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SYMPOSIUM PROCEEDINGS

Use of defects mapping and damage indexes in the evaluation of structural members degradation of road bridges

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Summary

In the light of cost optimisation in designing the rehabilitation project for a deteriorated structure it is of great importance the condition assessment of each structural member. Due to the different type of defects related to concrete or reinforcement and their different influence on structural member performance, a damage index have to be defined in order to perform a relative comparison for intervention priority definition.

An application of such a procedure is reported in the paper on a 13 spans post tensioned concrete beam bridge. Following identification and classification of defects, a damage index was calculated for the different structural members: beams, bearings, decks, piers and abutments. Edge beams, and overall sea side edge beams, were characterized by the higher damage indexes. Span damage indexes, calculated as a weighted sum of the damage indexes of beams and deck, evidenced a higher degradation level on a specific section of the viaduct.

Keywords: inspection, deterioration, bridge, corrosion, defect mapping

1. Introduction

The increasing age of the bridge stock throughout Europe has highlighted the problems associated with deterioration in existing structures. Surveys indicate that the main reason for deterioration, besides normal wear and tear, are the increasing weights and volumes of traffic using the road network, adverse environmental conditions such as exposure to chloride and freeze-thaw attack, and unanticipated problems with the use of unsuitable construction materials or problems connected to use of materials whose behaviour in the environmental conditions were not quite clear at the time of building (i.e. use of prestressing steel sensible to stress corrosion cracking), or the choice of design solution not well optimised to durability (that is the case of the early prestressed concrete structures).

The analysis of recent data on the status of bridge structures in Europe [1] and the United States of America [2] showed a not encouraging picture: generally more than 30% of the structures show defects related to deterioration phenomena that could negatively influence structural performance in a short time or in a near future and that, therefore, require an immediate or close rehabilitation intervention.

Such a situation lead road owners and administrators over all the world to a pressing demand for safety assurance and for determination of the residual load bearing capacity of the deteriorated structures. For a similar reason there is an increasing interest for the quantification of the damages in order to optimise the rehabilitation projects in the frame of an adequate technical and economical planning of maintenance[3].

At the base of a right economical and managing evaluations it is of fundamental importance to have an adequate identification and classification of the whole bridge stock. That is possible only with a capillary inspection performed by high qualification personnel.

The inspection stage is therefore a step very delicate and essential in the general frame of the management and maintenance of the structures.

2. Defect cataloguing and indexing

Since the importance of defect indexing a great attention have to be done on the choice of the methodology used to do that. An example of that, developed by the Authors, is described herewith following and applied to a viaduct as described in the next paragraph.

The objective evaluation of the deterioration of a concrete structure or of their members have to be obtained starting from the on site redaction of dedicated inspection forms (collected in a data bank) following available defect catalogues [4]. In order to properly identify each defect, structural elements (abutments, decks, beams, bearings, piers, etc...) in our case have been

identified following a pre-defined convention and schematised in a grid. Referring to a multi span bridge, each span has been progressively numbered starting from the road origin, and each beam in a span has been numbered from left to right side (observer's back toward road origin). For each beam the resulting grid, considering any beam segment, consisted on three strips (left and right side, and beam underside). Inspection forms have been filled reporting evaluated defect by means of a suitable symbology (figure 1)

Fig. 1 Example of defect mapping on a beam grid

Defects have been classified unto four classes:

- *Extensive*: defect evaluated in percentage on the ratio between its extension on the single element (or area of the structural element) and the total dimension of the element itself.
- *Intensive*: defect evaluated as before, but the extension of the defect as well as of the total amount of the defects will be referred to the element area where defect was more consistent.
- *Quantitative*: defect evaluated referring to its numerosness on the element.

- *Qualitative*: defect evaluated following a classification that is independent on its extension in percentage on the whole element.

Defect severity was quantified giving an intrinsic mark, on a scale from 1 to 6.5. Mark entity was linked to several factors such as defect growing in the time, repair intervention urgency and influence of the defect on the safety coefficients of the structure. Defects are then classified following a three level entity (A, B and C) in order to differentiate quantitatively the same defect respecting the belonging class (Table 1).

Table 1. Defect classification and indexing

Defect	Defect class	Mark	Entity level (linked to defect extension or intensity)		
			A	B	C
Humidity	Extensive	1,5	< 0,2	0,2:0,4	>0,4
Leaching	Extensive	2,5	< 0,2	0,2:0,4	>0,4
Crazing	Extensive	1	< 0,2	0,2:0,4	>0,4
Honeycomb	Extensive	1	< 0,2	0,2:0,4	>0,4
Reinforcing bars exposure and/or oxidation	Extensive	4	< 0,2	0,2:0,4	>0,4
Stirrup exposure and/or failure	Extensive	2	< 0,2	0,2:0,4	>0,4
Peeling	Extensive	1,5	< 0,2	0,2:0,4	>0,4
Scaling	Extensive	2,5	< 0,2	0,2:0,4	>0,4
Cross section reduction of prestressing steel	Intensive	6,5	< 0,05	0,05:0,1	>0,1
Spalling	Extensive	4	< 0,2	0,2:0,4	>0,4
Delamination	Extensive	2	< 0,2	0,2:0,4	>0,4
Efflorescence	Extensive	1,5	< 0,2	0,2:0,4	>0,4
Water leakage	Extensive	1	< 0,2	0,2:0,4	>0,4
Stalactites	Quantitative	4	< 1	2:3	> 3
Cracks	Qualitative	2,5	fine	medium	wide
Crack and exudation	Quantitative	3	1	2	>= 3
Crack and efflorescence	Quantitative	3,5	1	2	>= 3
Impact	Quantitative	2	-	-	present
Stain spots	Extensive	1	< 0,2	0,2:0,4	>0,4
Cracked or absent elements in the masonry	Extensive	5,5	< 0,05	0,05:0,1	>0,1
Erosion	Extensive	2,5	< 0,2	0,2:0,4	>0,4

In order to compare quantitatively the degradation status of the different structural elements a Damage Index (DI) has been defined as it follows:

$$DI = a \sum_{i=1}^{i=n} d1_i + b \sum_{j=1}^{j=m} d2_j + c \sum_{k=1}^{k=p} d3_k \quad (1)$$

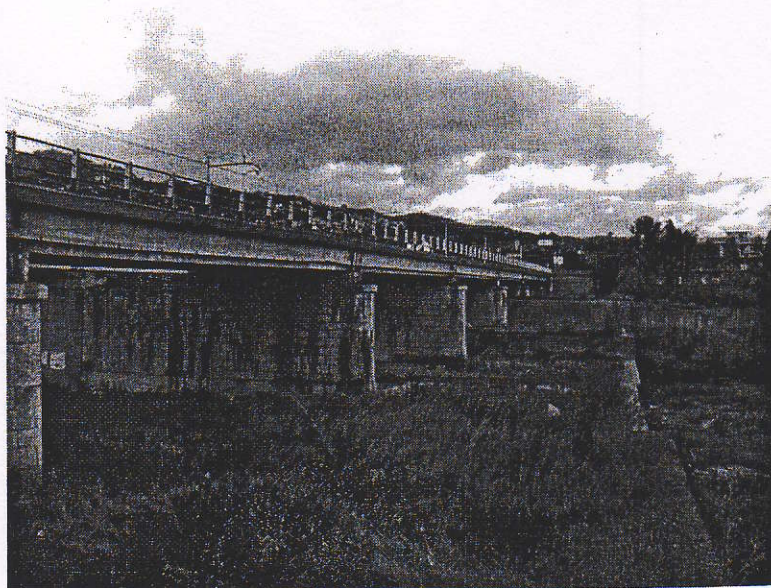
Where $d1$, $d2$ and $d3$ are the defect marks defined in the table 1, the multiplicative coefficients (a , b and c), linked to the entity level of the defect, took into account the following considerations: a defect with the higher entity level has a higher influence on the status of the structure than defects with a lighter entity which appeared with an higher frequency during inspections.

As a consequence marks concerning defects with the lower entity level will be considered with their own values, those ones in the middle level will be multiplied by a 1.5 factor and marks related to the high severity defects will be tripled. Moreover since structural elements have a different influence on the service life of the structure, further multiplicative factors was considered: that is for example:

- 0.19 for the beams and 0.05 for the deck that constitute the span;
- 0.90 for the backwall and 0.1 for the components of the abutment.

3. The Agrò Viaduct

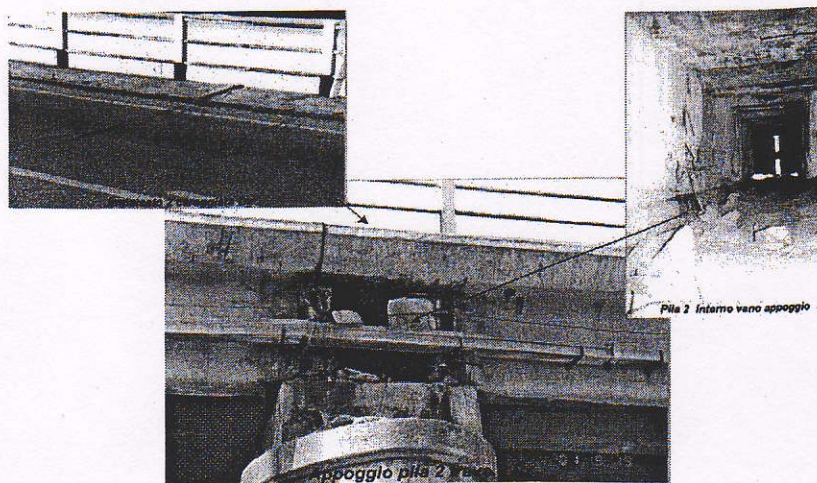
The Agrò viaduct, on the national road number 114 on the oriental coast of the Sicily island (figure 2) has been designed in the 1954 by Riccardo Morandi and built during the 1955.



It is a 13 spans viaduct with a span length of about 22 m and a total length of 287 m. The viaduct is a segmental cast-in-place post-tensioned prestressed concrete box girder type, characterised by a five cell longitudinal T-box girder. Four cast-in-place diaphragms were provided at each end and along each span of the bridge. The 11 cm thick top slab was monolithically cast-in-place. The post-tensioning ducts of 40 mm diameter were drilled in-place and the post-tensioning internal tendons consisted of 5 mm wires bundle.

Fig. 2 Sea side view of the Agrò viaduct

From the visual inspection and the corresponding analysis of the defect map it was possible to give a first evaluation of the degradation status of the viaduct.



The Agrò viaduct is a structure quite sensible to environmental aggression and it was designed, as all the first prestressed concrete structures, with a low consideration on durability. The type of structure itself, precast segments and cast in place joints, is quite sensitive to water and chloride inlet in post tensioning ducts. Environmental exposition class, following EN 206-1 is now classified as XS1.

Fig. 3 Degradation of deck near bearings

The structure appeared on the whole quite deteriorated with a great concentration of defects on the edge beams and on bearings. On bearings the original design did not take properly into

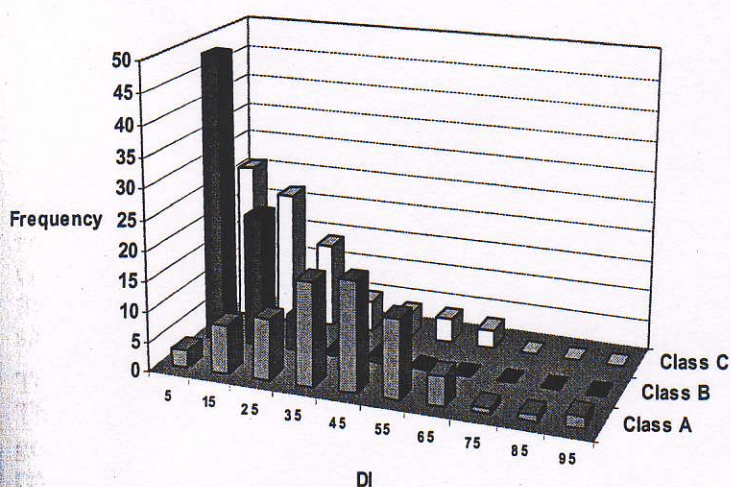
account water drainage causing so an almost complete destruction of the bearing equipment themselves.

Several longitudinal cracks were also observed along the beams. Such cracks were frequently observed in conjunction with the presence of carbonatic concretion and/or exudation just in correspondence to post tensioning tendon ducts. Extended delamination, generally located near segment joints were also detected.

Deck deterioration was detected either on the underside (extended area of concrete delamination) and on asphalt pavement especially near the bearing were rebar corrosion and fatigue caused the formation of transversal cracks (figure 3).

An objective description of the relative condition of the structural elements of the viaduct was obtained by using the DI as described in the previous paragraph.

The frequency distribution for the DI calculated for each structural element (beams, decks and piers) is reported in the figure 4, where the



occurrence of defect in each of the three entity levels is also reported (partial summation in equation 1). DI in the entity level A have a distribution centred around a value of about 45, whilst DI in the entity level C have a distribution, even if shifted towards lower values, with a tail extending up to of 65-70.

Fig. 4 Frequency distribution of partial DI for all the structural elements

If we compare the calculated mean DI for a typical structural element (that is a mean damage index for deck, one for beam n°1 [a mean on thirteen values] and so on) interesting results appeared. Edge beams have a higher DI compared to internal beams, and sea side beams resulted more damaged than land side beams (figure 5).

Considering the need to accurately locate the intervention area in the rehabilitation project, it could be useful to consider the plot of the DI for each structural element along the viaduct. In such a way (figure 5) the presence of "hot spots" could be easily detected.

4. Discussion and conclusion

The need to have a suitable instrument to compare degradation status of different element in a bridge structure or to compare different bridges, in order to define a prioritisation of the intervention actions, can be fulfilled with adoption of an adequate defect cataloguing and indexing.

In such a way it is possible to define a damage index (DI) that could take into account not only the extension of the defects themselves, but also their influence on the performance of the structure and its urgency of intervention. A more complete definition of the DI can include an estimation of the failure probability and/or of the residual service life of the structure, even if in this case more information are required such as an estimation of the residual steel cross section,

material properties (concrete and steel strength) and other data obtained by means of instrumental inspection techniques as well as information about structure and design details [5]. A considerable gain in using a defect mapping and indexing could be the availability to easily locate critical area where to concentrate instrumental inspection and to prioritise in the definition of the rehabilitation program.

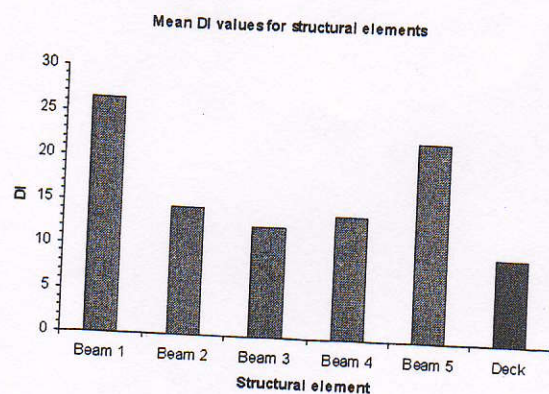


Fig. 5 Mean DI for the different structural element of the spans

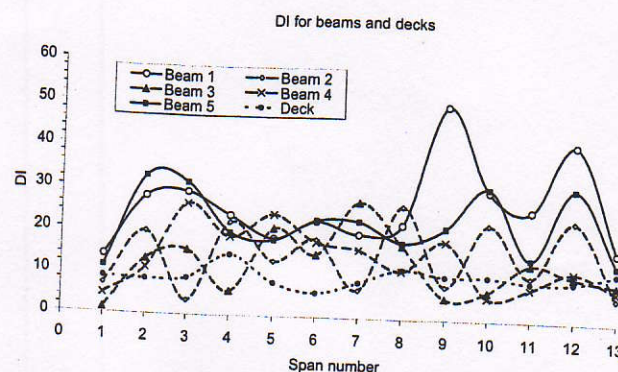


Fig. 6 DI for the structural element for each span

An application of such a procedure has been reported in the paper. A 13 spans post tensioned concrete beam bridge was assessed in the view of upcoming repair actions. Following identification and classification of defects, a damage index was calculated for the different structural members: beams, bearings, decks, piers and abutments. Such results allowed the definition of an on site testing project limited to some spans of the viaduct. Residual load carrying capacity and steel reinforcement continuity being the principal aims of such instrumental inspection campaign.

5. References

- [1] BRIME project, "Modelling of Deterioration in Bridges" *Deliverable D11*, EC 4th Framework Programme 4th Framework Programme, BRIME PL97-2220, 1999.
- [2] Chase S.B., Washer G., "Nondestructive evaluation for bridge management in next century, *Public Roads* 61, 1, 1997.
- [3] Cooper J.D., McCormick R. J., Small E.P., "Balancing bridge management and system preservation needs against the need to replace and rehabilitate deficient bridges", *Proc. Int. Conf. Bridge Maintenance, Safety and Management IABMAS '02*, Casa J.R., Frangopol D.M., Nowak A.S. eds., CINME, Barcelona 2002.
- [4] American Concrete Institute, "Guide for making a condition survey of concrete in service", *ACI report 201.1 R-92*, Farmington Hills, MI 1992.
- [5] CONTECVET, EC Innovation Programme "A Validated User Manual for Assessing the residual Service Life of Concrete Structures: Manual for assessing corrosion-affected concrete structures" IN30902I, Madrid, 2001.

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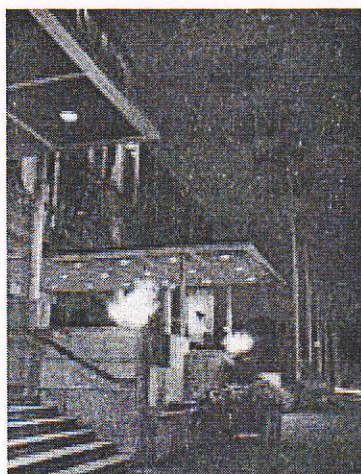
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**December 1-3, 2003
Kuopio, Finland**

**Kuopio Music Centre
Kuopionlahdenkatu 23**

SCIENTIFIC COMMITTEE

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SYMPOSIUM SECRETARIAT

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The symposium secretariat will sell extra copies of the proceedings after the symposium.

GENERAL INFORMATION

Symposium Venue

The Symposium venue is Kuopio Music Centre.

Address: Kuopionlahdenkatu 23

Tel: + 358 17 182 371(operator)
+ 358 40 534 1381 (registration)

Fax: + 358 17 182 373 (registration)

The registration and information desk

The registration and information desk will be open at the symposium venue at 8.00-17.00 during the symposium days.

Tel: + 358 40 534 1381

Symposium Badge

The official Symposium badge is received from the registration, and it must be worn for admittance to the sessions and to the social programme events. The badges will be coloured according to the following system:

Symposium participants	White
Visitors and press	Red
Accompanying persons	Green
Students	Yellow
Organizers	Blue

Speakers' Hall

Speakers will have a place daily at their disposal for preparing their presentations on the Scenic Foyer on the 3rd floor. Technical assistance is given only on request.

Speakers' meeting is held every morning on the second floor. The meeting will be at on Monday at 8.30 and on Tuesday and Wednesday at 8.00. Please participate the meeting on the day of your lecture.

Meal Arrangements

Lunch and coffee are served during lunch and coffee breaks given in the programme. The lunch buffet tables are located in the "Hall of Light" on the first floor. The coffee will be served on the foyer located on the second floor.

Additional small meals, snacks and soft drinks can be purchased from the cafeteria located in the lunch area.

Accompanying persons can purchase lunch vouchers from the information desk for the price of 60 € / 3 days. The lunch voucher includes the lunch buffet.

The lunch menu can be found from the information board.

All special diets or request are kindly asked to contact the cafeteria desk during the lunch hour.

Wardrobe and internet connection

There is a guarded wardrobe in the entrance hall. The luggage can be left there as well.

The internet connection is arranged for checking e-mails etc. by the registration desk. Please, keep in mind that there is only one connection for all participants and keep the use as short as possible.

Symposium Agency Congrex

The official symposium agency CONGREX will have an information desk next to the registration and they will help you with all inquiries concerning registration, accommodation and tours.

Banks and ATM

Most of the public and banking services are located around the market square. The banking hours are 9.30-16.00.

The ATM's are marked as 'OTTO'.

Smoking

According to the national law in Finland, smoking is prohibited in all educational and public buildings. We kindly ask you to smoke outside and to pay attention to the non-smoking signs.

Transportation

There is a shuttle service between the symposium hotels and the symposium venue in the mornings and in the afternoon.

SYMPOSIUM BANQUET

Tuesday December 2, 2003 at 19.30 – 22.30

Departure: Bus transfers from the
symposium hotels at 18.45
Price: 80 €, a few tickets still available!
Place: The Lakeside Inn Eevantalo
(Sylvänniemi)
Dress code: Business suit

All participants and accompanying persons are welcome to enjoy Finnish cuisine at the symposium banquet. The buffet includes traditional Finnish Christmas cuisine and there is a possibility that even Santa Claus will pay a visit...

The inn is located in the countryside of Kuopio, a 30 min bus ride to the west of Kuopio. The restaurant is specialised in traditional Finnish countryside cooking and tonight they have prepared a Finnish Christmas dinner.

The dinner includes cold starters, main course from a buffet and a Christmas dessert. Wine, beer and refreshments are included in the price.

Please wait for the buses in front of the main entrance of your hotel. Transportation back to the hotels starts at 22.30.

SNOWMOBILE SAFARI

Wednesday December 3 at 9.30 – 12.30

Departure: Bus transfers from Scandic
Hotel Kuopio at 9.30 and Sokos
Hotel Puijonsarvi at 9.40
Price: 73 €, a few tickets still available!
Place: Rauhalahdi area
Dress code: Hats and gloves needed,
driving costumes and helmets
are provided by the organizers

The tour will start by changing in to the driving clothing (helmets and overalls). The guide will give a short lesson on how to drive a snowmobile. Each snow mobile will take two persons, who take it in turns to drive during the safari.

The tour includes a coffee stop by a campfire. After the tour, the coach will take participants back to the symposium venue, early enough to make it for the lunch and closing session.

BUS TRANSFERS TO SOCIAL PROGRAMME

SUNDAY

November 30

Scandic Hotel Kuopio 17.45	→	Sokos Hotel Puijonsarvi 17.55	→	Get together party 18.10
Scandic Hotel Kuopio 20.55	←	Sokos Hotel Puijonsarvi 20.45	←	Get together party 20.30

MONDAY

December 1

Scandic Hotel Kuopio 18.40	→	Sokos Hotel Puijonsarvi 18.50	→	Welcome Reception 19.00
Scandic Hotel Kuopio 20.50	←	Sokos Hotel Puijonsarvi 20.40	←	Welcome Reception 20.30

TUESDAY

December 2

Scandic Hotel Kuopio 18.45	→	Symposium Banquet 19.30		
Sokos Hotel Puijonsarvi 18.45	→	Symposium Banquet 19.30		
Scandic Hotel Kuopio 22.40	←	Sokos Hotel Puijonsarvi 22.30	←	Symposium Banquet 22.00
Scandic Hotel Kuopio 22.55	←	Sokos Hotel Puijonsarvi 22.45	←	Symposium Banquet 22.15

SHUTTLE SERVICE

Scandic Hotel Kuopio 8.05 (Mon) 7.35 (Tue, Wed)	→	Sokos Hotel Puijonsarvi 8.15 (Mon) 7.45 (Tue, Wed)	→	Music Centre 8.25 (Mon) 7.55 (Tue, Wed)
Scandic Hotel Kuopio 8.30 (Mon) 8.00 (Tue, Wed)	→	Sokos Hotel Puijonsarvi 8.40 (Mon) 8.10 (Tue, Wed)	→	Music Centre 8.50 (Mon) 8.20 (Tue, Wed)
Scandic Hotel Kuopio 17.40	←	Sokos Hotel Puijonsarvi 17.30	←	Music Centre 17.20

Monday December 1, 2003		
Time	Concert Hall Plenary session 1: Principles and Praxis Chairman: Prof. Asko Sarja, FINLAND	Social Programme
8.30	Speakers' Meeting	
9.00	Opening Session Opening address: Mr. Jaakko Heikkilä, Association of Finnish Civil Engineers RIL Music presentation: A quintet from Kuopio City Orchestra	
9.30	Keynote Lecture Owner's Expectations for Lifetime Engineering Mr. Aulis Kohvakka, FINLAND	
10.15	Coffee	
10.40	Performance Based Building – Some Implications on Construction Materials and Components C. Sjöström and J. Lair, SWEDEN - FRANCE Speaker: Christer Sjöström (pp. 13)	
11.00	Lifetime Oriented Maintenance Planning in The Netherlands A. Straub, NETHERLANDS Speaker: Ad Straub (pp. 21)	
11.20	A Web-Based Maintenance Support System for Apartment Buildings S.K. Kim, T.H. Kim, G.J. Lee and J.T. Kim, REPUBLIC OF KOREA Speaker: Sun Kuk Kim (pp. 27)	
11.40	Life Cycle Economics: State-of-The-Art in The Nordic Countries K. Haugbølle, DENMARK Speaker: Kim Haugbølle (pp. 33)	
12.00	Lunch	
Time	Session 1 A: Auditorium Theme 3: Lifetime Management Systems (LMS) Chairman: Prof. Kunibert Lennerts, GERMANY	Session 1 B: Chamber Music Hall Theme 2: Integrated Life-Cycle Design (ILCD) Chairman: Dr. Jean-Luc Chevalier, FRANCE
13.30	LIFECON LMS, Life Cycle Management of Concrete Infrastructures M-K. Söderqvist, FINLAND Speaker: Marja-Kaarina Söderqvist (pp. 175)	Failure Mode Effect and Criticality Analysis for Decision Aid At Design and Exploitation Stages J. Lair, A. Talon, J-L Chevalier, D. Bossier, FRANCE Speaker: Jean-Luc Chevalier (pp. 41)
13.50	Infrastructure for Different Lifespan P.A. Erkelens, NETHERLANDS Speaker: Peter A. Erkelens (pp. 181)	Integrated Life Cycle Design Applied To Concrete Residential Buildings M. Öberg, SWEDEN Speaker: Mats Öberg (pp. 47)
14.10	The Complex Model for Maintenance Management: A National Approach R. Lias, ESTONIA Speaker: Roode Lias (pp. 187)	Eco-efficiency in Norwegian C&D Waste Recycling Systems. R.A. Böhne and H. Brattebo, NORWAY Speaker: Rolf André Böhne (pp. 53)
14.30	IFD Technology for the Renovation of Apartment Buildings: Project Flexible Breakthrough N.A. Hendriks, H. van Nunen and P. G.S. Rutten, NETHERLANDS Speaker: Nico A. Hendriks (pp. 193)	Lifetime Performance Modelling of Structures With Limit State Principles A. Sarja, FINLAND Speaker: Asko Sarja (pp. 59)
14.50	Building Flexibility Management A. Saari and P. Heikkilä, FINLAND Speaker: Arto Saari (pp. 199)	Integrating Lifetime Aspects into Initial Evaluation of Road: How to Proceed? A. Ventura, T. Hoang, A. Jullien and P. Monéron, FRANCE Speaker: Anne Ventura (pp. 67)
15.10	Coffee	
15.40	Brand Concept and Brands in The Real Estate Business J. Porkka and M. Riihimäki, FINLAND Speaker: Janne Porkka (pp. 205)	Life Cycle Design Concept Considering Environmental Performance K. Kawai and T. Sugiyama, JAPAN Speaker: Kenji Kawai (pp. 73)
16.00	The Management of Hazardous Wastes in Buildings. The Existence of Mercury and PCB in Finnish Building Stock J-P. Majjala, FINLAND Speaker: Juha-Pekka Majjala (pp. 211)	Service Life Planning – From Theory to Practical Processes T. Häkkinen, FINLAND Speaker: Tarja Häkkinen (pp. 79)
16.20	Environmental Sensitivity Analysis of The Life-Cycle Phases of Office Buildings S. Junnila and A. Horvath, FINLAND - USA Speaker: Seppo Junnila (pp. 215)	The Evaluation of RAMS Characteristics for Use in Lifetime Repair Planning Iain H.B. Miller, NORWAY Speaker: Iain H.B. Miller (pp. 85)
16.40	Economical and Environmental Sustainability in Construction and Operation F. Tolman and A.A. Tolman, NETHERLANDS - FINLAND Speaker: Fedde Tolman (pp. 221)	Reliability, Availability, Maintainability and Safety (RAMS) Assessment With Quality Function Deployment (QFD) Method M. Sarkkinen, FINLAND Speaker: Minna Sarkkinen (pp. 91)
17.00-17.15	Discussion	Discussion
18.45-20.30 Evening programme	Welcome reception at 19.00-20.30 on the City Hall. Fee: complimentary (confirmation needed) Bus transfers from the hotels at 18.40.	

Sightseeing tour to Valamo Monastery

Departure at 11.00 in front of the main entrance of the Music Centre. Bus transfer back to the hotels around 17.00.

Fee: 75 euros (lunch included)

Few tickets still available.

Please note: included in the accompanying person's fee

Tuesday
December 2, 2003

Time	Session 2 A: Concert Hall Theme 3: Lifetime Management Systems (LMS) Bridges Chairman: Dr. C.K. Chau, HONG KONG (P.R.C.)	Session 2 B: Auditorium Theme 2: Integrated Life-Cycle Design (ILCD) Life Cycle Costing LCC Buildings Chairman: Dr. Muthena Alisa, UNITED KINGDOM	Session 2 C: Chamber Music Hall Theme 5: Data for Lifetime Design and Management Environmental Assessment (LCE) Chairman: Prof. Christer Sjöström, SWEDEN	Social Programme
8.00			Speakers' Meeting	
8.30	Keynote Lecture Japanese Strategy of Life-Cycle Management in Civil Infrastructures Systems Prof. Ayaho Miyamoto, JAPAN (pp. 1)			
9.00	Moving to the parallel sessions			
9.20	Algorithm for The Condition Assessment of Concrete Bridges Based on Inspection Data E.M. Eichinger, M. Vill and J. Kollegger, AUSTRIA Speaker: Markus Vill (pp. 227)	A Model for A Complex Analysis of A Building's Life Cycle A. Kaklauskas, LITHUANIA Speaker: Arturas Kaklauskas (pp. 97)	Towards Ecological Life-Cycle Design: Measuring The Environmental Impact of Housing Transformations G. Klunder, NETHERLANDS Speaker: Gerda Klunder (pp. 421)	
9.40	LCC Based Bridge Management System for Existing Concrete Bridges in Japan A. Miyamoto and H. Nakamura, JAPAN Speaker: Hideaki Nakamura (pp. 233)	Total LCC and Sustainable Construction O. Tupamäki, FINLAND Speaker: Olavi Tupamäki (pp. 103)	LCNPV As A Tool for Evaluation of Environmental Investment Projects M. Góralczyk and J. Kulczycka, POLAND Speaker: Małgorzata Góralczyk (pp. 427)	
10.00	Coffee			
10.30	Use of Defects Mapping and Damage Indexes in The Evaluation of Structural Members Degradation of Road Bridges E. Proverbio, G. Lagana and V. Venturi, ITALY Speaker: Edoardo Proverbio (pp. 239)	Methodology for Value Quantification of Industrial Building Sustainable Projects R. Losada, J.T. San José, E. Rojí, J. Cuadrado I. Vegas and G. Ormazabal, SPAIN Speaker: J. Tomás San José (pp. 111)	Identification of Environmental Impact of Office Buildings by Building Element and Material Groups S. Junnila, FINLAND Speaker: Seppo Junnila (pp. 43)	Spa visit Departure: 9.00 Scandic Hotel Kuopio 9.10 Sokos Hotel Puijonsarvi Bus transfer back to the Music Centre and symposium hotels around 13.30. Fee: 38 euros (lunch included) Few tickets still available! Please note: own swimming costume needed towels are provided by the spa.
10.50	Capacity and Repair Index in Railway Bridge management in Finland J. Wuorenjuuri, FINLAND Speaker: Janne Wuorenjuuri (pp. 245)	Life Cycle Cost Considering Factors Influencing Performance of Piers M. Sakai, H. Seki and M. Matsushima, JAPAN Speaker: Hiroshi Seki (pp. 117)	Environmental Impact Assessment of Residential Buildings A. Balaras et al., GREECE Speaker: Constantinos A. Balaras (pp. 439)	
11.10	Design Durability of Bridges in Moscow G. Kornoukhov et al., RUSSIA Speaker: Vadim Seliverstov (pp. 251)	Optimisation and Decision-making in Sustainable Construction and Operation F. Tolman and A.A. Tolman, FINLAND - NETHERLANDS Speaker: Fedde Tolman (pp. 123)	Procedure for Environmental Assessment and Declaration of Building Products, Building Components and Buildings T. Häkkinen, FINLAND Speaker: Tarja Häkkinen (pp. 445)	
11.30	Reliability Prediction of Utility Tunnel Structures During Operation A.A. Shilin et al., RUSSIA Speaker: Alexey Krikenko (pp. 257)	The Appraisal of Structure's Value on The Different Stages of its Life-Cycle J. Miljan and K. Sahk, ESTONIA Speaker: Kaarel Sahk (pp. 131)	Legislative Base for Life Time Energy Performance in Buildings. E. Dzelzitis, A. Kreslins and A. Steinerts, LATVIA Speaker: Egils Dzelzitis (pp. 451)	
11.50	IT-Prototype of Lifetime Management System "Lifecon LMS" O. Lahus, G. Krigsvoll and O. Kristiansen, NORWAY Speaker: Ove Kristiansen	Financial forecasting Algorithms for Long-Range Facility Management of Apartment Buildings S.K. Kim, J.K. Joo, S.J. Kim and C.S. Lee, REPUBLIC OF KOREA Speaker: Sun Kuk Kim (pp. 137)	The Factor Time in Sustainability: Integration of The Building Lifespan in Environmental Performance and Decisions Between Demolition and Re-use A.A.J.F. van den Dobbelsteen, M.J.P. Arets and A.C. van der Linden, NETHERLANDS Speaker: Andy van den Dobbelsteen (pp. 457)	
12.10	Discussion	Discussion	Discussion	
12.20	Lunch			
Time	Session 2 D: Concert Hall Theme 4: Integration of Design and Management Processes Chairman: Prof. Arturas Kaklauskas, LITHUANIA	Session 2 E: Auditorium Theme 2: Integrated Life-Cycle Design (ILCD) Durability design Chairman: Prof. Adam Wysokowski, POLAND	Session 2 F: Chamber Music Hall Theme 5: Data for Lifetime Design and Management Condition Assessment (CA) of Buildings Chairman: Mr. J-P Lepoivre, FRANCE	
13.30	Seeking Value With The Performance Approach J. Leinonen, P. Huovila, S. Fox and P. Paevere, FINLAND Speaker: Janne Porkka (pp. 361)	Performance Check on Frost Attack To Concrete Structure in Durability Design M. Kagaya, JAPAN Speaker: Makoto Kagaya (pp. 145)	Experience Transfer - Case Study Statsbygg M.A. Le Thi, NORWAY Speaker: Le Thi Mai Anh (pp. 463)	
13.50	Integration of Plant Lifetime Design, Maintaining and Management H. Schillberg, K. Hautala and H. Drozella, GERMANY Speaker: Kirsi Hautala (pp. 367)	Moisture Conditions and Biodegradation Risk of Building Materials and Structure H. Viitanen, T. Ojanen, A.C. Ritschkoff and M. Salonvaara, FINLAND Speaker: Hannu Viitanen (pp. 151)	A Comparative Analysis of Residual Lifetime of Cowsheds R. Miljan and J. Miljan, ESTONIA Speaker: Mihkel Kiviste (pp. 469)	
14.10	Design Aid information System for Recurrent Architecture Composed of Reusable Structural Members H. Kawamura et al., JAPAN Speaker: Atsushi Takizawa (pp. 373)	Integrated Life Cycle Design of Coatings on Exterior Wood L. Strömberg and J. Ekstedt, SWEDEN Speaker: Larissa Strömberg (pp. 157)	LC(l)a Comparison of Two Alternative Building Structures for the XX Office-Building Delft, Netherlands, Each as a Result of a Different Design Approach. F. van Herwijnen and R. Blok, NETHERLANDS Speaker: Frans van Herwijnen (pp. 475)	
14.30	Digital Method for Optimal Life Cycle Management J. Mittmann, GERMANY Speaker: Jürgen Mittman (pp. 379)	Life-Cycle Design of Concrete Structures P. Rovnanikova, Z. Kersner and B. Těpy, CZECH REPUBLIC Speaker: Břetislav Těpy (pp. 163)	The Assessment of Technical Situation of Buildings in Estonia T. Keskküla, ESTONIA Speaker: Tõnu Keskküla (pp. 483)	
14.50	Application of A Life-Time Management Method on Existing Concrete Structures of 25 Scholastic Buildings By Probabilistic Evaluation of The Residual Service Life. T. Teruzzi and E. Cadoni, SWITZERLAND Speaker: Tiziano Teruzzi (pp. 385)	Prediction of The Ultimate Limit State of Degradation of Concrete Structures J. Cairns and D. Law, UNITED KINGDOM Speaker: John Cairns (pp. 169)	Influence of Service Life on Life Cycle Assessments H. van Nunen, N.A. Hendriks and P.A. Erkelens, NETHERLANDS Speaker: Haico van Nunen (pp. 487)	
15.10	Coffee			
Time	Session 2 D: Concert Hall Theme 4: Integration of Design and Management Processes Chairman: Prof. Arturas Kaklauskas, LITHUANIA	Session 2 G: Auditorium Theme 3: Lifetime Management Systems (LMS) Historic Buildings Chairman: Prof. Luigia Binda, ITALY	Session 2 H: Chamber Music Hall Theme 3: Lifetime Management Systems (LMS) Environmental Assessment (LCE) Chairman: Prof. Makoto Kagaya, JAPAN	
15.40	Deterioration Processes of Building Elements and Their Impacts on Economic Life-Time Decisions - A Model Under Uncertainty M. Wilhelm and T. Lützendorf, GERMANY Speaker: Martin Wilhelm (pp. 391)	The Vulnerability of Ancient Buildings Under Permanent Loading: A Probabilistic Approach A. Anzani, L. Binda and E. Garavaglia, ITALY Speaker: Elsa Garavaglia (pp. 263)	Life Time Material Effectiveness Analysis of Building Components A. Saari, FINLAND Speaker: Arto Saari (pp. 287)	
16.00	Risk Assessment and Control in Concrete Facility Management, Lifecon Approach T. Rissanen, FINLAND Speaker: Tommi Rissanen (pp. 397)	Parametrical Analysis for Monitoring and Control The Sustainability of Historic Buildings: A Tool for LIFETIME ENGINEERING A. Moropoulou et al., GREECE Speaker: Antonia Moropoulou (pp. 269)	Opportunity for Using Recycled Aggregates in Reinforced Concrete: Carbonation Study R. Hadjieva-Zahrieva and F. Buyle-Bodin, FRANCE Speaker: Francois Buyle-Bodin (pp. 293)	
16.20	Pilot Project of Lifetime Design of Asphalt Concrete in Finnish Road Administration S. Mäkinen, FINLAND Speaker: Seppo Mäkinen (pp. 403)	Lifetime Enhancement of Historical Structures on Flooded and Underrated Territory R. Cajka, CZECH REPUBLIC Speaker: Radim Cajka (pp. 281)	A Reuse Management Model of Building Steel Structures Using Information Technology M. Iwata, JAPAN Speaker: Mamoru Iwata (pp. 299)	
16.40	From Deterioration To Structural Assessment of Corroded RC Beams M. Dekoster, F. Buyle-Bodin and O. Maurel, FRANCE Speaker: Francois Buyle-Bodin (pp. 409)	Discussion	Environmentally Sound Steel Making Process and Products T. Mononen and T. Hemminki, FINLAND Speaker: Toni Hemminki (pp. 305)	
17.00-17.15	Discussion		Discussion	
18.45-22.30	Symposium Banquet at 19.30-22.30.			
Evening programme	Fee: 80 euros (some tickets still available)			
	Departure at 18.45 from the hotels. Bus transfer back to the hotels around 22.45.			

ILCDES 2003 Technical Programme

Wednesday December 3, 2003			
Time	Concert Hall Theme 8 A: EU Growth Project Cluster "Lifetime" Chairman: Prof. Francois Buyle-Bodin, FRANCE		Social Programme
8.30	Speakers' Meeting		
9.00	Keynote Lecture A Process Towards Lifetime Engineering in the 5th and 6th Framework Programme of EU Prof. Asko Sarja, FINLAND (pp. 7)		
9.30	Discussion		
9.40	Coffee		
10.00	Probabilistic Approach for Predicting the Life Cycle Costs and Performance of Buildings and Civil Infrastructure P. Bamfort, UNITED KINGDOM Speaker: Muthena Alisa (pp. 553)		Snowmobile safari Departure at 9.30 in front of the main entrance of the Music Centre. Bus transfer back to the hotels and Music Centre around 12.30. Fee: 73 euros Few tickets still available! Please note: helmets and driving costumes are provided by the organizers
10.30	A Decision-Making Tool for Long-term Efficient Investment Strategies D. Caccavelli, FRANCE Speaker: Dominique Caccavelli (pp. 559)		
10.50	Life Cycle Assessment of Mining Projects for Waste Minimisation and Long Term Control of Rehabilitated Sites S. Durucan, UNITED KINGDOM Speaker: Sevet Durucan (pp. 565)		
11.10	Life Cycle Management of Concrete Infrastructures for Improved Sustainability Asko Sarja, FINLAND Speaker: Asko Sarja (pp. 573)		
11.30	Life-Time Prediction of High-Performance Concrete with Respect to Durability M. Setzer and S. Palecki, GERMANY Speaker: Max J. Setzer (pp. 581)		
11.50	Discussion		
12.10	Lunch		
Time	Concert Hall Theme 8 B: EU Thematic Network: Lifetime Engineering Chairman: Prof. Antonia Moropoulou, GREECE	Session 3 A: Auditorium Theme 7: Best Practices in Applying Life-Cycle Design and Management Chairman: Mr. Hector Pantoja, MEXICO	Session 3 B: Chamber Music Hall Theme 3: Lifetime Management Systems (LMS) Chairman: Dr. Hannu Viitanen, FINLAND
13.30	Objectives and Content of the EU GROWTH Thematic Network LIFETIME A. Sarja, FINLAND Speaker: Asko Sarja (pp. 587)	A System To Support Service Life Design for Concrete Structures K. Quillin, P. Nixon and G. Somerville, UNITED KINGDOM Speaker: Keith Quillin (pp. 513)	Probabilistic Analysis of Service Life of Marine Concrete Structures M. Ferreira, O.E. Gjorv and S. Jalali, NORWAY Speaker: Odd E. Gjorv (pp. 311)
13.50	Best practice and Future Perspectives of Lifetime Engineering K. Lennerts and K. Diez, GERMANY Speaker: Kunibert Lennerts (pp. 595)	A Planning System for The End-of-Life Management of Buildings F. Schultmann, GERMANY Speaker: Frank Schultmann (pp. 519)	Service Life Prediction: Identifying Independent Durability Factors P. Gaspar, J. de Brito, PORTUGAL Speaker: Pedro Gaspar (pp. 319)
14.10	Promoting and Generating Processes and Actions for Introducing Lifetime Principles into Practice of all Stakeholders S. Durucan, UNITED KINGDOM Speaker: Sevet Durucan	Development of Cost-Effective Sustainable Building J. Punkki and R. Pääjärvi, FINLAND Speaker: Jouni Punkki (pp. 525)	Optimal Sensor Arrangement for Bridge Life Cycle Monitoring System Using Genetic Algorithm B. Yan and A. Miyamoto, JAPAN Speaker: Banfu Yan (pp. 325)
14.30	Technical and Methodological Contents of Lifetime Engineering A. Sarja, FINLAND Speaker: Asko Sarja (pp. 601)	The Municipal Elevated Water Tower – Lifetime Assigning Factors M. Malesza, C. Miedziolowski and J. Malesza, POLAND Speaker: Mikolaj Malesza (pp. 529)	Temperature Characterisation of LPG Sensors for Monitoring Deterioration in Reinforced Concrete F.J. O'Flaherty, Z. Ghassemloo, P.S. Mangat and K.P. Dowker, UNITED KINGDOM Speaker: F.J. O'Flaherty (pp. 331)
14.50	Lifetime Data and Systematics for Presenting Lifetime Data P. Bamfort, UNITED KINGDOM Speaker: Muthena Alisa (pp. 607)	Performance of High Stiffness Concrete Repairs Over a Five Year Period F.J. O'Flaherty and P.S. Mangat, UK Speaker: F.J. O'Flaherty (pp. 529)	Lifetime Moisture Monitoring System for Buildings J. Voutilainen et.al., FINLAND Speaker: Jukka Voutilainen (pp. 337)
15.10	Demonstration, Dissemination and Exploitation of Life Time Principles J.-L. Chevalier, FRANCE Speaker: Jean-Luc Chevalier (pp. 617)	Predicting The Progress of Deterioration of RC Deck in Pier H. Yokota, JAPAN Speaker: Hiroshi Yokota (pp. 541)	The Determination of Residual Bearing Capacity of Reinforced Concrete Panels J. Miljan, M. Kiviste and H. Tomann, ESTONIA Speaker: Mihkel Kiviste (pp. 343)
15.30	Discussion	Discussion	Discussion
15.45	Coffee		
16.15	Conclusion of the symposium		
16.30	in the Concert Hall		
19.00	Dinner for members of Lifecon Project and Thematic Network Lifetime Scandic Hotel Kuopio at 19.00 - 21.00		

POSTER PRESENTATIONS

Number	Title Authors, Country	Theme
1	Life Cycle of Road Structures in Road Construction in Practice A. Kalliokoski and T. Kasari, FINLAND Speaker: Ari Kalliokoski	Lifetime Management Systems (LMS)
2	Examining The Use of Wavelet Multi-Resolution Analysis for Damage Detection in Structural Health Monitoring Systems M. M. Reda Taha, N. Noureldin, CANADA Speaker: Mahmoud Reda Taha	Lifetime Management Systems (LMS)
3	Energy Consumption and Environmental Impacts of Public Swimming Baths A. Saari and T. Sekki, FINLAND Speaker: Arto Saari	Data for Lifetime Design and Management
4	Extending Bridge Life With Consideration for Extreme Environmental Loads in Design V. Seliverstov, RUSSIA Speaker: Vadim Seliverstov	Structural Design
5	Eco-Efficiency of Commercial Property J. Saarivuo and K. Tattari, FINLAND Speaker: Johanna Saarivuo	Data for Lifetime Design and Management
6	The Mental Health of People Living in Urban Conditions in The Slavonia and Baranya Region S. Takac, CROATIA (HR) Speaker: Stjepan Takac	Data for Lifetime Design and Management
7	Mechanical Properties of Composite Timber Flitch Beams Laminated Vertically With Fibre Reinforced Plastic and Steel Reinforcements P. Alam, M. P. Ansell and D. Smedley, UNITED KINGDOM Speaker: Parvez Alam	Structural Design
8	Investigation of A Stress-Strained State of Vertical Cylindrical Reservoirs With Local Geometrical Imperfections Y.V.Gorokhov, V.F. Mushchanov and A.A. Kulik, UKRAINE Speaker: Yevgeny Gorokhov	Structural Design

The posters will be presented parallelly with the oral presentations. The poster exhibitoin is located in the hallway in front of the main hall (2nd floor).

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