

# BETTER ROADS

STATE-OF-THE-ART TECHNIQUES IN CRACK DETECTION AND UTILIZING INNOVATIVE MATERIALS FOR THE REPAIR AND MAINTENANCE OF ROADS

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# QUALITY OF ROADS

- ESSENTIALS PART OF COUNTRY'S ECONOMY
- WORLD ECONOMIC FORUM RANKED NORWAY IN 2015-16: 67TH GLOBALLY (INDEX 4.1)  
(WHERE 1 = EXTREMELY UNDERDEVELOPED; 7 = EXTENSIVE AND EFFICIENT BY INTERNATIONAL STANDARDS)
- COUNTRIES WITH SIMILAR TERRAINS
  - SWITZERLAND – 7TH (INDEX 6.0)
  - FINLAND – 12TH (INDEX 5.7)
  - SWEDEN – 21ST (INDEX 5.3)



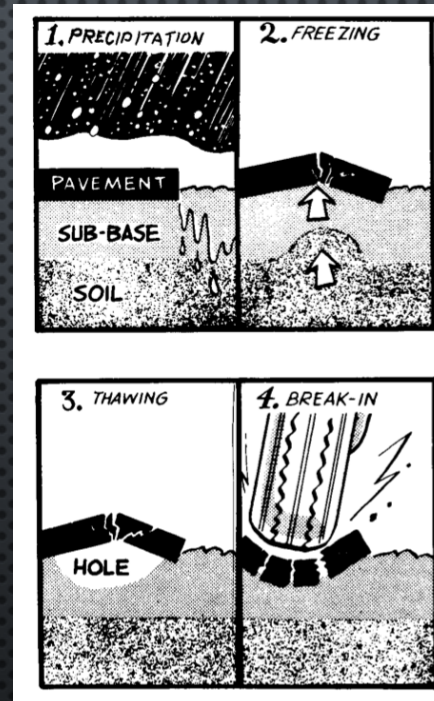


# CONSTRUCTION LAYERS





# CRACKS AND POTHOLES





# CRACKS AND POTHOLES CONT....





# INSPIRATION

WE CANNOT SOLVE OUR PROBLEMS WITH THE SAME THINKING WE USED WHEN WE CREATED THEM.

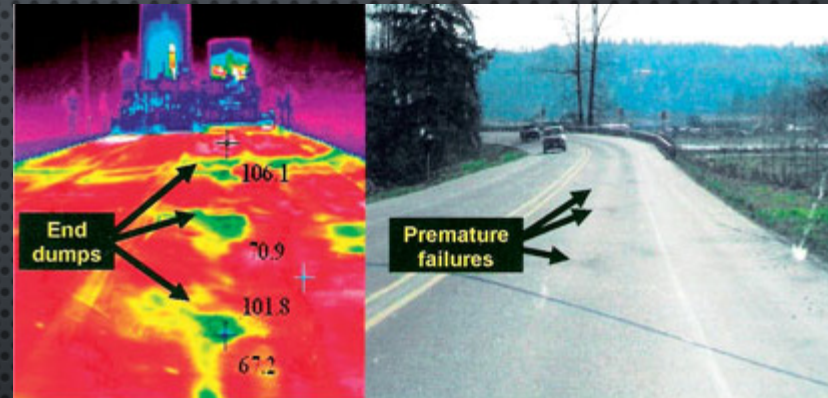
ALBERT EINSTEIN





# DETECTION TECHNOLOGY

- THERMOGRAPHY
- GEOLOGICAL SURVEY
- ULTRASOUND



IN SUPPORT WITH INFRARED, SPECTROSCOPY AND NUMERICAL MODELLING RESEARCH GROUP AT  
THE ARCTIC UNIVERSITY OF NORWAY





# REMEDY: ICEFREE®/ISFRI® FILLER MATERIAL

- LAB TESTED – UIT, TROMSØ, NORWAY
- ENVIRONMENTALLY CERTIFIED (ACCORDING TO ISO STANDARDS)

FOUND TO BE RELIABLE AND EFFECTIVE SOLUTION.

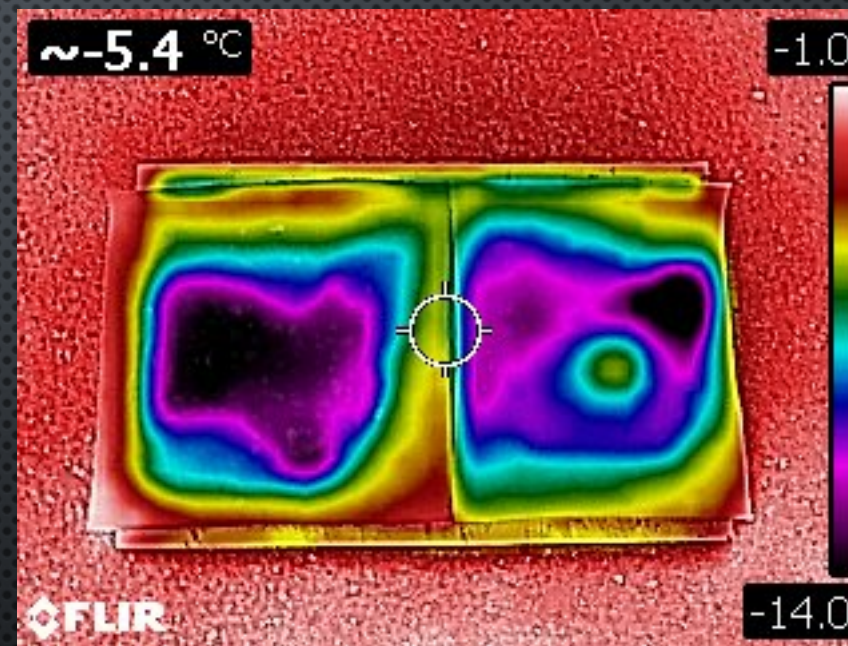




# PRELIMINARY EXPERIMENTS



Layer of ice

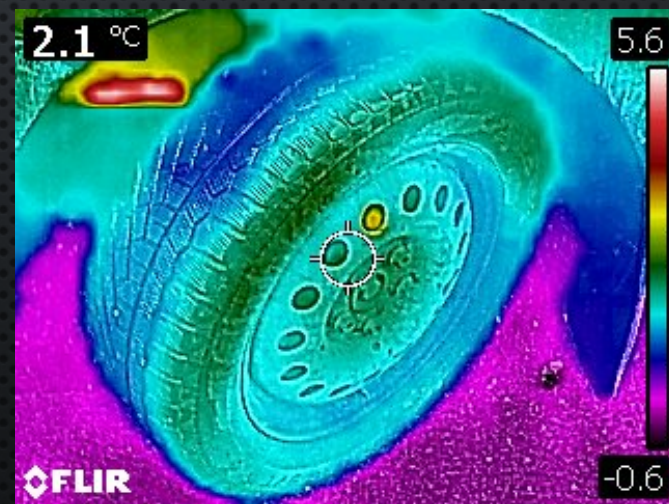
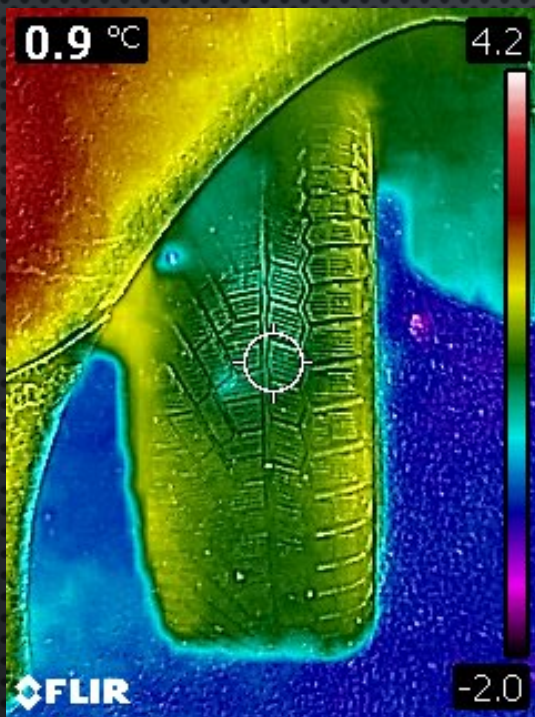


Corresponding IR Image





# NON-STUDDDED WINTER TIRE



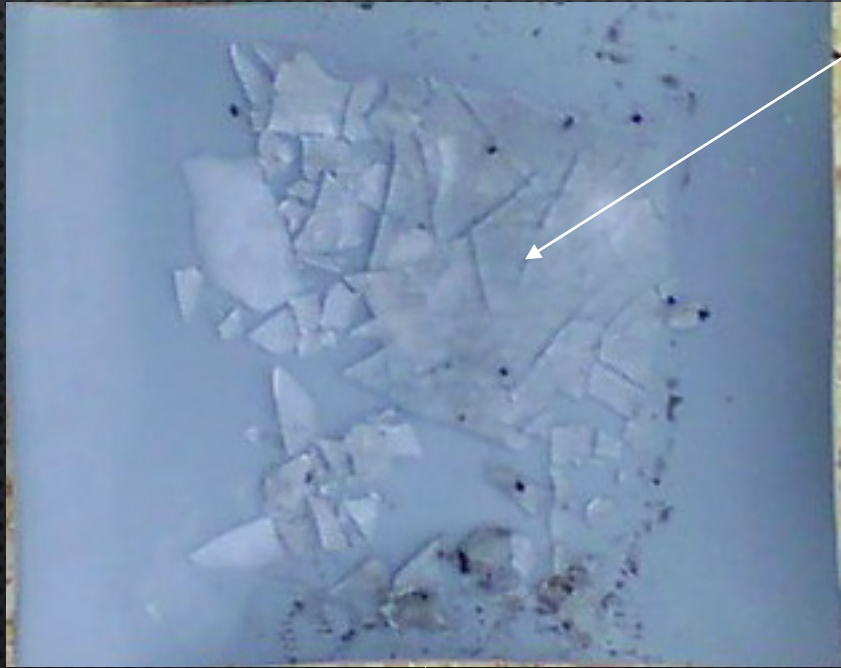
\*Courtesy of Kåre Edvardsen



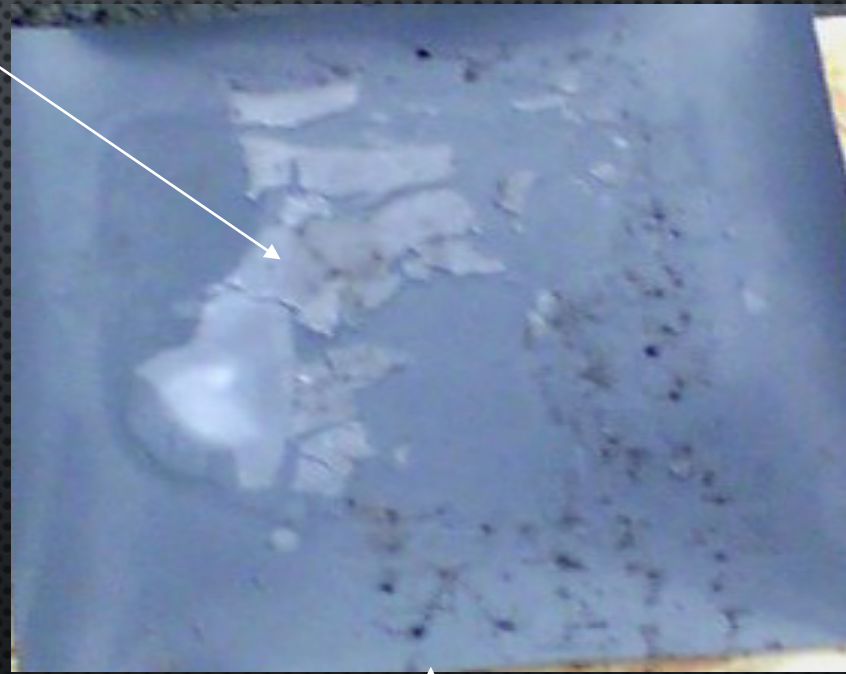


# TIRE PASSED AT DEAD SLOW SPEED

Ice fractures and separates



↑  
Drive Direction

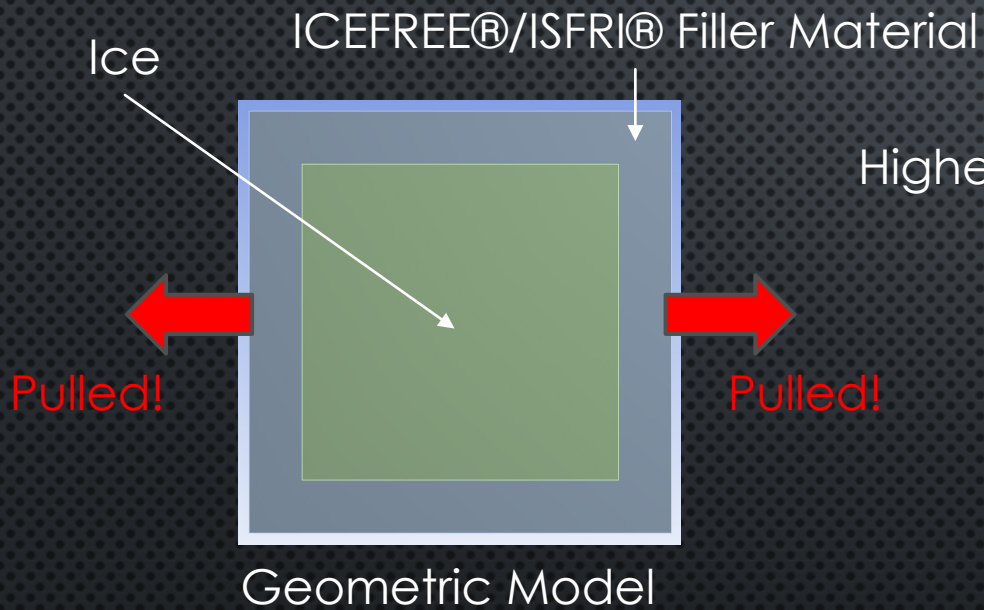


↑  
Drive Direction

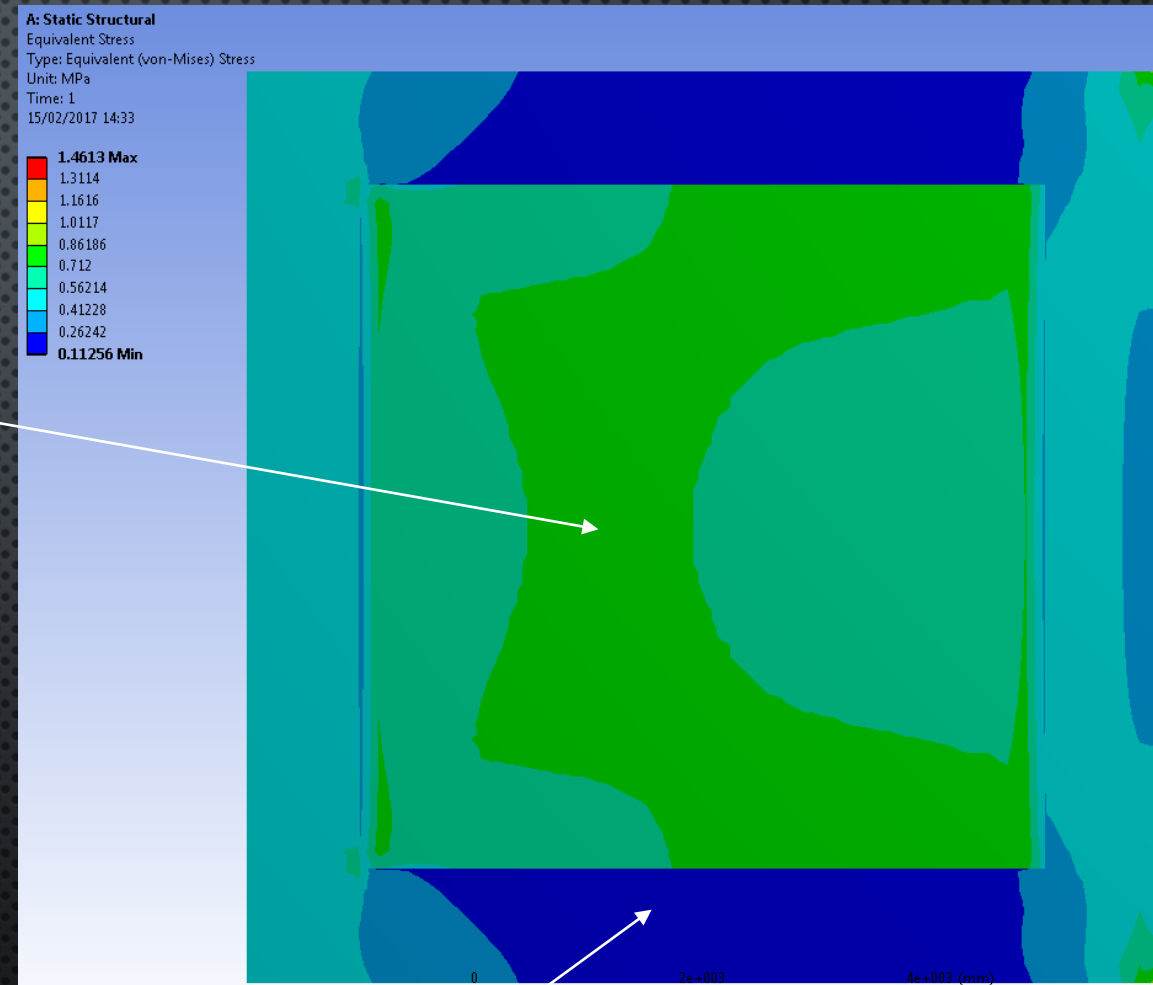




# ANSYS® SIMULATION



Higher stresses

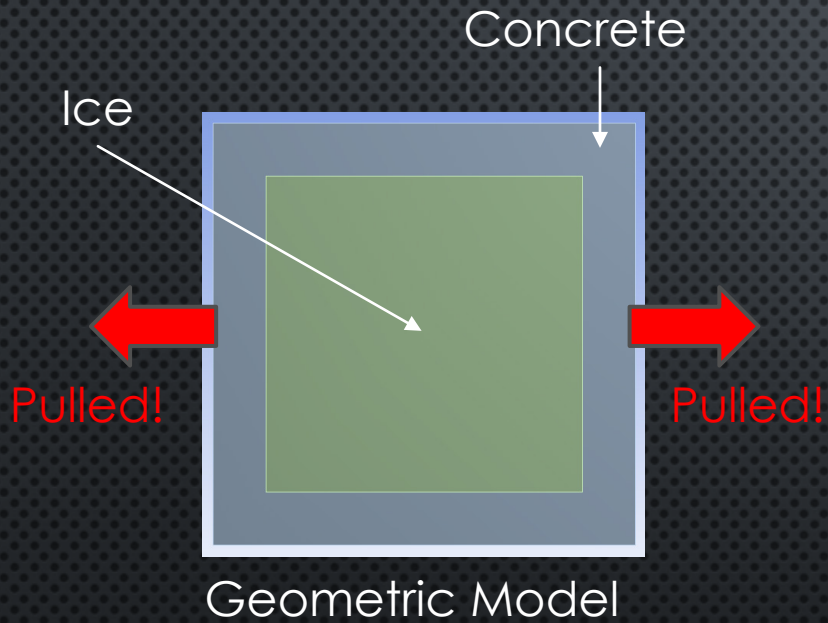


Lower stresses

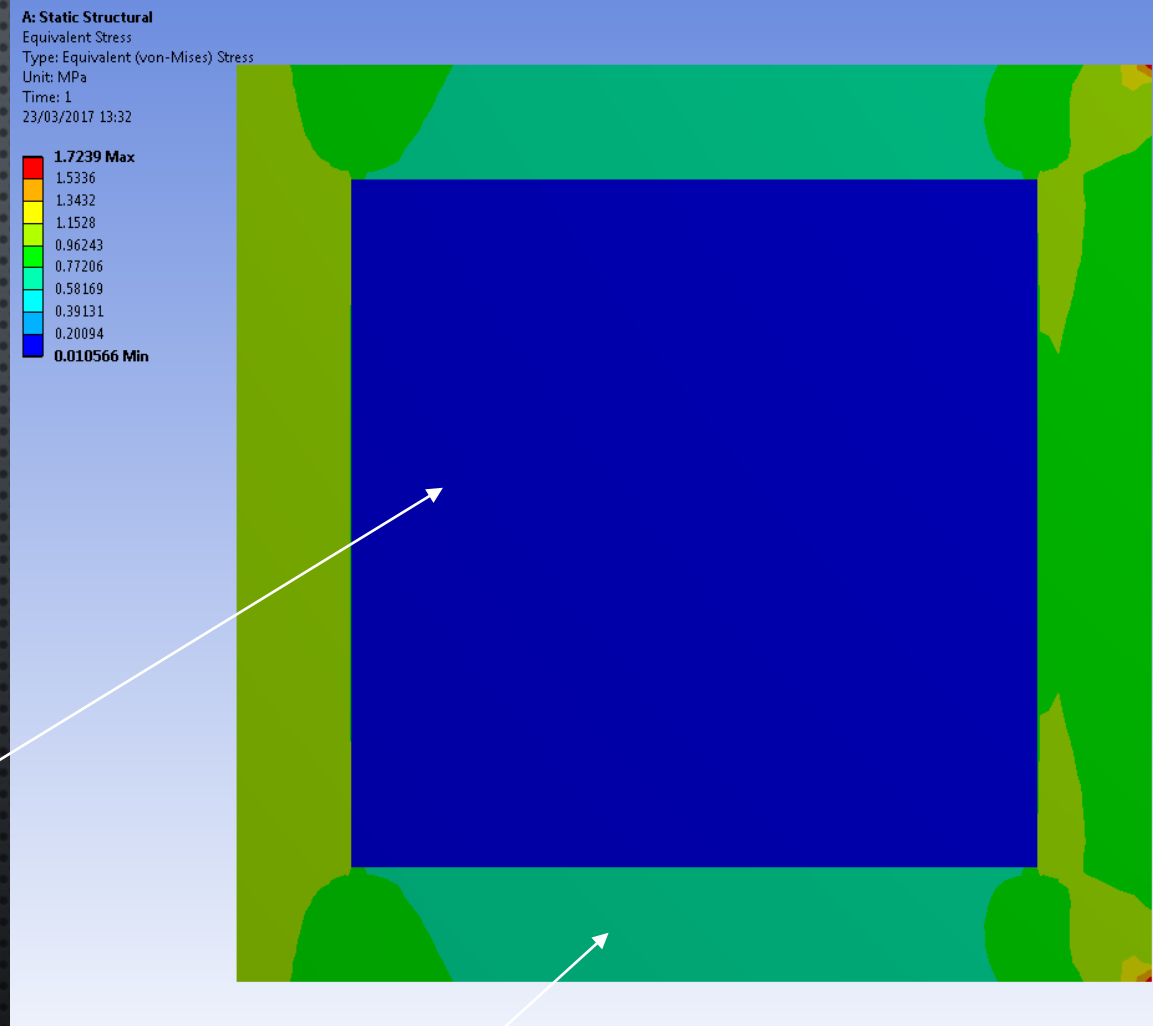




# ANSYS® SIMULATION



Lower stresses



Higher stresses



# CONCLUSION

- ICE FRACTURES AND SEPARATES FROM ICEFREE®/ISFRI® FILLER MATERIAL
- ICE IS TWICE AS STIFF AND THIRTY TIMES AS WEAK IN TENSILE STRENGTH THAN ICEFREE®/ISFRI®.

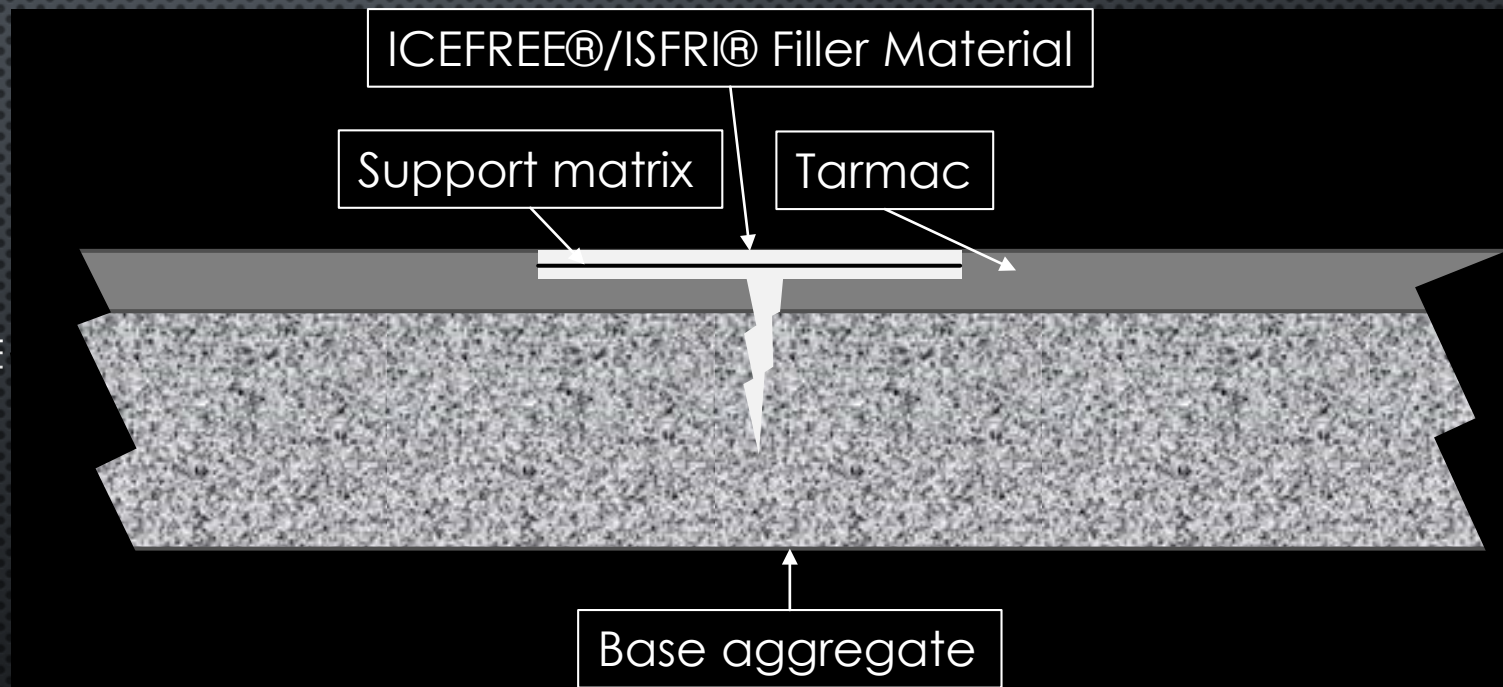
Materials	Young's Modulus	Tensile Yield Strength
Ice	1-4 GPa	2 MPa
Concrete	14-41 GPa	5 MPa
ICEFREE®/ISFRI®	0.069-0.69 GPa	69 MPa





# ROAD REPAIRS

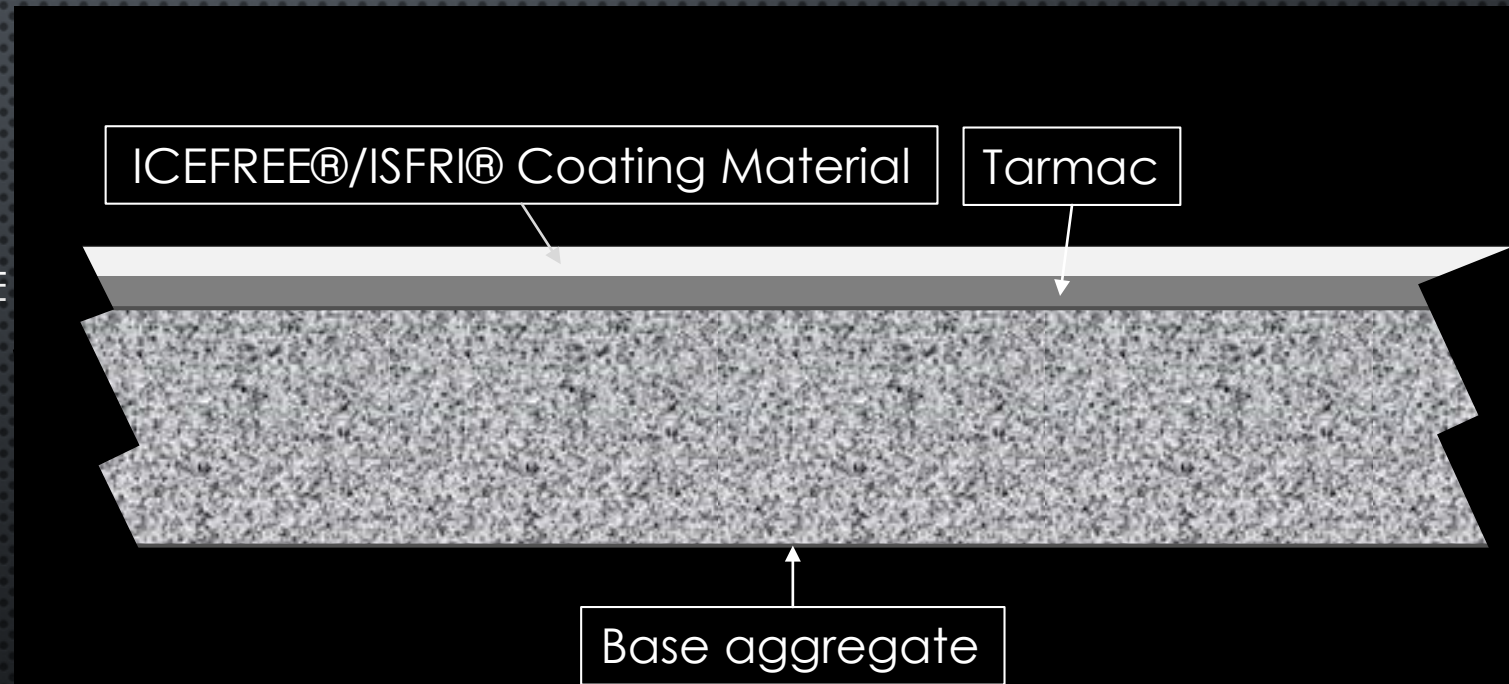
- SIMPLE AND EFFECTIVE
- LONG LASTING
- WATER PROOF
- WITHSTAND UP TO -45 °C
- LESSER EROSION THAN CONCRETE
- GUARANTEED FOR 5-10 YEARS





# COATED ROADS

- LONG LASTING
- WATER PROOF
- WITHSTAND UP TO -45 °C
- LESSER EROSION THAN CONCRETE
- NO PM-10 POLLUTANTS
- SELF DE-ICING





# COLLABORATION



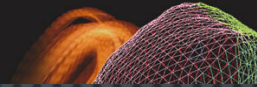
STATENS VEGVESEN  
(NORWEGIAN HIGHWAYS AUTHORITY)





# SUPPORTING PARTNERS

**MULTIPHYSICS**



**China Institute of Water Resources and  
Hydropower Research**

Centre for Sustainable Development and Innovation of Water  
Technology (CSDI)



**SINTEF**







THANK YOU  
AND  
DRIVE SAFE

