



### **Building techniques under review**





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Insuring future climate change 3. – 4. November 2008, Oslo



### De mest vanlige byggskadene

Grunnmur:





### Contents

- Basis for Norwegian building traditions
- Climate scenarios and changes effects on Norwegian building stock
- Challenges variations in climate and building techniques
- High number of building defects
- Moisture main problem, early stage origin
- Legal framework with weak focus on climate adaptation and moisture
- Model for development and differentiation of building techniques
- Concluding remarks



Photo: Siri Eriksen, UiO



### **Building traditions and climate challenges**



Foto: C.F. Øyen



#### What is Norwegian climate? Cold summers Cold winters Hot summers Hot winters Lots of precipitation **Dry areas** Strong wind **Light breeze** High mountain areas Lowlands Coast Inland **Permafrost** Winters without frost Large spatial variations ...



### Scenario: Changes in precipitation 2000 > 2050



Beregnet endring fra 2000 til 2050 av nedbør i %.



Foto: © aftenposten.no

Source: RegClim ©





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### **Extreme climate variations**



Mean annual precipitation: More than 3,5 meter: Along the Western coast (Sogn & Fjordane and Hordaland)

Largest amount of precipitation in 24h : 206.0 mm, Grøndalen (Western coast/Sogn & Fjordane)

Less than 300 mm: In the Central Eastern (Oppland) and Central Northern Norway (Nordland, Troms og Finnmark)



## Climate change - consequences for the built environment

- More frequent instances of floods, avalanches and landslide, sea level rise
- Stronger wind increase of flash floods and lashing rain
- More pronounced climate variations within short distances
- Exact siting more critical than before
- Building at exposed sites need more thorough evaluation
- Assessment of areas of responsibility
- Increasing demands of cooperation in the building processes







### Building in a harsh climate Longyearbyen, Spitsbergen

KKE PART 243230 US 770

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Photo: Cecilie Flyen Øyen

### **Building traditions and climate challenges**



Photo: T. Kvande



# New built environment and climate challenges



Tomasjordneset, Tromsø (photo: TORGRIM RATH OLSEN / NORDLYS)



## Functionalistic building style and climate strain



Foto: K.R. Lisø



### **Aerated claddings**



Foto: K.R. Lisø



# Focus in legal framework and implementation

- Indistinct focus on moisture and climate adaptation in planning and building act, building regulations and guidelines
- Moisture and climate adaptation not afforded sufficient attention by local authorities
- Local authorities' knowledge not substantiated in plans, guidelines or tools
- Calculations show that an increase of only 10 % of the precipitation may increase the insurance payments may raise with as much as 40 %



Photos: K.R. Lisø





## Moment when building defects emerge

- 60 % of defects originate in early stages:
  - > 20 %: Owners' decisions to lower costs
  - 20 %: Planning or design omissions
  - > 20 %: Planning or design errors
- 30 % are due to workmanship mistakes during construction
- 10 % are due to material defects



Photo: T. Kvande



### **Process induced building defects**

- Impact of climate loads during construction substantially greater than desired
- Moisture dominant source up to 75 % moisture related
- 60 % of defects originate in early stages:
  - 20 %: Owners' decisions to lower costs
  - > 20 %: Planning or design omissions
  - 20 %: Planning or design errors



### **Construction industry**

- Clear need for improved knowledge and information regarding driving forces and preventive measures
- See potentials of improvement and actual expenditure cuts such improvements represent
- Similar solutions being utilised despite varying climatic loads and locations
- Recurring defects
- Build as they see fit not always according to design in drawings



Damage due to insufficient static system. Photo: Kjell Langmyren (Building detail sheet Property management - 720.550)



### Moisture and building defects

- Large number of processrelated defects
- Originate in early planning and design stages
- Moisture dominant source
- Impact of climate loads during construction substantially greater than desired



Photo: T. Kvande



### Climate change and extreme weather events



- More often and more severe extreme weather events to come
- High degree of process related building defects at present
- Large amount of defects due to climate strain, esp. moisture
- Natural disasters caused by extreme weather events inflict huge challenges to the built environment
- Technical and legal framework not sufficient to ensure necessary adjustments of practice
- Large variations in local climate conditions; Local knowledge vital to quality of built environment
- Climate strain differentiated building techniques required

Adresseavisen 11.02.2006 (foto: Harald Sæterøy)



### Need for enhanced focus on climate

- Enhance focus on climate and moisture-related problems at earliest possible stage
  - Increase authorities' attention in legal framework and local planning and building approval activities
  - Apply management tools for decision support and QC
  - Apply techniques and locally differentiated solutions
  - Implementation of weather protective measures
  - Choose suitable materials and designs
  - Develop technical solutions fit for a harshening climate and local differentiated design





### **Building design knowledge** system 50 years (1958-2008)

Småskadene medfører større oppfuktinger og nye, større skader. Hovedhensikten med tilsvn er å avdekke skader



\*gging > 🗍 311.125 Tilsyn og vedlikehold av utvendige mur-, puss- og betongo... og sørpeskred. Farevurdering Legg i handlekurven dsfortegnelse Url til bladet Innholdsfortegnelse itt i samarbeide med Skriv ut Kommentarer tes Geotekniske Institutt Legg i handlekurven » Last ned PDF Generelt » Send inn egne relt kommentarer Kommentarer Minimer dette vindu » Last ned PDF » Send inn egne kommentarer Partner: Norges Geotekniske Institutt Minimer dette vindu st ved konsentrasjon av vann utenfor ane, Gaular. Foto: P. Askvoll Dette bladet omhandler tilsyn og vedlikehold av utvendige karakteristiske trekk ved snø- og mur-, puss- og betongfasader. Bladet er et hjelpemiddel for oppstår og hvordan man kan dem som planlegger og utfører tilsyn og vedlikehold av 01 ved bebyggelse, oppholds- og e utbyggingsområder. Hensikten 9 i stand til å vurdere skredfare og slike fasader. er forårsaket av skred. Overflater av mur, puss og betong krever vanligvis lite Vedlikeholdsbehov ertid komplisert. Ved behov bør vedlikehold. Men når det oppstår skader på slike overflater, orges Geotekniske Institutt. får skadene ofte en akselererende utvikling. Et lite riss kan 02 nlag for å vurdere snøstabilitet, f.eks. medføre en lokal oppfukting som gir småskader. ekkevidde av snø- og





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#### **SINTEF Building and Infrastructure**

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Frost decay exposure index	5,0

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### **Concluding remarks**

- Climate change is here
- Amount of building defects are not satisfactory
- Adaptation to climate change is essential
- Locally differentiated building techniques and new solutions will be important steps towards a sustainable adapted built environment
- Possible measures:
  - Enhance focus on climate change and adaptation
  - Strengthening of legal framework
  - Development of tools and information
  - Connect local climate information to municipal plans
  - Review technical solutions
  - Incorporate differentiated technical solutions, fit for different climate strain
  - Implementation of new systems for design management









### **The Physical Science Basis**



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#### Technology for a better society

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