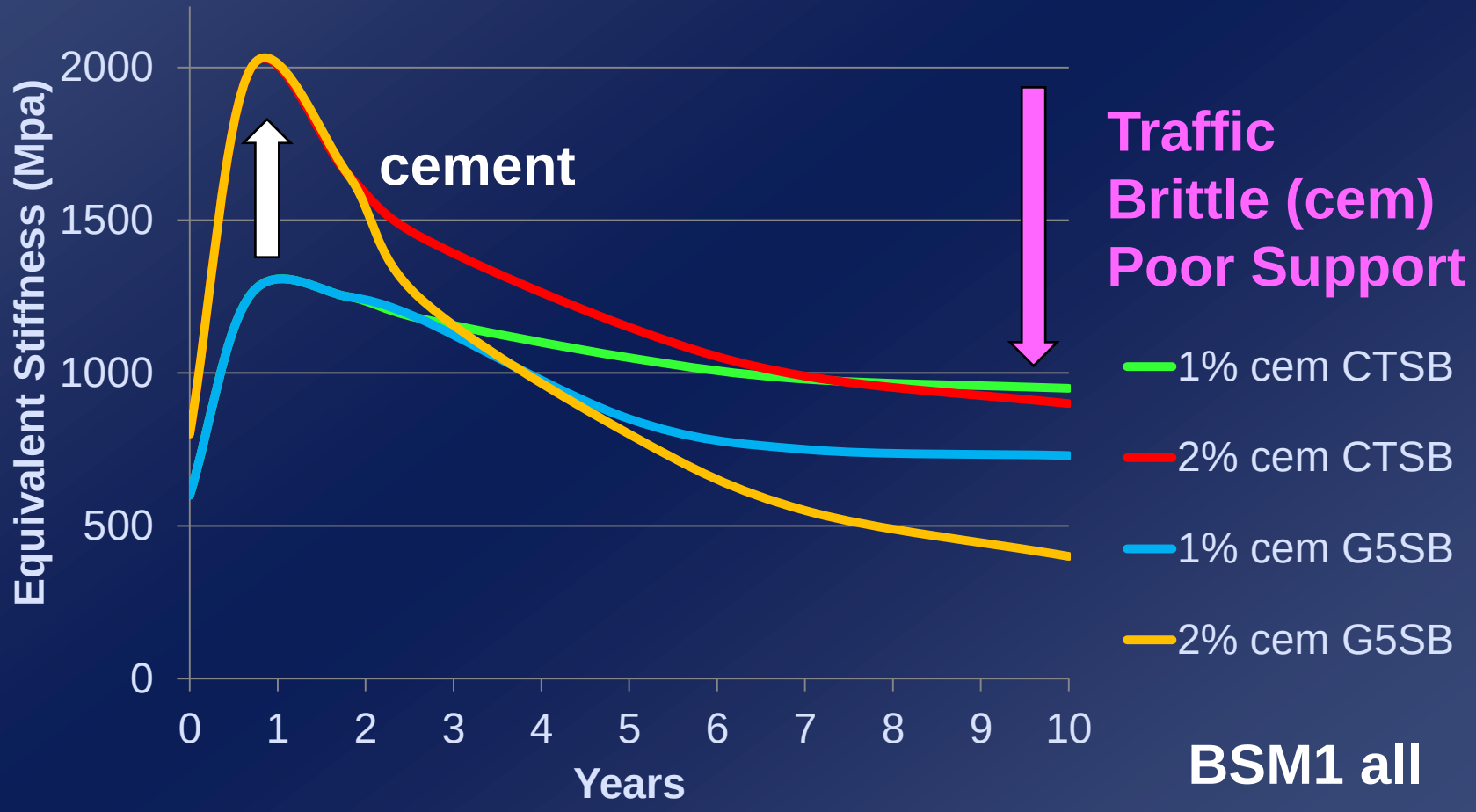
# BSMs Mr change: Effective Long Term Stiffness




**BSM1 all**

**(Jenkins)**

# BSMs Mr change: Effective Long Term Stiffness




**BSM1 all**

**(Jenkins)**

# Trial Section

## Figline Veldarno: Prof A Marradi

# Performance Evaluation

# 2014?

- Preparations for CAPSA 2015
- STAR extension, publications and synthesis
- Conferences to link with
- Etc