

# Documenting and Optimizing Storage Conditions at the National Museum of Denmark



**Museum Microclimates**  
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# Management Perspective for Preventive Conservation

- ▶ Identify and minimize risks
- ▶ Lengthen useful life
- ▶ Reduce repair and energy costs
- ▶ Environmental responsibility



# Assessing Storage Conditions

- ▶ **Required: meaningful, standardized determinations of degree of risk or benefit to collections**



# National Museum of Denmark



# **Environmental Assessment Project at NMD 2004 - 2007**

- ▾ **Strategic priority assessment**
  - **Census of conditions**
  - **Parallel effort to identify key collection elements**
  - **Enough capacity to properly care for collections?**



# **Contract with Image Permanence Institute (IPI)**

- ▶ **IPI is a university-based  
preservation research laboratory  
in Rochester, NY USA**
- ▶ **Joint effort with NMD scientific,  
conservation research, and  
collection management staff**













# Project Design

- ▶ **Monitor 200 locations**
  - ▶ **150 PEM® dataloggers**
  - ▶ **Tiny Tag® and BMS data**
- ▶ **IPI's Climate Notebook® software**
- ▶ **Additional locations**
  - ▶ **Royal Library**
  - ▶ **Conservation Center, Ribe**
  - ▶ **Ribe Antiquities Collection**



# Strategic and Tactical Issues in Monitoring Project Design

- ▶ **Strategic goals**
  - ▶ **Create variety of overviews**
  - ▶ **Evaluate alternatives in future construction**



# Strategic and Tactical Issues in Monitoring Project Design

- ▾ **Tactical goals**
  - **Document conditions for all important collections**
  - **Explore known issues**



# Difficulties With Data...



- ▶ **More data, more organizational problems**
- ▶ **Spreadsheets and small databases inadequate**
- ▶ **Naming locations**
- ▶ **Naming files**
- ▶ **Tools insufficient**





# Interpretation, Analysis, and Reporting

- ▾ **Strategic analysis**
  - **Composite overviews by site, building, department, etc.**
  - **Quantitative ranking of risks and benefits**



# Interpretation, Analysis, and Reporting

- ▶ **Tactical analysis**
  - ▶ Weigh specific risks
  - ▶ Assess factors affecting climate
  - ▶ Determine possible corrective actions



# Metrics in Environmental Analysis at NMD

- ▶ Algorithms that transform temperature and RH data into standardized, quantitative estimates of decay rate
  - ▶ Chemical aging
  - ▶ Corrosion
  - ▶ Mould
  - ▶ Mechanical (Physical) Damage



Metric	Deterioration Type	Basis for Analysis	Algorithm
<b>TWPI</b>	Spontaneous chemical change in organic materials	Generalized treatment of hydrolysis reaction kinetics	Integrates over time, weighing each interval according to reaction rate
<b>Mould Risk Factor</b>	Mould	Based on empirical studies with food grains	Integrates over time, creates running sum of progress toward mould germination
<b>Dryness</b>	Shrinkage and stress related damage in wood, leather, etc	Based on physical behaviour of wood of “average species”	Estimates moisture content using moving averages of T & RH
<b>Dampness</b>	Expansion and compressive stress related damage in wood, leather, etc.	Based on physical behaviour of wood of “average species”	Estimates moisture content using moving averages of T & RH
<b>Dimensional Change</b>	Fatigue and stress related damage in wood, leather, etc.	Based on physical behaviour of wood of “average species”	Estimates moisture content and maximum dimensional change
<b>Corrosion</b>	Metal corrosion	Moving average RH level	Two levels of severity based on adjusted RH





# Environmental Metrics in Practice

- ▶ Describe general characteristics of conditions in a concise, standardized way
- ▶ Enable quick screening for dangerous or changed conditions
- ▶ Must know collections to know which metrics matter most



# Development of a Web Database and Interface to Climate Data

- ▶ Organize only once
- ▶ Consolidate databases
- ▶ Make data and analysis more accessible



# MyClimateData

- ▶ **Extensible database of information on collections, buildings, systems**
- ▶ **Data storage and analysis on web server**
- ▶ **Geographic navigation or keyword searchable**
- ▶ **Floor plans, photos, notes**



File Edit View Go Bookmarks Tools Help

http://www.myclimatedata.com/asp

**NATIONALMUSEET**

**myclimate**  
Evaluate Locations

Gen. Notes Jump To

Search For Search By

Location Tree Pick List

12 Months Set Year

Click to expand to:  
Site Bldg Flr Rm Loc

- natmusdenmark
  - Arnemagneanske
    - Arnemagneanske
  - Brede
    - Brede Hovedbygning
    - Bygning 10
    - Bygning 4
    - Bygning 6
    - Bygning 7
    - Bygning 8
    - Bygning 9
    - Industriens Vugge
  - Det Kongelige Bibliotek
    - Diamanten
    - Holm Bygningen
  - Farum
    - Bunker
  - Frihedsmuseet

12 Months

Click labels  
Currently ordered

Order by Risk

- fl-202-1-2-p
- fl-202-2-104-p
- fl-202-2-117-p
- fl-202-2-137-p
- fl-202-2-145-p
- fl-202-2-157-p
- fl-202-2-171-p
- fl-202-1-18-p
- fl-202-3-207-p
- fl-204-2-107-p
- fl-204-2-113-p
- fl-203-2-117-p
- fl-203-3-205-p
- fl-203-2-103-p
- fl-203-3-208-p





# myclimatedata THE COLLECTION STORAGE INFORMATION SYSTEM (new server)

Evaluate Locations Explore Materials Utilities Home Log Out Contact Us

[Risk](#) [Metrics](#) [Maps](#) [Photos](#) [Notes](#) [Compare](#)

Mouse over the value for comparative placement among locations during 12 Months.

12 Months  Use this year

Click on the column labels to change sort order, click on 'bars' tab to see the appropriate column as a bar chart.

Click labels to sort -> Currently ordered by mold <a href="#">Order by Risk</a>	C h e m	M e c h	M o l d	C o r r	<a href="#">TEMP</a>	<a href="#">RH</a>	<a href="#">DP</a>	<a href="#">TWPI</a>	<a href="#">MOLD</a>	<a href="#">%DC</a>	<a href="#">EMC MIN</a>	<a href="#">EMC MAX</a>
					<a href="#">bars</a>	<a href="#">bars</a>	<a href="#">bars</a>	<a href="#">bars</a>	<a href="#">bars</a>	<a href="#">bars</a>	<a href="#">bars</a>	<a href="#">bars</a>
fl-202-1-2-p					17	40	3	81	0	0.59	6.5	8.6
fl-202-2-104-p					16	59	8	51	0	1.36	8.6	13.4
fl-202-2-117-p					15	61	7	53	0	1.18	9.3	13.5
fl-202-2-137-p					19	47	7	50	0	0.54	7.9	9.9
fl-202-2-145-p					20	44	7	45	0	0.94	6.8	10.1
fl-202-2-157-p					17	53	7	52	0	1.04	7.9	11.6
fl-202-2-171-p					17	58	8	46	0	1.59	8.1	13.7
fl-202-1-18-p					19	57	10	40	0.05	1.10	8.5	12.5
fl-202-3-207-p					14	63	7	51	0.39	2.24	8.5	16.5
fl-204-2-107-p					13	69	7	51	1.04	2.26	9.6	17.7
fl-204-2-113-p					12	72	7	54	1.1	2.22	10.1	18
fl-203-2-117-p					13	71	7	52	2.01	2.01	10.5	17.6
fl-203-3-205-p					13	72	7	51	5.66	2.95	9.4	19.9
fl-203-2-103-p					11	78	7	55	7.04	2.77	11.7	21.6
fl-203-3-208-p					12	75	7	51	7.62	3.49	9.7	22.2
fl-204-1-7-p					11	78	7	51	8.35	2.39	11.9	20.4
fl-215-1-2-p					12	76	7	52	9.28	3.26	9.9	21.6
fl-204-1-12-p					11	81	8	50	10.21	2.77	12.3	22.2
fl-216-1-3-p					11	81	8	50	11.41	3.08	11.9	22.9
fl-203-k-07-p					16	78	12	32	28.82	3.42	11.9	24.2
fl-203-k-05-p					14	92	12	32	71.77	1.92	17.4	24.2
<b>AVG (21 locations)</b>					14	67	8	50	7.85	2.05	9.9	17.3
	C h e m	M e c h	M o l d	C o r r	TEMP	RH	DP	TWPI	MOLD	% DC	EMC MIN	EMC MAX

Restart Search

Summary

Metrics

Information

12 Months

Use this year

Edit

Jump direct to a location:

FL-203-K-05-p

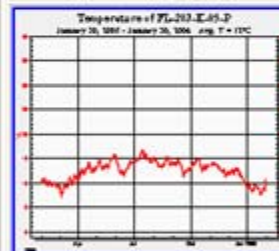
Jump

FL-203-K-05-p

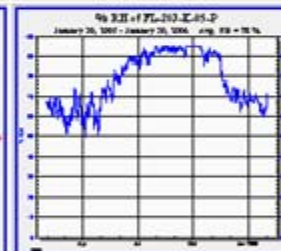
METRICS for 12 Months 1/30/05 - 1/30/06

°C	T		RH		DP
	12 avg. 7 min, 17 max		78 avg. 50min, 95 max		9
	TWPI	Mold	% DC	EMC min	EMC max
	46	43.76	3.37	11.4	23.5

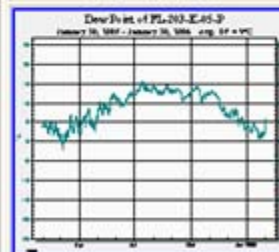
Temp



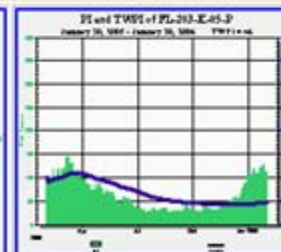
RH



Dew Point



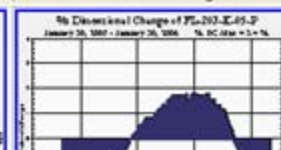
TWPI



Mold



% Dim Chng



# Project Outcomes

- ▶ **Working web system**
- ▶ **Strategic goals met**
  - ▶ **Characterize storage overall**
  - ▶ **Choose among alternatives for future construction**



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