



HORIZON 2020

TRUSS

Training in Reducing Uncertainty
in Structural Safety

ESR₁₁: António Barrias



UNIVERSITAT POLITÈCNICA
DE CATALUNYA
BARCELONATECH

Development of optical fibre distributed sensing
for SHM of bridges and large scale structures



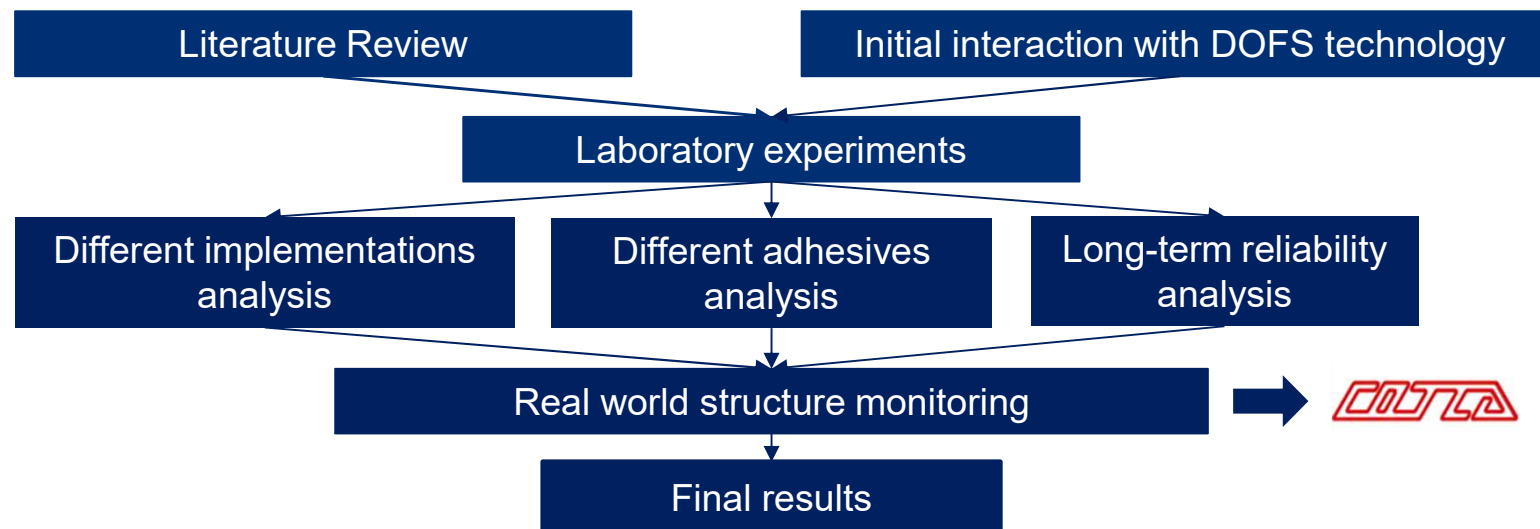
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Research

Overall goals of the project: “...*to study the spatial resolution and strain accuracy obtained with optical distributed fibre when applied to concrete elements, and to see the potentiality of detecting crack or abnormal deflections without failure or debonding. Therefore, the **most suitable bonding adhesives as well as the technique of attachment of the fibre to the concrete will be investigated** (...)*”





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Research

In this way and having these goals in mind, the ESR during the conduction of this project has contributed with the following points for this topic state of the art:

- A novel implementation technique of the fiber to a reinforced concrete (RC) member was proposed and analysed;

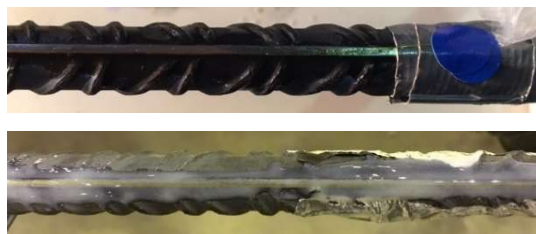


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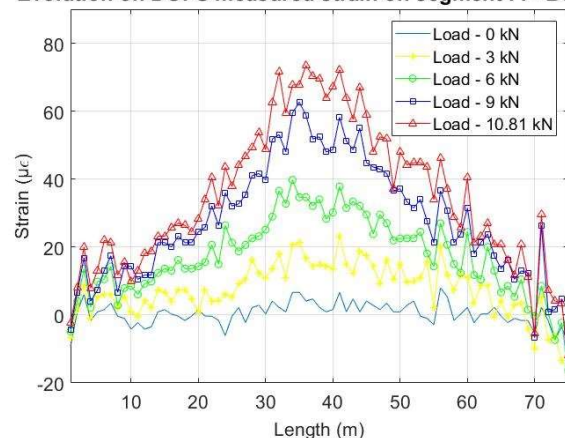
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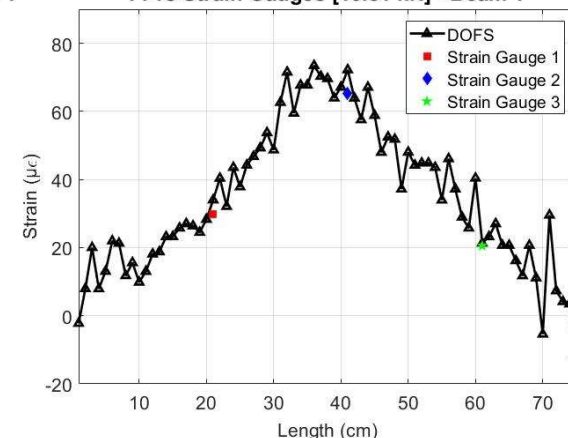
Research



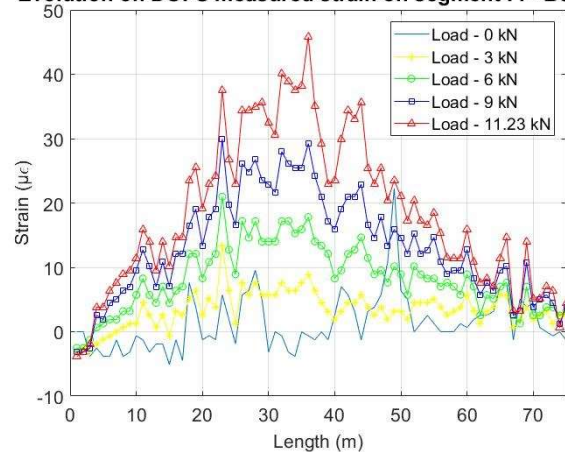
Evolution on DOFS measured strain on segment FI - Beam 1



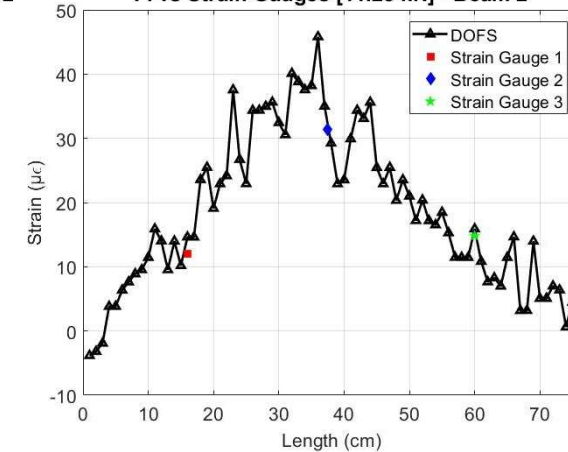
FI vs Strain Gauges [10.81 kN] - Beam 1

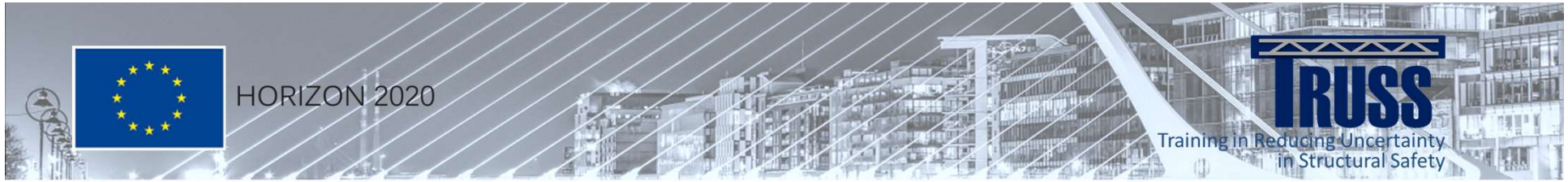


Evolution on DOFS measured strain on segment FI - Beam 2



FI vs Strain Gauges [11.23 kN] - Beam 2





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- Different bonding adhesives for the implementation of DOFS to concrete members was performed and assessed;



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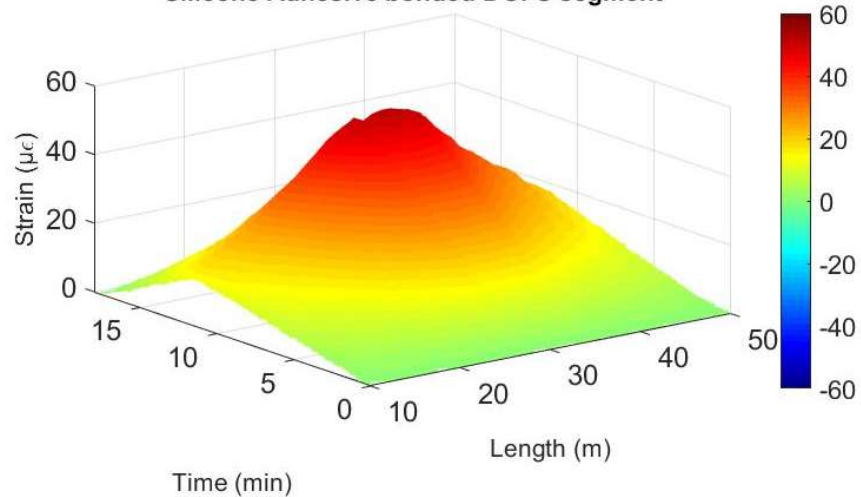
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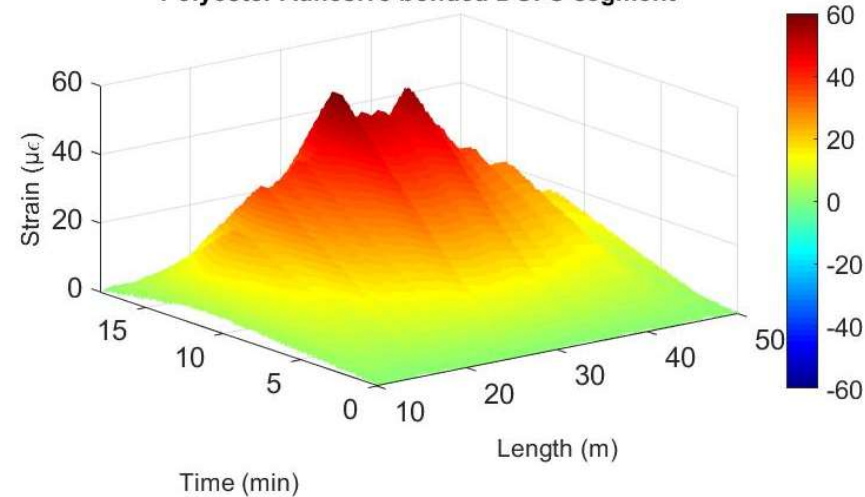
Research

BEAM - BOTTOM VIEW

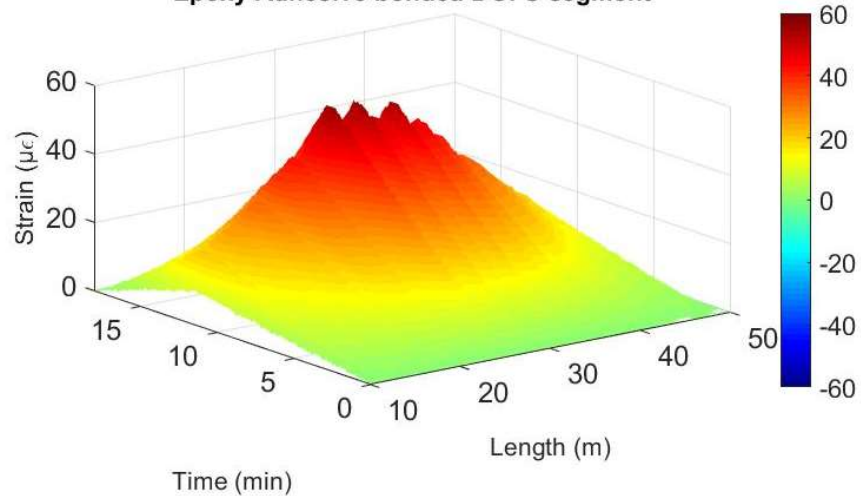
Silicone Adhesive bonded DOFS segment



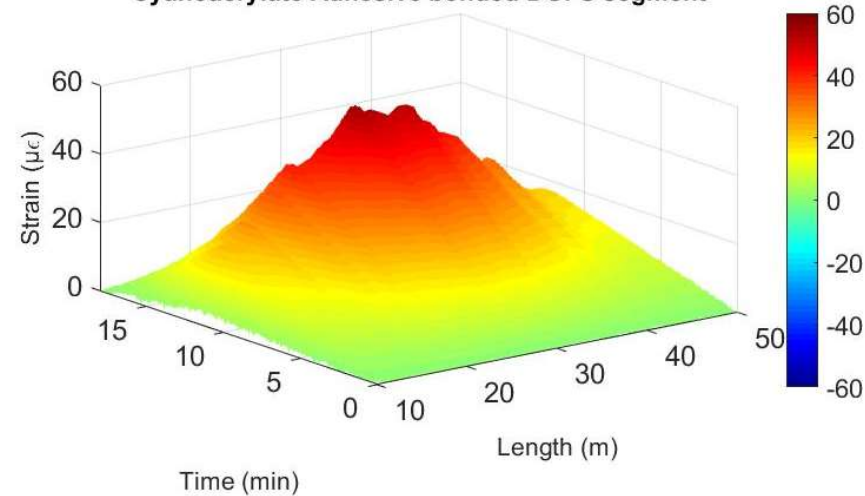
Polyester Adhesive bonded DOFS segment

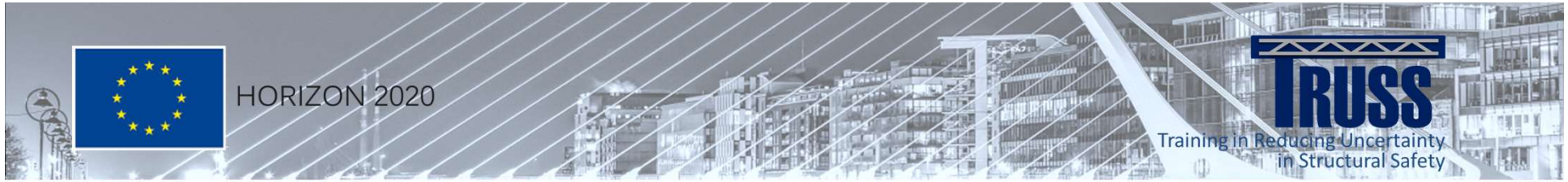


Epoxy Adhesive bonded DOFS segment



Cyanoacrylate Adhesive bonded DOFS segment





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- Different bonding adhesives for the implementation of DOFS to concrete members was performed and assessed;
- A study of the influence of the inputted spatial resolution on DOFS measurements was conducted;

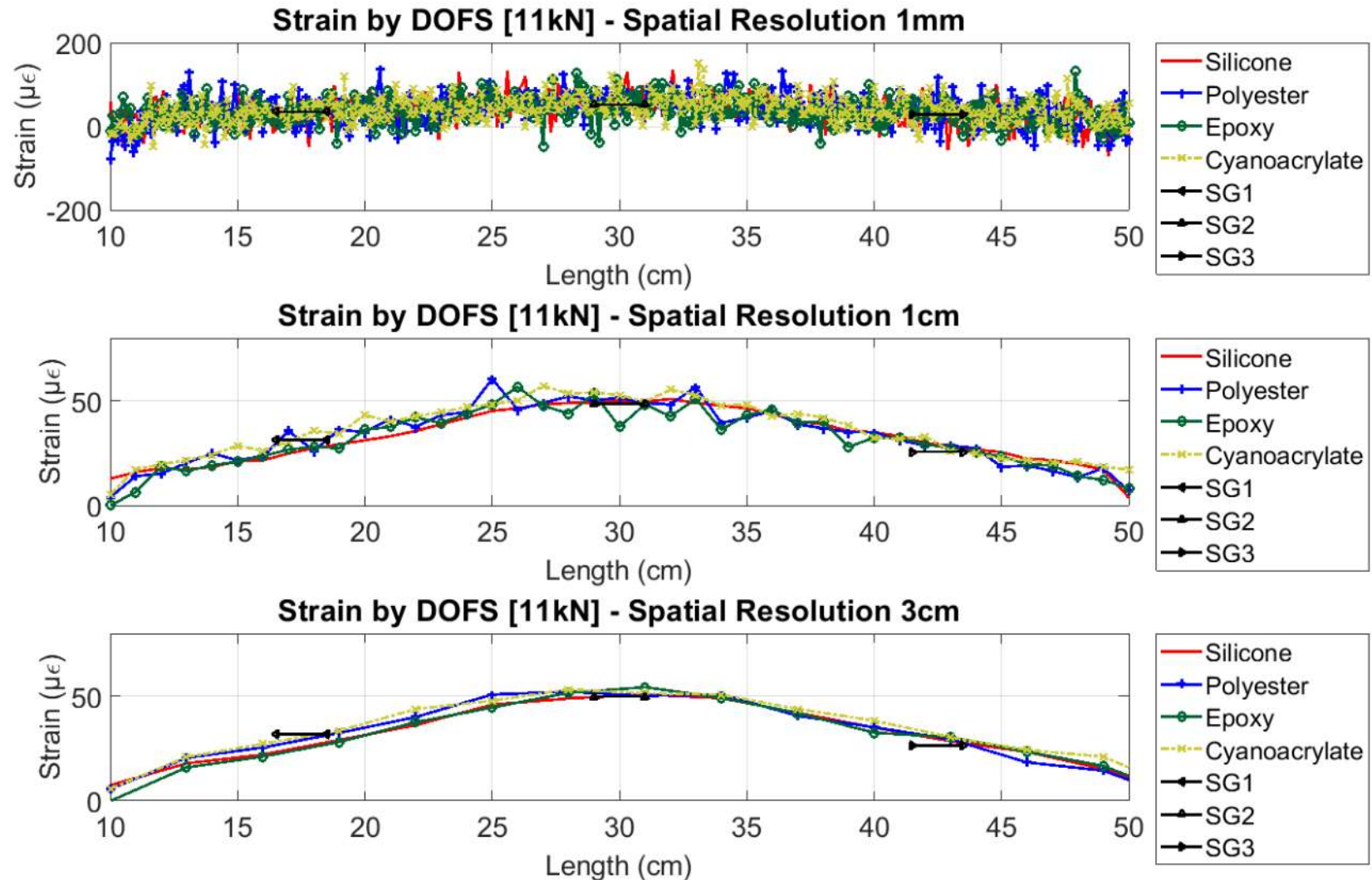


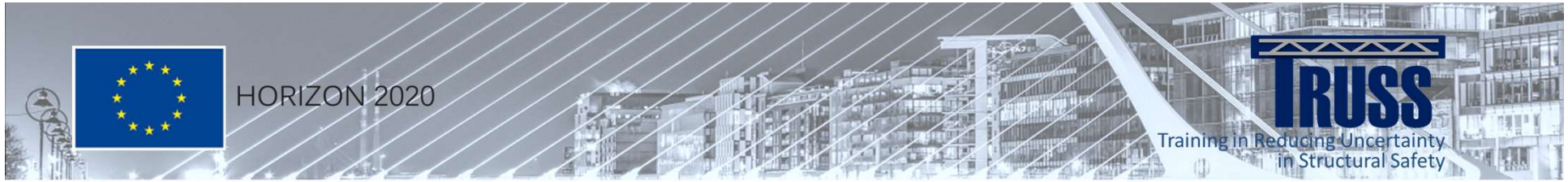
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- Different bonding adhesives for the implementation of DOFS to concrete members was performed and assessed;
- A study of the influence of the inputted spatial resolution on DOFS measurements was conducted;
- It was evaluated the performance of DOFS when instrumented to RC members under a high number of load cycles in order to replicate the long-term reliability of this technology when applied in a standard bridge structure.



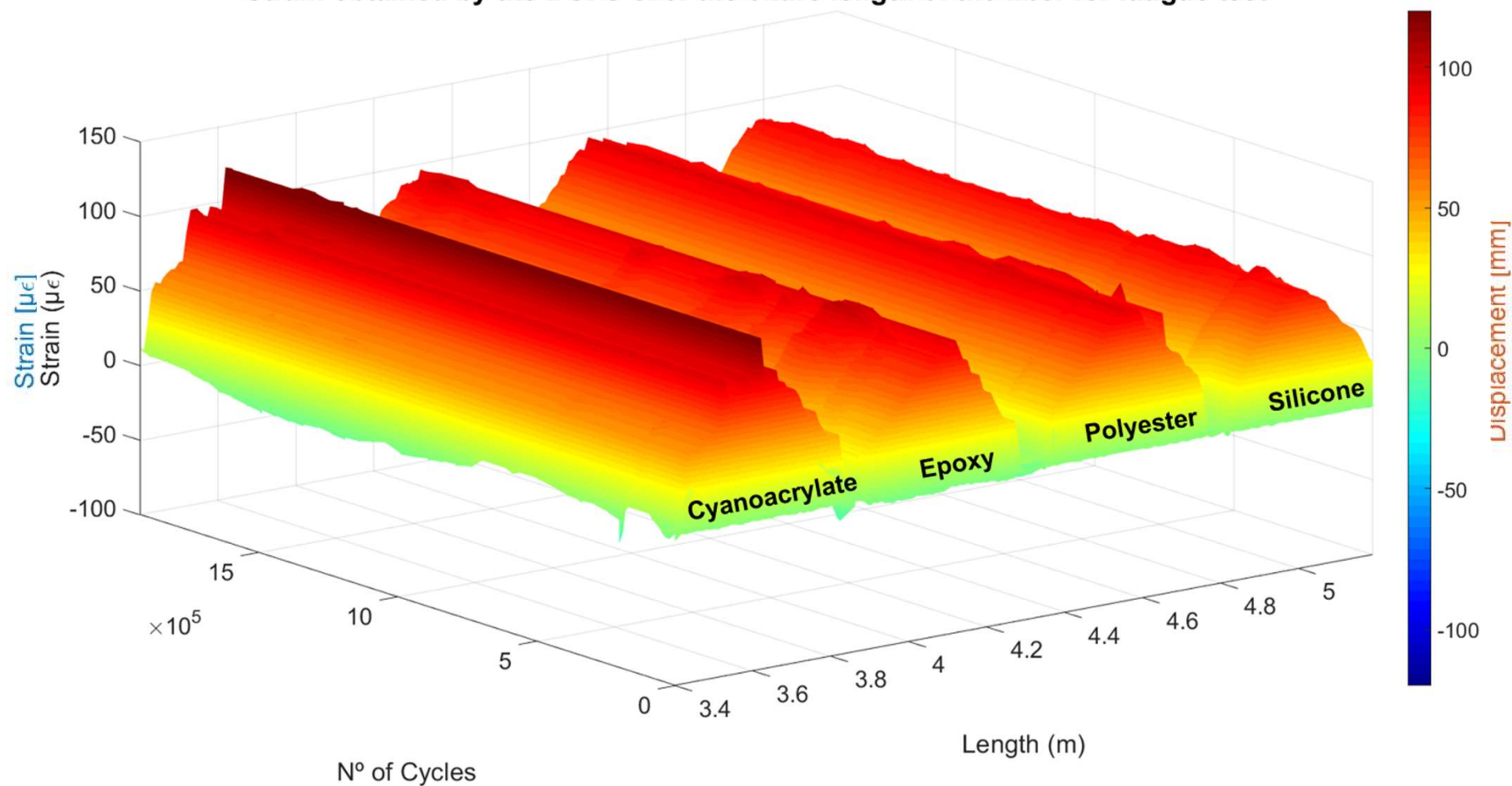
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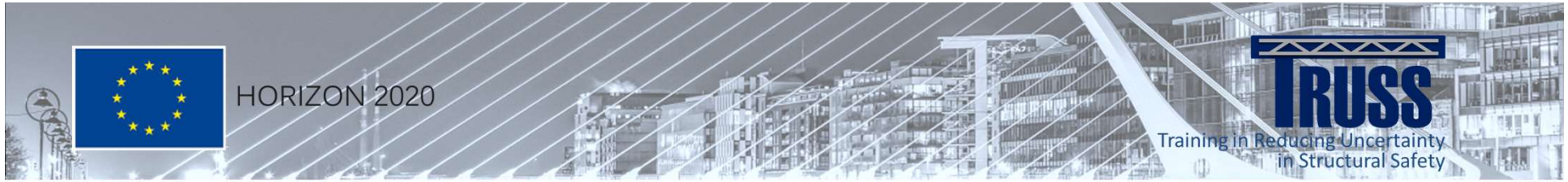
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Strain obtained by the DOFS over the entire length of the fiber for fatigue test





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- Different bonding adhesives for the implementation of DOFS to concrete members was performed and assessed;
- A study of the influence of the inputted spatial resolution on DOFS measurements was conducted;
- It was evaluated the performance of DOFS when instrumented to RC members under a high number of load cycles in order to replicate the long-term reliability of this technology when applied in a standard bridge structure.
- Finally, it was performed the deployment of this technology in two real world structures in Barcelona where new imperative conditions had to be addressed such as the long-term effect of temperature variation and its compensation.



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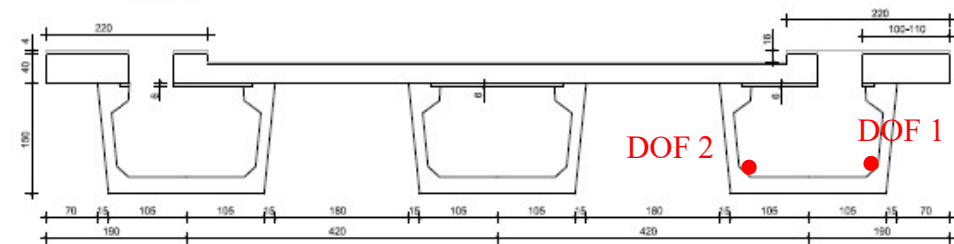
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Rehabilitation works on Sarajevo bridge in Barcelona



Bridge Cross Section
scale 1:50



Work Station 

Distributed Optical Fiber sensor 



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Training

Type	Type of Activity	Start date	End date	Title of course/conference/activity and location	No. hours	Total hours
W	Seminar (<=1 day)	05/04/17	05/04/17	"Corrosion detection in concrete bridges" presented by Prof. Al Ghorbanpoor from University of Wisconsin-Milwaukee	1	10
L	Language Course	09/03/17	01/06/17	Catalan language course Elemental 1, UPC, Barcelona, Spain	75	325
W	Workshop	24/05/17	24/05/17	TRUSS Workshop on Structural Safety and Infrastructure Management	4,5	12
C	Outreach(open day, talks)	08/06/17	08/06/17	Open day activity of the UPC's doctoral school	3	
W	Conference	18/06/17	22/06/17	European Safety and Reliability Conference (ESREL 2017) at Portoroz, Slovenia	24	
L	Course (>1 day)	17/07/17	04/08/17	2017 Asia-Pacific-Euro Summer School on Smart Structures Technology (APESST)	120	50
C	Conference	22/07/17	23/07/17	ANCRISSST 2017 Conference	12	
C	Conference	10/09/17	13/09/17	X International Conference on Structural Dynamics (EURODYN 2017)	18	
L	Conference	19/09/17	23/09/17	39th IABSE Symposium	18	
C	Workshop	20/09/17	20/09/17	Bridge Dynamic Response by Design	9.5	50
L	Laboratory Test	26/10/17	11/12/17	Laboratory test with four concrete beams instrumented with DOFS		
C	Conference	09/07/18	13/07/18	IABMAS 2018	24	50
S	Conference	22/07/18	25/07/18	7th World Conference on Structural Control and Monitoring	18	
(L	Workshop	29/08/18	30/08/18	Civil Engineering Research in Ireland CERI 2018	6	
m	Conference	29/08/18	31/08/18	12th fib International PhD-Symposium in Civil Engineering	12	6
M	Conference	28/10/18	31/10/18	IALCCE 2018		



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Dissemination

Type of Publication	Start date (only if confere...)	End date	Title of Publication	Authors (in the same order as published)	Full ref.(name,location or volume, page nos.,year)	Brief description of activity
Conference publication	29/08/18	31/08/18	Performance analysis of Distributed Optical Fiber Sensors on reinforced concrete elements under fatigue testing	Barrias A., Casas J.R. and Villalba S.	12th fib International PhD Symposium in Civil Engineering, Prague, Czech Republic	Accepted
Conference publication	28/10/18	31/10/18	On the bonding performance of distributed optical fiber sensors (DOFS) in structural concrete	Barrias A., Casas J.R. and Villalba S.	The Sixth International Symposium on Life-Cycle Civil Engineering, Ghent, Belgium	Accepted
Journal publication		26/03/18	Embedded distributed optical fiber sensors in reinforced concrete structures: a case study	Barrias A., Casas J.R. and Villalba S.	Sensors, 18(4), 980, 2018	Published
Journal publication			Distributed optical fiber sensors in concrete structures: Performance of bonding adhesives and influence of spatial resolution	Barrias A., Casas J.R. and Villalba S.		Under revision
Journal publication			Fatigue performance of distributed optical fiber sensors in reinforced concrete elements (DOFS)	Barrias A., Casas J.R. and Villalba S.		Under revision
Conference publication	18/09/17	23/09/17	Performance assessment of embedded distributed optical fiber sensors in reinforced concrete structures	Barrias A., Casas J.R. and Villalba S.	39th IABSE Symposium	Presentation of paper



Outreach

UPC Open Day 2017

