


# Bending Beam Fatigue Test – Update

GM Rowe

Mixture ETG Meeting, Salt Lake City  
April 26<sup>th</sup> 2016

# Thanks to our task group

- ▶ Last meeting (yesterday) – to finalize some actions:
    - Attendees
      - Geoff Rowe
      - Bill Criqui
      - David Jones
      - Andrew Cooper
      - Kieran McGrane
  - ▶ Other members not present
    - Phil Blankenship, John Harvey
  - ▶ Objective – to review actions and decisions made – agree path forward
    - 10 Items – see last meeting notes
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# 10 Items

1. Wave form
2. LVDT reference location
3. Rotational and lateral translation at clamping locations
4. Clamping stress
5. Response sampling intervals and numbers
6. Details calculations of each reporting interval
7. Strain level selection for testing
8. Add discussion about test termination and fatigue life where  $N_f$  is desired outcome.  

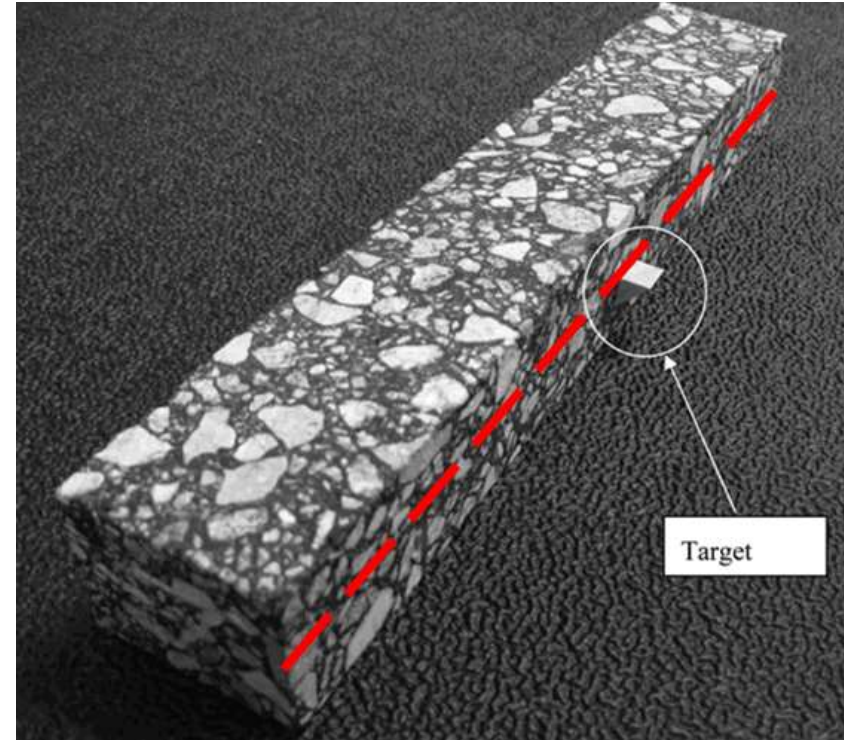
Run test to S.n with at least reduction of 15 % beyond failure defined as S.n peak. Currently in AASHTO and ASTM.
9. Add note about NMAS min and max and variability
10. Minimum results that must be reported

# 1. Wave form

- ▶ Agree that both standards would use sine curve about initial zero position
  - No haversine or versine or offset language in specification
  - Makes specification language simpler
  - Consistent with majority view on what most the majority of tests labs have been doing in the USA
  - Use of other wave forms has shown been shown as not statistically significant in recent review by UC Davis

## 2. LVDT reference location

- ▶ Agreed that all standards would use method that was originally proposed by SHRP A003a research
  - Target reference at mid point of beam on specimen
  - Agreement from major equipment manufactures (IPC, Cooper, James Cox & Sons)
  - Makes this issue of possibly needed two standards go away



### 3. Rotational and lateral translation at clamping locations

- ▶ Consider this is not an issue – just check wording in ASTM and AASHTO
  - Concern had been raised on ASTM wording
  - Equipment provides for this

# 4. Clamping stress

- ▶ Provisional agreement on  $300 \text{ N} \pm 30 \text{ N}$ 
  - With area of  $25 \text{ mm}^2$  – just need to check with manufactures to make sure no issue – but this will be written into both standards

# 5. Response sampling intervals and numbers

- ▶ Agreed that following table will be written into standard

repetitions	Intervals (space equally within each range)	Cycles at each collection points included in average reported
0 to 100	1-10, then every 10 to 100	5 (except for 1-10, report individual cycle)
100 to 1000	10	5
1000 to 10,000	40 equally spaced data points	5
10,000 to 100,000	At least one every 1,000 repetitions	5
100,000 to end of test	At least one every 10,000 repetitions	5

- ▶ Current manufactures already do this – but provides minimum standard acceptable for data capture rate
- ▶ Needed to ensure adequate data to fully capture peak that is needed to define the failure location in the test



## 6. Details calculations of each reporting interval

- ▶ Manufactures both noted that they have been implementing the AASHTO TP79/NCHRP 9-29 methods
  - Asked both to check
  - Refine report value to include errors reported in TP79
- ▶ *Essential agreement on way forward – check will be done!*

# 7. Strain level selection for testing

- ▶ Dave Jones will provide a guidance note on this
- ▶ Advice to user about how to start test – depends upon initial stiffness estimate for beam
  - No disagreement on need for this

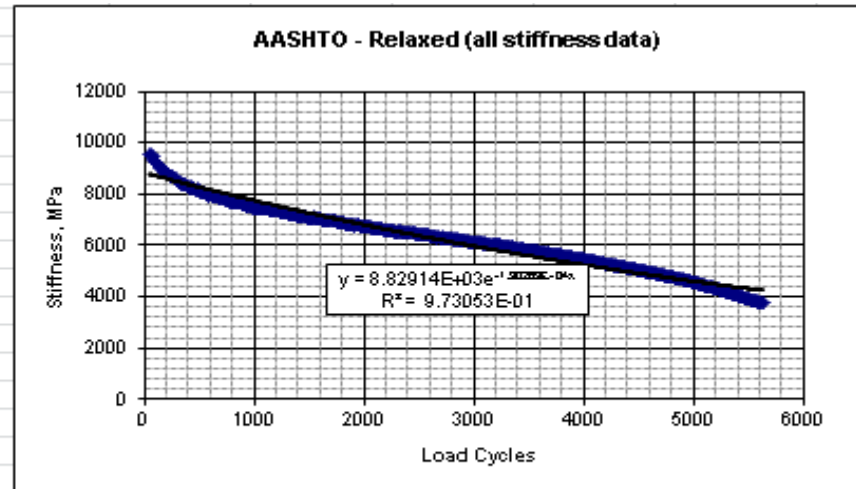
## 8. Add discussion about test termination and fatigue life where $N_f$ is desired outcome.

- ▶ Run test to  $S_n$  with at least reduction of 15 % beyond failure defined as  $S_n$  peak. Currently in AASHTO and ASTM.
  - Need to have equipment manufactures terminate test on this criteria
    - Essential agreement – does depend on manufactures workload
    - User has to currently set a lower stiffness – which results in longer test times
- ▶ Agreement on use of six order poly fit with differential method – rather than having choice of procedures
  - Make same in both ASTM and AASHTO standards

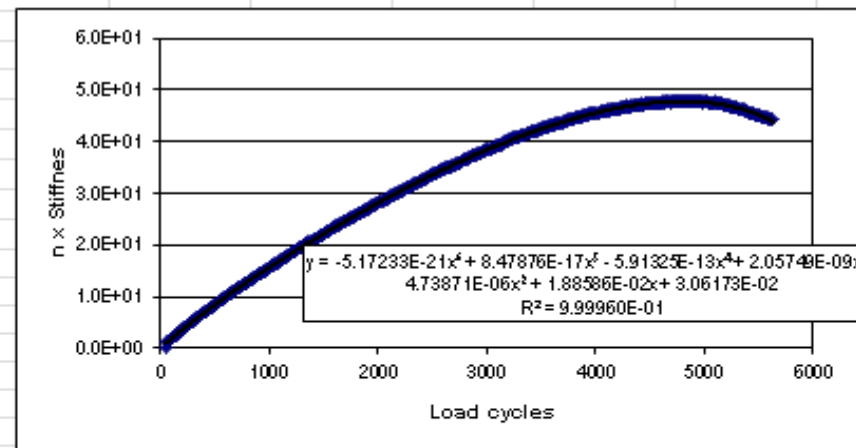
# 8. cont.

AASHTO - relaxed - all data	
Stiffness measured, N=50	9,570
A	8.83E+03
b	-1.30E-04
$N_{r50}$	<b>5,321</b>
% of Stiffness (N=50) at Termination	<b>39.3</b>

Difference in AASHTO and compared to 50%	
50% of measured stiffness	4,785
First record below	4,790
Point when all records below	4,790
Average	<b>4,790</b>
Percent error (AASHTO methods)	16%
Percent error (AASHTO vs. 50%)	29%



ASTM Method	
6-order poly fit method	
-5.17E-21	$x^6$
8.48E-17	$x^5$
-5.91E-13	$x^4$
2.06E-09	$x^3$
-4.74E-06	$x^2$
1.89E-02	$x^1$
dy/dx = 0 at turning point	
dy/dx	0.00
x (by POLY/SOLVER)	<b>4,796</b>
Max (strict definition)	22928014
x (at Max)	<b>4,720</b>



Specimen Ref.	$S_{mix, n=50}$	$S_{mix, AASHTO A}$	AASHTO (S)	AASHTO (R)	% Stiff @ Term	50%	ASTM (poly)	ASTM (max)
12.5mm 64-22 600ms	9,570	8,484	<b>6,173</b>	<b>5,321</b>	<b>39.3</b>	<b>4,790</b>	<b>4,796</b>	<b>4,720</b>
Specimen Ref.	$S_{mix, n=50}$	$S_{mix, AASHTO A}$	AASHTO (S)	AASHTO (R)	% Stiff @ Term			
12.5mm 64-22 600ms	9,570	9,003	<b>5,181</b>	<b>5,181</b>	<b>57.0</b>			

## 9. Add note about NMAS min and max and variability

- ▶ Agreed – use note from ASTM standard!
  - Make same note for both standards

# 10. Minimum results that must be reported

- ▶ Agreed to make consistent with item 5 and item 6
  - Will add errors reported – but a small change to both standards

# New practice

- ▶ Needed for “Use of and Interpreting Bending Beam Fatigue Results”
  - Number of results vs. confidence in result
  - Specification advice
  - Averaging results – log basis not linear
  - How to make a fatigue curve
- ▶ Will be drafted by next meeting

# Actions

- ▶ AASHTO T321
  - Geoff Rowe – Need to get edits to standard – what date needed by?
  - Need action by AASHTO asap!
  - A few typos to fix as well!
- ▶ ASTM D7460
  - Bill Criqui – Need to update draft for ASTM ballot – needed by next week?
- ▶ New practice
  - Geoff Rowe to draft outline a key items and send to group by mid year
  - Goal to present at next ETG as draft – go to AASHTO end of 2016/2017



# Thanks to our task group!

.... and greetings from those  
back home

