出國報告（出國類別：國際會議）

第 20 屆環境系統國際研討會 (ICES 2018 : 20th International Conference on Environmental Systems) 出國報告書

服務機關：行政院環境保護署
姓名職稱：羅禮淳薦任技士
派赴國家：西班牙
出國期間：**107** 年 **5** 月 **14** 日至 **107** 年 **5** 月 **20** 日
報告日期：**107** 年 **8** 月 **14** 日

摘　　要

第 20 屆環境系統國際研討會(ICES 2018 : 20th International Conference on Environmental Systems）是由全球知名之國際科學與工業學院(WASET ,World Academy of Science, Engineering and Technology)所舉辦，目的為匯集各領域的科學家、研究人員和學者，就環境、經濟、生態、資源、醫療等環境系統的各個面向進行交流並分享研究成果。本研討會每年會議地點遍布世界各地，提供了一個學術界、教育界、環保團體、政府組織等專業人士與會之交流平台，以展示環境系統領域最新的技術、趨勢，並討論環境領域面臨的挑戰與解決方案。

目　　錄

壹、出國目的

世界科學，工程與技術科學院（WASET，World Academy of Science, Engineering and Technology）為國際性學術組織，訂於今年（2018 年）5 月 15 日至 5 月 16 日於西班牙巴塞隆納舉辦第 20 屆環境系統國際研討會（ICES 2018 : 20th International Conference on Environmental Systems），環境系統是將生態、社會、經濟、文化等等各種環境中的要素，通盤納入做為一個整體進行考量與分析。本研討會目的是匯集各領域的科學家、研究人員和學者，就環境、經濟、生態、資源、醫療等環境系統的各個面向進行研究成果分享並交流討論。本署派員出席與會，即是希望藉由本次會議，參考國際間環境系統技術的相關趨勢及研究，做為我國環保政策及環境影響評估制度的檢討與改進。

貳、行程

日期	地點	工作內容
5 月 14 日（一）至 5 月 15 日（二）	臺北至西班牙巴塞隆納	啟程（於荷蘭轉機）
5 月 16 日（三）	西班牙巴塞隆納	準備研討會會議資料
5 月 17 日（四）	西班牙巴塞隆納 會議地點：芳塔爾國際機場國會酒店	參加第 20 屆環境系統國際研討會會議
5 月 18 日（五）	西班牙巴塞隆納 會議地點：芳塔爾國際機場國會酒店	參加第 20 屆環境系統國際研討會會議
5 月 19 日（六）至 5 月 20 日（日）	西班牙巴塞隆納至臺北	返程（於義大利轉機）

參、活動地點及內容

西元 2018 年第 20 屆「環境系統國際研討會(ICES 2018 : 20th International Conference on Environmental Systems）)於西班牙巴塞隆納舉辦，會議時間為 5 月 17 日至 18 日，舉辦地點為巴塞隆納芳塔爾國際機場國會酒店(Hotel FrontAir Congress Barcelona)

本次會議議程共 2 天，主要由各國環境領域之研究學者就環境系統最新科學技術進行發表及討論，2 天的會議共發表了 23 篇論文，詳細議程及會議論文如附錄。

圖 4　本署代表與本國際研討會主辦單位合影

肆、參加人員

本次會議共有來自美國、英國、德國、波蘭、葡萄牙、巴西、墨西哥、南韓、泰國、臺灣等 10 餘國之環境相關學術領域人員參加，總計近 40 人與會，本署由綜合計畫處薦任技士羅禮淳代表參加。

圖 5　西元 2018 年第 20 屆環境系統國際研討會會議現場情形

圖 6　西元 2018 年第 20 屆環境系統國際研討會會議現場情形

伍、2018 年第 20 屆環境系統國際研討會概要

本次會議來自各國不同領域的專家學者就各專業領域提出發表，其中精選幾篇與環境保護相關的重要論文，摘要如下：

（一）公共空間的藝術設計：預防環境風險及回收再利用作為景觀建築的趨勢(Land Art in Public Spaces Design: Remediation, Prevention of Environmental Risks and Recycling as a Consequence of the Avant-Garde Activity of Landscape Architecture)：

本研究發現，近幾十年來，利用地形面貌設計雕塑造景漸漸成為景觀藝術的趨勢，作者認為其原因除了越來越多藝術家開始涉略景觀及造景的領域外，最重要的因素是環境的綠地逐漸在減少，使得公共空間的景觀設計已難以利用大量的綠地及樹木進行規劃，轉而朝向廢棄材料回收再利用作為景觀藝術設計的核心。

本研究挑選 5 處城市公園做為研究對象，分別為 Northala Fields（英國）、Parc Des Iles（加拿大）、Byxbee Park（美國）、Governors Island Park（美國）、Playa Vista Central Park（美國），他們皆使用了廢棄材料做為公園造景，並強調資源再利用及永續環境生態，符合了國際自然保護聯盟（International Union for Conservation of Nature and Natural Resources, IUCN）所提出的「以自然之道(Nature-based Solutions)因應全球變遷」。

本研究結論認為以此概念規劃的城市公園，可緩慢修復當地已遭受破壞的環境，並同時保有做為遊憩公園的目的，且使用了廢棄材料，降低了建造成本卻能吸引遊客的目光，並推廣永續環境的理念。

（二）評估納入河川做為環境友善的城市發展：以依傍黃河的濟南市為例進行四維分析(Exploration of an Environmentally Friendly Form of City Development Combined with a River: An Example of a Four-Dimensional Analysis Based on the Expansion of the City of Jinan across the Yellow River)：

中國大陸黃河流經濟南市北部，然而濟南市過往的都市規劃長期以來一直忽視黃河的要素，近年隨著經濟發展，濟南市的規模逐漸擴大，卻受限於黃河而只能朝東西橫向發展。中國大陸政府於西元 2003 年 5 月起推動濟南市跨河政策，自此推動跨河發展一直是都市規劃的重點。

本研究針對需跨越河流的城市議題，提出了一個由時間軸、地理空間 X 軸、Y 軸和 Z 軸的四維分析，進行跨河城市發展的規劃。其中 X 軸探討平行河流方向的規劃，主要為依傍黃河的親水公園設計，Y 軸為跨越河流的交通規劃，包含連通的橋梁及隧道，Z 軸以河川剖面圖進行防洪安全的分析及規劃，最後在地理

空間 3 軸中加入時間推移的要素。

本論文最後結論建議應藉由跨河發展政策，將濟南市打造為依傍黃河的親水都市，認為城市跨河發展應更加注重及順應當地生態環境，並建議濟南市政府規劃局及城鄉水務局跨部會協調及合作以達成前揭目標。

（三）無黏結劑多孔氧化銅光電陰極用於 P 型染料敏化太陽能電池的效率(Binder-Free Porous Photocathode Based on Cuprous Oxide for High-Performing P-Type Dye-Sensitized Solar Cells)：

染料敏化太陽能電池(DSSC)又被稱為格雷策爾電池，其具有結構簡單，製造容易及成本低廉等優點，在近年逐漸吸引了科學界的關注，並有望成為傳統矽晶體太陽能電池的替代品。另外在過去的幾年中，由於串疊型太陽能電池的發明成功提高了電池的轉化效率，高效能的 P 型染料敏化太陽能電池開發已成為研究的焦點。

本研究推測多孔薄膜可能是 DSSC 的絕佳材料，因為該材料表面積很大，可以有效地吸收染料和太陽光，於是便製作了用無粘結劑的多孔氧化銅光電陰極，並分析其用於 P 型染料敏化太陽能電池的性能。

實驗步驟使用一步水熱法以低成本製作了多孔氧化銅薄膜材料，並利用掃描電子顯微鏡檢查確認其多孔型態，最後藉由光學法及 Mott-Schottky 法測量證實了無黏結劑的多孔氧化銅薄膜其用於 P 型染料敏化太陽能電池的高轉換效率。

陸、心得及建議

本次會議圍繞環境系統的研討會主題，會議論文涉及範圍非常廣泛，舉凡就生物技術、交通、城市規劃、能源等議題皆出現於會議論文上，尤其以科學技術的學術論文居多，故可藉由參與本次研討會，吸收國際最新的環保技術、科技發展的議題，並作為我國相關環保技術更新之參考資料，另針對環境保護政策相關研究，有「評估納入河川做為環境友善的城市發展：以依傍黃河的濟南市為例進行四維分析」(Exploration of an Environmentally Friendly Form of City Development Combined with a River: An Example of a Four-Dimensional Analysis Based on the Expansion of the City of Jinan across the Yellow River)等將城市發展規劃融合生態及防災進行評估之論文；針對環境影響評估相關業務，亦有「社區服務的社會影響評估：以葡萄牙城市為例」(Assessing the Social Impacts of Regional Services: The Case of a Portuguese Municipality)等論文供參考。

本會議雖然不是針對開發行為環境影響評估或是環保綜合業務進行討論，但對於各論文提出環境系統的分析或環境技術的發展及研究，可以看出國際間對於環境保護的重視與努力，且對於環境議題也越來越不只侷限於污染的整治，而開始將各種社會面向的發展或現象加入環境因素進行分析及評估。建議我國可參考國際間趨勢，就未來環境資源部成立的機會，重新檢視思考環境資源部於政府部門中應有的角色與功能，以創造永續發展的目標。

20.
INTERNATIONAL RESEARCH CONFERENCE

CERTIFICATE OF ATTENDANCE

This certificate is awarded to

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in oral and technical presentation, recognition and appreciation of research contributions to ICES 2018 : 20th International Conference on Environmental Systems

BARCELONA, SPAIN

Authorized Signature

MAY 17-18, 2018

附錄：會議議程及論文資料

Scholarly Integrity Remarks:

1)Authors must be ready in the meeting room at least 10 minutes prior to the start of the session. Presenters must introduce themselves to the session chair(s) and upload their Oral and ePoster presentations to the computer.

2)Authors must be able to present on any day of the conference – the program cannot be tailored around specific requests from individual authors to present on particular days.

3)The international research conference program is designed for original research contributions and presentations in all research fields. Presentations scheduled in the Oral and ePoster sessions are drawn from a selection of the peer reviewed papers from a wide range of scientific and other disciplines of inquiry.

CONFERENCE VENUE
Hotel Frontair Congress Barcelona
Carrer dels Alberedes, 16,
08830 Sant Boi de Llobregat,
Barcelona

CONFERENCE REGISTRATION
May 17, 2018 from 08:00 to 11:00

CONFERENCE PROGRAM
May 17, 2018
Session I: 08:15-09:00

The group photo will be taken at the end of the session in the conference room.
You can share the photos you have taken at https://waset.org/conference/2018/05/barcelona/photos

Chair: Salma Balazadeh

1		A Novel Control Module for Heat Stress Memory in Plants	Mastoureh Sedaghatmehr, Venkatesh P. Thirumalaikumar, Bernd Mueller-Roeber, Salma Balazadeh Max-Planck-Institut für Molekulare Pflanzenphysiologie Germany
2	e-Poster	Useful Characteristics of Pleurotus Mushroom Hybrids	Suvalux Chaichuchote, Ratchadaporn Thonghem Department of Agriculture / Biotechnology Research and Development Office Thailand
3	e-Poster	Characteristics of Tremella fuciformis and Annulohypoxylon stygium for Optimal Cultivation Conditions	Eun-Ji Lee, Hye-Sung Park, Chan-Jung Lee, Won-Sik Kong National Institute of Horticultural and Herbal Science Korea, Republic Of
4	e-Poster	The Increase in Functionalities of King Oyster Mushroom (Pleurotus eryngii) Mycelia Depending on the Increase in Nutritional Components	Hye-Sung Park, Eun-Ji Lee, Chan-Jung Lee, Won-Sik Kong Rural Development Adminisitration Korea, Republic Of

5	e-Poster	Effect of Inorganic Fertilization on Soil N Dynamics in Agricultural Plots in Central Mexico	Karla Sanchez-Ortiz, Yunuen Tapia-Torres, John Larsen, Felipe Garcia-Oliva Universidad Nacional Autónoma de México Mexico
6		Determination of Relationship among Shape Indexes Used for Land Consolidation	Firat Arslan, Hasan Degirmenci, Serife Tulin Akkaya Aslan Kahramanmaras Sutcu Imam University Turkey

May 17, 2018
Session II: 09:00-10:45
Coffee Break: 10:45-11:00

Chair: Ebru Cubukcu, David De Leon

1		Analyzing the Street Pattern Characteristics on Young People's Choice to Walk or Not: A Study Based on Accelerometer and Global Positioning Systems Data	Ebru Cubukcu, Gozde Eksioglu Cetintahra, Burcin Hepguzel Hatip, Mert Cubukcu Dokuz Eylul University Turkey
2		Land Art in Public Spaces Design: Remediation, Prevention of Environmental Risks and Recycling as a Consequence of the Avant-Garde Activity of Landscape Architecture	Karolina Porada Cracow University of Technology Poland
3		Exploration of an Environmentally Friendly Form of City Development Combined with a River: An Example of a Four-Dimensional Analysis Based on the Expansion of the City of Jinan across the Yellow River	Zhaocheng Shang Karlsruhe Institute of Technology Germany
4		Mechanical Properties of Ordinary Portland Cement Modified Cold Bitumen Emulsion Mixture	Hayder Kamil Shanbara, Felicite Ruddock, William Atherton, Nassier A. Nassir University of Liverpool United Kingdom
5		Fiber-Based 3D Cellular Reinforcing Structures for Mineral-Bonded Composites with Enhanced Structural Impact Tolerance	Duy M. P. Vo, Cornelia Sennewald, Gerald Hoffmann, Chokri Cherif Institute of Textile Machinery and High Performance Technology (ITM), TU Dresden Germany
6		Optimal Mitigation of Slopes by Probabilistic Methods	D. De-León-Escobedo, D. J. Delgado-Hernández, S. Pérez Universidad Autónoma del Estado de México Mexico
7		Jalovchat Gabbroic Intrusive, the Caucasus: Petrological Study, Geochemical Peculiarities and Formation Conditions	Giorgi Chichinadze, David Shengelia, Tamara Tsutsunava, Nikoloz Maisuradze, Giorgi Beridze Alexander Janelidze - Ivane Javakhishvili Tbilisi State University Georgia

May 17, 2018

Session III: 11:00-12:00

Chair: Mary Ruppert-Stroescu

1		Literature Survey of Local Energy Systems: Prime Movers, Energy Storage Systems, Renewable Energy, Modelling, and Control System Methods	Ameer Al-Kaykhan, John M. Counsell, Matt J. Stewart, Y. Khalid, Nassier A. Nassir University of Liverpool United Kingdom
2		Textile-Based Sensing System for Sleep Apnea Detection	Mary S. Ruppert-Stroescu, Minh Pham, Bruce Benjamin Washington University in St. Louis United States
3		Surface Modification of Titanium Alloy with Laser Treatment	Nassier A. Nassir, Robert Birch, D. Rico Sierra, S. P. Edwardson, G. Dearden, Zhongwei Guan University of Liverpool United Kingdom
4		Manufacturing Process of S-Glass Fibre Reinforced Poly-Ether-Ketone-Ketone Prepregs	Nassier A. Nassir, Robert Birch, Zhongwei Guan University of Liverpool United Kingdom

May 17, 2018
Session IV: 12:00-12:20

Chair: Yong Wook Kim

1	e-Poster	An Analysis of Instruction Checklist Based on Universal Design for Learning	Yong Wook Kim Daegu University Korea, Republic Of
2	e-Poster	Treatment Impact on Neuropsychological Traits of Female Victims of Sexual Violence with Post Traumatic Stress Disorder: A Prospective Study	Adriana C. F. Mozzambani, Marcelo F. Mello Federal University of São Paulo Brazil
3	e-Poster	Neuropsychological Aspects in Adolescents Victims of Sexual Violence with Post-Traumatic Stress Disorder	Fernanda Mary R. G. Da Silva, Adriana C. F. Mozzambani, Marcelo F. Mello Federal University of São Paulo Brazil

May 18, 2018
Session V: 07:45-08:20

Chair: Catarina Grande

1		The Impact of Childhood Cancer on the Quality of Life of Survivor: A Qualitative Analysis of Functionality and Participation	Catarina Grande, Barbara Mota University of Porto Portugal

2	Representations of Germanophobia during the German Unification and the Euro Crisis: A Comparative Study in the Portuguese Press	Ana Luisa Mouro, Ana Maria Ramalheira University of Aveiro Portugal.
3	Assessing the Social Impacts of Regional Services: The Case of a Portuguese Municipality	A. Camões, M. Ferreira Dias, M. Amorim University of Aveiro Portugal

PROGRAM GUIDELINES

1.GUIDE FOR ORAL AND e-POSTER PRESENTATIONS

We kindly ask ORAL presenters to prepare electronic presentations of 15 minutes (allowing 5 minutes for discussions) and e-POSTER presenters to prepare short electronic presentations of 5 minutes (allowing 5 minutes for discussions) (NO PRINT OUTS). A Linux-based operating system is used for both Oral and e-Poster presentations. All presenters should make a PDF file version of their presentation and upload it to the system.

2. PRESENTATION SET UP

Laptop Computer, Projector, USB Flash Drive (No CD Drive), MS. PowerPoint/AcrobatReader

3. SYSTEM SECURITY ALERT

As many delegates insert their USB devices into the laptop computer provided for the presentations, we cannot avoid Cyber/Computer viruses. You are kindly advised to bring a USB Flash Drive containing ONLY your .ppt, .ptx or .pdf presentation file or risk other files being corrupted or made permanently inaccessible.

4. ROLE OF THE SESSION CHAIR

The duties of the Session Chair include the following:

1. Arrive at the conference hall at least 10 minutes before the session begins. Identify the paper presenters and discussant(s) in advance, and introduce yourself. Remind each presenter of the time limits that apply, and describe the method you will use to alert them of time limits during the actual presentation.
2. At the start of the session, introduce yourself to the audience, announce the session/title, and offer a brief overview indicating how the papers are related.
3. Prior to each presentation, introduce the speaker, announce the paper's title, the name(s) of the author(s), and provide brief comments regarding the affiliation and/or background of each presenter. Identify the individual who will be speaking if it is someone other than the first author.
4. During the presentations enforce time limits strictly so that no author (or audience member) monopolizes someone else's time. Oral paper presentations each have 20 minutes (15 minutes for full presentation papers, 5 minutes for discussions), and 10 minutes for e-Poster (electronic poster) presentations (5 minutes for poster presentation, 5 minutes for discussions).
5. Once presentations are complete (oral paper presentations and e-Poster presentations), the remaining time can be used for informal discussion between the audience and session participants. It is your job to field questions from the audience.
6. Try to conduct the session as informally as possible (e.g., use first names when addressing participants and members of the audience) to encourage as much audience participation as possible.

5. BEST PAPER AWARDS / BEST PRESENTATION AWARDS

A 'Best Paper Award / Best Presentation Award' will be conferred on the author(s) of an abstract or a full paper presented at the conference. Selection is made based on the best combined marks of the abstract / paper review and presentation quality appraisal conducted by the Session Chair at the conference venue, and assessed by the Program Committee. Award winners will be announced after the conference. The author(s) of a selected paper/presentation will receive a signed and stamped official Best Paper Award / Best Presentation Award e-certificate.

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A Novel Control Module for Heat Stress Memory in Plants

Mastoureh Sedaghatmehr, Venkatesh P. Thirumalaikumar, Bernd Mueller-Roeber, Salma Balazadeh

***Abstract*—**Plants have the capacity to 'memorize' stressful events and protect themselves from future stresses. Furthermore, they are able to 'reset' or 'forget' memories of certain stressful situations, which helps to maximize growth after returning to non-stress conditions. A delicate balance between the consolidation of stress memory and the degree of forgetfulness is critical for plant growth and productivity under changing environmental conditions.

Here we report a novel control module for heat stress memory (thermomemory) in plants. Recently we identified HSP21, a chloroplast-localized small heat shock protein, as a crucial component of thermomemory. Variation in HSP21 protein level contributes to the differential thermomemory performance of Arabidopsis accessions, indicating a strong link between protein abundance of HSP21 and enhanced thermomemory capacity. Employing a combined pharmacological/genomics approach, we discovered a plastid-localised metalloprotease, FtsH6, for which no previous *in vivo* function was reported, as a protease involved in the initial degradation of HSP21 during the memory phase in Col-0. Furthermore, we showed that in addition to FtsH6, autophagy contributes to the selective degradation of HSP21 at later stages of the thermomemory phase. Our results thus reveal the presence of a novel HSP21- a plastidial protease – autophagy control module for thermomemory in plants and hold a great promise for understanding how plants grow and reproduce in highly dynamic environments with many predictable and unpredictable variables. Details will be presented and discussed.

***Keywords*—**Autophagy, chloroplast, FtsH6, HSP21, thermomemory.

M. S. is with the Max Planck Institute of Molecular Plant Physiology, Am Mühlenberg 1, 14476 Potsdam-Golm, Germany (e-mail: Sedaghatmehr@mpimp-golm.mpg.de).

VP. T. is with the Max Planck Institute of Molecular Plant Physiology, Am Mühlenberg 1, 14476 Potsdam-Golm, Germany (e-mail: Thirumalaikumar@mpimp-golm.mpg.de).

B.M-R. is with University of Potsdam, Institute of Biochemistry and Biology, Karl-Liebknecht-Straße 24-25, Haus 20, 14476 Potsdam-Golm, Germany (e-mail: bmr @uni-potsdam.de).

S. B. is with the Max Planck Institute of Molecular Plant Physiology, Am Mühlenberg 1, 14476 Potsdam-Golm, Germany (phone: 0049 331 5678352; e-mail: balazadeh@mpimp-golm.mpg.de).

Useful Characteristics of *Pleurotus* Mushroom Hybrids

Suvalux Chaichuchote, Ratchadaporn Thonghem

Abstract— *Pleurotus* mushroom is one of popular edible mushrooms in Thailand. It is much favored by consumers due to its delicious taste and high nutrition. It is commonly used as an ingredient in several dishes. The commercially cultivated strain grown in most farms is the *Pleurotus* sp., Hed Bhutan, that is widely distributed to mushroom farms throughout the country and can be cultivated almost all year round. However, it demands different cultivated strains from mushroom growers, therefore, the improving mushroom strains should be done to their benefits. In this study we used a di-mon mating method to hybrid production from Hed Bhutan (P-3) as dikaryon material and monokaryotic mycelium were isolated from basidiospores of other three *Pleurotus* sp. by single spore isolation. The 3 hybrids: P-3XSA-6, P-3XSB-24 and P-3XSE-5 were recognized from the 12 hybridized successfully. They were appropriate hybridized in terms of fruiting body performance in the three time cycles of cultivation such as the number of days until growing, time for pinning, color and shape of fruiting bodies and yield. For genetic study, genomic DNAs of both Hed Bhutan (P-3) and three hybrids were extracted. A couple of primer ITS1 and ITS4 were used to amplify the gene coding for ITS1, ITS2 and 5.8S rRNA. The similarities between these amplified genes and databases of DNA revealed that Hed Bhutan (P-3) was the *Pleurotus pulmonarius* as well as P-3XSA-6, P-3XSB-24 and P-3XSE-5 hybrids. Furthermore, Hed Bhutan (P3) and three hybrids were distributed to 3 small-scale farms, with mushroom farming experience, in the countryside. To address this, one hundred and twenty mushroom bags of each strain were supplied to them. The findings, by interview, indicated two mushroom farmers were satisfied with P-3XSA-6 hybrid and P-3XSB-24 hybrid, thanks to their simultaneous fruiting time and good yield. While the other was satisfied with P-3XSB-24 hybrid due to its good yield and P-3XSE-5 hybrids thanks to its gradually fruiting body, benefiting in frequent harvest. Overall, farmers adopted all hybrids to grow as commercially cultivated strains as well as Hed Bhutan (P-3) strain.

Keywords— Dikaryon, monokaryon, Pleurotus, strain improvement.

I. INTRODUCTION

PRODUCTION of mushroom has been very much interesting due to its return in a short time. Mushrooms have been grown on many different substrates, usually agricultural by-products. The species of the genus *Pleurotus* are widely recognized for cultivation. They are valued for their nutritional properties: being rich in protein, fibre, carbohydrates, vitamins, and minerals while containing low fat as food purposes. Also, the medicinal properties of them are recognized as an immune system enhancer, promoting human health, and as dietary supplements. Several compounds have been isolated from mushrooms and found to have antioxidant, anticancer, antimicrobial, antidiabetic, antihypercholestrolemic and immunomodulatory properties [1],[2]. *Pleurotus* mushroom cultivated widely in mushroom farms is Hed Bhutan strain. It can be cultivated almost all year round and has grown for local consumption and commercially for the market in many parts of Thailand. It is very popular among consumers due to its delicious taste and ability to be an integral part of many dishes, from soups to stir-fried, curry and beyond. A popularity of production has resulted in demands for new mushroom strains from the cultivators and consumers. The developing new mushroom strains could be done by the techniques such as selection (monospore and multispore) and cross breeding (hybridization) as performed in mon-mon or di-mon mating. The formation of clamp connections is used as provided evidence of dikaryon formation [3],[4],[5]. The hybrid strain has been accomplished by trial, then to be cultivated to evaluate the production characteristics [6],[7]. The success hybrid strains will benefit both mushroom farmers and consumers.

The presented study aimed to obtain hybridized strains of the *Pleurotus* mushroom using a di-mon mating method. The *Pleurotus* sp Hed Bhutan (P-3) was used as dikaryon and monokaryotic mycelium were isolated from basidiospores of other *Pleurotus* sp. by single spore isolation. The hybrid production was evaluated on cultivation, genetic characterization and on-farm trials in comparison with the parental strains.

II. MATERIALS AND METHODS

A. Strains and Isolation of Mycelium

Pleurotus mushrooms for this study obtained from our culture collection: *Pleurotus* sp., Hed Bhutan (P-3), is a commercially cultivated strain while other three were *Pleurotus* sp. A-15, A-16 and A-19. They were fruited in the mushroom house under natural environment. Pure culture of P-3 was isolated under aseptic technique from mushroom fruiting body. It was used as dikaryon. The monokaryotic mycelium were isolated from basidiospores of *Pleurotus* sp. A-15,A-16 and A-19 fruiting bodies by single spore isolation method. Basidiospores from spore prints were suspended in 9 mL sterile distilled water and a ten fold dilution up to 10^{-5} was made. Spore suspension (0.1 mL) was added onto the water

Suvalux Chaichuchote is with Biotechnology Research and Development Office, Department Of Agriculture,Phaholyothin Road, Chatuchack, Bangkok, 10900. THAILAND. (corresponding author, phone: 662-579-8558; fax: 662-940-6656; e-mail: suvalux@ yahoo.com).

Ratchadaporn Thonghem is with Biotechnology Research and Development Office, Department Of Agriculture, Phaholyothin Road, Chatuchack, Bangkok, 10900. THAILAND.
(e-mail: ratchadaporn29@hotmail.com)

agar (WA) plate and spread using a sterilized glass spreader. The plate was incubated at 30°C for 4-5 days. As soon as the first appearance of colony was noticed, it was picked, transferred to potato dextrose agar (PDA) slants, and incubated at 30°C for 4-7 days to grow as single spore culture. Monokaryons were confirmed to be truly monokaryotic under the light microscope by the absence of clamp connections. The dikaryotic, P-3 and selected monokaryotic mycelia were maintained on PDA slants for a mating experiment.

B. Dikaryon–Monokaryon Matings

The dikaryotic and monokaryotic mycelia were inoculated about 2 cm apart from each other in the centre of the same PDA plate (90 mm diameter) and was incubated at 30°C for 5-10 days. To analyze the mating interaction between individual dikaryon and monokaryon, the growing margin of monokaryotic mycelium side was examined using microscopy. Formation of clamp connections was used as the indicative of dikaryon formation. The selected hybrid mycelia were maintained on PDA slants as well as P-3 culture for cultivation and productivity tests.

C. Cultivation and Productivity Tests

For the cultivation, the substrate was consisted of sawdust (100kg), rice bran (10kg), $MgSO_4 \cdot 7H_2O$ (200 g), $CaCO_3$ (1kg) and gypsum (500 g) and adjusted the moisture content to approximately be 60-70%. The substrate was packed in plastic bags (800g each) and pasteurized without any pressure at 100°C for 3 hours. After the pasteurized media were cooled down, the substrate bags were inoculated with actively mycelium spawn growing on sorghum grain. The parameters that were measured for performance of mushroom cultivated included the number of days to full colonization, time to fruiting (initiation of pin heads), color and shape of fruiting bodies. The average yield per bag, which be determined by weighing the whole cluster of fruiting bodies without removing the base of stalks, were also collected. The experiment was laid out in a Randomize Complete Block Design (RCBD) with four replications (20 substrate bags in each replication). The treatments were consisted of Hed Bhutan (P-3) and the selected hybrids. Data analysis was done using analysis of variance (ANOVA), and tests of significance carried out by Duncan's multiple range test (DMRT) at $P< 0.05$. The cultivation test has been done in the three time cycles and the cropping period of each cycle was four months.

D. Genetic Characterization

Genomic DNA was extracted from the mycelium of Hed Bhutan (P-3) and selected hybrid strains using the modified CTAB method [8].The internal transcribed spacer (ITS) region was amplified on Gene Amp 9700 thermal cycle with a pair of primers: forward ITS1 (5'-TCCGTAGGTGAACCTGCGG-3') and reverse ITS4 (5'-TCCTCCGCTTATTGATATGC-3'). The PCR assay was performed in 25-µL reaction mixtures, containing 12.5 µL of 2 × PCR buffer GoTaq® Green Master Mix (Promega, USA), 1 µL of each PCR primer (5 µM), and 2 µL of DNA extract, and the total volume was adjusted to 25 µL with sterile deionized water. PCR amplification was conducted according to the following procedure: 95°C for 2 min, 30 cycles of 94°C for 30 sec, 55°C for 30 sec, and 72°C for 1 min, and a final extension at 72°C for 10 min. PCR products were analyzed by electrophoresis in a 1.5 % agarose gel. The amplicons were purified using the QIAquick PCR Purification Kit (QIAGEN, Germany). The purified PCR products of ITS amplified regions were done cycle sequencing using BigDye™ Terminator Cycle Sequencing V 3.1 (Applied Biosystems, USA). The cycle sequencing products were used as template for sequencing using an ABI PRISM 310 Genetic Analyzer (Applied Biosystems, USA). Nucleotide sequence comparisons were performed by using network services against the GenBank.

E. On- Farm Trials

The mushroom farmers in the countryside who had an experience of cultivation were selected. The ready fruiting mushroom bags of each strain were supplied to them. Data were gathered by way of interviews.

III. RESULTS AND DISCUSSION

A. Strains and Isolation of Mycelium

The dikaryon culture, Hed Bhutan (P-3) was isolated from cultivated mushroom fruiting body showed as Fig.1, as well as thirty-five monokaryon cultures from A-15 (designated as SA1 through SA35), thirty-five monokaryon cultures from A-16 (designated as SB1 through SB35) and forty-five monokaryon cultures from A-19 (designated as SE1 through SE45).

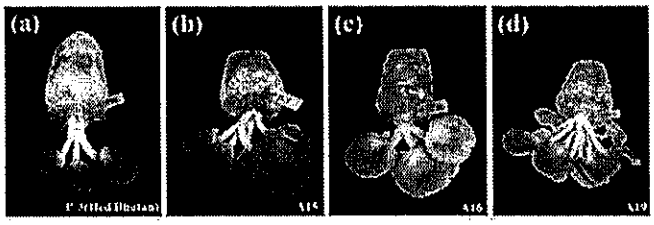

Fig. 1 Fruiting body of *Pleurotus* sp. (a) Hed Bhutan (P-3); (b) A-15, (c) A-16, (d) A-19

B. Dikaryon–Monokaryon Matings

The mating test of dikaryon culture of Hed Bhutan (P-3) and monokaryon cultures of A-15,A-16 and A-19 were successfully hybridized and produced heterokaryotic mycelium in 12 combinations out of 115. The formation of clamp connections on the growing margin of monokaryotic mycelium side was observed (Fig.2). Out of 35 pairings between of Hed Bhutan (P-3) and A-15, 6 pairings were successfully hybridized while pairings of Hed Bhutan (P-3) and A-16 were successfully hybridized in 5 combinations out of 35 and pairings of Hed Bhutan (P-3) and A-19 were successfully hybridized in only 1 combinations out of 45. The 12 successfully hybrids designated as P-3XSA-2, P-3XSA-4, P-3XSA-5, P-3XSA-6, P-3XSA-7, P-3XSA-25, P-3XSB-14, P-3XSB-20, P-3XSB-23, P-3XSB-24, P-3XSB-25 and P-3XSE-5 were for cultivation and productivity test.

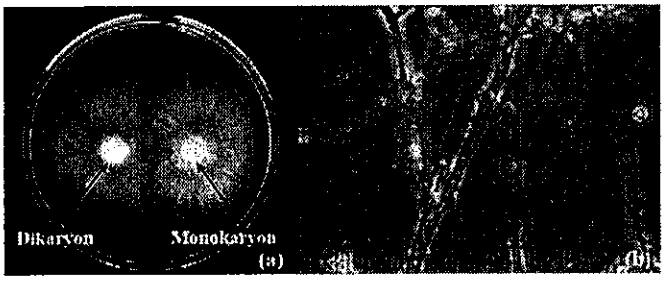

Fig.2 Crossing and appearance of clamp connection. (a) Compatibility between dikaryotic and monokaryotic mycelium,(b) Clamp connection in mycelium of the growing margin of monokaryotic mycelium side.

C. Cultivation and Productivity Tests

Cultivation characteristics in the three time cycles of cultivation of Hed Bhutan (P-3) and the 12 hybrids were presented in Table 1. Accordingly, it was found that all tested cultures were successfully cultivated at the first cycle of cultivation. In the second cycle of cultivation only Hed Bhutan (P-3), P-3XSA-2, P-3XSA-6, P-3XSB-24 and P-3XSE-5 produced fruiting bodies while the P-3 x SA-4, P-3 x SA-7, P-3 x SB-20, P-3 x SB-23 and P-3 x SB-25 hybrids could grow on the substrate but did not form any fruiting bodies. Similarly, the third cycle of cultivation, only Hed Bhutan (P-3), P-3XSA-2, P-3XSA-5, P-3XSA-6, P-3XSA-7, P-3XSA-25, P-3XSB-20, P-3XSB-24, P-3XSB-25 and P-3XSE-5 produced fruiting bodies while the P-3 x SA-4 and P-3 x SB-23 could grow on the substrate but did not form any fruiting bodies. Hereby, color and shape of fruiting bodies showed in Fig.3, 4 and 5. The mushroom fruiting bodies were found in diverse colors like cream, creamy to gray, gray and grayish to brown, and shape were almost circular to fan-shaped or fan-shaped with wavy edge or inrolled margins or lobed margins. Results obtained showed that there were four hybrid strains, P-3XSA-2, P-3XSA-6, P-3XSB-24 and P-3XSE-5 produced fruiting bodies in all cycles of cultivation as well as Hed Bhutan (P-3). Among the four hybrids, P-3XSA-6, P-3XSB-24 and P-3XSE-5 took a time to fully colonize the spawn in 30.84-36.33, 34.68-44.83 and 32.05-36.76 days respectively and time to fruiting (initiation of pin heads) were 5.10-13.10, 7.39-11.20 and 7.63-12.76 days respectively. These resembled Hed Bhutan (P-3) that were 27.25-36.50 and 5.56-21.00 days. In addition to, the hybrids showed similar color and shape of fruiting bodies and gave more or less yield than those of Hed Bhutan (P-3). Consequently, based on the criteria : ability to form fruiting bodies in all cycles of cultivation, the number of days until growing, time for pinning, color and shape of fruiting bodies and yield, P-3XSA-6, P-3XSB-24 and P-3XSE-5 hybrids were selected for further evaluation of its potential as a new variety of mushroom for commercial production.

TABLE 1 CULTIVATION CHARACTERISTICS OF HED BHUTAN (P-3) AND HYBRID STRAINS IN THE THREE TIME CYCLES OF CULTIVATION.
(a) The first cycle of cultivation (b) The second cycle of cultivation
(c) The third cycle of cultivation

(a)

Strains	Number of days to full colonization	Time to fruiting (initiation of pin heads)	Average yield per bag (g/bag)
Hed Bhutan (P-3)	27.25 a	5.56 a	125.43 a
P-3 x SA-2	33.50 d	5.38 a	100.61 b
P-3 x SA-4	35.76 g	13.69 bc	20.03 gh
P-3 x SA-5	27.90 a	5.04 a	100.87 b
P-3 x SA-6	30.84 b	5.10 a	113.39 ab
P-3 x SA-7	32.40 c	11.96 ab	33.97 efg
P-3 x SA-25	62.25 h	25.88 d	25.88 fg
P-3 x SB-14	63.21 i	19.50 c	4.05 h
P-3 x SB-20	34.26 e	26.75 d	38.64 ef
P-3 x SB-23	34.69 ef	29.06 d	45.59 de
P-3 x SB-24	34.68 ef	8.07 ab	71.42 c
P-3 x SB-25	35.12 fg	12.93 bc	62.09 cd
P-3 x SE-5	32.05 c	7.63 ab	116.82 ab

(b)

Strains	Number of days to full colonization	Time to fruiting (initiation of pin heads)	Average yield per bag (g/bag)
Hed Bhutan (P-3)	36.50 a	21.07 b	42.84 b
P-3 x SA-2	40.06 c	21.98 b	53.99 b
P-3 x SA-4	49.00 e	ND	ND
P-3 x SA-5	ND	ND	ND
P-3 x SA-6	36.33 a	12.19 a	79.03 a
P-3 x SA-7	48.64 e	ND	ND
P-3 x SA-25	ND	ND	ND
P-3 x SB-14	ND	ND	ND
P-3 x SB-20	38.26 b	ND	ND
P-3 x SB-23	45.31 d	ND	ND
P-3 x SB-24	36.33 a	11.20 a	76.64 a
P-3 x SB-25	36.56 a	ND	ND
P-3 x SE-5	36.76 ab	12.76 a	80.23 a

(c)

Strains	Number of days to full colonization	Time to fruiting (initiation of pin heads)	Average yield per bag (g/bag)
Hed Bhutan (P-3)	33.65 a	10.65 a	82.48 b
P-3 x SA-2	52.10 e	27.18 d	33.65 c
P-3 x SA-4	57.86 f	ND	ND
P-3 x SA-5	46.31 cd	14.43 abc	18.91 cd
P-3 x SA-6	33.68 a	13.10 ab	77.44 b
P-3 x SA-7	48.08 d	23.99 cd	16.32 d
P-3 x SA-25	57.69 f	21.42 bcd	4.17 d
P-3 x SB-14	ND	ND	ND
P-3 x SB-20	41.28 b	7.20 a	104.20 a
P-3 x SB-23	47.62 d	ND	ND
P-3 x SB-24	44.83 c	7.39 a	92.42 ab
P-3 x SB-25	41.71 b	14.71 abc	5.79 d
P-3 x SE-5	33.53 a	12.09 ab	88.76 ab

Averages values under the same column with different letters are significantly different at $p \leq 0.05$.
ND stands for Not Detectable

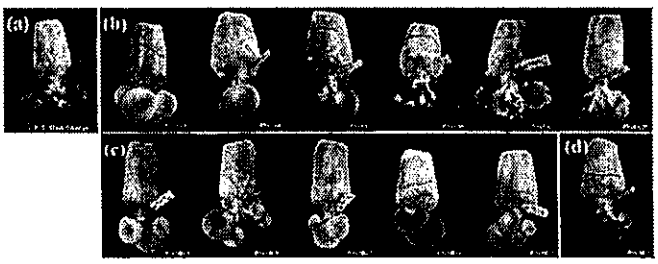

Fig.3 Fruiting bodies of cultivated Pleurotus sp. at the first cycle of cultivation. (a) Hed Bhutan (P-3), (b) P-3 x SA-2, P-3 x SA-4, P-3 x SA-5, P-3 x SA-6, P-3 x SA-7, P-3 x SA-25 (c) P-3 x SB-14, P-3 x SB-20, P-3 x SB-23, P-3 x SB-24, P-3 x SB-25 (d) P-3 x SE-5

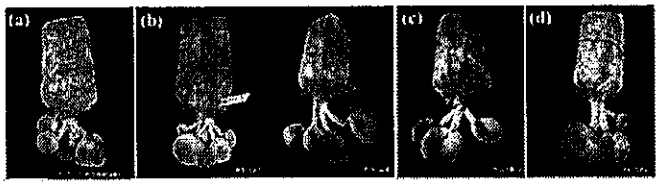

Fig.4 Fruiting bodies of cultivated Pleurotus sp. at *the second cycle of* cultivation.(a) Hed Bhutan (P-3), (b) P-3 x SA-2, P-3 x SA-6 (c) P-3 x SB-24 (d) P-3 x SE-5

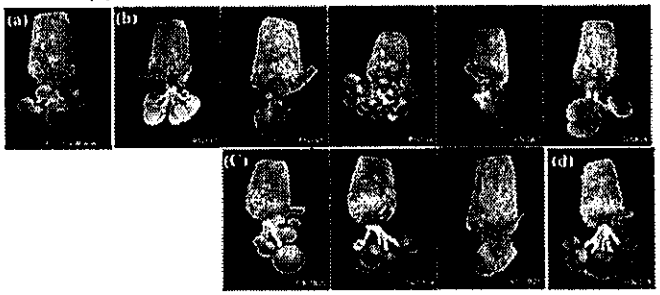

Fig.5 Fruiting bodies of Pleurotus sp, cultivated at *the third cycle* of cultivation.(a) Hed Bhutan (P-3), (b) P-3 x SA-2, P-3 x SA-4, P-3 x SA-5, P-3 x SA-6, P-3 x SA-7, P-3 x SA-25 (c) P-3 x SB-20, P-3 x SB-24, P-3 x SB-25 (d) P-3 x SE-5

D. Genetic Characterization

The nucleotide sequence of Hed Bhutan (P-3), P-3XSA-6, P-3XSB-24 and P-3XSE-5 hybrids were found to have 662, 652, 647 and 648 bp respectively (Tables 2.). The nucleotide sequence comparisons were performed by using network services against the GenBank. The BLAST results revealed that Hed Bhutan (P-3) was the *Pleurotus pulmonarius* as well as P-3XSA-6, P-3XSB-24 and P-3XSE-5 hybrids (Tables 3.). The ITS region of species of *Pleurotus* mushroom had been shown in several reports. The size of it was 654 bp in length for *Pleurotus eryngii*, 646 bp in the *Pleurotus sajor-caju*, 654 bp in the *Pleurotus sapidus*, 652 bp in the *Pleurotus citrinopileatus*, 654 bp in the *Pleurotus florida*, 655 bp in the *Pleurotus ostreatus* [9]. And the other range 660 bp in the *Pleurotus pulmonarius* , 666 bp in the *Pleurotus citrinopileatus*, 668 bp in the *Pleurotus floridanus*, 669 bp in the *Pleurotus ostreatus*, 668 bp in the *Pleurotus sapidus* and *Pleurotus eryngii* [10].

TABLE 2. PARTIAL NUCLEOTIDE SEQUENCES OF *PLEUROTUS* SP. (a) HED BHUTAN(P-3) (b) P-3XSA-6 (c) P-3XSB-24 (d) P-3XSE-5 HYBRIDS

Sample	Sequences
(a)	CTTATTGATATGCTTAAGTTCAGCGGGTAGTCCTACCTG ATTTGAGGTCaAATTGTCAAATTGTCCTTGCGGACGATT AGAGAGCTGGACTCTATTCATGCGTGCTATTGATGAGT GATAATTATCACATCATGCGCAGAGGCAATGAGAAGTC CTGCTAATGCATTTAAGAGGAGCCGACTTGTTACAGCC AGCAACCCCCAACAATCCAAACATCACAAATAAATGTG AGTTTGAGAATTTAATGACACTCAAACAGGCATGCCCC TCGGAATACCAAGGGGCGCAAGGTGCGTTCAAAGATTC GATGATTCACTGAATTCTGCAATTCACATTACTTATCGC ATTTCGCTGCGTTCTTCATCGATGCGAGAGCCAAGAGAT CCGTTGTTGAAAGTTGTATTATGGTTTATAGGCACAAGG CCCATTAAATGACATTCGTAGACATACATTTGGGGTGTG TTAAGTAAATAGACTGCGTTGTCACACCGAGACGTTTA AATCCCAGCAAACCAAGTCTGACGACTTGAAGGACGAC TTCACAGATCTATCAAAAGTTCACAGGTGGTTGAAAGA CTAGTGAAGCGTGCACATGCCCCTAGAGGCCAGCAACA ACTCCATAGTGAATTCATTAATGATCCTTCCGCAGGTTC ACCTACGGA
(b)	GCTTATTGATATGCTTAAGTTCAGCGGGTAGTCCTACCT GATTTGAGGTCAATTGTCAAATTGTCCTTGCGGACGATT AGAGAGCTGGACTCTATTCATGCGTGCTATTGATGAGT GATAATTATCACATCATGCGCAGAGGCAATGAGAAGTC CTGCTAATGCATTTAAGAGGAGCCGACTTGTTACAGCC AGCAACCCCCAACAATCCAAACATCACAAATAAATGTG AGTTTGAGAATTTAATGACACTCAAACAGGCATGCCCC TCGGAATACCAAGGGGCGCAAGGTGCGTTCAAAGATTC GATGATTCACTGAATTCTGCAATTCACATTACTTATCGC ATTTCGCTGCGTTCTTCATCGATGCGAGAGCCAAGAGAT CCGTTGTTGAAAGTTGTATTATGGTTTATAGGCACAAGG CCCATTAAATGACATTCGTAGACATACATTTGGGGTGTG TTAAGTAAATAGACTGCGTTGTCACACCGAGACGTTTA AATCCCAGCAAACCAAGTCTGACGACTTGAAGGACGAC TTCACAGATCTATCAAAAGTTCACAGGTGGTTGAAAGA CTAGTGAAGCGTGCACATGCCCCTAGAGGCCAGCAACA ACTCCATAGTGAATTCATTAATGATCCTTCCGCAGGTC
(c)	TTATTGATATGCTTAAGTTCAGCGGGTAGTCCTACCTGA TTTGAGGTCAAATTGTCAAATTGTCCTTGCGGACGATTA GAGAGCTGGACTCTATTCATGCGTGCTATTGATGAGTG ATAATTATCACATCATGCGCAGAGGCAATGAGAAGTCC TGCTAATGCATTTAAGAGGAGCCGACTTGTTACAGCCA GCAACCCCCAACAATCCAAACATCACAAATAAATGTGA GTTTGAGAATTTAATGACACTCAAACAGGCATGCCCCT CGGAATACCAAGGGGCGCAAGGTGCGTTCAAAGATTCG ATGATTCACTGAATTCTGCAATTCACATTACTTATCGCA TTTCGCTGCGTTCTTCATCGATGCGAGAGCCAAGAGATC CGTTGTTGAAAGTTGTATTATGGTTTATAGGCACAAGGC CCATTAAATGACATTCGTAGACATACATTTGGGGTGTGT TAAGTAAATAGACTGCGTTGTCACACCGAGACGTTTAA ATCCCAGCAAACCAAGTCTGACGACTTGAAGGACGACT TCACAGATCTATCAAAAGTTCACAGGTGGTTGAAAGAC TAGTGAAGCGTGCACATGCCCCTAGAGGCCAGCAACAA CTCCATAGTGAATTCATTAATGATCCTTCCGCA
(d)	CTTATTGATATGCTTAAGTTCAGCGGGTAGTCCTACCTG ATTTGAGGTCAAATTGTCAAATTGTCCTTGCGGACGATT AGAGAGCTGGACTCTATTCATGCGTGCTATTGATGAGT GATAATTATCACATCATGCGCAGAGGCAATGAGAAGTC CTGCTAATGCATTTAAGAGGAGCCGACTTGTTACAGCC AGCAACCCCCAACAATCCAAACATCACAAATAAATGTG AGTTTGAGAATTTAATGACACTCAAACAGGCATGCCCC TCGGAATACCAAGGGGCGCAAGGTGCGTTCAAAGATTC GATGATTCACTGAATTCTGCAATTCACATTACTTATCGC ATTTCGCTGCGTTCTTCATCGATGCGAGAGCCAAGAGAT CCGTTGTTGAAAGTTGTATTATGGTTTATAGGCACAAGG CCCATTAAATGACATTCGTAGACATACATTTGGGGTGTG TTAAGTAAATAGACTGCGTTGTCACACCGAGACGTTTA AATCCCAGCAAACCAAGTCTGACGACTTGAAGGACGAC TTCACAGATCTATCAAAAGTTCACAGGTGGTTGAAAGA CTAGTGAAGCGTGCACATGCCCCTAGAGGCCAGCAACA ACTCCATAGTGAATTCATTAATGATCCTTCCGCA

TABLE 3. SUMMARY OF BLAST RESULTS.

Sample	Percentage (%) identity	Accession number	Identified name of sample
Hed Bhutan (P-3)	100	MG819734.1	*Pleurotus pulmonarius* DMRP-15
P-3 x SA-6 hybrid	99	MG819743.1	*Pleurotus pulmonarius* DMRP-24
P-3 x SB-24 hybrid	100	MG819743.1	*Pleurotus pulmonarius* DMRP-24
P-3 x SE-5 hybrid	100	MG819743.1	*Pleurotus pulmonarius* DMRP-24

E. On-farm trials

Hed Bhutan (P3) and P-3XSA-6, P-3XSB-24 and P-3XSE-5 hybrids were distributed to small-scale farms, with mushroom farming experience, in the countryside. They cultivated mushroom as an extra income source, and sold the fresh mushrooms at markets near their houses. They were supplied a total one hundred and twenty mushroom bags of each strain. The mushroom yield was shown in Table 4 by 3 month harvesting period. The performance of P-3XSA-6 hybrid and P-3XSB-24 hybrid in terms of simultaneous fruiting time and good yield were satisfied by farmer-1 and farmer-2.While the farmer-3 was satisfied with P-3XSB-24 hybrid due to its good yield and gradually the fruiting body of P-3XSE-5 hybrid which benefiting in frequent harvest (Fig.6). They could get more income from production of mushroom (Table 5). However, they all accepted the three hybrid mushrooms to grow as commercially cultivated strains as well as Hed Bhutan (P-3) strain.

Fig.6 The small-scale mushroom farms, with mushroom farming experience, in the countryside. (a) Farmer-1 (b) Farmer-2 ,both of them who were satisfied with P-3XSA-6 hybrid and P-3XSB-24 hybrid (c) Farmer-3 who was satisfied with P-3XSB-24 hybrid.

TABLE 4. THE YIELD OF HED BHUTAN (P-3) AND HYBRID STRAINS BY 3 MONTHS HARVESTING PERIOD

Sample	Fresh mushroom weight (kg/120 bags)			
	Hed Bhutan (P-3)	P-3 x SA-6 hybrid	P-3 x SB-24 hybrid	P-3 x SE-5 hybrid
Farmer-1	29.1	29.0	28.1	24.4
Farmer-2	16.5	18.7	17.7	17.2
Farmer-3	14.9	16.0	19.8	19.0
Average yield	20.1	21.2	21.8	20.2

TABLE 5. ASSESSMENT OF BENEFIT INCOME FROM HYBRID STRAINS PRODUCTION

Topics	Commercially Cultivated Strain	Hybrid Strains		
	Hed Bhutan (P-3)	P-3 x SA-6 hybrid	P-3 x SB-24 hybrid	P-3 x SE-5 hybrid
Average yield (kg)	20.1	21.2	21.8	20.2
Income (mushroom weight x 60THB/kg)	1,206	1,272	1,308	1,212
% of revenue increased	-	5.47	8.45	0.49

IV. CONCLUSION

The improving *Pleurotus* mushroom strains had been done by using a di-mon mating method. To accomplish this, dikaryotic mycelium obtained from the commercially cultivated strain, Hed Bhutan (P-3). On the other hand, the basidiospores of other three *Pleurotus* sp. were being as monokaryotic mycelium. The mating test were successfully hybridized and produced heterokaryotic mycelium in 12 combinations out of 115. The 12 successfully hybrids designated as P-3XSA-2, P-3XSA-4, P-3XSA-5, P-3XSA-6, P-3XSA-7, P-3XSA-25, P-3XSB-14, P-3XSB-20, P-3XSB-23, P-3XSB-24, P-3XSB-25 and P-3XSE-5 were for cultivation and productivity tests. There were four hybrid strains, P-3XSA-2, P-3XSA-6, P-3XSB-24 and P-3XSE-5 produced fruiting bodies in all cycles of cultivation. The hybrids showed similar color and shape of fruiting bodies and gave more or less yield than those of Hed Bhutan (P-3). Consequently, based on the criteria : ability to form fruiting bodies in all cycles of cultivation, the number of days until growing, time for pinning, color and shape of fruiting bodies and yield, P-3XSA-6, P-3XSB-24 and P-3XSE-5 hybrids were selected for further evaluation of its potential as a new variety of mushroom for commercial production. The similarities between the amplified genes coding for ITS1, ITS2 and 5.8S rRNA and databases of DNA revealed that Hed Bhutan (P-3) was the Pleurotus pulmonarius as well as three hybrids. On-farm trials, a total of 3 mushroom farm participated in the trials adopted all hybrids to grow as commercially cultivated strains as well as Hed Bhutan (P-3) strain. The simultaneous fruiting time and good yield characters of P-3XSA-6 and P-3XSB-24 hybrids satisfied two farmers. The another farm was satisfied with P-3XSB-24 hybrid due to its good yield and P-3XSE-5 hybrids thanks to its gradually fruiting body, benefiting in frequent harvest.

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Characteristics of Tremella fuciformis and Annulohypoxylon stygium for Optimal Cultivation Conditions

Eun-Ji Lee, Hye-Sung Park, Chan-Jung Lee, Won-Sik Kong

Abstract—We analyzed the DNA sequence of the ITS (Internal Transcribed Spacer) region of the 18S ribosomal gene and compared it with the gene sequence of T. fuciformis and Hypoxylon sp. in the BLAST database. The sequences of collected T. fuciformis and Hypoxylon sp. have over 99% homology in the T. fuciformis and Hypoxylon sp. sequence BLAST database. In order to select the optimal medium for T. fuciformis, five kinds of a medium such as Potato Dextrose Agar (PDA), Mushroom Complete Medium (MCM), Malt Extract Agar (MEA), Yeast extract (YM), and Compost Extract Dextrose Agar (CDA) were used. T. fuciformis showed the best growth on PDA medium, and Hypoxylon sp. showed the best growth on MCM. So as to investigate the optimum pH and temperature, the pH range was set to pH4 to pH8 and the temperature range was set to 15°C to 35°C (5°C degree intervals). Optimum culture conditions for the T. fuciformis growth were pH5 at 25°C. Hypoxylon sp. were pH6 at 25°C. In order to confirm the most suitable carbon source, we used fructose, galactose, saccharose, soluble starch, inositol, glycerol, xylose, dextrose, lactose, dextrin, Na-CMC, adonitol. Mannitol, mannose, maltose, raffinose, cellobiose, ethanol, salicine, glucose, arabinose. In the optimum carbon source, T. fuciformis is xylose and Hypoxylon sp. is arabinose. Using the column test, we confirmed sawdust a suitable for T. fuciformis, since the composition of sawdust affects the growth of fruiting bodies of T. fuciformis. The sawdust we used is oak tree, pine tree, poplar, birch, cottonseed meal, cottonseed hull. In artificial cultivation of T. fuciformis with sawdust medium, T. fuciformis and Hypoxylon sp. showed fast mycelial growth on mixture of oak tree sawdust, cottonseed hull, and wheat bran.

Keywords—cultivation, optimal condition, tremella fuciformis, nutritional source

Corresponding Author
Lee Eun Ji from National Institute of Horticultural and Herbal Science, Korea, Republic Of
e-mail: ejg1105@korea.kr

The Increase in Functionalities of King Oyster Mushroom (*Pleurotus eryngii)* Mycelia Depending on the Increase in Nutritional Components

Hye-Sung Park, Eun-Ji Lee, Chan-Jung Lee, Won-Sik Kong

Abstract—This study was conducted to research King oyster mushroom (*Pleurotus eryngii)* mycelia with reinforced functionalities.

0 to 4% of saccharide components, such as glucose(glu), lactose(lac), mannitol(man), xylose(xyl), and fructose(fru) and 0 to 0.04% of amino acid components, such as aspartic acid(asp). Cysteine(cys), threonine(thr), glutamine(gln), and serine(ser) were added to liquid media, and antioxidant activities, nitrite scavenging activities, and total polyphenol contents of the cultured mycelia were measured.

In the saccharide-added group, 4 strains except ASI 2887 had high antioxidant activities when 1% of xyl was added and especially, the antioxidant activity of ASI 2839 was 73.9%, which was the highest value.

In the amino acid-added group, the antioxidant activity of ASI 2839 was 66.3% that was the highest value when 0.2% of ser was added. But all the 5 strains had lower antioxidant activities than the saccharide -added group overall.

In the saccharide-added group, 4 strains except ASI 2887 had higher nitrite scavenging activities than other group when 1% of xyl was added and especially, the nitrite scavenging activity of ASI 2824 was 57.8% that was the highest value.

It was revealed that the saccharide-added group and the amino acid-added group had a similar efficiency of nitrite scavenging activity. Although the same component-added group did not show a certain increase or decrease in total polyphenol contents, ASI 2839 with the highest antioxidant activity had 6.8mg/g, which was the highest content when 1% of xyl was added.

In conclusion, this study demonstrated that when 1% of xyl was added, functionalities of *Pleurotus eryngii* mycelia, including antioxidant activities, nitrite scavenging activities, and total polyphenol contents improved.

Keywords—King oyster mushroom, Saccharide, Amino acid, Mycelia.

All Authorsare with the Mushroom Research Division, National Institute of Horticultural and Herbal Science, RDA Bisanro 92, Eumseong, Chungbuk, 27709, Republic of Korea (phone: +82-43-871-5722; fax: +82-43-871-5702; e-mail: hyesung2@korea.kr).

Effect of Inorganic Fertilization on Soil N Dynamics in Agricultural Plots in Central Mexico

Karla Sánchez-Ortiz, Yunuen Tapia-Torres, John Larsen, Felipe García-Oliva

***Abstract*—**Due to food demand production, the use of synthetic nitrogenous fertilizer has increased in agricultural soils to replace the N losses. Nevertheless, the intensive use of synthetic nitrogenous fertilizer in conventional agriculture negatively affects the soil and therefore the environment, so alternatives such as organic agriculture have been proposed for being more environmentally friendly. However, further research in soil is needed to see how agricultural management affects the dynamics of C and N. The objective of this research was to evaluate the C and N dynamics in the soil with three different agricultural management: an agricultural plot with intensive inorganic fertilization, a plot with semi-organic management and an agricultural plot with recent abandonment (2 years). For each plot, the soil C and N dynamics and the enzymatic activity of NAG and β-Glucosidase were characterized. Total C and N concentration of the plant biomass of each site were measured as well. Dissolved organic carbon (DOC) and dissolved organic nitrogen (DON) was higher in abandoned plot, as well as this plot had higher total carbon (TC) and total nitrogen (TN), besides microbial N and microbial C. While the enzymatic activity of NAG and β-Glucosidase was greater in the agricultural plot with inorganic fertilization, as well as nitrate (NO_3) was higher in fertilized plot, in comparison with the other two plots. The aboveground biomass (AB) of maize in the plot with inorganic fertilization presented higher TC and TN concentrations than the maize AB growing in the semiorganic plot, but the C:N ratio was highest in the grass AB in the abandoned plot. The C:N ration in the maize grain was greater in the semi-organic agricultural plot. These results show that the plot under intensive agricultural management favors the loss of soil organic matter and N, degrading the dynamics of soil organic compounds, promoting its fertility depletion.

***Keywords*—**Mineralization, nitrogen cycle, soil degradation, soil nutrients.

K. V. Sánchez-Ortiz is with the Universidad Nacional Autónoma de México, Instituto de Investigaciones en Ecosistemas y Sustentabilidad, Morelia, Michoacán, México, CP 58190 (e-mail: kvsanchez@cieco.unam.mx).

Y. Tapia-Torres is with the Universidad Nacional Autónoma de México, Escuela Nacional de estudios superiores, Morelia, Michoacán, México, CO 58190 (e-mail: ytapia@enesmorelia.unam.mx).

J. Larsen is with Universidad Nacional Autónoma de México, Instituto de Investigaciones en Ecosistemas y Sustentabilidad, Morelia, Michoacán, México, CP 58190 (e-mail: jlarsen@cieco.unam.mx).

F. García-Oliva is with Universidad Nacional Autónoma de México, Instituto de Investigaciones en Ecosistemas y Sustentabilidad, Morelia, Michoacán, México, CP 58190 (e-mail: fgarcia@cieco.unam.mx).

Determination of Relationship among Shape Indexes Used for Land Consolidation

Fırat Arslan, Hasan Değirmenci, Şerife Tülin Akkaya Aslan

***Abstract*—**The aim of the current experiment was to determine the relationship among shape indexes which are used by the researchers in many fields to evaluate parcel shapes which is very important for farming even if these indexes are controversial. In the current study, land consolidation project of Halitaga village in Mersin province in Turkey which has 278 parcel and cover 894.4 ha, was taken as a material. Commonly used indicators such as fractal dimension (FD), shape index (SI), form factor (FORM), areal form factor (AFF) and two distinct area-perimeter ratio (APR-1 and APR2) in land consolidation are used to measure agricultural plot's shape. FD was positively correlated with SI, APR-1 and APR-2 whereas it was negatively correlated with FORM and AFF. SI was positively correlated with APR-1 and APR-2 whereas it was negatively correlated with FORM and AFF. As a conclusion, it is likely that these indexes involved may be used interchangeably due to high correlations among them.

***Keywords*—**GIS, Land consolidation, Parcel shape, Shape index.

F. A., Kahramanmaraş Sütçü İmam University, Agriculture Faculty, Biosystem Engineering Department, Onikişubat, Kahramanmaraş, Turkey (phone: +903443002077, e-mail: farslan@ksu.edu.tr).

H. D. Kahramanmaraş Sütçü İmam University, Agriculture Faculty, Biosystem Engineering Department, Onikişubat, Kahramanmaraş, Turkey (corresponding author, phone: +903443002067, e-mail: degirmenci@ksu.edu.tr).

Ş. T. A. A. Uludağ University, Agriculture Faculty, Biosystem Engineering Department, Nilüfer, Bursa, Turkey (phone: +902242941625, e-mail: akkaya@uludag.edu.tr).

Analyzing the Street Pattern Characteristics on Young People's Choice to Walk or Not: A Study Based on Accelerometer and Global Positioning Systems Data

Ebru Cubukcu, Gozde Eksioglu Cetintahra, Burcin Hepguzel Hatip, K. Mert Cubukcu

Abstract—Obesity and overweight cause serious health problems. Public and private organizations aims to encourage walking in various ways in order to cope with the problem of obesity and overweight. This study aims to understand how the spatial characteristics of urban street pattern, connectivity and complexity influence young people's choice to walk or not. 185 public university students in Izmir, the third largest city in Turkey, participated in the study. Each participant had worn an accelerometer and a global positioning (GPS) device for a week. The accelerometer device records data on the intensity of the participant's activity at a specified time interval, and the GPS device on the activities' locations. Combining the two datasets, activity maps are derived. These maps are then used to differentiate the participants' walk trips and motor vehicle trips. Given that, the frequency of walk and motor vehicle trips are calculated at the street segment level, and the street segments are then categorized into two as 'preferred by pedestrians' and 'preferred by motor vehicles'. Graph Theory-based accessibility indices are calculated to quantify the spatial characteristics of the streets in the sample. Six different indices are used: (I) edge density, (II) edge sinuosity, (III) eta index, (IV) node density, (V) order of a node, and (VI) beta index. T-tests show that the index values for the 'preferred by pedestrians' and 'preferred by motor vehicles' are significantly different. The findings indicate that the spatial characteristics of the street network have a measurable effect on young people's choice to walk or not. Policy implications are discussed.

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Keywords—Graph theory, walkability, accessibility, street network.

E. C. is with the City and Regional Planning Department, Dokuz Eylul University, Izmir, Turkey (e-mail: ebru.cubukcu@deu.edu.tr).

G. C. is with the City and Regional Planning Department, Dokuz Eylul University, Izmir, Turkey (e-mail: gozde.eksioglu@deu.edu.tr).

B. H. is with the City and Regional Planning Department, Dokuz Eylul University, Izmir, Turkey (e-mail: burcin.hepguzel@deu.edu.tr).

M. C. is with the City and Regional Planning Department, Dokuz Eylul University, Izmir, Turkey (e-mail: mert.cubukcu@deu.edu.tr.

Land art in Public Spaces Design - Remediation, Prevention of Environmental Risks and Recycling as a Consequence of the Avant-Garde Activity of Landscape Architecture

Karolina Porada

Abstract— Over the last forty years, there has been a trend in landscape architecture which supporters do not perceive the role of pro-ecological or postmodern solutions in the design of public green spaces as an essential goal, shifting their attention to the 'sculptural' shaping of areas with the use of slopes, hills, embankments, and other forms of terrain. This group of designers can be considered avant-garde, which in its activities refers to land art - a trend in fine arts created in the 1960s, represented by artists who decided to leave art gallery interiors and create in an outdoor, open space, so that nature becomes the object of the work and its background. Among the landscape architects whose projects are characterized by this trend are Maya Lin, Martha Schwarz, Hargreaves Associates and Charles Jenks.

Initial research shows that such applications are particularly frequent in places of former post-industrial sites and landfills, utilizing materials such as debris and post-mining waste in their construction. Due to the high degradation of the environment surrounding modern man, the brownfields are a challenge and a field of interest for the representatives of landscape architecture avant-garde, who through their projects try to recover lost lands by means of transformations supported by engineering and ecological knowledge to create places where nature can develop again. The analysis of a dozen or so facilities made it possible to come up with an important conclusion: apart from the cultural aspects (including artistic activities), the green areas formally referring to the land are important in the process of remediation of post-industrial sites and waste recycling (e. g. from construction sites). In these processes, there is also a potential for applying the concept of Natural Based Solutions, i. e. solutions allowing for the natural development of the site in such a way as to use it to cope with environmental problems, such as e. g. air pollution, soil phytoremediation and climate change. According to IUCN, nature-based solutions can be applied on a landscape scale, independently or in an integrated way, e. g. with engineering solutions. They should be defined by the natural and cultural context of local tradition, as well as foster the increase in biodiversity in its evolution over time.

The paper presents examples of modern parks, whose compositions are based on shaping the surface of the terrain in a way referring to the land art, at the same time providing an example of brownfields reuse and application of waste recycling. For the purposes of object analysis, research methods such as historical-interpretation studies, case studies, qualitative research or the method of logical argumentation were used. The obtained results provide new information about the role that landscape architecture can have in the process of remediation of degraded areas, at the same time guaranteeing the benefits, such as the shaping of landscapes attractive in terms of visual appearance, low costs of implementation, and improvement of the natural environment quality.

Karolina Porada is with the Cracow University of Technology (Department of Landscape Architecture), Cracow, 31-155 Cracow, Poland (phone: +48-12-628-24-69; fax: : +48-12- 628-24-69; e-mail: karoporada@gmail.com).

Keywords—brownfields, landscape architecture, contemporary parks, remediation

I. Introduction

IN his book [1], Victor Papanek draws attention to the environmental and ecological imbalance of the planet and the need to preserve and conserve land resources, as well as to the changes our consumption, manufacture and recycling patterns. According to the author, designers may have an influence on the improvement of situation. There are three routes they might follow in order to achieve it: throughout individual actions (for example buying fuel – efficient cars), by joining organizations that promote environmental protection and finally – by adapting green design thinking and processes [2]. The latter guideline is often used nowadays for the design of green architecture and infrastructure, but there is a great potential for landscape architects - due to the specific of the profession, they create public spaces in which nature can often freely develop. Of particular environmental importance are the projects developed in the brownfield areas, i. e. post-industrial spaces, which are now becoming a typical element of the city's spatial structure.

According to the applicable polish Governmental Programme [3], those spaces are defined as "degraded, unused or partially used areas originally designated for business activity which terminated". To this definition one should also attach areas degraded through industrial activity, i.e. those in close proximity to industrial plants (e.g. landfills, areas with contaminated soil and water). Abandoned factories, former airports or excavations as areas devoid of a specific function in the field can be transformed into public parks, which spawned a movement of pro-ecological parks, also known as eco-parks. The basic concept was developed alongside, originating in the 1992 Earth Summit in Rio de Janeiro, which turned the architects' attention to aspects related in particular to ecology and sustainable development. Eco-parks are characterized by the fact that they are usually created on post-industrial areas, with minimum involvement of the designer, which is often limited to enabling unhindered movement in the area and installing basic functional elements such as sports facilities, pavilions or toilets. Often the synanthropic flora is maintained

and its natural succession ensured. This trend is currently enjoying dynamic growth due to at least two main reasons: firstly, there are more and more post-industrial areas requiring reclamation and development, and secondly – this method is relatively cheap in terms of construction costs and maintenance (there is no need, for instance, to maintain the plants which take care of themselves).

Apart from the above-mentioned eco-parks movement, there is another tendency which takes up a challenge of reclamation of post-industrial areas. What strikes one most is how the terrain is treated as a sculpture: shaped through slopes, hills, incisions in the ground or long embankments. These areas resemble works characteristic for land art which is a movement originated in the 1960s and developed mainly in the USA, and later also in Europe (especially England). Artists living on both side of the Atlantic began to turn away from "commercial" art galleries and sought new forms of expression which could not be contained within the walls of a museum. Abandoning the models of easel painting or graphics, the artists gained an interest in creating large-scale sculptures as well as conceptual art in which the creative process itself becomes the subject and is often more important than the work itself (e.g. performance).

At the same time, thanks to awareness of environmental issues and bad living conditions in the city, promoted by Kevin Lynch [4] and Jane Jacobs [5] among others, future representatives of the movement became interested in the natural environment and its relationship with man, making it the main theme of their works. Generally speaking, land art was characterized by the relationship between the work of art and the natural landscape which often became the background of artistic endeavours or a source of inspiration (and sometimes both). Sand, soil, plants, water, rocks, untreated wood – these are only some of the materials used by land artists, who found them attractive due to their natural origins. They also used such materials as a form of rebellion, since they were not traditionally used in the fine arts. In the 60s, this movement spawned numerous works which were at the time described as land art, earthworks, earth art or ecologic art . Moreover, all these terms were employed in the titles of collective exhibitions (exhibitions of European and American artists presented in 1968 – 69: Earth Works (Dwan Gallery, New York, 1969), Land Art (broadcast on German TV in April 1969) or Ecologic Art (John Gibson, New York 1969) [6]. It is therefore difficult to decide upon a single name for the movement, as it was never officially defined. However, in Europe the term "land art" is more commonly used, while in USA "earth art" is more frequent. This serves to further illustrate the numerous differences in the activity of artists on both sides of the Atlantic.

The artists were also directly influenced by the contemporary movements in art and architecture. In the first case, this concerned mainly minimal art, which was characterized by a purity and simplicity of form and shape, thus standing in opposition to land art, while inspiring artists to employ organized composition. Conceptual art also played an important role, leading land artists to turn their attention to the creative process itself, thus adding the fourth dimension of time to their works – the objects were often temporary, in extreme cases lasting only a brief moment. This opens up a new perspective on the notion of the transience and changeability of the work of art, which in this case may, for instance, be destroyed by weather conditions, overgrowth and, ultimately, complete disappearance.

II. Land Art and Landscape Architecture Avant-Garde

Land art is nowadays often used as an inspiration in the process of creating public spaces, manifesting itself mainly in the use of land forms as significant compositional elements. Although landscape architecture is primarily an engineering discipline of science, and land art is an artistic movement, their origins seem closely related. The means of expression, spatial forms used by the architects and artists (see fig 1), and the archetypes (see table I) that inspire them seem to overlap.

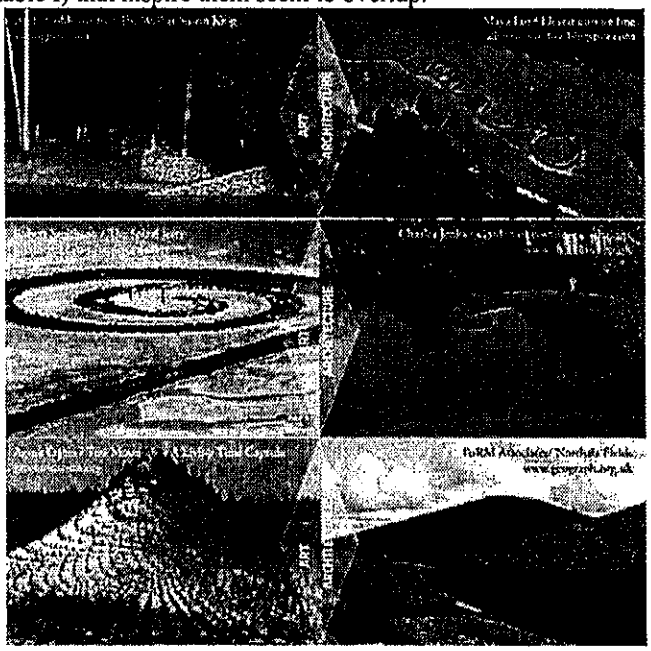

Fig. 1 Comparing land art and landscape architecture

TABLE I
COMPARING THE OCCURRENCE OF ARCHETYPES IN NATURE, CULTURAL HISTORY, LAND ART AND LANDSCAPE ARCHITECTURE WORKS.

Labyrinth	Fingerprints	Mythical labyrinth on Crete	Robert Irwin, garden in Getty Gallery (LA, USA)	West 8, *'Garden of 10,000 Bridges'*
Meandering line	River, spring	The Serpent Mound (Ohio, USA)	Andy Goldsworthy 'Storm King Wall'	Maya Lin 'Eleven Minute Time'
Mound	Hill	Tumulus / burial mound	Robert Smithson, *'Broken Circle/ Spiral Hill'*	Charles Jenks 'Spirals of time'
Archetype	Nature	Prehistory / history	Land art	Landscape architecture
Line	Spring, sunbeam	Canals in Mauritanian gardens	Richard Long 'Walking in Line'	Dani Karavan 'Way of peace'
Circle	Sun, stars	Stonehenge	Robert Morris 'Observatory'	SWA Group, 'Burj Khalifa Park and Plaza'

Spiral	Shell, Milky Way	Symbols characteris-tic of the Celtic culture	Robert Smithson 'Spiral Jetty'	Charles Jenks 'Garden of Cosmic Speculations'

It is originated in the works of landscape architects like Maya Lin, Dani Karavan and Isamu Noguchi. What connects those persons is not only the fact that they designed public spaces but also that they all have an artistic education (sculpture, painting) as opposed to a strictly architectural one, which may have contributed to the creation of a separate and peculiar creative language. Another feature is the use of simple, minimalistic and often large-scale elements, such as the white, concrete statues created by Noguchi and Karavan. It seems appropriate to apply the term avant-garde here, since it can be defined as artistic or, in this case, architectural autonomy, breaking away from traditional movements and creating a unique language of expression, which in this case is often highly symbolic. Initially a small group, possibly related more to high art than landscape architecture as a technical field, these people inspired a wide circle of designers who have been active from the 90s to this day. The architects employ unconventional solutions and complex shapes, as well as surprising cubic objects to attract the public and draw them into a dialogue with their work, most often conveying a specific idea or narrative. These solutions are a far cry from traditional landscape art – it seems their main role is not to provide a clear composition or green enclave but rather to give the design an eccentric and individualistic character expressed through elements such as complex pavilion structures or land objects, vivid colors, dynamic shapes and the use of forms of expressions such as minimalism or pastiche. Contemporary landscape architects whose work clearly reflects this phenomenon include Martha Schwarz, Kathryn Gustafson, Maya Lin, George Hargreaves and Adrian Geuze – their works are well known in the industry, often portrayed as examples of good design practices and serving as an inspiration to all young landscape architects.

III. Cases studies

Comparisons with high art do not end with avant-garde. For at least twenty years scholars have observed and researched the connection between landscape architecture and the so-called land art or earth art. This topic is explored, among others, by Professor Udo Weilacher [7] of the Technical University of Munich. Such research is grounded in the fact that the designers shape land forms in an organized, sculpture-like manner, use natural materials as well as create specific installations (temporary and permanent) which very often appear in urban spaces. Moreover, public areas inspired by land art are popular among visitors and experts alike, and have received numerous prestigious awards. The objects themselves become a recognizable element of the image of districts, and even whole cities. Thus, on the one hand these objects have a positive impact on the development of landscape architecture – they are intriguing, unique, convey elements of contemporary art in a way that is accessible to everyone, and liven up the public space. On the other hand, they carry a certain risk, namely the desire to use connotations to land art as a recipe for creative success, resulting in the commercialization of this phenomenon. Interestingly enough, this dilemma perfectly fits the essence of avant-garde artists, who fight tradition and strive for splendour but must avoid it so as not to lose their own independence and freshness. Indeed, the avant-garde's popularization is synonymous with its end.

The shaping of public spaces by the avant-garde of landscape architecture is in many cases used for the revitalisation of the previously mentioned post-industrial areas and as a result of the use of recycled materials for the construction of parks, monuments, etc. In order to examine the topic, an analysis of five parks was made, additionally assuming the following criteria:

- They are examples of the use of references to land art in public spaces;
- They were created in post-industrial areas or with the use of materials from recycling;
- They were created in the last 50 years;
- They are located in Europe or USA;
- They constitute part of the cultural landscape

A. Northala Fields

Northala Fields was established in 2008 in West London (one of the youngest parks in the city). The designers' intention was to create a vast, attractive visual and recreational space along the A40 motorway. The concept, selected via a competition, was developed by FoRM Associates.

The idea of the park composition is based on the pouring four hills of various sizes (18,22,18 and 12 meters) covered with meadows - these high earth forms play an important role both as objects from which the panorama of London can be admired (e. g. the city center and Canary Wharf), as well as characteristic landmarks, which are a gateway in the western part of the city, standing out from the surrounding flat terrain. The 27 hectare park has a rich selection of attractions for the public - starting from the viewpoints, through playground, walking path systems, meadows and seating places. However, Northala Fields is not only a recreational space - it is also an area designed for nature and pollution elimination. The main attraction of the park - the earth mounds were built with debris, bricks and wood from the demolition of unused facilities, among others from Wembley Stadium, which is an example of recycling construction waste. Moreover, each mound has been created in different soil conditions, which are covered with different mixtures of grasses and flowers, providing four separate habitats. In addition, those high earth forms are important in the reduction of noise and pollution spreading from the nearby motorway.

The park also functions as a system of ecological reservoirs - one of its main elements are meandering watercourses and small lakes, forming enclaves in which the nature characteristic of wetlands can develop. The range of the existing forest area nearby was also extended. The project meets the requirements of the design to minimize potential collisions of birds and aircraft from close proximity to Northolt airport.

B. Parc des Iles

The French Park des Iles in Drocourt and Rouvroi was developed in the place of a former coke plant (operating since 1930), which is now gradually transformed into a public green space. This type of industry is responsible for the emission of large quantities of harmful substances - dusts and gas combustion products enter the air. Coke-ovenants, ammonia, benzene and its derivatives, phenol, hydrogen sulphide and other, in turn water is contaminated with phenols, tar, oils, cyanides, sulphides and ammonium salts and anions such as chlorides, sulphates, sulphides, thiosulphates, etc [8]. In turn, water is contaminated with phenol, hydrogen sulphide and other substances. The implementation of the project was a major challenge due to land pollution and the habits imposed by these prohibited areas. After the final closure of the coking plant in 2003, the area was reclamated and the greenery planted in several stages. The park concept developed by the Ilex office has been gradually implemented - so far, 45 ha of the planned 160 ha space has been opened to the public.

The composition of the park is rooted around a system of small islands on an artificial lake, constituting a microniches through which a straight path leads the visitor. Those enclaves were built with excaveted materials and were shaped as simple, ellipsoidal, flat shapes framed by gabion edges and supplemented with materials such as wood. The site was shape with 200 000m3 of earthworks cuts and fills. Large post-mining mounds were left in the field and a system of vast meadows - which are confining the most polluted soils was established. In the field there are also attractions for the public - thematic gardens (on islands), open spaces, tracks for Nordic walking, etc. The central island located on the lake was called "Aquaterra" and serves as an educational garden and is a place of environmental awareness raising- including resources conceding [9]. Left mining heaps are used as hills for sports such as cycling, running and paragliding.

Parc des Illes is an example of post-industrial space revitalized for recreational purposes, preceded with recultivation and renaturalisation of the site. Flora nad fauna in the terrain are gradually revived and the park itself has become a hub of destination for the inhabitants of Lille Conurbation, who would like to rest with nature or do outdoor sports. The attractiveness of the site is further enhanced by the park's composition - freely submerged mining heaps contrast and become a background for flat, oblate islands located on the lake. The minimalist approach of designers - using simple shapes and fitting the idea of the park into the existing post-industrial landscape (treating it both as a background and a place of active leisure time) makes it possible to talk about references to the land art..

C. Byxbee Park

Hargreaves Associates studio has for years designed numerous projects based on land art, which shall be understood as a usage of distinctive 'land shaping' with slopes, hills or embankments. The Byxbee Park in Paolo Alto is one of their earliest implementations for which the office was collaborating with two artists: Peter Richards and Michael Oppenheimer. The project spanned the surface of 27 acres and was opened for the public in 1991. It is worth to mention that two years later the conception was recognized by ASLA [10] – the Society honoured the architects with the award for excellence in its annual prestigious competition for the best implementations in the field of landscape architecture and garden design.

The team's task was to develop the concept of public space in the former landfill, which has already been remediated and took the form of large, grassy fields. Because the previous place destination, short-term changes in the area became impossible, so the designers after having a local vision decided to implement in the future park minimally invasive earthworks and artistic installations [11]. These were in turn: hills, field of wooden poles, a composition of jersey barriers arranged in chevrons. Those elements are not only artefacts - they're becoming landmarks (orientation points) which moreover can be seen not only from ground perspective but the sky as well – chevrons of jersey barriers are pointing in the direction of the Paolo Alto airport, which can be noticed when flying by plane.

Although Byexbee Park does not have a clear recreation activities program, it is a popular tourist destination - the space is complemented by a system of paths, thanks to which visitors can get around and walk comfortably. On the other hand, despite the existence of a functional communication system, the use of durable materials (concrete) and the development of a clear composition of park interiors, this project can be placed on the borderland between land art and landscape architecture. Unfortunately, the unique value of the park, including its visual aspects and attractiveness to the public, failed to protect it from gradual destruction. Currently, because of the planned release to the public of the next area of remediated landfills, the park, which shall be partially rebuilt, is deteriorating - currently among the many structures built there the only ones left are field of wooden poles and a row of concrete curbs visible from the air.

D. Govenors Island Park

The project was selected to perform in an international competition announced and conducted in 2006. The area occupies 29 acres of land in the very prestigious location of the Govenors Island in New York's harbor, near Manhattan and Brooklyn. For over 200 years the island was used as a military base, traces of which can still be seen in structures like Fort Williams (whose construction started in the years 1806-1809 [12]) and a number of former military buildings. The other part of the island for many years functioned as undeveloped open space, which makes the creation of the park an important element in the transformation and revitalization of the area.

To grain proper insight and to determine its potential as a future public space, the designers spent hundreds of hours on the island during which they watched visitors and held mass events [13]. They also carried out a public consultation with the residents of New York. The effect that studio achieved is outstanding - the park fits the context of the New York harbour, highlighting its ecological and cultural values, history and also allows visitors to observe the panoramas of the nearby districts of Manhattan and Brooklyn by linking the viewpoints. The

designers wanted to capture the feeling of walking across an open green area surrounded by water and sky - so that visitors can forget that just a few kilometres away, one of the most famous cities in the world is situated.

The basis of the composition is to keep the vast ecological space from which the city skyline can be watch. To enable the framing of views and to diversify the flat surface of the land, the park designers implemented earth embankments with heights from a few to several meters which are constructed out of demolition debris from old buildings formerly located in the area [14]. Undulating paths run on the hills as well as between them, with roads located in the eastern-western direction where the Statue of Liberty can be seen. All the earthworks also serve entertainment purposes - the city skyline can be watched from their top. A playground is scheduled to be built on one of the hills, with slides running along the escarpment. The central area is implemented as a large lawn with a view of Manhattan, sports grounds and the amphitheatre. Visitor can also take a walk over the waterfront promenade which is designed in line with contemporary trends. The northern part of the park was arranged as botanical gardens, and at the edge it has been provided as an educational area of a swamp. The park contains a large number of plantings that include approximately 3000 trees and shrubs. The composition is complemented by decorative grasses and perennials. In total, 54 species of plants were used, which were selected due to their resistance to the difficult conditions in the port, including resistance to soil salinity and frost proofness.

Govenors Island Park certainly stands out from other parks in New York - it is a popular tourist destination and may significantly contribute to the revitalization of the island.

E. Playa Vista Central Park

Surrounded by office buildings in Playa Vista (Los Angeles, California) there is a small modern park offering visitors numerous attractions. The project has a surface of 7 acres and its composition is based on the system of intersecting straight paths. Along the main axis on a straight avenue passing through the center of the park, which connects the square with seating and the emerging office building (designers refer to the runway formerly located in this area of an old airport Hughes [15]), there are some interesting landscape interiors. The park includes elements such as an amphitheatre, playgrounds for basketball and football, playgrounds for children, as well as wooded areas and lawns. An interesting solution, reminiscent of land art, was to place numerous pyramid-shaped hills on the originally flat ground. The hills were covered with decorative plants characteristic of the Californian climate. Decorative grasses and perennials planted in wide rows or surfaces endow the space with diverse shapes and colors, creating a distinct image. Those colourful hills are the most distinctive element of the park - they fit its modern character and give it its unique identity.

In general Playa Vista Central Park presents itself as a very modern and well-designed public space. Its structure and wide range of elements like benches or small buildings perfectly reflect contemporary trends in landscape architecture. However, the area is not very popular with locals and tourists [16], which is surprising given the extensive program of activities and the unique look. One can only hope that in time, with the development of new office buildings and housing in a nearby location, Playa Vista Central Park will gain importance and appreciation.

IV. Conclusion

The above mentioned examples of projects not only show the existence and activity of the avant-garde of a landscape architecture, but above all show how designers can contribute to improving the natural environment and biodiversity while creating attractive public spaces. The subject appears extremely important due to the possibility of applying Natural Based Solutions (NBA), i.e. solutions enabling the development of natural terrains to help solve issues such as air pollution or climate changes. According to IUCN's classification [17], the following types of approaches can be observed in post-industrial areas:

- Issue-specific ecosystem-related approaches (e.g. climate adaptation services and ecosystem-based disaster risk reduction);
- Infrastructure-related approaches (e.g. natural infrastructure, green infrastructure);
- Ecosystem-based management approaches (e.g. integral water resources management).

Also according to IUCN there are eight preliminary principles which should be considered in conjunction with the NbS definition [18]. The examples of parks discussed above reflect them very well, as shown in the table below (see table II):

TABLE II
COMPARING PRELIMINARY PRINCIPLES OF NBS DEFINITION [18] AND THE EXAMPLES FROM CASE STUDIES

Preliminary principles of NbS definition	The examples from case studies
They take into account nature conservation through the application of appropriate rules and standards.	All the projects discussed above were made with a view to revival and future nature conservation in mind.
They can be integrated with other engineering and modern technology solutions.	This principle manifests itself in the use of earthworks, strengthening of slopes and embankments, taking appropriate measures for waste disposal, construction of communication routes, etc.
They are connected with the specificity of a given place - its culture and nature, they combine scientific knowledge with local and cultural issues.	Partial preservation of post-industrial heritage (e. g. mine heaps in Park des Ilés), creation of symbolic and characteristic places, framing and opening views of natural or cultural surroundings
They generate social benefits that are equally accessible to all.	All parks are dedicated and open to the public, they are to become places of rest and recreation for visitors.
The play an important role in maintaining biodiversity, cultural diversity and the development of ecosystems.	All the parks in question use greenery characteristic of a given climate as well as a full or controlled natural succession is assumed in these areas.
They are most often introduced as large-scale solutions.	All of these projects are located in open landscapes or constitute a green enclave in urban development.

They help to achieve the economic benefits associated with the investment, while at the same time reconciling them with the future improvement and functioning of ecosystems.	The projects of the discussed parks already at the stage of implementation brought economic benefits - the implementations were carried out using recycled materials, were built on abandoned, unattractive and often polluted land of low market value. In the longer term, their development brings numerous ecological and environmental benefits.
They play an important role in shaping policies and other activities that lead to the achievement of specific objectives..	The discussed public parks were established in accordance with the decisions of the relevant authorities. Their creation improves the comfort of life in cities and eliminates the problem of abandoned post-industrial spaces.

In addition to environmental benefits of the Nature Based Solutions concept, these examples also include other positive natural, landscape (including views) or cultural phenomena related to the activities of the contemporary avant-garde of landscape architecture related to land art.

These include the following [19]:

a) They constitute a form of artistic expression, a dialogue between the designer and the public;
b) They can have symbolic values;
c) They are used for sports and recreation;
d) They constitute an acoustic barrier against the noise generated by cars and planes;
e) They constitute a barrier against the pollution generated, for instance, by car fumes;
f) They serve as landmarks;
g) They can serve the role of vantage points;
h) They can be used to mask and frame views;
i) They make the terrain more diverse and attractive;
j) They educate the society, making it more sensitive to new trends in art and design.

Scientists mentioned the phenomenon on many occasions but presented it in a very general light. Most scholars gloss over the subject and fail to analyse various concepts in detail. A study by Udo Weilacher [7] is an exception from this rule. However, due to its publication in 1995 and the fact it analyses only a small range of landscape architects, it is rather out of date. The concept is becoming increasingly popular among landscape architects and the public – such references to land art as building earthworks are perceived as attractive elements which provide the parks with a unique character. Earth forms are not only recreational objects, but also key landmarks, facilitating orientation and movement around the city. In addition, when they form large-scale spatial compositions, their contrast with the surroundings is so distinct that each viewer can see that it is a work of art set in the landscape, which often carries an idea or message. At the same time in the concept of new parks, the use of natural materials, the idea of a dynamically developing and changing nature, as well as views connections - similarly to the land art, make nature become both the subject of the work and its background.

The whole phenomenon may be also compared to environmental art – the direction in contemporary art wherein the boundaries between life and art are blurred by "involving the viewer in the work of art itself" [20] – or, in certain cases, to the concept of ecovention, according to which artists try to reclaim lost parts of the city by transforming areas which have been destroyed, degraded and post-industrial areas into places where nature can once more flourish [21].

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Exploration of an Environmentally Friendly Form of City Development Combined with a River

— An Example of a Four-Dimensional Analysis Based on the Expansion of the City of Jinan across the Yellow River

Zhaocheng Shang

***Abstract*—**The Yellow River in China is a suspended river with a large amount of sediment. It has been ignored for a long time in the city plan of Jinan and locates some distance to the north of the city. Since the reservoir construction of the 1950s and the standardization of embankment construction in 2002, the flood control capacity of the Yellow River has been greatly increased. Due to its location between the mountains to the south and the river to the north, Jinan's urban form has become narrower and narrower as the city has expanded. The policy encouraging Jinan to cross the river and develop to the north was introduced in May 2003 and has been the focus of urban planning since April 2017.

In order to study the issue cities crossing rivers, a Four-Dimensional Analysis Method consisting of timeline, X-axis, Y-axis, and Z-axis is proposed. Policies, plans, and their implications are summarized and researched along with the timeline. The X-axis is the direction which is parallel to the river. The research area was chosen because of its important connection function. It is proposed that more surface water network should be built because of the ecological orientation of the research area. And the analysis of groundwater makes it for sure that the proposal is feasible. After the blue water network is settled, the green landscape network which is surrounded by it could be planned. The promenade which is parallel to the river, as well as the transitional river belt, which is vertical to the river, could be built based on the blue-green network. The direction which is vertical to the river is the Y-axis. It is proposed that the landscape axis in the Y-axis direction should run through the transportation axis so that the urban texture could stretch in an ecological way. Therefore, it is suggested that the work of the planning bureau and river bureau should be coordinated. The Z-axis research is on the section view of the river, especially on the Yellow River's special feature of being a perched river. Based on water control safety demands, river parks could be constructed on the embankment buffer zone, whereas many kinds of ornamental trees could be used to build the buffer zone.

City Crossing River is a typical case where we make use of landscaping to build a symbiotic relationship between the urban landscape architecture and the environment. The local environment should be respected in the process of city expansion. The planning order of "Benefit- Flood Control Safety" should be replaced by "Flood Control Safety - Landscape Architecture- People - Benefit".

Keywords—Blue-Green landscape network, City Crossing River, Four-Dimensional Analysis Method, Planning Order

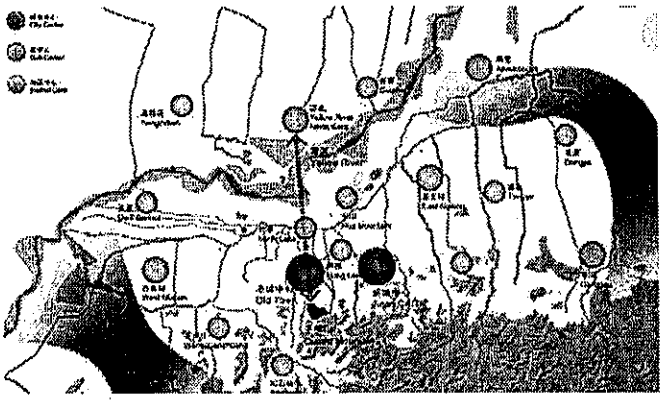

Fig. 1 Jinan city development along the river [1]

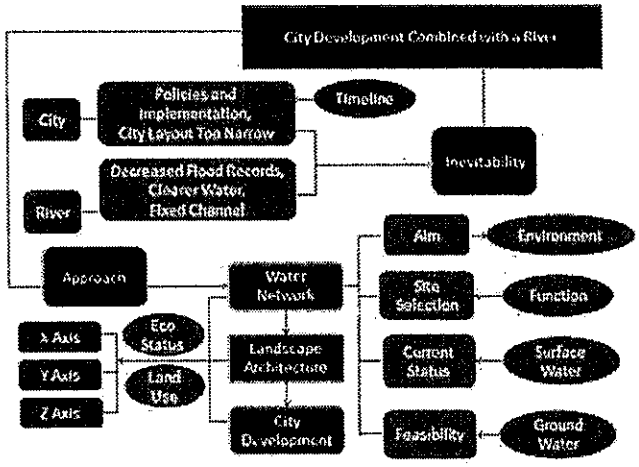

Fig. 2 The whole structure of this thesis

Zhaocheng Shang is Ph.D. from Prof. Henri Bava, with the Department of Landscape Architecture, Architecture Faculty, Karlsruhe Institute of Technology, Kollegiengebäude am Ehrenhof Englerstr. 11, Geb 11.40 76131 Karlsruhe. (e-mail: zhaocheng.shang@partner.kit.edu)

1. The Inevitability of City Development Combined with a River

1.1. The Yellow River in China

The Yellow River is the second largest river in China, with a total length of 5464 km (sorted by river length). It originates from the basin of Yueguzonglie with an altitude of about 4500m, which is located in the northern foot of Bayan Har Mountain in Qinghai Province. It passes through 9 provinces and regions, including Qinghai, Sichuan, Gansu, Ningxia, Inner Mongolia, Shaanxi, Shanxi, Henan and Shandong, and in the end, flows into Bohai Sea in Kenli County, Dongying City, Shandong Province. Yellow River's watershed area is 752,400 km2 and its average annual runoff is 58 billion m3.

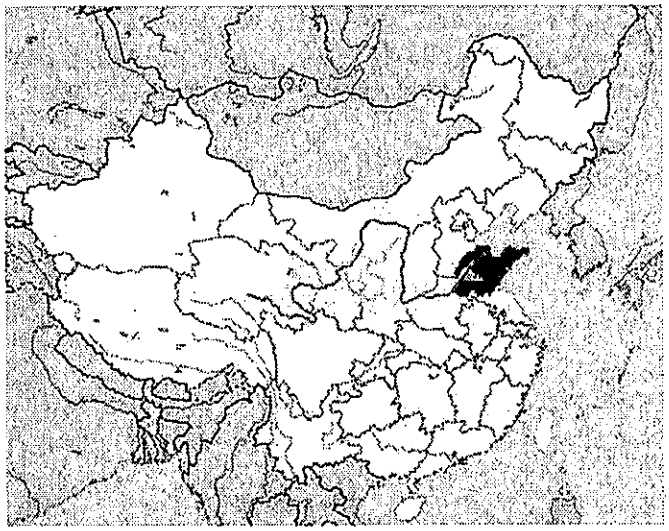

Fig.3 The Yellow River and the city of Jinan in China

The Yellow River is divided into three distinct parts: the mountainous upper course, the middle course across a plateau, and the lower course across a low plain. [2]

The upper course is with larger water flow and is rich in water sources. The middle course is with many tributaries. The river takes away a large amount of sediment from the plateau, which causes water loss and soil erosion. The river goes slowly in the lower course because of the flat terrain, and this causes the suspended river because of silt since the last diversion since 1855.The yellow river rechanneled much in history and causes frequent floods. [3] But in recent decades it is under controlled, because of irrigation, reservoirs and hydraulic engineering.

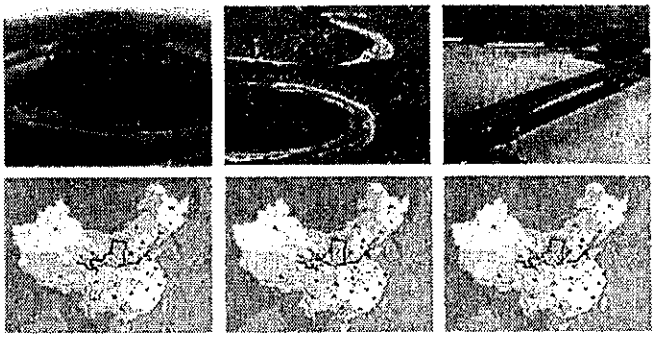

Fig 4. Three distinct parts of the Yellow River

1.2 Sediment Deposition and Suspended River throughout History

The study area is in the lower course. The main tributaries to the lower course are Jindi River, Daqing River, and Yufu River. The main features of Yellow River lower course are flat gradient and serious sediment deposition.

The middle reaches of the Yellow River run through the Loess Plateau, therefore the tributaries carry a large amount of sediment, making the Yellow River the world's highest sediment-laden river. The maximum annual sediment discharge amounted to 3.91 billion tons (1933). The highest sediment concentration in 1977 reached 920 kg/m3.

The river bed has been rising year by year and it has been higher than the ground on both sides of river. Among them, the Yellow River Section in Jinan is 4~6 meters higher than the ground of the banks. That is why the river is known as "Suspended River". [4]

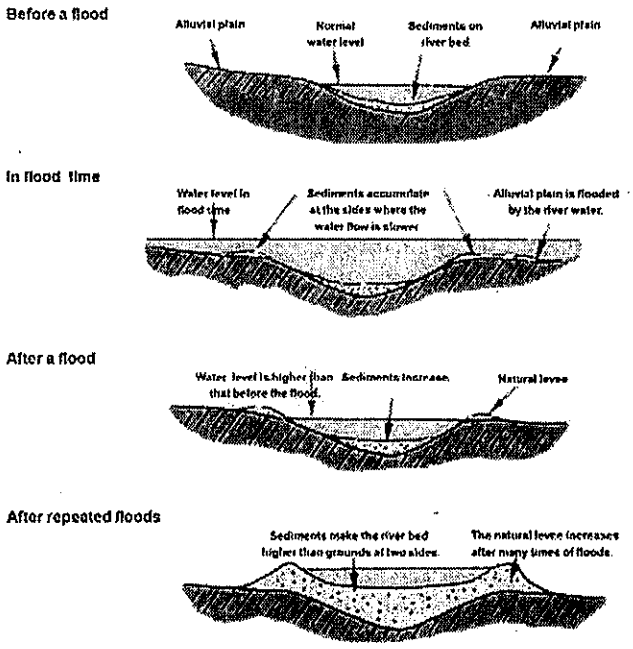

Fig.5 The formation of the suspended river

1.3 Three Good Changes of the Yellow River in Modern Times

1.3.1 Fewer Flood Records Since 1970s

Since the 1970s, there are fewer flood records in the Yellow River. There are 3 main reasons for the decrease. [5] The Yellow river's annual flow into the sea in recent years is only about 7.5~25 billion m3. Compared to the Yellow River annual water for irrigation of 35~40 billion m3 (Summary according to the Yellow River Water Resources Bulletin from the Yellow River Commission of the Ministry of Water Resources), and the amount of reservoirs storage of over 50

billion m3, the water in the Yellow River is basically controlled. Besides, the standardization of embankment construction since 2002 makes the channel of certain design standards, which is another guarantee for the safety.

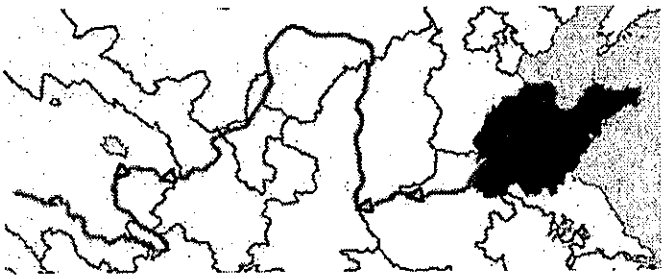

Fig.6 The main Reservoirs on the Yellow River

1.3.2 Fixed Channel Since 2002

The standardization of embankment construction on the lower reaches of the Yellow River has been under construction since 2002 and is constructed according to the flood control design standards. The embankment top width is 12m. The embankment hardening part width is 6m. Two rows of landscape trees are planted on both sides of the embankments. Flowers are planted on the embankment slopes. 50 meters wide anti-wave forests are planted in the flat sections along the river. On the back of the river is 100 meters wide buffer zone, the elevation of which is as high as the water level of the fortification in 2000. Suitable forests would be planted after the siltation area construction is finished. [6]

Because of the standardization of embankment construction on the lower reaches of the Yellow River since 2002, the channel is basically fixed.

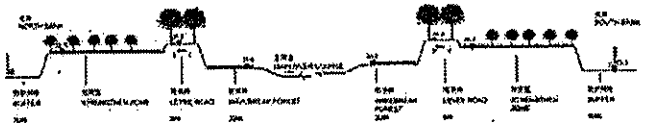

Fig.7 Section Standard from Yellow River Authority

From Yellow River Authority

1.3.3 Clearer Water Since 2002

Since the project of withdrawing from cultivated land for ecology in 2002, the Yellow River has been clearer and clearer. [7]

1.4 Jinan Landform and Hydrology Introduction

1.4.1 Jinan Landform

Jinan locates in the northern anticlise in the western of Shandong Province and it is generally a gentle incline. The terrain of Jinan is high in the southeast and low in the northwest with a transition from low mountains and hilly to piedmont plain and yellow river floodplain. The elevation of mountainous area is mostly between 150 and 700m, with a height difference of 100 ~ 500m, while the elevation in plain area is mostly at 20 ~ 60m. The overall stratigraphy slopes northward, with an inclination of 5° ~10° [8]

Confined to the topography and geological formations, karst groundwater runs from southeast to the northwest, at the same time infiltrated through the Ordovician limestone into the ground. It is blocked by the magmatic rock in the old city area, and the groundwater rises up, the groundwater gush out to make the famous spring groups.

Jinan is located in the mid-latitude zone and is a typical warm temperate continental monsoon climate. Jinan's average annual rainfall is 643mm, while the average evaporation of Jinan is 1250mm.

The river system of Jinan is mainly divided into Yellow River system and Xiaoqing River system.

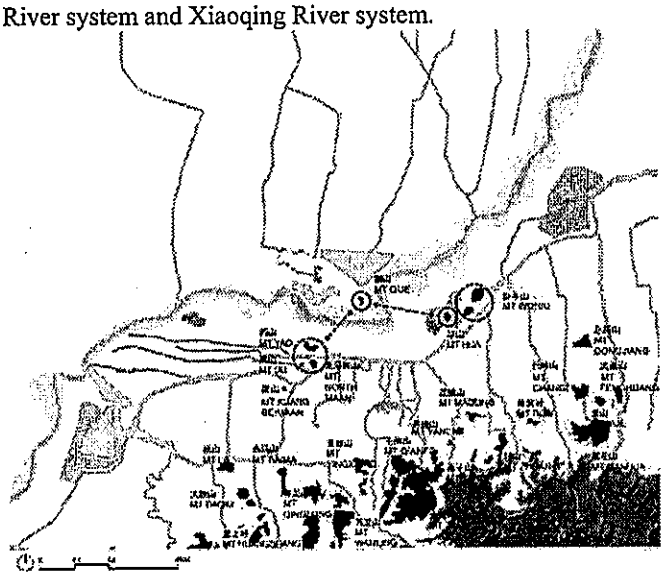

Fig.8 Jinan landform

Repainted from SOM design

1.4.2 Jinan Hydrology

1.4.2.1 The Yellow River in Jinan

Due to the three good changes of the Yellow River in modern times, the Yellow River has great potential to be developed as a landscape river.

1.4.2.2 Introduction to the Xiaoqing River

The mainstream of Xiaoqing River is an artificially excavated canal. Its tributaries are mostly from natural rivers. Since the 1960s, a large amount of industrial wastewater and domestic sewage have been poured into Xiaoqing River, causing extremely serious pollution. However, over the last 10 years' massive efforts with comprehensive management projects, the water quality and the landscape of Xiaoqing River have been significantly improved. [9]

There are five main sources of Xiaoqing River water: firstly, the spring water from the old city; secondly, the treated urban sewage; thirdly, the rainfall from the southern mountainous areas from June to September; fourthly, Yufu River (a tributary of the Yellow River) diversion; fifthly, groundwater lateral seepage from its riverbanks (because the banks are high than the river).

1.5 Jinan City Layout

1.5.1 Jinan City Layout Development

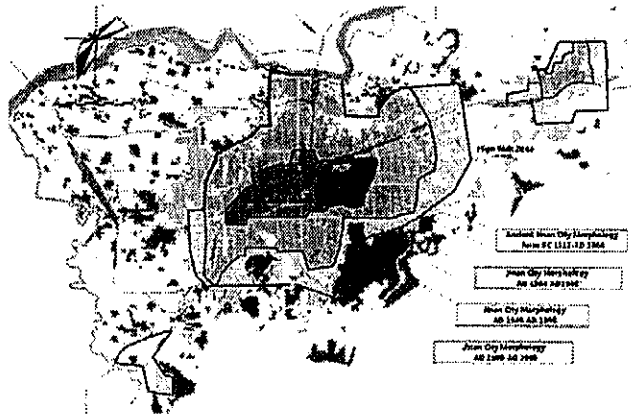

Fig. 9 Jinan city layout development

From "Planning the Spring City"

The city of Jinan has developed rapidly since the year 1904. Due to the natural geographical conditions of Jinan — mountains to the south and the Yellow River to the north — without guidance, the city development would be bound to the east and west. Not only would the traffic efficiency suffer from the narrow city form, but also the potential Yellow River landscape cannot play a role. [10] Since the south mountain area is to be protected, the issue that Jinan people are currently facing now is how to deal with the relationship between the river and the city as the city develops.

1.5.2 Existing Jinan City Layout: Development without the Yellow River

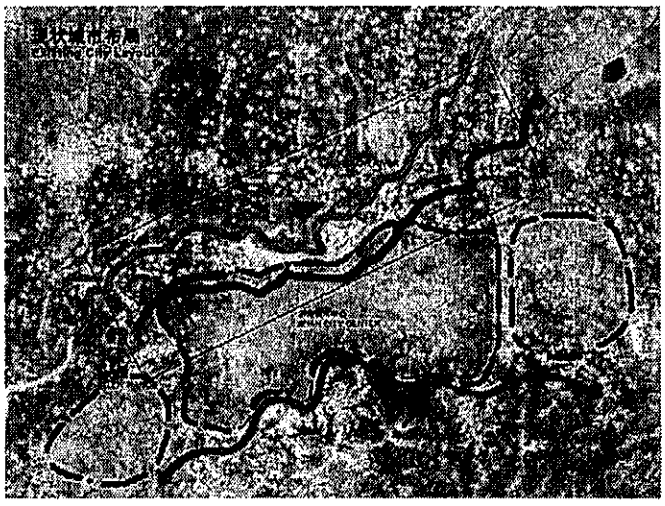

Fig. 10 Existing City Layout of Jinan

The river is an integral part of the city. [7] But in Jinan, the Yellow River has been for years a barrage of city development. The existing city layout is long and narrow. The city has developed without the Yellow River.

1.5.3. Policies and Implementation

1.5.3.1 Development on the South Side of the Yellow River

The Hundred-Mile Yellow River Scenic Area is sine 1992 in construction, with a total length of 51.98 kilometers, an area of more than 50 square kilometers. The scenic area is mainly along the meandering Yellow River and is consisted of the Yellow River flooding zone, embankments, buffer zone and vulnerable spots.

The Mother River Park is built in 2003.

The North Lake is since 2015 in construction.

Hua Mountain Scenic Area, Yao Mountain Scenic Area, Jinniu Mountain Scenic Area, and Meili Lake are on and off reconstructed and expanded in recent decades. They are scenic areas which have been existed since ancient times.

Jinan Culture Expo Park Covers an area of 1,000 mu and costs 2.8 billion yuan. It has been built since 2013 and is the largest culture expo park in China.

1.5.3.2 Development on the North Side of the Yellow River

The North Crossing Process can be divided into three phases.

(1) In May 2003, the proposal of the North-Crossing Policy was first proposed.

The Dragon Lake was built in 2005.

In order to prepare for the October 2009 the 11th National Games of the People's Republic of China, the Chemical Industry Park was urgently moved from Yuxing Chemical Factory to the current Chemical Industry Park.

The Dinghui Temple was built in 2009.

(2) Qihe actively develops projects, responding to the Jinan North-Cross Policy.

The Ocean Polar World was built in 2011, the Europark Dream World in 2014.

The Qihe Science and Technology Town is still under construction.

And the Qihe Hot Spring Town is in Planning.

(3) In December 2016, the Policy of City Development Combined with a River was issued, indicating turning the Yellow River into an inland river.

In April 2017, the **Instruction of the pre-construction area of the National Comprehensive Test Area for New and Old Kinetic Energy Conversion** was made by prime minister, making the North-Cross Policy the Focus of Current Planning.

In June 2017, large-scale demolition of "Illegal Buildings" was carried on.

1.6 Conclusion: the Inevitability of City Development Combined with a River

In terms of natural conditions, the flood control security is guaranteed. The water quality turned much better, and the Yellow River is now much clearer than a decade ago.

In terms of social conditions, the government, which plays a large role in a socialist country, encourages the city of Jinan to develop with the Yellow River.

Therefore, the inevitability of Jinan developing combined with the Yellow River is proved.

2. Analysis of Surface Water to Build Water Network in X-Axis

2.1 The Reason to Choose the Study Range

Normally, it is comprised of three gradient spaces: the new district, the transitional river belt, and the urban area. The three gradient spaces are mainly divided based on the urban density transition, which is the outward manifestation of the urban expansion process.

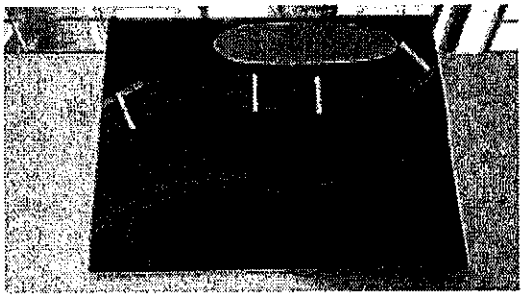

Fig. 11 Three gradient spaces of Jinan

From the urban areas in the South to the Yellow River in the North, the farther to the north, the smaller the city density is, as well as the smaller the radiation influence of the urban area is. In order to be connected with the urban development, the transition area between the urban area in the South and the new area in the North should be firstly considered. And then with the help of its connection, the new area can be spread.

As the development on south side of the Yellow River are more about ecological projects, the area on the south side of the Yellow River which goes to the edge of Xiaoqing River is chosen to be the study range, since the area between two rivers is more correspondent to the theme of ecology.

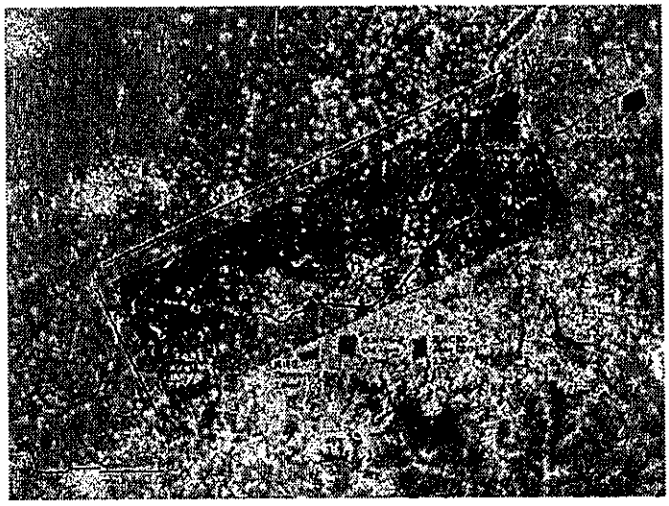

Fig. 12 Site selection of the research

Repainted from SOM design

2.2 Surface Water Network Status Analysis

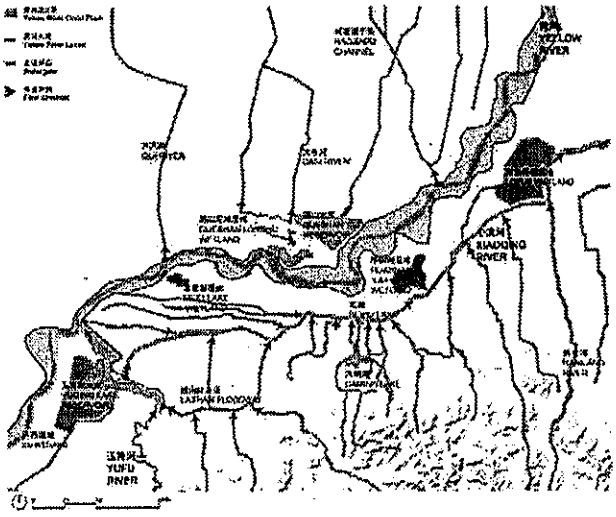

Fig. 13 Surface water in Jinan

Repainted from SOM

There are mainly two water sources:

(1) Surface water from the southern mountain area

(2) Water from the Yellow River

To analyze with the terrain, the surface water goes from the highest southern mountainous terrain (with an elevation of 100~900m: Qianfoshan 270m, Ladder Hill 900m) to the Xiaoqing River.

The Yellow River (with an elevation of 33.5~40.5m) is higher than the banks (with an elevation of 24~36m) since it is a suspended river. Therefore, there are a few water networks stretching from the Yellow River.

The elevation of the bank of Xiaoqing River is 5~8m lower than the south bank of the Yellow River. The tailwater from the Yellow River Irrigation flows into the three tributaries of the Xiaoqing River, forming the only water network in the western part of the current research area.

2.3 Groundwater Network Status Analysis

The groundwater table on the riversides is generally stable and has been for years. The depth of the underground water in the river transitional belt is less than 2 meters. Therefore, it is feasible for artificial rivers to be disclosed, and for green spaces to be built along them.

2.3.1 Groundwater Classification Based on Aquifer Medium

Based on the aquifer medium classification, the groundwater which is stored in the pores of loose rock and soil (such as sand and soil layers) is called porewater; the groundwater which is stored in the soluble karst caves or the miarolitic is called karst water; the groundwater which is stored in the fractures of non-soluble rocks is called fissure water.

TABLE I
GROUNDWATER CLASSIFICATION BASED ON AQUIFER MEDIUM

Aquifer Medium Classification	Groundwater Classification
Stored in the pores of loose rock and soil	Porewater
Stored in the soluble karst caves or the miarolitic	Karst Water
Stored in the fractures of non-soluble rocks demagnetizing factor	Fissure Water

The groundwater in the area between Yellow River and Xiaoqing River belongs to porewater since the it mainly exists in loose formation pores.

The porewater is distributed in layers and is spatially continuous and uniform. The hydraulic connection within the water system is good. Therefore, to disclose the porewater is of a high success rate.

2.3.2 Groundwater Classification Based on Groundwater Confining Layer

Classified according to groundwater confining layer, Confined Water is the gravity water which fills between two stable aquicludes. Phreatic Water is the gravity water with free water surface, which is stored in the first aquifer under the ground.

In other words, if there is a continuous water-resisting layer above the aquifer, this type of groundwater is confined water; if not, it is phreatic water.

TABLE 2
GROUNDWATER CLASSIFICATION
BASED ON GROUNDWATER CONFINING LAYER

Whether there is a continuous water-resisting layer above the aquifer	Groundwater Classification
Yes	Confined water
No	Phreatic water

Due to no continuous water-resisting layer above the aquifer, the groundwater in the Transitional River Belt between Yellow River and Xiaoqing River belongs to phreatic water. It is buried in a relative shallow depth.

Evaporation occurs when the buried depth of groundwater table is less than 4m. Since the depth of the groundwater in this area is generally less than 2m, the evaporation here is relatively strong. Therefore, evaporation of phreatic water becomes one of the main drainage of groundwater in this area.

Under the same conditions, the natural water quality of the confined water is better than that of the phreatic water.

2.3.3 The Aquifer and its Water Yield Property

The aquifer in this area lacks water-bearing sand layer and gravel layer, instead, it is consisted of clay sand or sandy clay. The aquifer's water yield property is relative weak. If strongly mined, it is easy to be drained.

2.3.4 Conditions of Groundwater Recharge, Runoff, and Discharge

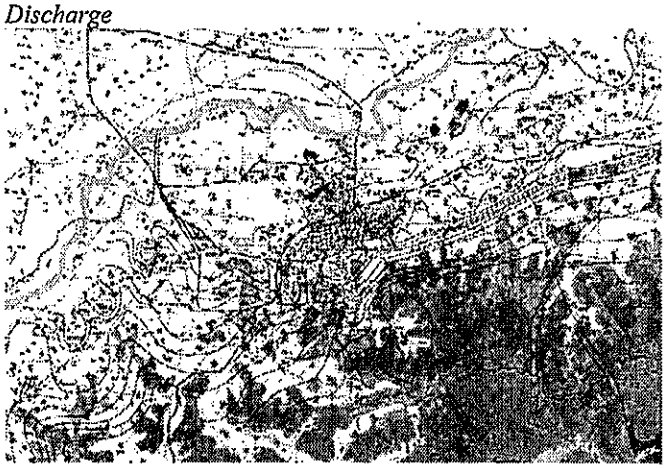

Fig. 14 Jinan contour of water table
From Hydrological Survey Bureau

After analyzing the contour of water table in Jinan, the groundwater recharge, runoff, and discharge is shown as follows:

2.3.4.1 Groundwater Recharge

Yellow River lateral seepage, the upper reaches of the lateral runoff recharge as well as direct rainfall (little impact) infiltration are the three main sources of groundwater recharge in this region. The water sources supply is relative stable and guaranteed.

2.3.4.2 Groundwater Discharge

The groundwater seep into Xiaoqing River surface water.(Xiaoqing River locates 1 ~ 2m lower the groundwater level of is its river banks, indicating that Xiaoqing River continuously receives the seepage supply of groundwater from the river banks.) Besides converting to surface water of Xiaoqing River, amount of groundwater is evaporated as shallow phreatic water, or it runs to the lower course in the direction of NEE (North, East, East).

2.3.5 Conclusion: Groundwater Available Value to Build Blue-Green Network

2.3.5.1 Relatively Stable Groundwater Table

The groundwater table for years in this area is generally stable, with fluctuations in the range of 1 ~ 1.5m for years. Fluctuation of the groundwater table per year is about 1m. The depth of the groundwater is generally less than 2m, which is a relative shallow depth. The water sources supply is stable and guaranteed.

2.3.5.2 Suitable for Disclosing Ground Water

The pore water is suitable to be disclosed as surface water. The phreatic water is in a shallow depth and is also suitable to be disclosed.

2.3.5.3 Not the Best Choice to Be Used as Drinking Water

Runoff conditions have a great impact on the natural water quality of groundwater. The terrain in this area flat, the permeability of rock-soil is weak, so the groundwater flows slowly. Under the same conditions, the natural water quality of the still water is not as good as the flowing water. Since the in this area is relative still, the water quality here is not very good.

2.3.5.4 Groundwater Available Value to Build Blue-Green Network

Since the groundwater here belongs to phreatic water as well as still water, the water quality here is not good enough to be drinking water. But instead, it is **suitable to be used as landscape water.**

Due to the weak water yield property, the groundwater in this area is **easy to be drained.** Here is not suitable form a large-scale centralized water supply source. However, small-scale decentralized water supply such as landscape water is acceptable.

Since this area locates in the **crucial area for the city crossing river,** it is feasible that we take full use of the favorable conditions of **guaranteed sources of water supply, shallow depth of stable groundwater table,** to excavate artificial rivers and form green space around to form a blue-green landscape network.

2,5 The Aim to Build a Water Network

The aim to build a water network is to have a blue-green network for people. The landscape axis is later designed based on the need of people. The sequence of the design should be Blue Network- Green Network- Yellow Network, with the keywords sequence of River- Park- People.

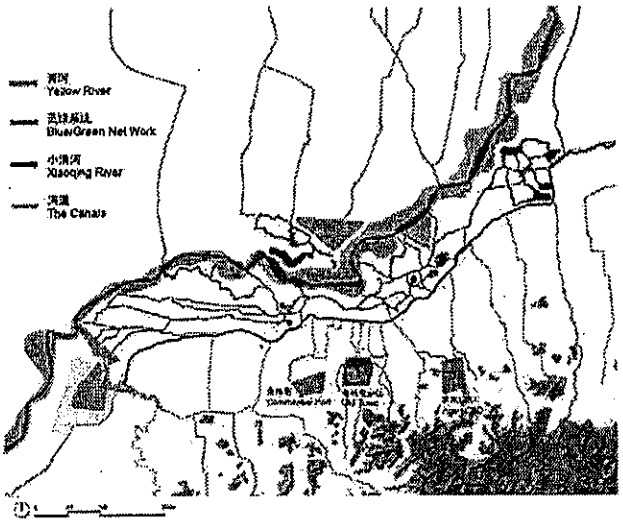

Fig. 15 Blue Network- Green Network- Yellow Network

3. A Proposed Landscape Research Concept — Across-River Landscape Architecture

3.1 Water Network, Landscape Architecture and City Development

Firstly, the surface water network as the water network status quo should be analyzed. And then where to build the water network, is based on the need of the city development need. Thirdly, whether the groundwater can be disclosed as landscape water, is determined by the condition of the groundwater. The last step is belongs to the study of landscape architecture, that is how the surface water should be designed as a landscape water network. In this process, the four-dimension analysis is proposed, which is especially for the study of cities crossing rivers.

3.2 The Aim to Build a Four-Dimension Analysis for the Cities Crossing Rivers

To learn from the history and to know more about the status quo, the timeline of the city development should be first summarized.

Usually, the side which is near to the urban area is the focus of the research, since it plays a role in connecting the urban area to the new area. The area along the river belongs to the research X direction. The research about it should first respect the natural conditions. In the river crossing process, it is the blue surface water and the green landscape space. To develop the Blue-Green Network, the groundwater in this area should be firstly analyzed, as a basis of the blue water network.

The Crossing River Process is a process in the direction of Y-axis. The role of transportation should be studied. The research of bridges is the basis, and then is the research of railways and airports. It is also suggested that the bridges should go through the landscape axes. Therefore, the coordination of city planning office and the river case office is also proposed.

Since the Yellow River is a suspended river, the Z- axis is needed. The anti-wave forest in the buffer zone and the strengthen zone which is on the back side of the embankment, are the research focus in the aspect of landscape.

3.3 Analyze of the Timeline of City Development with the River

3.3.1 The South Side of the Yellow River

The projects on the south side of the Yellow River are mainly the places of interests with historical culture and ecological value.

The Hua Mountain Scenic Area, Yao Mountain Scenic Area, Jinniu Mountain Scenic Area, and Meili Lake are the scenic areas with history.

All the projects on the map are of color blue or green, which means water or park. The implementation of the city development on the south side of the river is focused on the ecological construction, which is correspondent to the geographical condition of the area.

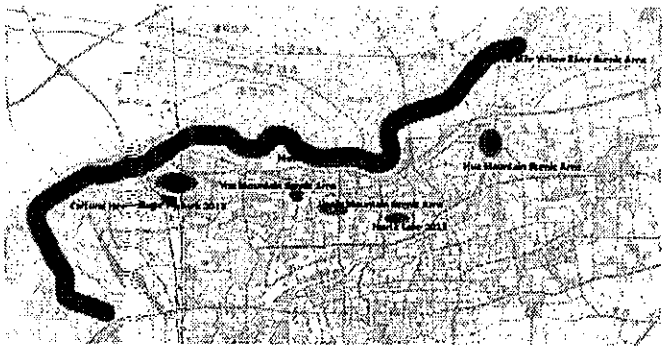

Fig. 16 Projects on the south side of the river

3.3.2 The North Side of the Yellow River

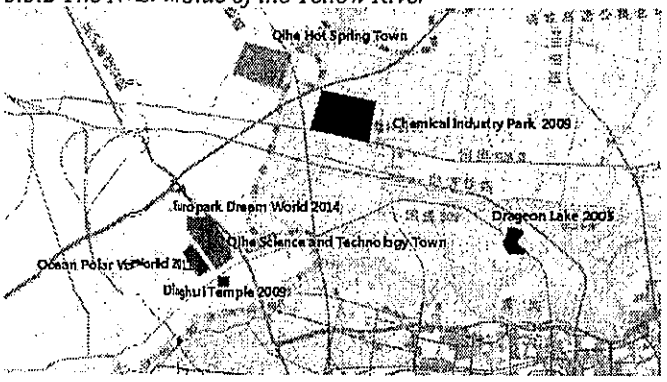

Fig. 17 Projects on the north side of the river

The projects on the north side of the Yellow River are mainly recreational playgrounds or new towns. The aim of the construction on the north side of the Yellow River is to develop the new areas. The construction in the municipal district of Qihe is built very quickly, which is coincident to the Jinan North-Cross Policy very well.

3.3.3 Conclusion

The policy of city development combined with the river is consisted of two parts: the south part and the north part. The policy to develop on the north side of the Yellow River is called North-Cross Policy.

From the two timeline maps above, we can conclude that the focus of the south part is ecological connection, and that of the north part is new town. We can also see that the progress of city combining the river can be more scientific and logical so that the parcels are not only fragments here and there.

3.4 Landscape Architecture X-Axis: How can the river landscape characteristics be highlighted?

3.4.1 Existing Ecological Condition

Jinan is south to Tai Mountain, with the Yellow River crossing the northern area of city, high-lying in south and low-lying in north. Jinan has two major east-west rivers of Yellow River and Xiaoqing River, with a large number of rivers and springs in urban area. The Yellow River is an earth suspended river in Jinan area, which interrupts the extension of ecological system between Xiaoqing River and the Yellow River. An ecological link between the southern mountainous area and the northern Yellow River within Jinan urban area should be established.

3.4.2 Existing Land Use and Fixed Parcels

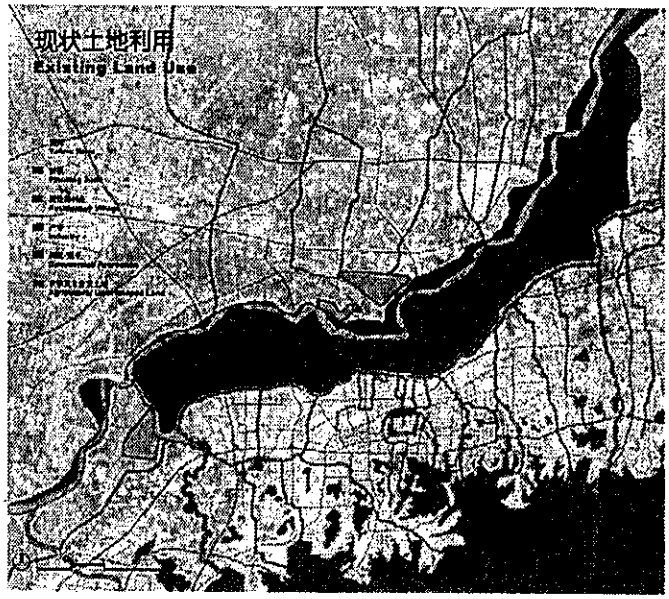

Fig. 18 Existing Land Use

From SOM

The map of existing land use shows the current development of the city. Firstly, there is a large area of agricultural/ undeveloped land, which could be developed based on the subject of landscape design. Secondly, there is also a certain area of industry. It is apparent that in the ecological transitional area, the industry should not account for a large amount of area. Thirdly, the residential/village area is all along the river in the X direction, but their forms are fragments and not well planned. Fourthly, there is a small area of commercial /recreation area. As a whole, this transitional area could be reused as a ecological river transitional belt. Whether the parcels are fixed or not, should be paid attention to in the city plan.

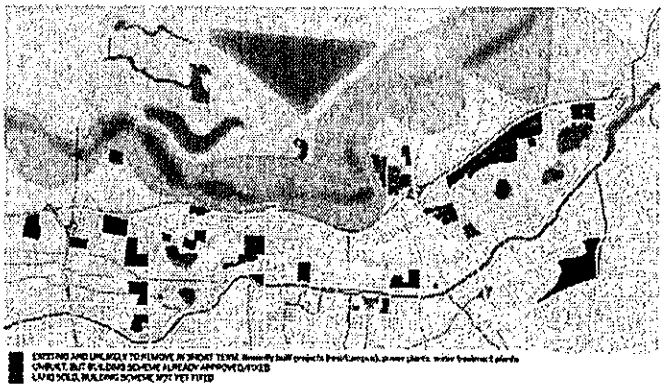

Fig. 19 Fixed parcels

From SOM design

The map of fixed parcels shows that the possibility of the Land to be planned and improved. The red and the orange parcels are fixed and therefore cannot be moved. When making a plan, these fixed parcels should be respected and preserved. Whereas, the yellow parcels are the land which have been sold but not yet fixed. When making landscape design, the yellow

parcels could be moved and they have potential to be changed and improved.

This map of fixed parcel is a basis for the future urban planning.

3.4.3 Blue-Green Landscape Network along the X-Axis

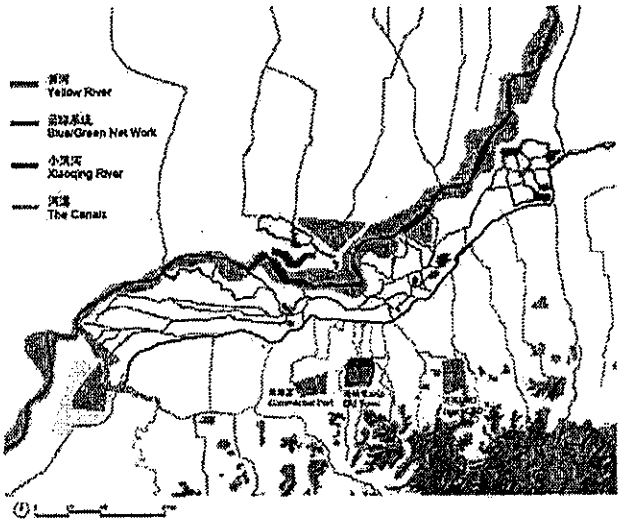

Fig. 20 Blue network

From SOM design

The blue network should connect the Yellow River to the Xiaoqing River, and provide areas for gathering, conveying and purifying rainwater. The channels, as well as the river edges, are supposed to be designed in a natural way, in order to enhance the water quality and reduce flooding.

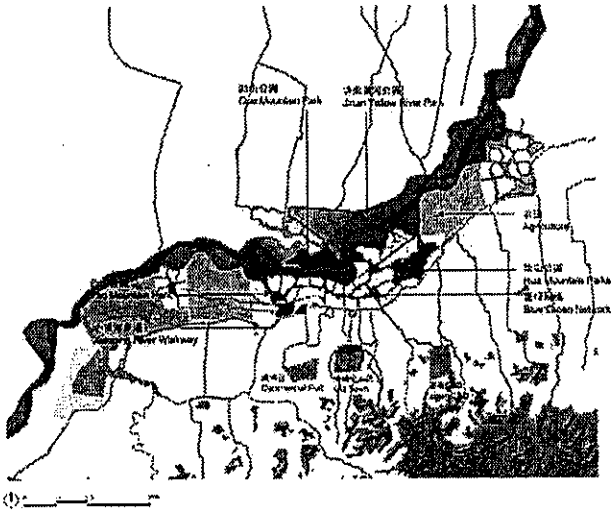

Fig. 21 Green network

From SOM design

The green network is supposed to be built on a basis of the blue network. Based on the map of projects on the south side of the Yellow River, the green space such as landscape parks as well as residential areas could be designed. The relevant landscape green space design along the river such as the cologne right bank, which is consisted of Grünzug Charlier and Rheinboulevard, can be taken a reference to.

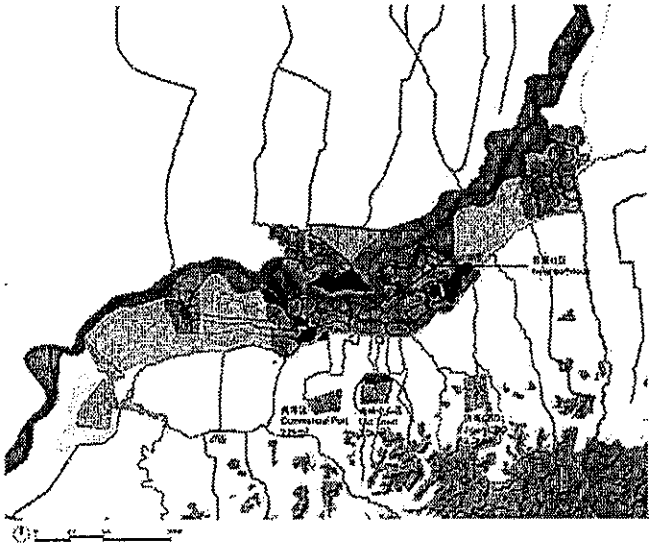

Fig. 22 Orange/Yellow network

From SOM design

In order to build the community surrounded by high-quality open space, t is proposed that the atmosphere of the landscape park influence each development plot, in order to help the plot to have an interaction with nature. The self-sufficient community is intended to be designed with green infrastructure in a low carbon design way.

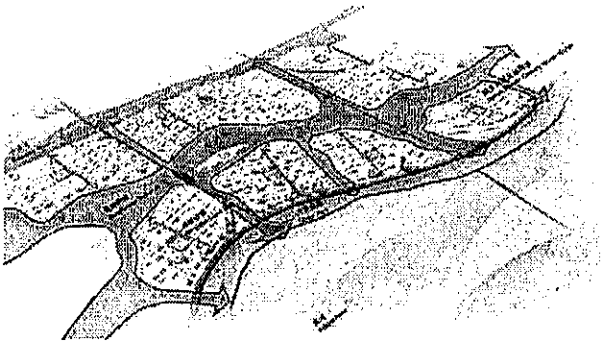

Fig. 23 Community surrounded by high-quality open space

From SOM design

3.5 Y-Axis: How can people on both sides of the river reach each other satisfactorily?

3.5.1 Study Case: Prague

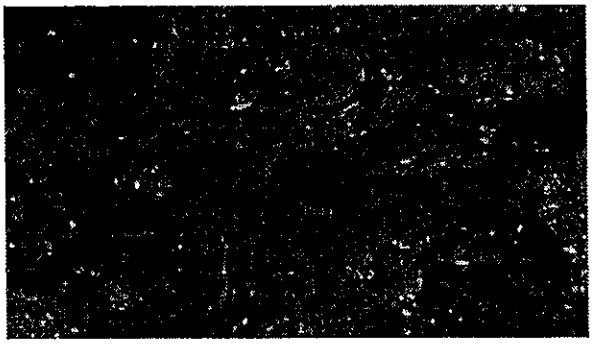

Fig. 24 Connected city centers with bridges in Prague

Repainted from Google map

From the google map of the city of Prague, it is clear that the city centers are connected with the bridges. The bridge is a useful tool for the city expansion.

3.5.2 Bridges, Railways and Airports in Y-Axis in Jinan

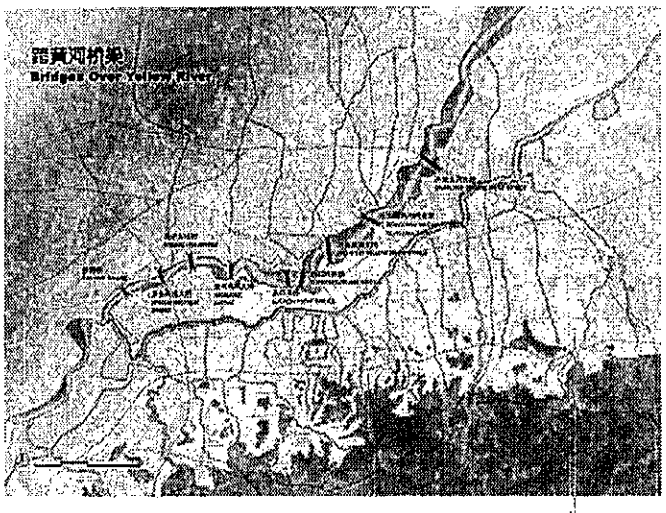

Fig. 25 Jinan main bridges

From SOM

In Jinan, there have been 9 main bridges, which connect the south of the city to the north. Based on the bridges, the railway and airport are designed to help the city communicate with the areas around.

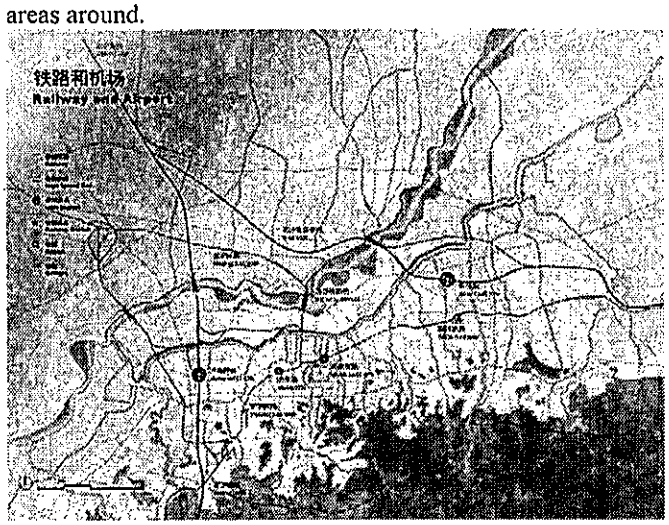

Fig. 26 Jinan main railways and airports

From SOM

3.5.3 The Proposal of the Consistency of Landscape and Transportation

Fig. 27 X-axis design in Jinan

From "Planning the Spring City"

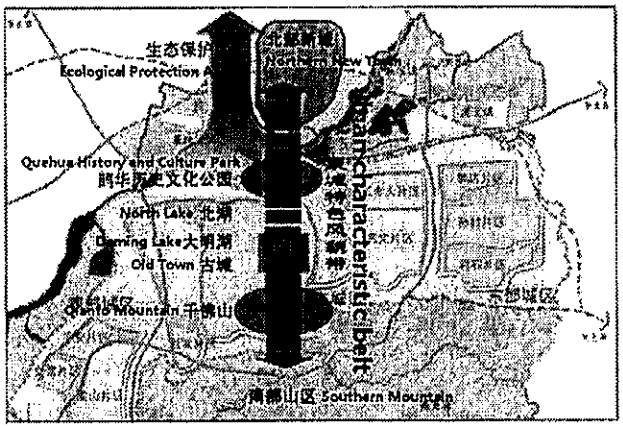

Fig. 28 Y-axis design in Jinan

Repainted from "Planning the Spring City"

Above are the river crossing plans in Jinan in the direction of X and Y. We can see that there is little consideration of bridges. According to the river case office, the work for the bridges has also very little to do with the city plan. The work division in the two offices is not clear and the cooperation is not enough.

In order to help people on both sides of the river reach each other satisfactorily with the beauty of landscape, the coordination of city planning office and the river case office is suggested.

3.6 Z-Axis: Landscape on the Embankment

3.6.1 Starting and ending points of the Yellow River Bank embankments

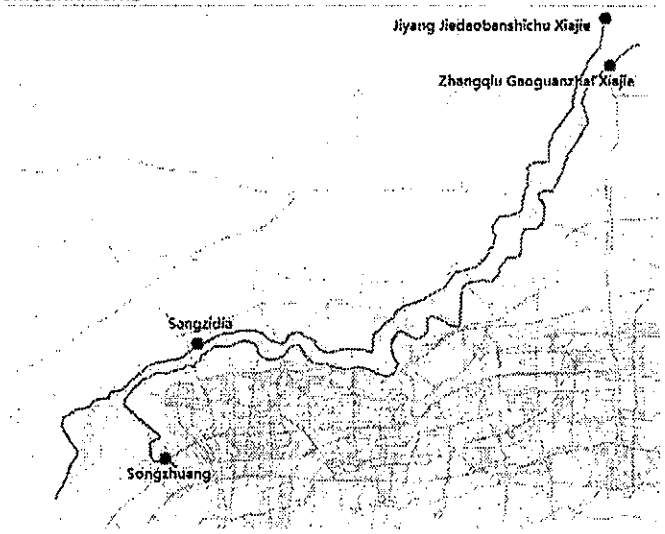

Fig. 29 Plan of Yellow River Embankments

The south embankment of the river originated from Songzhuang in Huaiyin District, and goes to the lower boundary of Gaoguanzhai Town in the municipal district of Zhangqiu, with a total length of 72.8 kilometers. The north embankment of the river starts from Sangzidian in Tianqiao District, and stops at the lower boundary the Jiyang Subdistrict Office, with a total length of 60.8 km.

3.6.2 Section View of the Embankments

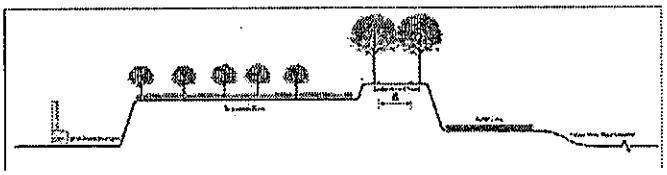

Fig. 30 Section view of a Yellow River embankment

Repainted from Yellow River Authority

Based on the Standardization of Embankment Construction, the section data is strictly ruled. The construction of buffer zone, embankment road, as well as strengthen zone can be planned with the help of landscape architecture.

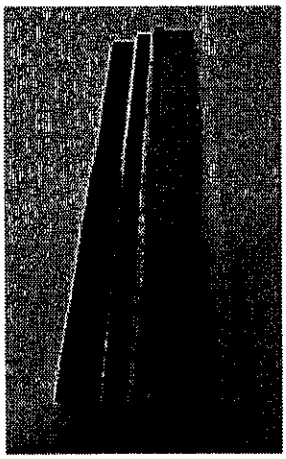

Fig. 31 Bird view of the model of a Yellow River embankment

The anti-wave forest in the buffer zone is shown in dark green color in the model above. The strengthen area is presented in the light green color. The two areas, especially the strengthen zone, has potential to be developed as landscape Forrest. At present, there has been some, but usually, they are pure forest, which is not well planned. The construction of landscape park is allowed by the river case office in the strengthen zone. [5]

3.6.3 Wide Use of Z-Axis for the Research of Cities Crossing Rivers

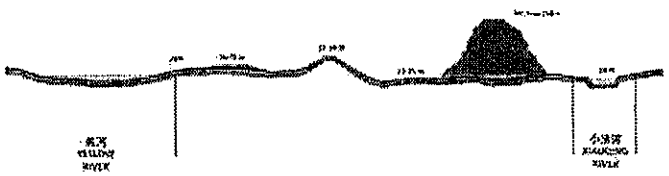

Fig. 32 One section view of the research area

Z-axis research can also be made for the whole research area of a section view between the Yellow River and Xiaoqing River, not only for the terrain of the suspended river. Widely speaking, the Z-axis research is suitable for the elements with altitude, when a city crosses a river.

4. Considerations and Suggestions on Urban Design in China

4.1 River and City

In the spatial pattern analysis of river landscapes, river corridors can be studied in the four-dimensional direction, including three-dimensional changes in spatial scale and changes in timescale. [10] The method of four-dimensional analysis was used in this study.

The idea of Blue-Green Network for Cities Crossing Rivers is first raised in the Quehua District Conceptual Urban Design. Based on this idea, the landscape innovation points of Four-Dimensional Analysis and the sequence of Surface Water- Groundwater- Landscape Water to be considered for Blue-Green Network are raised.

During the first step of the sequence, the groundwater in the research area is analyzed. The groundwater which is suitable for disclosing and which owns a relatively stable groundwater table has available value to be used to build blue-green network. The groundwater which belongs to pore water or phreatic water is relatively easy to be disclosed as surface water. The stable recharge and discharge of the groundwater cause a relatively stable groundwater table as a balance.

City development is determined by landscape design. Landscape design is determined by ecological water network. Ecological water network is determined on groundwater's potential to be disclosed. And all the process should be considered in a logical sequence.

4.2 Space and Value

China's present planning order is summarized as Benefit - Flood Control Safety. The city development is based on the need of benefit. The role of hydrology and landscape design in the process of city planning is missing. [11] As a result, the city development considers little about the river, the transportation and the feelings of people to enjoy the beautiful environment. [12]

Instead, the ideal planning order is Flood Control Safety - Landscape Architecture-People – Benefit. The safety should be first taken into consideration, which has been done as a whole quite well in the last decades in China. It could be done even better if the water network designing in the city could be taken into consideration. After that, the landscape design for the people could be made. And with so harmonious space, to get a good benefit is an inevitability.

4.3 Value and Management

The coordination of the city planning office and river case office is suggested because the blue network and the green network are one network to be designed at the same time, also because the bridges are not only a means of transportation but also a tool to connect city centers.

In the process of doing this research, very little open and scientific information was found on the city official website. On the official websites are always the news of political conferences and the aim of the city planning. The government has invited some professional landscape designers from aboard, but on the website are only the words about how famous are the designing team is, not about how they make the design. As landscape designer, it is known to all that the status quo is the basis for all. But in China, it should be kept as a secret. The city plans, as well as some of the regional plans, are announced on the website, in order to have some feedback from the people. But without even making a land use map public, it is hard to propose some useful feedback even for a professional landscape designer.

In the socialist country, the government plays a big role. If the management method is improved by the government, the process of urban design in China would be safer and healthier.

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Mechanical Properties of Ordinary Portland Cement Modified Cold Bitumen Emulsion Mixture

Hayder Kamil Shanbara, Felicite Ruddock, William Atherton, Nassier A. Nassir

***Abstract*—**Cold bitumen emulsion mixture (CBEM) offers a series benefits as compared with hot mix asphalt (HMA); these include environmental factors, energy saving, the resolution of logistical challenges that can characterise hot mix, and the potential to reserve funds. However, this mixture has some problems similar to any bituminous mixtures as it has low early strength, long curing time that needed to obtain the maximum performance, high air voids and considered inferior to HMA. Thus, CBEM has been used in limited applications such as lightly trafficked roads, footways and reinstatements. This laboratory study describes the development of CBEM using ordinary Portland cement (OPC) instead of the traditional mineral filler. Stiffness modulus, moisture damage and temperature sensitivity tests were used to evaluate the mechanical properties of the produced mixtures. The study concluded that there is a substantial improvement in the mechanical properties and moisture damage resistance of CBEMs containing OPC. Also, the produced cement modified CBEM shows a considerable lower thermal sensitivity than the conventional CBEM.

***Keywords*—**Cold bitumen emulsion mixture, moisture damage, OPC, stiffness modulus, temperature sensitivity.

I. Introduction

ASPHALT mixture is a composite material that generally consists of bitumen as a binder, aggregate and voids. It has commonly been used as a material for constructing flexible road pavements because of the good adhesion that exists between binder and aggregates [1]. Recently, there is an increased awareness of using cold mixtures in pavement industry instead of using hot bitumen [2]. CBEM is one of the common types of cold mix asphalt (CMA) and defined as an alternative to the conventional hot mixtures, as no heating is required in its production. It is an emulsified bitumen mixture that can be manufactured at ambient temperatures and used in roadway construction. Accordingly, CBEM is considered as environmentally friendly, energy efficient, cost-effective and sustainable option. Although CBEM provides both economic and environmental advantages in terms of removing the need for heating huge amounts of aggregates and bitumen, it is rarely used due to its weak early strength, long curing time, high air voids and poor mechanical properties [3].

Several investigations have been carried out to enhance the mechanical properties of the CBEM using virgin natural materials. Several aspects to improve the performance of such mixture have been performed such as incorporating various types of materials and applying different preparation techniques. Reference [4] focused on the influence of curing procedures and compaction types, and concluded that the increasing of curing time develops the indirect tensile stiffness modulus. Increasing of compaction efforts leads to improve the degree of emulsion combination when using granite aggregate with 20 mm aggregate maximum size [5]. Reference [6] reported that the air voids of CBEMs could be within the specification limits by adopting heavy compaction (120 revolution, 240 kPa, 2° angle of gyration) rather than medium compaction (80 revolution, 240 kPa, 2° angle of gyration). The aimed air voids content of the compacted CBEMs (between 5 and 10%) could be obtained by applying 240 gyrations, which are categorised as extra heavy compaction. Additionally, a heavy compaction application is crucial to approve breaking of the emulsion and ensure that mixtures strengthen properly [7]. The excessive amount of liquids in CBEMs reduces the compaction effect and prevents mixtures from obtaining their acceptable air voids leading to decrease stiffness and strength properties. Reference [8] carried out a laboratory investigation to study the impact of polymers modified emulsions on the mechanical properties of emulsified bitumen macadam. Close graded surface course and dense graded binder course were used as aggregate grading with a cationic emulsion containing 65% base bitumen of 100-pen grade. It was concluded that Ethylene Vinyl Acetate (EVA) and Styrene-Butadiene-Styrene (SBS) polymers have positive effects on modification of the bitumen emulsion in terms of enhancing the stiffness and permanent deformation of CBEMs. In addition, fatigue resistance of 4% SBS and 6% EVA modified CBEMs were developed about 45 and 35 times, respectively, in comparison with the fatigue resistance of unmodified CBEMs. In further research, polyvinyl acetate was added to a rapid-setting emulsified bitumen to improve the compressive strength of CMA [9]. Recently, [10] used a specially developed polymer modified emulsifier in AC-13 asphalt mixture. It was concluded that in terms of moisture susceptibility, high temperature and resistance to low-temperature crack, the mixture met performance specification requirements in addition to an

Hayder Kamil Shanbara is with Liverpool John Moores University, Faculty of Engineering and Technology, Department of Civil Engineering, Henry Cotton Building, Liverpool L3 2ET, UK, and Civil Engineering Department, College of Engineering, Al Muthanna University, Sammawa, Iraq (corresponding author, phone: 00447459394984; 009647902274877; e-mail: h.k.shanbara@2014.ljmu.ac.uk).

Felicite Ruddock is the director of study and William Atherton is the second supervisor, Liverpool John Moores University, Faculty of Engineering and Technology, Department of Civil Engineering, Peter Jost Centre, Liverpool L3 3AF, UK (e-mail: F.M.Ruddock@ljmu.ac.uk, W.Atherton@ljmu.ac.uk).

Nassier A. Nassir is with the School of Engineering, University of Liverpool, Liverpool L69 3GH, UK .and Department of Materials Engineering, University of technology, Baghdad, Iraq (phone: 447417413264; e-mail: N.A.N.Almtteri@liv.ac.uk).

improvement in rutting resistance performance.

II. Cement Development

Additives can play a main role in governing the engineering properties of bituminous mixtures in terms of stiffness, permanent deformation resistance, fracture resistance and moisture sensitivity. Some of these additives are used as a filler replacement in the mix such as cement and lime. Cement can be technically defined as a material that if mixed with other non-cohesive particles give a hard mass. It is a fine powder such as Portland, slag, pozzolanic and high alumina which generate very strong and durable binding materials because of the hydration processes [11]. The use of cement in bituminous mixtures is not a new idea. Reference [12] carried out one of the first studies that used cement into emulsion-treated mixtures. It was concluded from this study that using cement as an activator in the bitumen emulsion mixtures can accelerate the rate of development of the resilient modulus due to the accelerated rate of curing of such mixtures. This means that Ca^{2+} ions from cement neutralises the anionic emulsifier allowing emulsion droplets to coalesce and adhere to the aggregates. This helps in breaking the emulsion quickly and absorbing water from the mixture thus decreasing curing times [13]. Reference [14] found that adding 1% OPC as a modifier to the cold asphalt mixtures increases the Marshall Stability by 300% compared with untreated mixtures. Reference [15] stated that the OPC modified emulsion mixtures decreases the layer thickness about 50% as a result stability improvements (200%-300%). Reference [16] reported that the cement-asphalt emulsion composite has a longer fatigue life, less temperature susceptibility and higher toughness. Reference [5] evaluated the effects of incorporating OPC into the bitumen emulsion mixtures. Cement type affects the rate of increase in strength of CBEMs [6]. Reference [6] testified that Rapid Setting Cement (RSC) gives a better rate of increase in strength in comparison to the OPC. The stiffness of the modified CBEMs with RSC was about 2000-2500 MPa after a few weeks of curing, whilst the unmodified mixtures needed 16 weeks to achieve same stiffness values. This is because the RSC behaves as an active filler in CBEMs causing an increase in the pH. References [17] and [18] carried out laboratory studies to evaluate the addition of 0-6% OPC as a filler replacement to the emulsified asphalt. The results showed significant developments in the mechanical properties of these modified mixtures with higher percentage of OPC. Reference [19] found that the cement in the cement asphalt emulsion mixtures can improve the micro hardness of the interface. Reference [20] investigated various cement percentages on the mechanical properties of CMAs that cured at different environmental humidity levels (35, 70 and 90% RH). It was proved that incorporation of cement into bituminous mixtures results changes in the pH of the emulsion leading to break it quickly. Reference [21] studied the effect of replacing all the conventional mineral filler with OPC in order to develop a new cement treated CBEM made with gap grading. The results indicated that gap-graded, cold rolled asphalt mixtures gained significant enhancements in mechanical properties, resistance to water damage and temperature susceptibility. Reference [22] investigated the use of rapid hardening cement to accelerate the development of mechanical properties of cement bitumen emulsion mixtures and obtain better understanding of the role of cement in such mixtures. After one day curing of mixtures with calcium sulfoaluminate and calcium aluminate cements, the mechanical properties were comparable to those mixed by using Portland cement after one week of curing.

III. Materials and Methods

A. Materials

1) Aggregate

CBEM performance mainly depends on the size, type and gradation of the aggregated used. According to the European Committee for Standardisation [23], asphalt concrete, close graded surface coarse with 14 mm aggregate maximum size was selected for producing CBEMs. This aggregate is granite crushed which is hard rock with a granular structure and considered the most common type in the world. The grading is as shown in Fig. 1 along with the specification for a 14 mm close graded surface course.

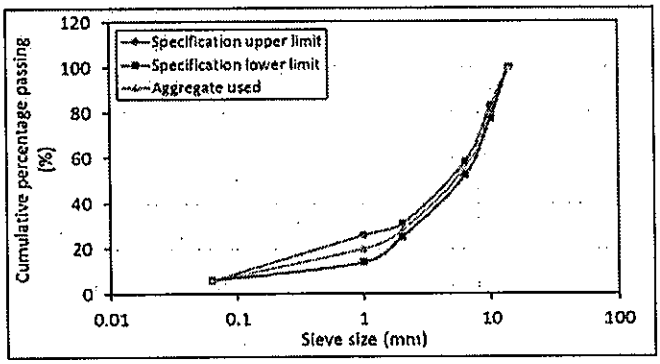

Fig. 1 14 mm close graded surface course

2) Filler

Filler is mainly a fine material that can pass through a sieve of 0.063 mm and it comes from aggregate or other types of comparable granular materials. One of the most common filler types is the limestone dust filler that was chosen to be used in this study. Filler is one of the most important bituminous mixture components, it has a significant impact upon the behaviour and properties of the resulting bituminous mixtures.

3) Bitumen Emulsion

The bitumen emulsion selection depends on the gradation and type of the used aggregate and the ability of emulsion to coat the aggregates. To achieve that, a cationic slow setting bitumen emulsion (C50B3) with 50% bitumen content was attempted and selected due to the high adhesion to aggregates. This type of emulsion is called Cold Asphalt Binder (CAB 50) based on 40/60 penetration grade base bitumen and is supplied by Jobling Purser, Newcastle, UK. The high stability and high adhesion of this cationic emulsion were the reasons for selection as recommended by the supplier.

B. Testing Program

1) Indirect Tensile Stiffness Modulus Test

The indirect tensile stiffness modulus (ITSM) test was used for the assessment of the mechanical properties of CBEMs [24]. Meanwhile the stiffness modulus ration (SMR) was utilised for examination of the water sensitivity of the CBEMs. The ITSM test was conducted in compliance with [25]. This test processes of the visco-elastic response of the bituminous material. For this test a cylindrical specimens prepared in the laboratory with a diameter of 100 mm and thickness of 63.5 mm. The test has been employed to measure small tensions on bituminous mixtures by applying intrinsic load over the vertical diameter of a cylindrical sample. ITSM test was conducted to determine the strength characteristics of the CAEMs. It was required to apply compressive loads to the specimen between two loading strips which transfers the loads to tensile stresses along the vertical diametric plane. The ITSM test was designed for testing the ability of individual pavement layer to distribute loads from traffic to the underneath layers. This test is a non-destructive test and usually employed in the evaluation of hot mix stiffness modulus. Currently, stiffness modulus is considered to be a very important indicator of performance in relationship to the properties of bituminous paving materials; the stiffness modulus can act as an indicator of the ability that bituminous layers can spread loads [26]. The stiffness modulus is also considered a most significant property that has a strong bearing upon critical strains that are generated in both subgrade and base [27].

2) Water Sensitivity Test

Water sensitivity test or moisture damage was carried out in order to provide an evaluation of the produced CBEM durability; this was conducted in relation to the stiffness modulus ratio according to the [28]. Two sample sets were prepared in this test; dry and wet, in which of each set five parallel samples were prepared for each mixture type. The first set of samples were prepared and tested within the dry condition with the temperature set at 20 °C. Prior to extraction, the samples were prepared, compacted and left in the mould for 24 hours at lab temperature. Following extraction, the sample was left on a flat surface for another 7 days before testing. The samples in the second set were saturated as prepared and left in the mould for a total of 24 hours at lab temperature and then extracted and submerged into a water bath at 20 °C for 4 days. Following these procedures, the samples were transferred to the vacuum container for 10 minutes in a vacuum pressure of 6.7 kPa and then re-submerged for 30 minutes more under water. Following all these, the samples were submerged for three days in the water bath of warm water at temperature of 40 °C before being tested. Lastly, the second set had a stiffness modulus test at a temperature of 20 °C; by testing water sensitivity an evaluation of the loss of mixture strength can be found whilst the mixtures are actually in contact with water through a determination of the ration between the ITSM of the dry and wet specimens. Water sensitivity was calculated using the stiffness modulus ratio (*SMR*) as shown in equation (1):

$$SMR = (\text{wet stiffness} / \text{dry stiffness}) \times 100 \quad (1)$$

3) Temperature Sensitivity

The investigation was carried out in relation to the sensitivity of CBEMs to the temperatures and in order to establish a type of methodology that could be used for rapid and economical experimental research in the future. The mixture temperature sensitivity was inspected at 45 °C, 20 °C and 5 °C. Specimens were prepared with the OPC which was used rather than the conventional mineral filler in different ratios of 6%, 3% and 0%.

C. Experimental Procedure

1) Washing, Drying and Sieving of the Aggregate

Aggregates that contain any dust might prevent the bonding of the aggregate with the asphalt binder and result in excessive loss from damage. Therefore, the aggregate washed and cleaned upon a sieve of 63μm to remove all the fine particles or dust. Then, the aggregate dried using an electrical oven at 100 °C and sieved through a number of separate sieves. These sieves size are 14, 10, 6.3, 2, 1, 0.063 mm and pan at the bottom.

2) Sample Preparation and Condition

CBEM samples were prepared according to the Marshall method for emulsified asphalt aggregate cold mixture designs (MS-14), as adopted by the Asphalt Institute [29]. According to this procedure, the pre-wetting water content, optimum emulsion content, optimum total liquid content at compaction and optimum residual bitumen contents were 3%, 12.4%, 15.4% and 6.2%, respectively. These results are comparable to those published by [21], [30], [31]. Samples were mixed using an electric blender as shown in figure 2 below and to ensure a consistent distribution of the OPC, water and emulsion in the mixtures, the aggregate together with the OPC and the pre-wetting water were added and mixed for 1 minute. Gradually, during the following 30 seconds of mixing, the bitumen emulsion was added and then the mixing was continued for 2 minutes. In addition, the mixed samples were placed in the moulds, and then a Marshall hammer was employed for impact compaction with a total of 50 blows for each of the sample faces as shown in the figure 3.

Two steps of samples curing were performed, firstly, compacted samples were kept in their moulds for one day at lab temperature (20 °C), and then removed so that samples would not collapse. The samples were then in the second step extruded and placed in the lab temperature and ITSM was applied at the various times of curing (2, 7, 14, 28, 90, 180 and 360 days). For indirect tensile stiffness modulus tests, five duplicate samples were tested and the average was taken for each individual value.

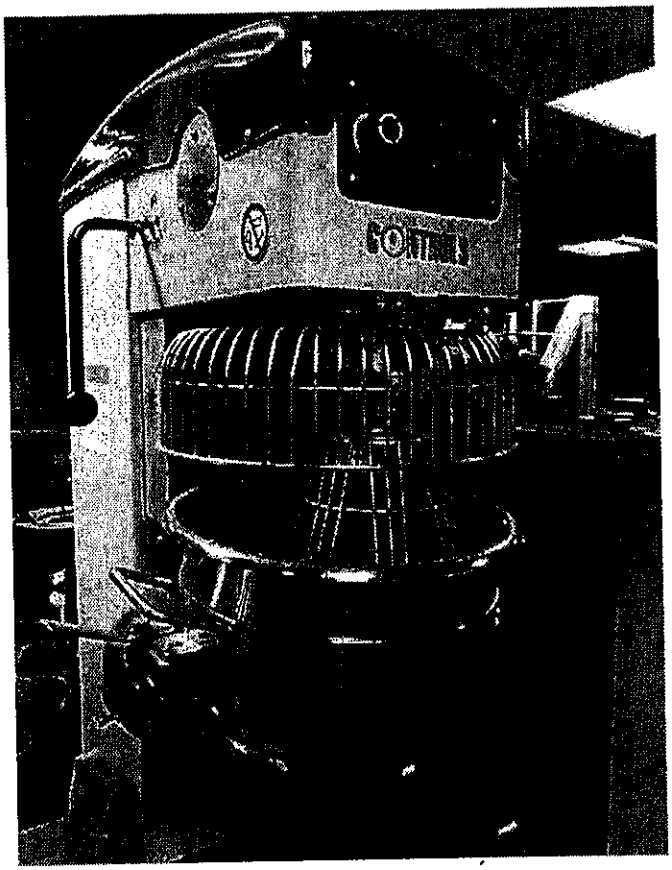

Fig. 2 Electrical blender

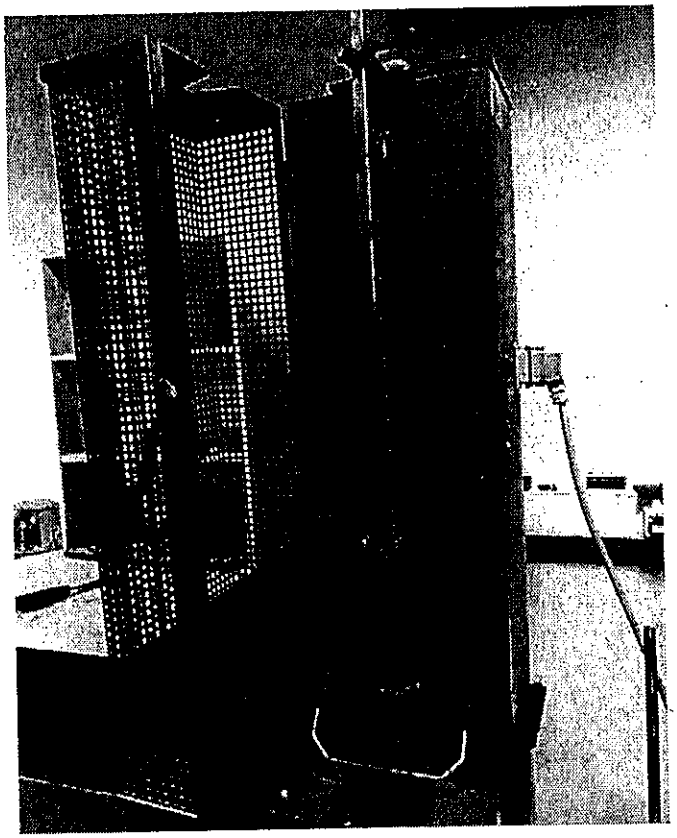

Fig. 3 Marshall hammer

IV. RESULTS AND ANALYSIS

A. Indirect Tensile Stiffness Modulus Test

The results of the ITSM tests for the OPC substitution are shown in figure 4. It is obviously shown that adding OPC as a replacement to the limestone dust in CBEMs develops the stiffness modulus of such mixtures. These mixtures have ranges of OPC with different percentage (0%, 1%, 2%, 3%, 4%, 5% and 6%) of total weight of the dry aggregate.

The stiffness modulus and strength properties of CBEMs were considerably improved by increasing the ratio of OPC. The latter is widely used in CMA as a stabilizer added to enhance the early age efficiency of the mixture as well as reducing the curing time. This application shows that cement hydration improves the development of strength by means of consuming more water and thus stimulating the bitumen emulsion mixture. Figure 4 shows that an increase in the OPC percentage facilitated to increase the stiffness modulus for the CBEMs in their initial stages. The stiffness modulus test was conducted in compliance to BS EN 12697-26:2004 at 20 °C and investigated the impact of replacing the conventional mineral filler (limestone dust) with the different percentage of OPC. The OPC was employed in its several stages (2, 7, 14, 28, 90, 180 and 360 days).

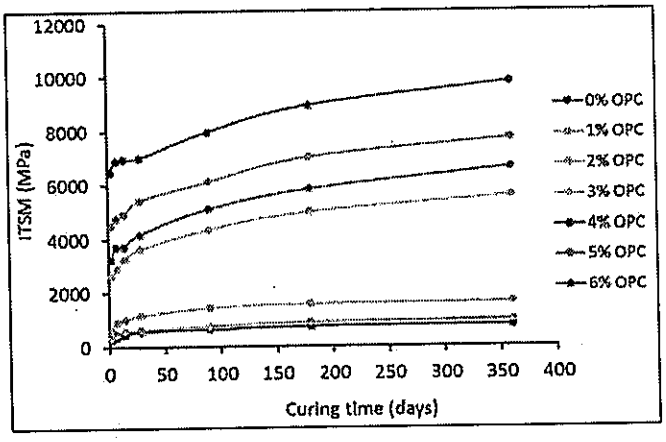

Fig. 4 ITSM of different mixtures with different curing times

B. Water Sensitivity Test

In this test, the loss of the strength of the CBEMs due to the water effect was evaluated by determining the ratio of the ITSM of the dry samples to the wet samples. This ratio is defined as the stiffness modulus ratio (SMR) in compliance [28]. Filler replacement with the OPC is significantly developed the durability of the CBEMs as shown in figure 5. The conventional bitumen emulsion mixtures have high risk of water damage during its curing period. This means that the conventional CBEMs is pertained to the issue of durability. Therefore, the mixtures can resist water damage by adding cement as a stabiliser. The bituminous specimens were prepared with three different mixtures in terms of OPC percentage (0%, 3% and 6%).

In terms of SMR, the water sensitivity of the CBEMs with 6% of OPC was improved more than other mixtures such as (0% and 3% OPC). It is clearly shown that the SMR of CBEM

with 6% OPC is about 95% while 60% for 3% OPC and 50% for 0%. This indicates that adding OPC to the CBEMs reduces the effects of water damage.

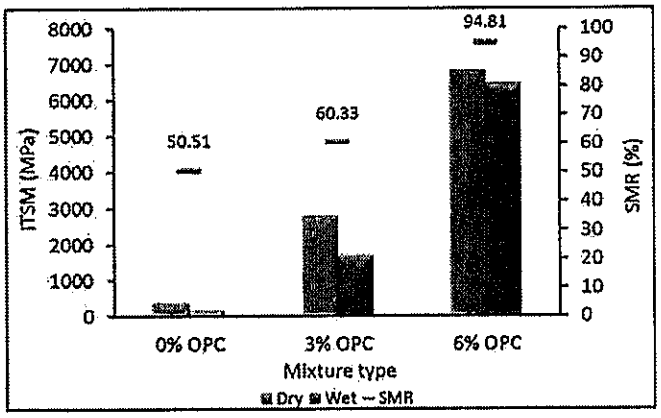

Fig. 5 Water sensitivity results

C. Temperature Sensitivity Test

The indirect tensile stiffness modulus of CBEMs was determined after 28 days to assess the performance of CBEMs at different temperatures. The bituminous samples were tested at 5 °C, 20 °C and 45 °C and the temperature sensitivity results are shown in the figure 6. The slope of the curves represents the temperature sensitivity of the mixtures. The mixtures having relatively higher rate of change show greater effect of temperature sensitivity. In this figure, it can be clearly seen that the maximum stiffness modulus occurred when the samples tested at the temperature 5 °C and the stiffness decreased when the temperature increased to 45 °C. Furthermore, by replacing limestone dust filler with the OPC, stiffness increased with the increasing of the OPC.

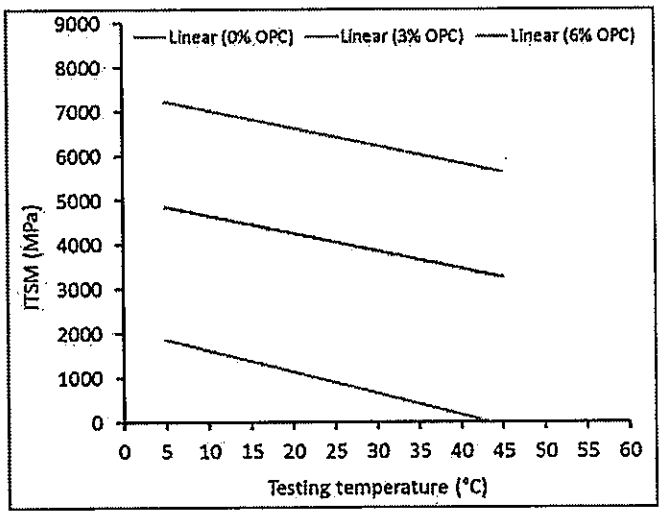

Fig. 6 Temperature sensitivity results

V. CONCLUSION

This experimental research focuses on the development of CBEMs treated by cement, and study the effects of cement on the enhancement of cold mix mechanical properties to be used as a layer at the surface of pavement roads. An assessment was undertaken the mechanical properties of the mixture that was produced through the ITSM and water sensitivity tests in relation to the SMR, which acted as a scale measuring durability improvement following the addition of OPC to the CBEMs. Depending on the specific materials utilised, a satisfactory solution was found for most significant CBEM problems as below:

- The stiffness modulus increased significantly with increasing in content of OPC, and the results can be maximised when, for example, 6% OPC is used to replace the whole of the mineral filler. In addition, with CBEMs that have 6% OPC cured faster than other mixtures.
- According to the results related to durability, resistance to moisture damage was developed when 6% OPC used.
- CBEMs with 3% and 6% OPC had temperature sensitivity results showing significantly lower figures than conventional mixture with the modulus change of the stiffness slope.

ACKNOWLEDGMENT

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Fiber-Based 3D Cellular Reinforcing Structures for Mineral-Bonded Composites with Enhanced Structural Impact Tolerance

Duy M. P. Vo, Cornelia Sennewald, Gerald Hoffmann, Chokri Cherif

Abstract— The development of solutions to improve the resistance of buildings to short-term dynamic loads, particularly impact load, is driven by the urgent demand worldwide on securing human life and critical infrastructures. The research training group GRK 2250/1 aims to develop novel mineral-bonded composites that allow the fabrication of thin-layered strengthening layers providing available concrete members with enhanced impact resistance. This papers presents the development of 3D woven wire cellular structures that can be used as innovative reinforcement for targeted composites. 3D woven wire cellular structures are truss-like architectures that can be fabricated in an automatized process with a great customization possibility. The specific architecture allows this kind of structures to have good load bearing capability and forming behavior, which is of great potential to give strength against impact loading. An appropriate combination of topology and material enables an optimal use of thin-layered reinforcement in concrete constructions.

Keywords—3D woven cellular structures, ductile behavior, energy absorption, fiber-based reinforced concrete, impact resistant

I. Introduction

THE majority of buildings and infrastructures that are available or being designed are composed of concrete or steel reinforced concrete. Beside a number of advantages, one major drawback of this type of construction is its relatively limited resistance to short-term dynamic loads such as collision, explosion or earthquake. This is primarily caused by the brittleness of concrete material. Considering the steadily increased danger brought about by the occurrence of such dynamic loadings, for example because of natural catastrophes or terrorist attacks, there is an urgent demand worldwide on enhancing building safety to secure human life and critical infrastructures.

A great number of studies have been carried out, proposing different protection methods for concrete constructions against short-term dynamic loads. One approach is to increase the thickness of main structure to prevent this from being penetrated through by the load source [1]. Another approach is to introduce external absorbent systems that can effectively diminish damage on the main structure [2], [3]. Because of the massive construction and complex designing requirements, a common adoption of such systems in building industry is challenging. In order to meet the present safety demands, development of innovative protective solutions that are cost-, material- and space-effective as well as easy-to-install is essential.

In this respect, the research training group GRK 2250/1 has the vision to develop novel mineral-bonded composites that can be applied as thin, flat strengthening layers on available concrete members to enhance their resistance to short-term dynamic loads, particularly impact load [4]. Among other elements, reinforcing structures have essential contribution in attaining desired composite properties. Therefore, a main research focus is the development of appropriate reinforcing structures that can provide the composites with sufficient energy absorption capability and ductility so that they are more resistant to dynamic loads. Beside significant mechanical properties, an economical, flexible, repeatable and automatized manufacturing technology of such reinforcements is required regarding industrial adoption of targeted composites.

Steel structures have been long employed as reinforcement for concrete construction. Generally, steel provides tensile strength, helping concrete to overcome the disadvantage of being brittle. To attain sufficient reinforcement in complex loading cases, steel members are usually formed into 3D truss structures using bending, welding as well as tying tools. Because of multi-stage and elaborated process, only simple structures can be obtained and conventional steel constructing method is not suitable for the fabrication of reinforcement for thin, flat strengthening layers. Recently, the introduction of textile reinforcements has gained increasing attention. The major advantage of employing textile technology is its flexibility in fabricating customized complex structures in an automated process. In addition, high-performance fibrous materials such as carbon and glass fiber can be employed, allowing the implementation of thin layered concrete structures in varied shapes [5]. At the moment, textile grids comprising of in-plane reinforcing elements (2D) are available. Experiments have shown that 2D textile reinforced concrete performs well when subjected to in-plane loads such as tension or bending [7]. To strengthen concrete members under impact, textile structures with out-of-plane reinforcing elements (3D) are crucially needed.

A potential textile structure that can meet mentioned requirements is 3D woven wire cellular structure, developed recently by researchers at ITM [8]. Thanks to the flexible weaving technique, a variety of 3D wire cellular structures with customized reinforcing elements can be fabricated in an

D. M. P. Vo is Research Associate at Institute of Textile Machinery and High Performance Technology (ITM), Technische Universität Dresden, 01062 Dresden, Germany (Corresponding author; phone: +49 351 463 34408; e-mail: duy.vo@tu-dresden.de).

automatized process. In general, these structures have good forming behavior in different directions. Wire cellular structures are truss-like architecture, hence good load bearing capability can be expected. When being used in sandwich panel, they shows high resistance to compression and impact loads [9]. For the application in thin-layered mineral-bonded strengthening layers under impact, it is essential to investigate appropriate designs and to establish an understanding on structure-material-relations of reinforcing structure. The development of 3D woven wire cellular structures that are suitable to reinforce concrete constructions is presented in this paper.

II. Topology Development of 3D Woven Wire Cellular Reinforcing Structures

A. Background

A substantial fundament for the development of efficient reinforcing structures is the failure analysis of concrete constructions under impact. When being struck by a hard impacting missile, a complex of loads is generated in the target concrete wall, including tension, compression, shear as well as bending. "Hard" impact results in both local damage and global dynamic response. Local damage consists of spalling of concrete from the front side and scabbing from the rear side together with missile penetration into the target. Perforation occurs if damage is sufficient. Global dynamic response of the target wall consists of flexural deformation, caused by residual kinetic energy of the impacting missile after missile deformability and target penetration. As the impact velocity increases, damage grade is intensified and local damage tends to be overwhelming [10]. Good impact resistant design practice consists of preventing excessive local damage and improving ductility of target structure to sufficiently withstand the absorbed energy.

3D woven wire cellular structures are composed of a number planar meshes, in which straight metal wires (1D) are interlaced at a right angle to each other. These are in-plane elements. The binding of two adjacent meshes is attained by means of other sets of wires that interweave with both surfaces. In order to realize a fully open cell configuration, in-plane elements are arranged distant from each other, while binding wires are bent into 2D or 3D shapes and integrated in out-of-plane directions, setting the distance between adjacent meshes. Fig. 1 illustrates the formation principal of 3D woven wire cellular structures [11].

Notable characteristics of 3D woven wire cellular structures for the application as concrete reinforcement are:

- fully open structure, which is advantageous for concrete casting,
- good deformation capability,
- truss-like architecture, providing potentially good load bearing capability and
- anisotropic behavior, allowing the customization of load oriented reinforcing structures for particular loading case.

The topology development is aimed to systematically investigate possible configurations of 3D woven wire cellular structure regarding their feasibility as well as applicability in concrete constructions. As the topology has a significant influence on forming capability and mechanical properties of resulting structures, a qualitative analysis of potential contribution of various 3D woven wire cellular structure to impact resistant mineral-bonded composites will be given. This serves as a good basis for the formulation a design concept as well as for the determination, implementation and optimization of appropriate 3D cellular reinforcement that meet the requirements of impact resistant design practice.

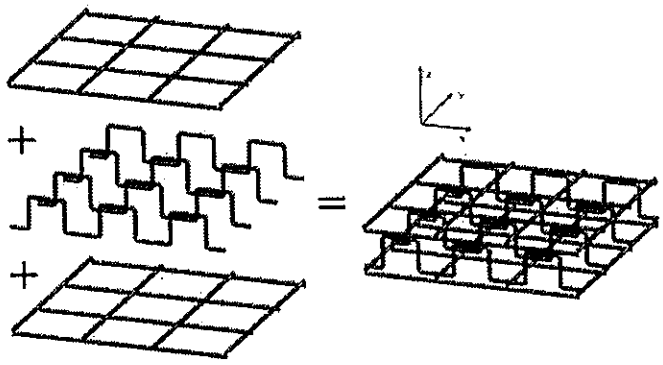

Fig. 1 Formation principal of 3D woven wire cellular structures

B. Single-layered 3D woven wire cellular structures

As mentioned above, a complex of loads is generated in the target concrete wall during an impact event. To each single type of load, target concrete is strengthened using suitable load carrying elements that are arranged in appropriate position as well as direction of acting force. The inherent structural characteristics of 3D woven wire cellular structures allow the combination of various reinforcing elements in a complex structure.

In 3D woven wire cellular structures, in-plane elements are designated to provide the target concrete wall with tensile and bending strength. In a weaving process, in-plane elements are fed at a right angle to each other as warp and weft yarns, hence a biaxial reinforcement is attainable. As impact damage tends to occur in all directions, a symmetrical arrangement of strengthening elements is favorable. For this reason, equal distance is set between warp and weft yarns in all planar meshes. In contrast to in-plane elements, out-of-plane elements are expected to provide reinforcement against compression and shear. A further function of these elements is to bind adjacent planar meshes together to form a membrane structure that prevents structural delamination, enables layer-to-layer load dissipation and activates global structural dynamic response.

In this paper, 3D woven wire cellular structures are categorized based upon the number of out-of-plane systems constructed in the structure. The term "single-layered 3D woven wire cellular structures" refers to structures composed of two planar meshes that are connected by one in-between out-of-plane system. In one system, out-of-plane elements can vary in their shapes and arrangement. Because of the requirement on global uniform behavior, configuration of a

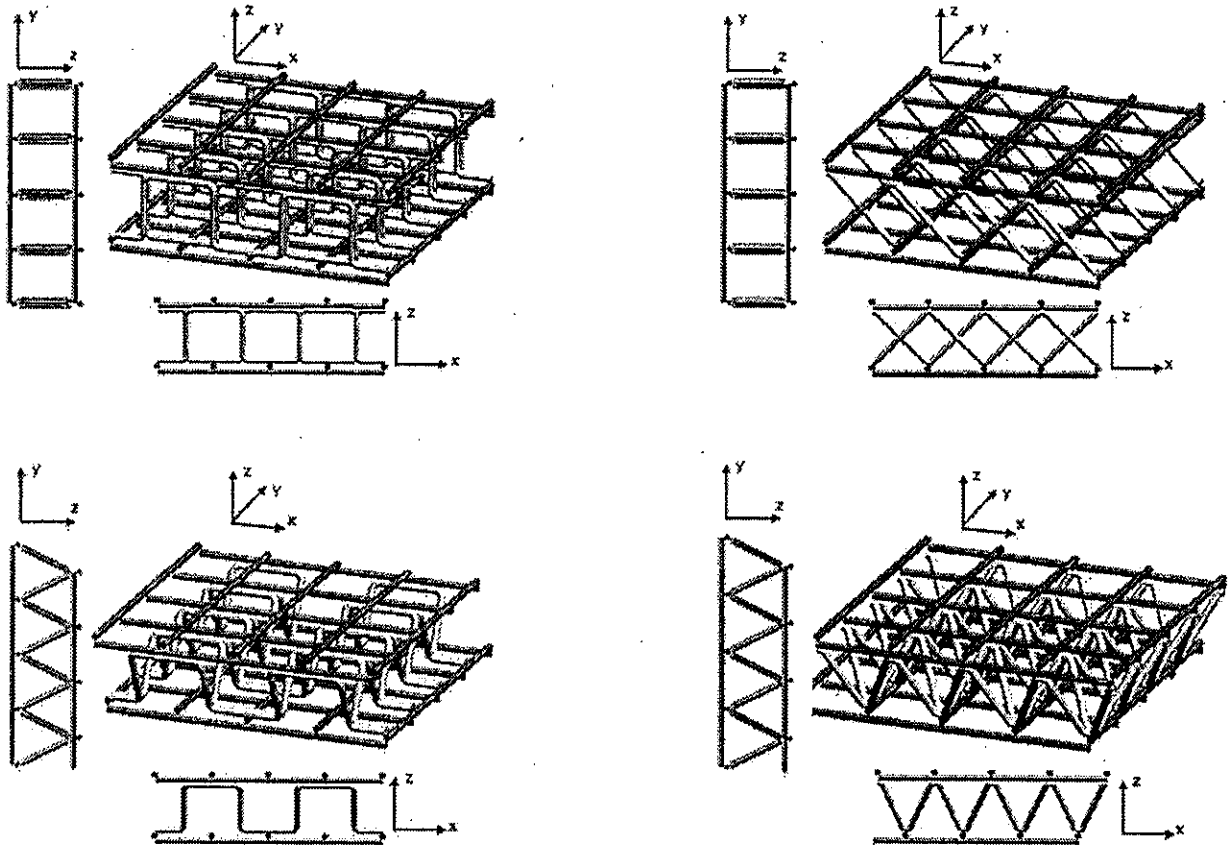

Fig. 2 Single-layered 3D woven wire cellular structures comprised of rectangular and triangular out-of-plane elements

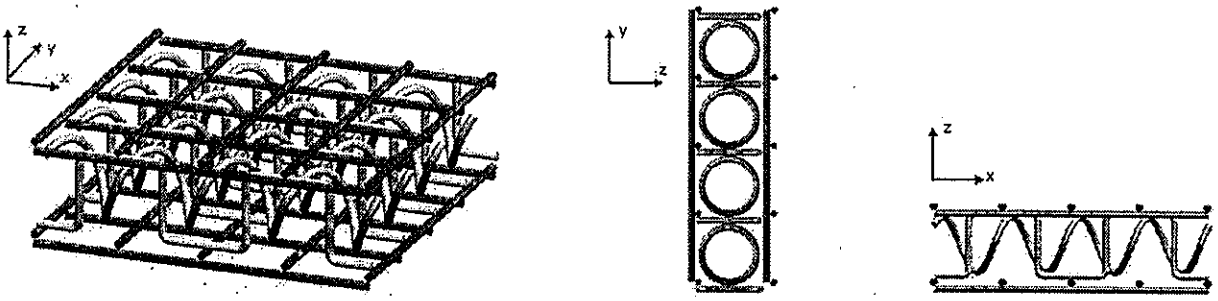

Fig. 3 Single-layered 3D woven wire cellular structure comprised of rectangular combined with helical out-of-plane elements

single out-of-plane element remains unchanged. Selected possible single-layered 3D woven wire cellular reinforcing structures are depicted in Fig. 2 and Fig. 3.

In Fig. 2, single-layered 3D woven wire cellular structures comprising of rectangular and triangular out-of-plane elements as well as their front and side views can be observed. Structures in the first row have out-of-plane elements that are arranged orthogonally to the top and bottom planes, forming truss-like structures that are commonly found in civil engineering. In the structures in the second row, out-of-plane elements are alternatively rotated through an angle ± 60° about the x-axis. Because of the diagonal disposal of out-of-plane elements, resulting structures potentially show better shear resistance and more effective load dissipating capability.

Beside 2D shapes, out-of-plane elements can also be made into 3D shapes. Employing helical springs makes resulting structure work as a damping system, which could be advantageous for enhancing flexural deformation or ductility of impact targeted concrete construction. It is possible to combine out-of-plane elements in 2D and 3D shapes, as can be seen in Fig. 3, so that good deformation and sufficient strength against compression can be attained. However, attention need to be paid to ensure an even penetration of concrete matrix into the complex reinforcing structure.

C. Multi-layered 3D woven wire cellular structures

Multi-layered 3D woven wire cellular structures refer to structures having two or more out-of-plane systems arranged along the z-axis. The possible maximal layer number depends on the relation between requested thickness of target concrete wall and measurement of out-of-plane systems in the z-axis. In comparison to single-layered general 3D woven wire cellular structures, contribution of multi-layered reinforcing structures to the impact resistance of target concrete are expected to be considerably greater. An increase in the number of planar meshes in the structure leads to a multiplicate number of in-plane elements involving in the impact event, giving the target concrete more strength to withstand occurring loads. Meanwhile, structural deformability remains. The membrane effect would become more evident, whereby the impact energy descends gradually when reaching one reinforcing plane after another.

Fig. 4 illustrates exemplary double-layered 3D woven wire cellular structures. The upper cage structure is comprised of rectangular out-of-plane elements arranged orthogonally to the planar meshes. Diagonal triangular out-of-plane elements are employed to form the lower diamond structure. This structure is very well self-supported, can be formed without being collapsed. Because of the disposal of reinforcing elements in four different out-of-plane directions, diamond structures are expected to show high potential for heavy load bearing applications, especially when compression and shear are critical.

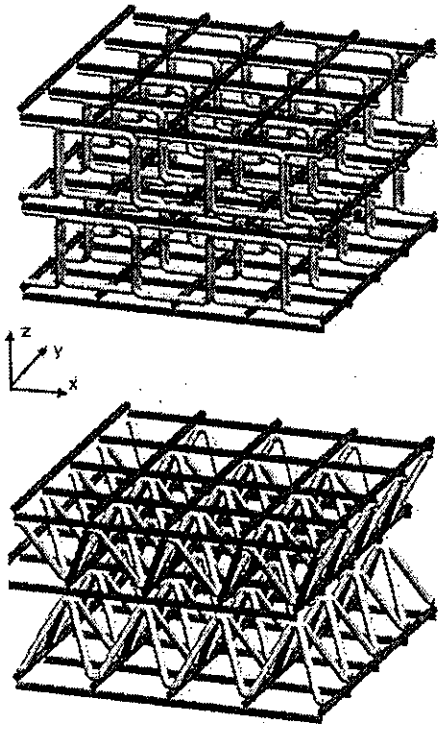

Fig. 4 Double-layered 3D woven wire cellular structures

III. Variations of 3D Woven Wire Cellular Reinforcing Structures

Using textile manufacturing technology, it is possible to introduce a wide range of variations on the basis of developed topology of 3D woven wire cellular structures. The aim is to further customize and enhance structural and mechanical properties so that reinforcing capability of resulting structures can be optimized for a particular use. Variable factors can be classified as following:

- Material type: in the fabrication of 3D woven wire cellular structures, fibrous metals are used as base material due to their capability of plastic deformation that is essential for the form stability of the structures. However, inherent strength of this material type is somewhat limited. This can be improved by means of hybrid structures in which high-performance materials such as glass or carbon filaments are integrated as in-plane reinforcing elements using textile process. Resulting structures possess all characteristics of 3D woven wire cellular structures with enhanced tensile and bending strength due to the availability of load oriented high-performance materials.
- Material parameters: in order to meet the property requirements of resulting structure, material parameters such as yarn count, yarn make-up can be adjusted.
- Structural parameters: yarn density, cell size can also be adapted in weaving process to attain desired performance.

Fig. 5 depicts different variations of single-layered 3D woven wire cellular structure comprised of orthogonal rectangular out-of-plane elements towards the aim of enhancing the structure in-plane strength. In the upper structure, biaxial carbon meshes are integrated in the top and bottom surfaces to form a hybrid structure. In the lower structure, planar meshes are composed of double wires to increase the reinforcement ratio.

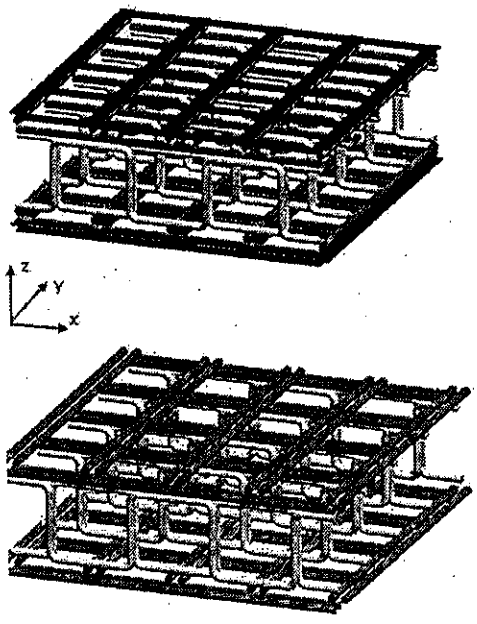

Fig. 5 Variations of 3D woven wire cellular structures

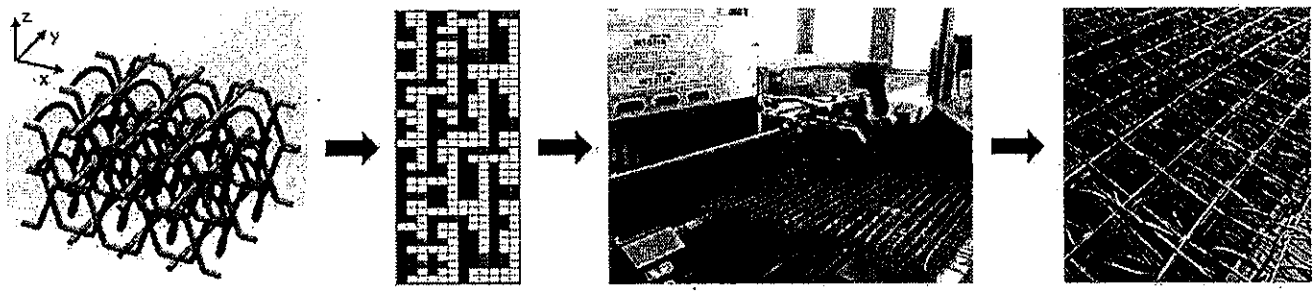

Fig. 6 Process chain to fabricate double-layered 3D woven wire cellular structures comprised of orthogonal trapezoids and helical springs

IV. Summary and Outlook

In this paper, the topology development and variations of 3D woven wire cellular structures are presented. Basis for the topology development is the failure analysis of concrete constructions under impact loading. In 3D woven wire cellular structures, in-plane and out-of-plane elements are employed at appropriate position and orientation to strengthen target concrete against different occurring loads such as tension, compression, bending and shear. The complex architecture is not only good load bearing but also deformable, allowing a global structural response. These characteristics have a great potential to contribute to the enhanced impact energy absorption capability of concrete constructions. Impact behaviors of 3D woven wire cellular structures are strongly influenced by structure topology, material and parameter selection. Multi-layered structures seem to be more promising due to a great number of reinforcing elements and possible layer-to-layer effects. Using textile manufacturing technology, it is possible to introduce a wide range of variations to 3D woven wire cellular structures such as creating hybrid structures and customizing reinforcing ratio to meet particular requirements. The topology development provides a substantial basis for impact resistant design practice. In the next step, selected 3D woven wire cellular structures will be fabricated and characterized, allowing a quantitative evaluation and determination of effective 3D woven wire cellular reinforcing structures for concrete construction with enhanced impact safety. The exemplary process chain to fabricate double-layered 3D woven wire cellular structures comprised of orthogonal trapezoids and helical springs is presented in Fig. 6.

Acknowledgment

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Optimal Mitigation of Slopes by Probabilistic Methods

D. De-León-Escobedo, D. J. Delgado-Hernández, S. Pérez

***Abstract*—**A probabilistic formulation to assess the slopes safety under the hazard of strong storms is presented and illustrated through a slope in Mexico. The formulation is based on the classical safety factor (SF) used in practice to appraise the slope stability, but it is introduced the treatment of uncertainties, and the slope failure probability is calculated as the probability that SF<1. As the main hazard is the rainfall on the area, statistics of rainfall intensity and duration are considered and modeled with an exponential distribution. The expected life-cycle cost is assessed by considering a monetary value on the slope failure consequences. Alternative mitigation measures are simulated, and the formulation is used to get the measures driving to the optimal one (minimum life-cycle costs). For the example, the optimal mitigation measure is the reduction on the slope inclination angle.

***Keywords*—**Expected life-cycle cost, failure probability, slopes failure, storms.

I. Introduction

MANY collapses have been produced as a consequence of slopes failure as the one in Puerto Rico in 1989 after the hurricane Hugo [1], and the one in Taiwan where the Typhoon Herb produced 1300 landslides in 1996 [2].

Monte Carlo simulation techniques and probability-based approaches have been widely used to analyze the slope stability and the parameters sensitivity [3], [4]. The rainfall-induced changes on the soil properties have been studied by using a variety of models [5]-[7].

Hazard management systems have been developed for slope stability with non-saturated soils [8], and it has been pointed out that most of the recent slope risk analyses have the deficiency that they are based on a single rainfall record for the hydro mechanical slope analysis. Instead of that, a Markov chain model has been proposed to generate a time series of rainfall records [9].

In Mexico, the States of Puebla, Veracruz, Hidalgo, Baja California and Chiapas have suffered strong consequences (in casualties and economic loss) due to rainfall induced slope failures [10], [11].

In this paper, a simplified procedure to assess, in a probabilistic manner, the cost-effectiveness of mitigation measures is proposed and applied to a slope in Mexico. One of the contributions is the calculation of the allowable failure probability in terms of the minimization of the expected life-cycle costs.

D. De-León-Escobedo, D. J. Delgado-Hernandez, and S. Perez are with the Universidad Autónoma del Estado de México, Engineering School, Ciudad Universitaria, 50130 Mexico (phone: 7222140855; e-mail: daviddeleonescobedo@yahoo.com.mx, delgadoh01@ yahoo.com, jspfsa@gmail.com).

II. Slope Stability Analysis

A. General Formulation

The procedure is based on the general limit equilibrium (GLE) method by Fredlund [12] and the following expression [13]:

$$s = c' + (\sigma_n - u_a) tg\phi' + (u_a - u_w)\left[\frac{\theta - \theta_r}{\theta_s - \theta_r}\right] tg\phi' \qquad (1)$$

where s = unsaturated soil shear strength, c' = effective cohesion of saturated soil, σn –ua = net normal stress on the failure path, ua-uw = matric suction on the failure path, ϕ = effective angle of shear strength for saturated soil, θ = volumetric water content, θs=saturated water content, θr = residual water content.

Monte Carlo simulation techniques are applied to account for the soil and rainfall variabilities and the SF is assessed throughout 1000 trials (see flowchart in Fig. 1). The steps are as follows:

1. Initial condition (trial with geometry and soil properties)
2. Rainfall simulation (trial from exponential distribution)
3. Slope stability analysis
4. i=n? (if the number of trials is not yet the proposed number, the process continues to step 5, otherwise it goes to step 6
5. Perform a new trial and goes to step 1
6. Calculate the slope failure probability (number of trials with failure divided by the total number of trials "n".

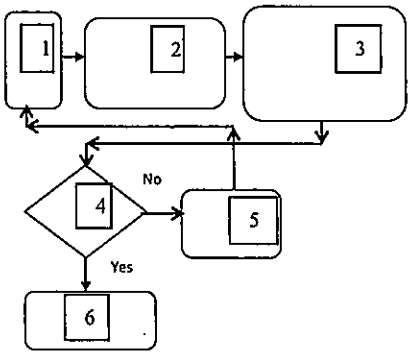

Fig. 1 Flowchart for the proposed procedure

The math is applied through commercial software by the SoilVision [14] which uses the relationships between water content and conductivity and the matric suction for each type

of soil in the slope.

B. Model of the Considered Slope and Data

The shape and profile of the considered slope (in Zinacantepec, Mexico) is shown in Fig. 2.

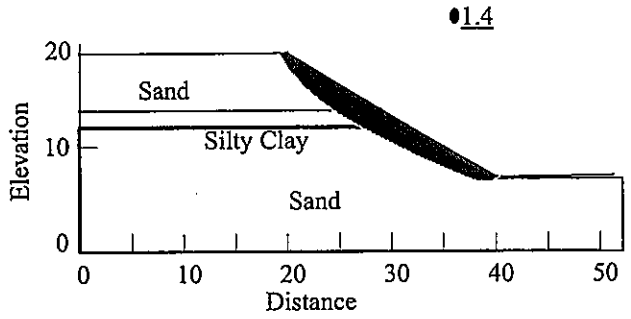

Fig. 2 Slope model (initial condition). Dimensions in m.

Table I shows initial data of soil conditions, without rain, for sand and clay.

TABLE I
SOIL PROPERTIES (INITIAL CONDITION)

Soil	Cohesion	Friction angle (°)	Volumetric Weight
Sand	2 kPa	35	18 kN/m³
Silty Clay	10 kPa	25	19 kN/m³

C. Rainfall Modeling

According to the World Meteorology Organization, a period of 30 years is representative for the simulation of rainfall series. Also, in this work, it is considered that the rain falls only on top of the slope (Fig. 2), the water slides on the seepage face and the pressure zero level corresponds to the highway level.

Data taken (1982 to 2014) from the meteorological station located in Zinacantepec, Mexico State, Mexico serve to fit an exponential distribution to these records.

$$f_R(r) = 1/\mu \exp(-r/\mu) \quad (2)$$

where $\mu = 1.665$.

D. Conductivity and Water Content Functions

Lab tests serve as a basis to get the curves of conductivity and water content for each material. In this paper, the ones for conductivity and water content for sand and clay are shown in Figs. 3-6.

III. MC SIMULATION AND ACCEPTABLE FAILURE PROBABILITY

Monte Carlo simulation is performed to calculate the slope failure probability, modifying the soil properties and rainfall intensity each trial. Slope final condition may be seen in Fig. 4.

The resulting slope failure probability is 9×10^{-2}. Now, the acceptable failure probability is obtained from the minimization of the expected life-cycle cost $E(C_L)$ [15]:

$$E(C_L) = C_i + E(C_f)P_f \quad (3)$$

where the initial cost C_i is expressed [16]:

$$C_i = C_1 - C_2 \ln(P_f) \quad (4)$$

where C_1 and C_2 are constants that depend on the slope geometry and soil characteristics. C_1 is the cost of the slope if no lateral forces exist (no earthquake), and C_2 is the cost of upgrading the slope so that the failure probability is reduced in an order of "e" the natural log base.

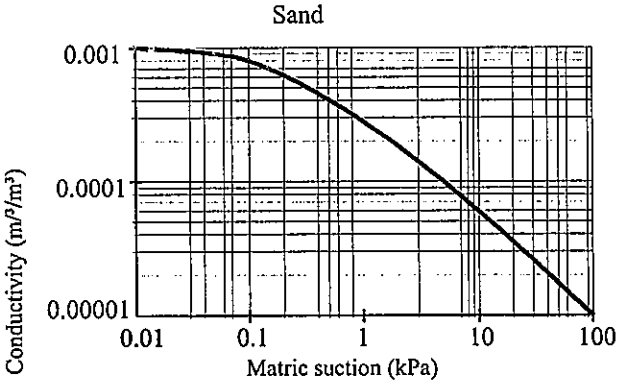

Fig. 3 Conductivity for sand

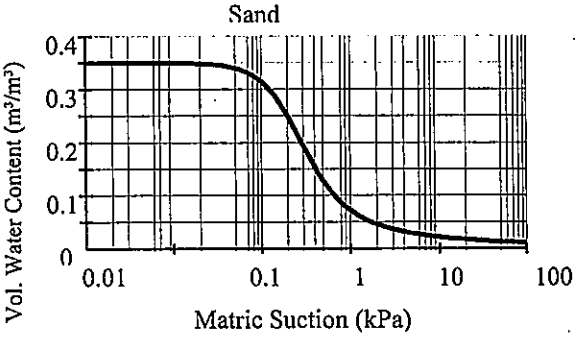

Fig. 4 Water content for sand

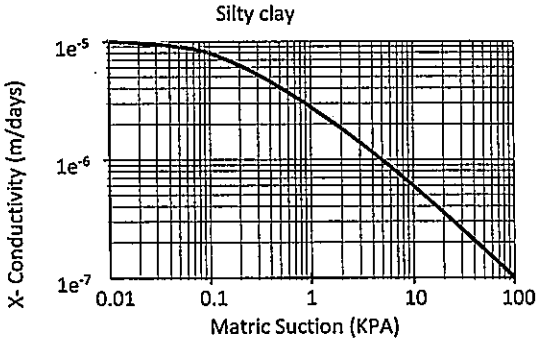

Fig. 5 Conductivity for clay

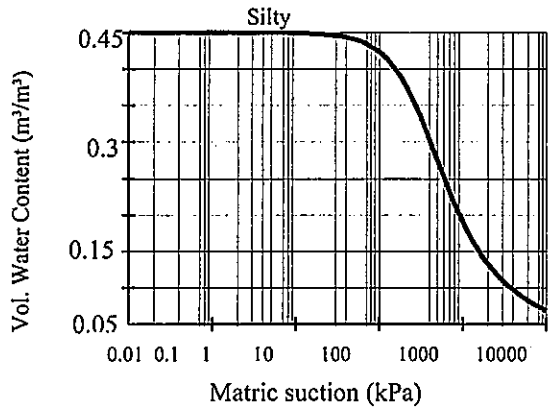

Fig. 6 Water content for clay

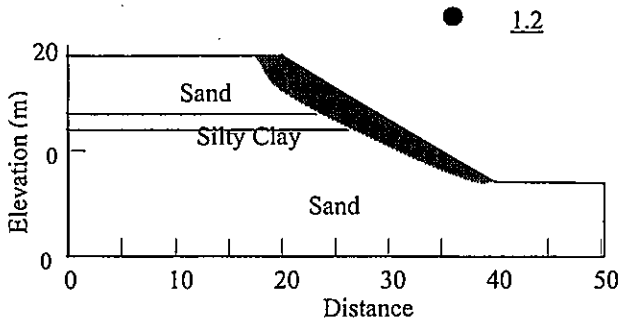

Fig. 7 Slope model (final condition). Dimensions in m

The expected failure cost $E(C_f)$ is expressed in present value, and they depend on the failure consequences of the slope, which are here calculated according to the concepts and amounts (estimated from worst scenario conditions) shown in Table II. P_f is the slope annual failure probability.

TABLE II
FAILURE CONSEQUENCES FOR THE SLOPE

Concept	Number	Amount (Million USD)
Fatalities	10	1.2
Injuries	10	0.65
Economic loss		5.15

The amount associated to the fatality cost was estimated according to the "human capital approach" by Rosenblueth [17].

The amount of fatalities and injuries is estimated from the number of vehicles and people usually traveling in the highway down the slope. The economic loss is derived from the worst scenario of a landslide: all the trucks and goods being transported in the highway are lost. The total loss C_f becomes around 7 million USD.

The criterion of minimum life-cycle cost is expressed:

$$\partial E(C_L) / \partial P_f = 0 \quad (5)$$

And, therefore, the acceptable failure probability is:

$$P_f = C_2 / PVF_1(C_f) \quad (6)$$

Therefore, the acceptable failure probability is $6x10^{-5}$.

By comparing this value with the one obtained for the slope, $9X10^{-2}$, one can realize that the slope is in non-acceptable conditions and requires urgent upgrading or mitigation works.

It is assumed that a concrete cover is applied over the top of the slope, producing a protection against water infiltration. By doing so, and calculating again the slope failure probability, it is obtained $P_f = 1X10^{-10}$.

The unit cost of providing the concrete cover is 150 USD/m^2 and, if it is applied over the slope length (considering that the whole area is 2550 m^2) the total cost becomes 0.38 million USD.

IV. CONCLUSION

A procedure to include uncertainties on soil properties and rainfall variabilities was presented to assess the failure probability of a critical slope under strong storms.

It is shown that the procedure may provide a technical basis to decide whether or not the slope is in acceptable conditions and may support the calculations to derive cost-effective mitigation measures.

Cost optimization requires the repetition of the exercise for several mitigation measures, producing different failure probability reductions and different costs. The formulation presented here may be extended to cover these issues.

The formulation may be applied to all the slopes pre-qualified as critical to derive a national or regional program of cost-effective mitigation measures, once they are calibrated against the corresponding costs.

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Jalovchat Gabbroic Intrusive of the Caucasus: Petrological Study, Geochemical Peculiarities and Formation Conditions

Giorgi Chichinadze, David Shengelia, Tamara Tsutsunava, Nikoloz Maisuradze, Giorgi Beridze

***Abstract*—**The Jalovchat intrusive is built up of hornblende gabbros, gabbro-norites and norites. Within the intrusive hornblende-bearing gabbro-pegmatites are widespread. That is a coarse-grained rock with gigantic hornblende crystals. By its unusual composition, the Jalovchat intrusive has no analogue in the Caucasus. However, petrologically and geochemically, the intrusive rocks were studied insufficiently. For comprehensive investigations, the authors applied appropriate methodologies: Microscopic study of thin sections, petro- and geochemical analyses of the samples and also different petrogenic, rare and rare earth elements diagrams and spidergrams. Analytical study established that the Jalovchat intrusive by its composition corresponds mainly to the mid-ocean ridge basalts and according to geodynamic type belongs to the subduction type. In general, it is an anomalous phenomenon, as in the rocks of such composition crystallization of hornblende and especially of its gigantic crystals is atypical. The authors believe that the water-rich magma reservoir, which was necessary for the crystallization of gigantic hornblende crystals, appeared as a result of melting of water-rich mid-ocean ridge basaltic rocks during the subduction process in Bajocian time.

***Keywords*—**Gabbroic intrusive, petrology, geochemistry, genesis, the Caucasus.

I. Introduction

THE Caucasus situated between the Eurasian and Afro-Arabian plates is a central link of the Mediterranean (Alpine-Himalayan) mobile belt. One of the most important components of the Caucasus is the Main Range structural zone of the Greater Caucasus. The zone thrust over the fold system of the southern slope of the Greater Caucasus by the Main Thrust. With the above thrust a number of Jurassic intrusives of basic and acid composition are associated. Their majority is elongated in general Caucasian direction and is spread both in the pre-Alpine crystalline basement of the Main Range zone and the Mesozoic fold system of the southern slope. One of the intrusives of basic composition is the Jalovchat gabbroic intrusive. The intrusive intruded into the rocks metamorphosed under conditions of a high-grade amphibolite facies and is exposed on both slopes of the axial part of the of the Main Range zone of the Greater Caucasus particularly in the Aksaut river head and in left tributaries of the Atsgara upper reaches (Fig. 1). It covers the area of about 25 km^2 with 10 km of length and with a maximum width of 3.5 km. Moreover, its thin (0.5-2.0 m) concordant or crossing bodies occur in host metamorphic rocks represented by quartz-plagioclase-mica bearing, garnet-, andalusite-, staurolite-, sillimanite- and cordierite-quartz-plagioclase-mica bearing schists, migmatites and epidote-, diopside-, garnet-quartz-plagioclase-hornblende bearing amphibolites. The K-Ar age dating of the intrusive shows 176±20 Ma [1].

Tamara Tsutsunava is with the Alexander Janelidze - Ivane Javakhishvili Tbilisi State University, Georgia (e-mail: tsutsunava@yahoo.com).

II. Petrological Description

It should be noted that by its composition the Jalovchat gabbroic intrusive has no analogue not only in the Main Range zone of the Greater Caucasus, but also in the Caucasus on the whole. The Jalovchat intrusive is composed mainly of hornblende gabbro; gabbro-norites and norites connected with each other by gradual transitions are less spread and do not form independent bodies.

Gabbroids are massive, medium- and coarse-grained rocks of black and dark grey color. Their structure is gabbroic, rarely gabbro-ophitic or poikilogabbro-ophitic. The main rock-forming minerals are: grayish brown hornblende (≈40%) of Mg-hastingstite and Mg-hornblende composition, hyperstene, diopside (≈20%) and plagioclase (Pl^{82-89}; ≈40%). Diopside, hyperstene and a grayish brown hornblende formed as a result of basite magma crystallization. Accessory minerals are represented by apatite, rutile and ore minerals. Due to postmagmatic transformations cummingtonite, blue-green hornblende, biotite, tremolite, actinolite, chlorite, prehnite and scapolite occur. As a results of petrographic study cummingtonization of primary minerals (hyperstene, diopside and of a grayish brown hornblende) and simultaneously deanorthitization of plagioclase took place. In particular, diopside partially was transformed into a grayish brown hornblende, but plagioclase is replaced by saussurite, prehnite and scapolite.

In the intrusive vein formations (thickness 0.3-0.6 m) of microgabbro and gabbro-diabase porphyrite, anorthosite and hornblende gabbro-pegmatite are widely spread. The veins of microgabbro and gabbro-diabase porphyrite do not differ in composition from the rocks of the intrusive; they rarely contain quartz. Anorthosites form thin bodies of uneven shape and veins; sometimes there occur up to 1 m thick veins forming eruptive breccias. The rock is mainly anchimonomineralic, though hornblende inclusions occur rarely (Fig. 2).

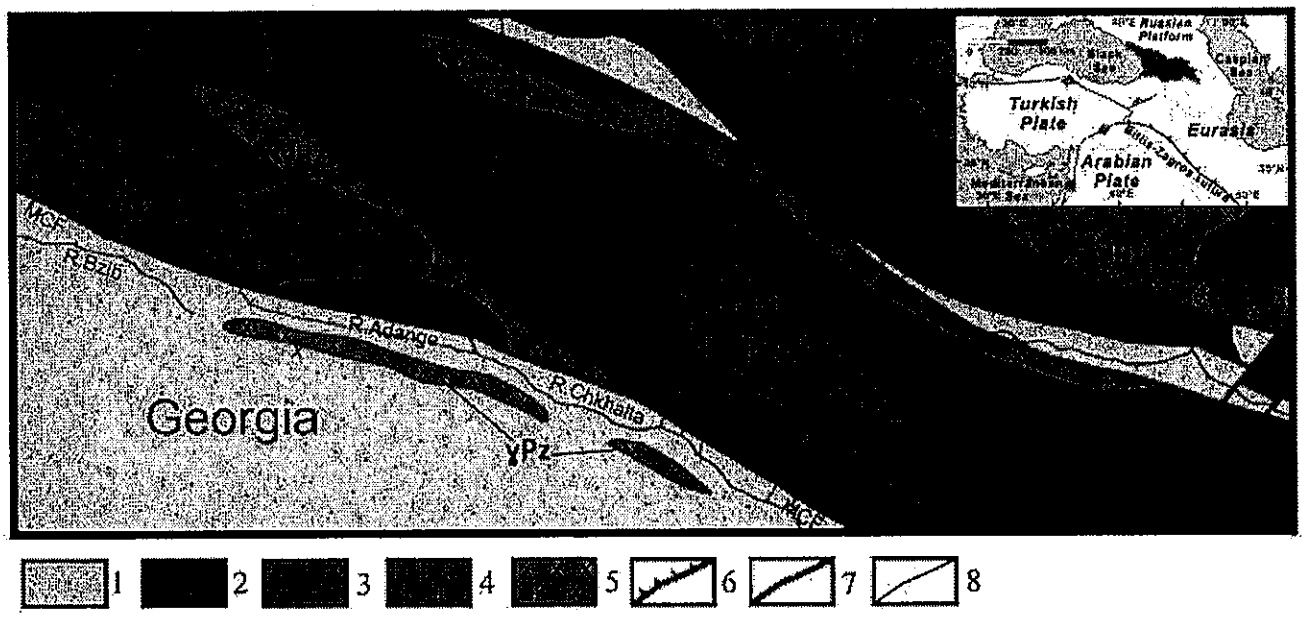

Fig. 1 Schematic geological map of the Greater Caucasus Main Range zone in the area of exposure of the Jalovchat intrusive. 1 - Jurassic sedimentary rocks; 2 - Pre-Alpine metamorphic complex; 3 - Middle Jurassic granitoids; 4 - Middle Jurassic gabbroids; 5 - Paleozoic granitoids; 6 - MCF- Main Thrust of the Greater Caucasus; 7 – Ruptures; 8 - Geological boundaries

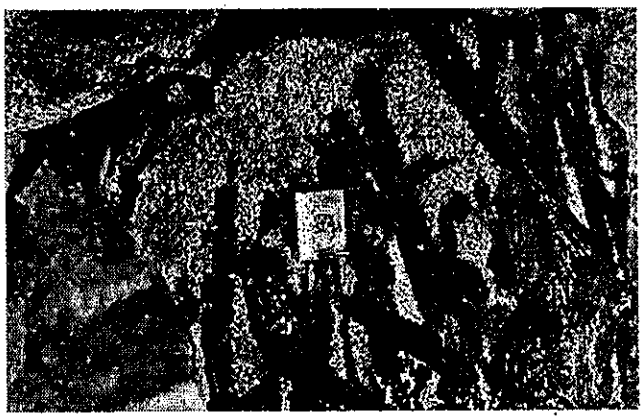

Fig. 2 Gabbro-pegmatites. Gigantic crystals of hornblende in anorthosite mass

Among the vein formations of the Jalovchat intrusive, hornblende gabbro-pegmatites are most widespread. Spatially, they are closely associated with anorthosites. The shape, size and position of gabbro-pegmatitic bodies vary within a very wide range. They occur in the form of veins, lenses and bodies of uneven shape. Their dimensions are measured in tens of centimeters, rarely reaching 1-1.5 m. Veins mainly of 15-40 cm thickness with indefinite orientation are observed. Contacts of bodies with enclosing rocks are usually clear, but in places, indistinct gradual transitions are observed as well. Hornblende gabbro-pegmatites are coarse inequigranular. Sizes of hornblende prisms amount several centimeters, sometimes reaching gigantic sizes of 30-50 cm. The crystals are arranged randomly, oriented along the strike or perpendicular to the vein salbands. Gabbro-pegmatites are very homogeneous: the main minerals are hornblende and plagioclase; secondary minerals - biotite, chlorite, tremolite, actinolite, prehnite, scapolite and epidote group minerals; accessories are apatite, ore minerals and rarely rutile.

The Jalovchat gabbroic intrusive contain xenoliths of amphibolites and metaterrigenous rocks. The first of them is more or less unchanged, and the xenoliths of meta-terrigenous rocks have been greatly altered as a result of the contact effect. There have been established mineral parageneses of regional and contact metamorphisms. The mineral parageneses of regional metamorphism are:

biotite+garnet+staurolite+gedrite+plagioclase+quartz;
biotite+ garnet+ sillimanite + plagioclase+quartz;
biotite+garnet+gedrite+plagioclase+quartz;
garnet+gedrite+plagioclase+quartz.

Due to influence of the intrusion cordierite, spinel (rarely replaced by corundum) and basic plagioclase (An_{78-82}) are formed in xenoliths and regionally metamorphosed rocks. Newly formed mineral parageneses correspond to hornblende-bearing hornfels facies of contact metamorphism.

III. Petro-Geochemical Study

The Jalovchat intrusive was insufficiently studied from the petrologic and geochemical viewpoint. There was an opinion about the formation of the Jalovchat intrusive in deep horizons of the Earth's crust as a result of crystallization of water-saturated Bajocian basalt magma [1]. Though, the above inference was not suitably corroborated by petro-geochemical data. This shortcoming is filled with new data adduced in the article.

Petrogenic elements and RE and REE contents in the rocks of the Jalovchat intrusive are presented in Tables I and II.

TABLE I
CONTENT OF PETROGENIC ELEMENTS (MASS %) IN THE ROCKS OF JALOVCHAT INTRUSIVE

№	6015	6025	6032	6093	6906	6029	6040	6909	6053	6095	6908
SiO_2	44.02	45.32	48.03	47.63	46.83	47.15	44.67	46.01	44.55	43.60	48.81
TiO_2	1.10	1.10	0.82	1.00	0.62	0.77	0.75	0.88	0.66	1.50	0.92
Al_2O_3	18.13	17.79	17.35	20.50	19.85	13.30	15.34	17.08	19.43	13.77	14.71
Fe_2O_3	4.95	4.76	5.11	3.50	3.69	5.10	4.53	4.04	4.10	7.65	3.00
FeO	8.64	6.12	7.56	5.08	7.92	7.08	7.92	7.36	6.09	9.36	7.82
MnO	0.14	0.14	0.21	-	0.14	0.17	0.21	0.33	-	0.21	0.25
MgO	7.68	7.96	8.29	5.83	5.60	11.15	10.24	9.86	8.56	10.26	10.09
CaO	11.69	12.21	2.89	12.13	10.02	10.93	13.30	11.00	12.94	10.48	10.03
Na_2O	2.00	2.40	2.0	2.60	2.40	1.91	2.00	1.92	2.30	2.10	2.56
K_2O	0.20	0.42	-	0.50	0.50	0.20	-	-	0.05	-	0.36
P_2O_5	0.12	0.08	0.09	-	-	0.07	0.08	0.09	-	0.11	-
H_2O^-	0.68	0.62	0.22	-	01.0	-	0.29	0.09	-	0.75	0.37
LOI	0.44	0.78	0.84	1.36	1.66	1.86	0.37	1.61	1.12	0.45	1.51
Σ	99.8	99.7	99.9	100.2	99.95	101.1	99.7	100.2	100.2	99.86	100.3

Gabbro - 6015, 6025, 6032, 6093, 6906; microgabbro - 6029, 6040, 6909; gabbro-pegmatite - 6053, 6095 and 6908. Analytical investigations are conducted in the Laboratory of the Department of Geology of Georgia.

The data of our researches are plotted on different petrochemical diagrams. On AMF diagram (Fig. 3) most of the spots are disposed in the field of tholeiitic basalts.

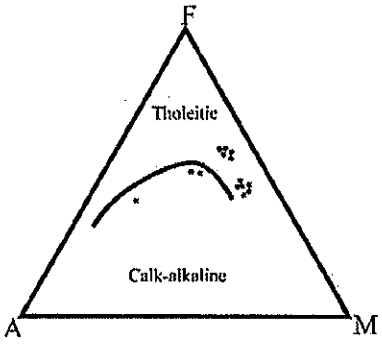

Fig. 3 Arrangement of spots of the Jalovchat intrusive rocks on AFM diagram. Series: I – tholeiitic, II – calk-alkaline [2]

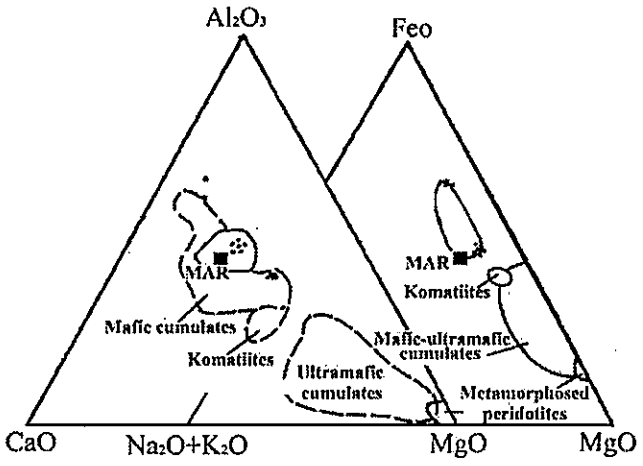

Fig. 4 Distribution of Spots of the Jalovchat Intrusive Rocks on ACM and AFM Diagrams [3]

According to ACM-AFM double diagram (Fig. 4) the samples have been distributed in the fields of mid-oceanic ridges and mafici cumulates.

On TiO_2-FeO/MgO, Zr-Y-Zr and Ti/Cr-Ni diagrams and on Ti-Zr-Y triangular diagram the figures arranged in the fields of island-arc and mid-oceanic basalts or along the trends corresponding to mid-oceanic ridges or island arcs (Figs. 5-8).

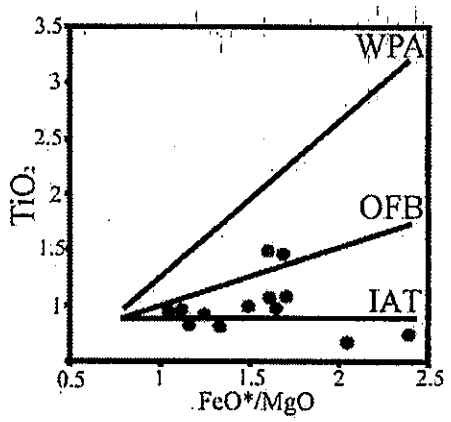

Fig. 5 Discriminative lines of island-arc tholeiites (IAT), mid-oceanic (OFB) basalts and within-plate (WPA) alkali basalts [4]

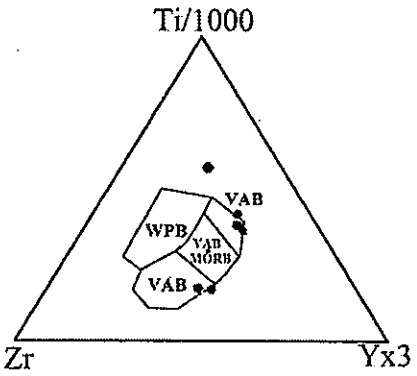

Fig. 6 WPB – within-plate basalts, VAB+MORB – island-arc basalts and basalts of mid-oceanic ridges, VAB – island-arc basalts [5]

In K_2O/TiO_2 diagram (Fig. 9) the spots occupy fields of normal and enriched type mid-oceanic ridges.

TABLE II
RE AND REE CONTENT (PPM) IN THE ROCKS OF THE JALOVCHAT INTRUSIVE

	6025	6906	6912	6092	6056	6913
P	399	465	1050	374	281	589
Sc	32.0	27.6	39.0	56.7	60.0	11.5
Ti	8910	6871	11000	10380	15240	2874
V	343	261	365	473	625	53.5
Cr	145	20.2	27.5	93.5	45.6	13.9
Mn	1130	1335	1460	1446	1181	1102
Co	36.9	32.0	35.2	51.8	59.9	15.1
Ni	31.3	13.7	15.9	58.9	84.4	8.39
Cu	21.1	43.1	46.4	33.4	72.4	11.5
Zn	67.6	85.7	84.0	84.5	80.4	57.2
Ga	16.9	20.8	19.4	16.1	16.2	15.8
Ge	1.24	1.49	1.75	1.63	1.60	0.919
As	0.476	0.439	1.89	0.518	0.544	0.402
Se	0.0334	0.0524	0.0109	0.0589	0.0449	0.0262
Rb	14.7	24.3	4.18	22.4	3.13	11.5
Sr	154	202	276	76.8	159	175
Y	31.6	30.2	7.47	37.0	37.2	20.3
Zr	34.8	47.2	50.9	77.5	35.6	90.3
Nb	1.86	3.10	11.0	3.48	3.11	2.90
Mo	—	—	1.48	—	—	—
Ag	0.0221	0.0248	0.0310	0.0338	0.0198	0.0421
Cd	0.0256	0.0308	0.0273	0.0415	0.0270	0.0281
Sn	1.01	0.793	—	1.76	1.11	0.640
Sb	0.266	0.168	0.184	0.0605	0.0857	0.0954
Te	0.0016	0.0047	0.0099	0.0034	0.0035	0.0023
Cs	0.443	0.819	0.423	1.17	0.144	0.540
Ba	35.2	102	28.7	74.0	25.5	75.3
La	2.60	6.31	11.7	5.78	2.29	8.41
Ce	7.44	16.5	25.4	15.8	8.12	18.1
Pr	1.34	2.58	3.38	2.42	1.60	2.36
Nd	7.74	12.6	14.4	11.6	9.60	10.1
Sm	3.08	3.92	2.98	3.92	3.95	2.58
Eu	1.05	1.20	1.17	1.20	1.25	0.834
Eu	1.10	1.25	1.23	1.28	1.29	0.860
Gd	4.05	4.44	2.62	4.95	5.06	2.96
Tb	0.746	0.754	0.294	0.874	0.929	0.461
Gd	4.53	4.75	2.41	5.38	5.67	2.96
Dy	5.43	5.21	1.48	6.26	6.68	3.13
Ho	1.21	1.14	0.301	1.38	1.46	0.703
Er	3.21	3.07	0.790	3.78	3.81	2.00
Tm	0.465	0.463	0.113	0.554	0.539	0.319
Yb	2.88	2.87	0.770	3.46	3.25	2.17
Lu	0.428	0.428	0.125	0.513	0.466	0.357
Hf	1.31	1.74	1.32	2.39	1.47	2.63
Ta	0.0039	0.0062	0.0211	0.0086	0.0063	0.0096
W	0.127	0.141	0.307	0.231	0.118	0.0537
Tl	0.226	0.374	0.123	0.355	0.0802	0.149
Pb	2.40	2.67	2.56	1.85	1.33	3.76
Th	0.360	1.15	1.08	1.05	0.118	2.38
U	0.124	0.310	0.309	0.425	0.0518	0.716

Gabbro - 6025, 6906, 6912, 6092; gabbro-pegmatite - 6056 and 6913. Analytical researches were conducted in the Laboratory of Geological Researches of National Chung-Cheng University, Taiwan.

According to Th/Nb/Y ratio the Jalovchat intrusive corresponds to the field of depleted mantle, but by Sm/Y-Ce/Sm – to the MORB area (Fig. 10).

Th/Y and Nb/Y ratios correspond to the MORB composition, Th/Yb-Ta/Yb and La/Nb-Ti ratios – to N MORB, and Rb/Y and N/Y correspond to the lower crust formations. Though, on Ce/Pb-Ce and Nb/Th-Nb diagrams the figures occupy the field of primitive mantle.

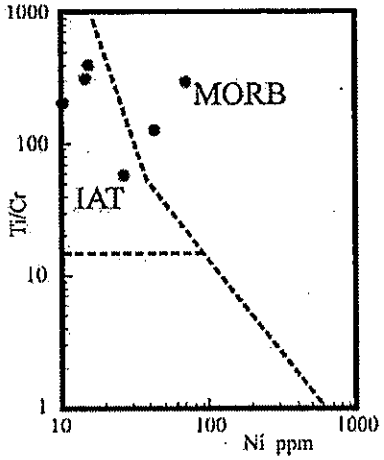

Fig. 7 IAT and MORB [6]

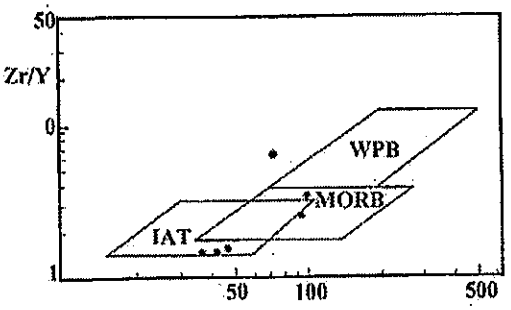

Fig. 8 IAT (island-arc tholeiites), MORB and WPB (within-plate basalts) [5]

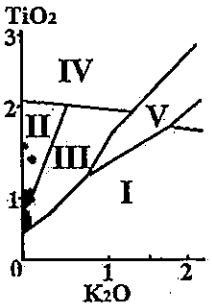

Fig. 9 Arrangement of spots of the Jalovchat intrusive rocks on K_2O/TiO_2 diagram. I – island-arc basalts; II – normal tholeiitic basalts of mid-oceanic ridges; III – enriched basalts of mid-oceanic ridges; IV – within-plate basalts; V – basalts of platform activation zones [6]

Spidergramms are characterized by almost horizontal trend, weakly expressed Eu minimums and by a slight depletion of light REE (Fig. 11).

A comparison of the spidergrams shows, that tholeiitic basalts of the Jalovachat intrusive are more depleted in light REE elements than the archaic tholeiitic basalts [7].

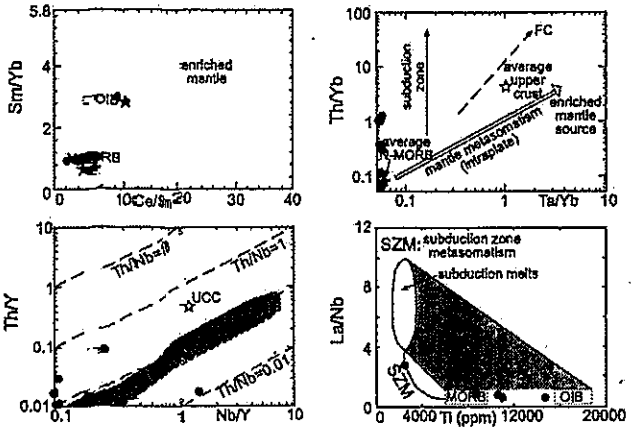

Fig. 10 Arrangement of spots of the Jalovchat intrusive rocks on Sm/Yb-Ce/Sm, Th/Y-Nb/Y, Th/Yb-Ta/Yb and La/Nb-Ti diagrams

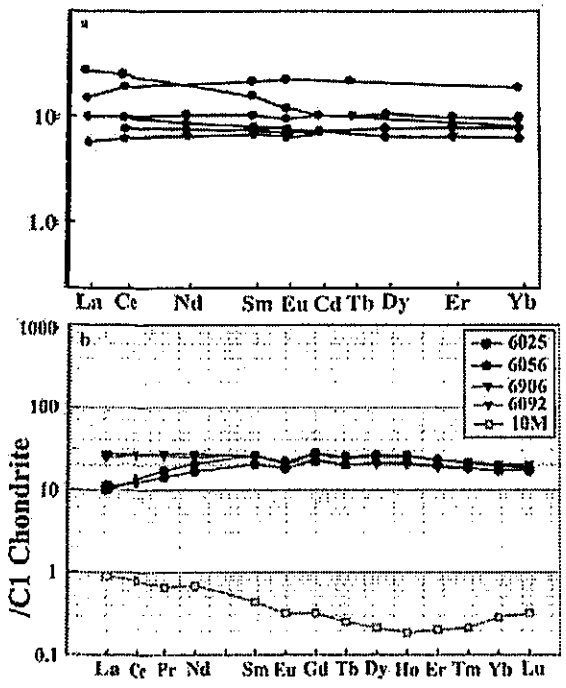

Fig. 11 (a) spidergram of REE distribution for the tholeiitic basalts [7]; (b) spidergram of REE distribution in the Jalovchat intrusive

According to above diagrams perto-geochemical characteristics of the Jalovchat gabbroic intrusive predominantly correspond to MORB. Generally, it is an anomalous phenomenon, as giant prysmatic gabbro-pegmatites are not indicated in the well-known "ophiolitic" section. For the crystallization of hornblende and especially of its gigantic crystals water-rich magma reservoir was needed; The authors believe that in the Jalovchat intrusive the existence of such magma reservoir was conditioned by melting of water-rich MORB rocks during the subduction process in Bajocian time. This event is presented by the authors on the scheme of the palinspastic reconstruction of the Caucasian segment of the Mediterranean (Fig.12).

IV. Conclusions

The above diagrams of petrogenic elements, RE and REE show that perto-geochemical characteristics of the Jalovchat gabbroic intrusive predominantly correspond to MORB. The authors consider that the existence of these rocks within the area of the Caucasian marginal sea (contemporary area of the Caucasian Main Range Zone) was conditioned by drawing down of water-rich MORB type rocks to the deeper horizons, by its melting, formation of magma chamber and finally by its intrusion into the Earth's crust during Bajocian time. Correspondlingly the Jalovchat intrusive belongs to the subduction geodynamic type.

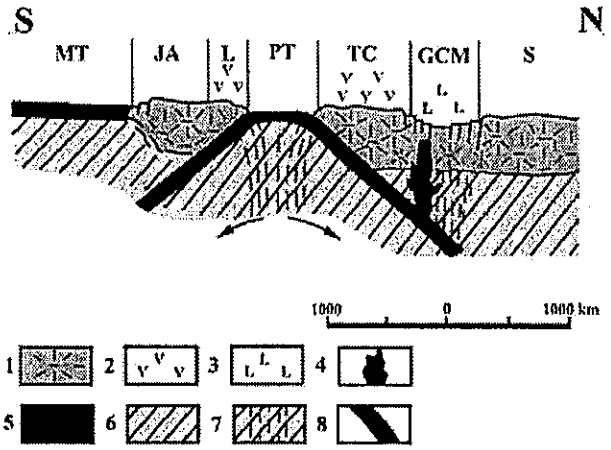

Fig. 12 Palinspastic reconstruction of the Caucasus segment of the Mediterranean belt along N-S profile for Jurassic time [8] with the authors additions:1 – consolidated continental crust; 2-3 – manifestation of volcanism: 2 – calc-alkaline, 3 – basaltic, 4 – gabbro of the Jalovchat intrusive; 5 – newly formed oceanic crust and ophiolites; 6 – upper mantle; 7 – heated upper mantle; 8 – subduction zones; Oceanic areas and small sedimentary basins: PT – Paleotethys, MT – Mesotethys (Neotethys), GCM – Greater Caucasus marginal sea. Continental plates and microplates: TC – Transcaucasian island arc, L – Lock-Karabach Zone, S – Scythian Plate, JA – Iran-Afghanian Plate

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Literature Survey of Local Energy Systems: Prime Movers, Energy Storage Systems, Renewable Energy, Modelling, and Control System Methods

Ameer Al-Kaykhan*, Professor John M Counsell , Dr. Matt J Stewart, Dr. Y. Khalid, Nassier A. Nassir**

Electronics and Electrical Engineering Department

University of Chester, UK

*PhD student at University of Chester and faculty of engineering at Al-Qadisiyah University, Iraq

** Lecturer in the department of materials engineering/university of technology, Baghdad, Iraq.

N.A.N.Almtteri@liv.ac.uk

Abstract: In mitigation, the UK's 2020 and 2030 climate change targets encourage increased efficiency of electricity generating technologies but the challenge for the sector is to deliver low carbon solutions at a viable cost.

Traditionally, colder climates including the UK, use natural gas as fuel to provide heating and hot water services as well as electricity supplied from centralised generators via the grid. However, Rather than limit local zero carbon renewable capacity and an alternative solution is to create and actively manage local energy systems. This would include a high saturation of local renewables, complemented by a Combined Heat and Power (CHP) plant at its heart.

CHP plants generate electricity for local use. Making use of by-product heat can increase CHP efficiency to well over 80% compared to conventional generation and grid supplies of less than 30% . Non-industrial local energy systems featuring CHP are suited to many different types of buildings and clusters such as hospitals, public buildings, schools, colleges and university campuses, residential complexes and private sector buildings. Regarding CHP-based Local Energy Systems (LES), increased efficiency translates into reduced carbon emissions, increased local energy security, and greater control over local energy prices. CHP-LES is also a viable solution for remote areas and can operate in island mode. This paper present, intensive lerature review for local energy systems and its components (CHP engines,electrical storage, heat storage, renewable energy, modeling) plus to the local energy system control methods and local energy system optimistions methods as well. As this article conclude there is a big gab in control methedoloy for a CHPV systems and more system modeling to give more information about Co2 emissions, electrical load tracking, heat energy tracking, gas consumbtion, exporting and importing with National Grid .... Etc.

key words: CHP engines,electrical storage, heat storage, renewable energy, modeling, control systems and optimistions methods

I. Introduction

There are many challenges associated with LES which need to be addressed. These challenges vary depending on the type of local energy system, its design and method of operation. However, there some common challenges to all systems:

- Large, relatively fast, out of phase fluctuations in local thermal and electrical demand by hour, day and season, characteristic of non-industrial consumers.
- Increased uncertainty in the magnitude of electrical power available via local renewable generation.
- How to control a local energy system, prime movers and energy storage in such a stochastic operating environment, constitute the most significant challenges. Feedback control methods allow superior dynamic control and the management of sudden large swings in energy supply and demand.
- Other non-technical challenges include regulatory and licensing constraints and capital financing.

II. Environmental reflections

The increase in efficiency of CHP over conventional generation can result in a reduction in emissions. The carbon intensity of natural gas is fixed and results in around 56.1g CO2e per MJ using a gas boiler. The carbon intensity of electricity however, is not fixed and depends on the respective capacities of the various fossil and other plant generation systems at any given time. Each plant performs a function in the grid; hydro stations have wide bandwidth, fast response and low carbon but expensive and usually kept in reserve for sudden changes in supply or demand or to dynamically fine-tune network frequency and power balance. Coal plants have low bandwidth and thus are slower to respond. They are cheaper than hydro stations but have high carbon emissions. Traditionally, coal plants provide additional winter baseloads. Combined cycle gas turbines (CCGT) lie somewhere between, being responsive enough to follow demand under normal conditions and having lower carbon emissions than coal but still cheap enough for bulk generation. Nuclear plants have no response and cannot follow demand meaning they are used for baseload generation.

The fuel mix and associated carbon emissions are therefore variable throughout the day and by season.
In the UK in 2016, DEFRA put the annual average carbon value attributed to supply and use of 1kWh of electricity as 0.4kgCO2e/kWh.
There are many elements which could be added to any LES to increase energy efficiency. An increase in efficiency could reduce the amount of Greenhouse Emissions (GHE) and operational costs; for example, the reduction of energy consumption (REC). A reduction in energy consumption is defined as using less energy to provide the same service. This results in fewer electrical losses, less CO2 emissions and a reduction in costs. The Committee for Climate Change (CCC) has estimated that a reduction in energy consumption and subsequent energy demand could save 17 million tons of CO2 per year [20].
Many non-domestic buildings can reduce up to 25% of their demands on energy by following some simple steps:

- Reduce heating and cooling energy demands to the lowest levels for any building by increasing building insulation and installing high quality, double glazed windows.
- The use of efficient and low powered equipment and appliances, for example replacing traditional light bulbs with LED lighting and using IT and ICT (information and communication technology) equipment.
- Improve ventilation and cooling systems.
- Integrate renewable energy (RWE) with LES.

Regarding the need to minimise CO2 emissions and GHE, renewable energy sources are one of the best approaches to tackle this problem and make significant improvements. RWE and LES for residential households could reduce pollution by between 21-62%, depending on the type and scale of RWE [21].
Effective RWE is not limited to creating positive environmental impacts but also effects the economy by reducing operational costs; RWE does not need fuel but only maintenance. There are different types of renewable energy sources of various size and energy production capacity. Regarding LES, there are two popular types which are widely used because they are easy to install and use:
Wind energy (WE): Wind generator systems convert wind energy into electrical power. WE is one of several promising and efficient types of RWE sources especially when it is integrated with CHP technology. This combination increases its efficiency and reliability by filling energy gap and reducing electrical energy demands, while reducing overall operational costs. Wind energy reduces total costs by up to 20% by supplying electricity through the use of wind turbines [22].
Photovoltaics (PV): This type of technology works to convert sunlight into electricity. PV technology is useful not only for the generation of electrical power but also solar thermal power generation for heating or cooling [26]. PV panels are found to operate up to 75-80% efficiency and supply more than 25% of the electrical power required in addition to 55% of thermal energy leading to a reduction in operational costs by approximately 30% [23,24].
However, the use of renewable energy sources presents challenges and has limitations. They are dependent on the weather and so cannot guarantee to work all the time. Windy or cloudy weather will reduce PV efficiency by up to 50%. In addition, all RES systems require continuous maintenance to keep them working properly.
Finally, one of the biggest technical challenges is integrating the (RWE) with (LES) and for optimum results while reducing the power curtailment especially unexpected curtailment. [25].

III. Energy storage systems (ESS)

Energy storage systems are an important element in any LES as they control and increase the efficiency and reliability of the system, at the same time minimising CO2 emissions. Many designers and companies use ESS to manage and schedule their power use. For example, a decrease in peak energy demand by using saved excess energy and supplying it when required will result reduced costs. There are two types of ESS thermal and electrical storage.

- **Thermal Heat Storage (THS)**

Thermal Heat Storage is used to store excess heat from the CHP engine. This heat is then pumped back into the system, or hot water network (HWN), when the system is short of heat energy or when the system needs more heat to meet energy demand at peak times, thus reducing the cost and CO2 emissions [28]. The Hot Water Network (HWN) is the network, or system of pipes, full of water which distribute the heat generated by the heating system.
Adding THS to LES gives the system more flexibility in that it can operate continuously with less switching on and off of the CHP engine in comparison with a local energy system (LES) working without a control system or working by only responding to energy demand. The CHP engine can then work for a longer time and generate more electricity and heat simultaneously, allowing the system to be more economic. There are also less CO2 emissions by reducing the amount of electricity imported from the National Grid, by burning fuel only for heating [27,29,30].
One of most important features of THS is its size as having a THS of the appropriate size in a local energy system can reduce operating costs by up to 6% [22]. Most designers do not recommend very large thermal storage for different reasons including construction costs and the cost of an insurance licence. Loss of heat to the environment (about 1% every hour) makes it less beneficial and efficient.
Smaller thermal storage facilities are flexible and more effective such as the system in [29] where it was recommended that the THS be no more than 25% of total heat production in the LES. Attention must also be paid to the hot water network (HWN) as it distributes enough heat energy to meet local demand; i.e. its' size is also important.

- **Electrical energy storage (EES)**

This type of storage works as a bank to store excess electrical power, returning it to the system when there is a deficit. Electrical energy storage is very effective when paired with CHP technology so that the system is operated to a schedule or is off-grid. When EES satisfies high or unexpected variations in electrical demands, this makes all local energy systems more efficient and economical [31].

Chen and Roskilly 2012 [32], demonstrated that EES can increase the total efficiency of a system up to 47.86% compared to conventional CHP. They also illustrated additional advantages when integrating EES with (CHP) technology such as reduced capital costs compared to renewable energy technology.

In common with THS, one of the biggest challenges for EES is size; if the system is larger than needed, it becomes more expensive and less effective. Choosing the correct size can substantially reduce the amount of electricity which needs to be exported. However, EES have economic advantages as they reduce the amount of electricity sold to the national grid at much reduced price, storing it instead until needed. At the same time, there are technical issue which are another benefit of EES, reducing exportation and importation of power from the national grid. While there are many different types of electrical energy storage systems, all involve high capital costs. The constant charging and discharging of the battery also reduces their lifespan [33,89,48].

IV. Prime movers

The prime mover is the heart of any combined heat cooling and power system providing its primary energy. There are many different types of prime mover engines, each having advantages and disadvantages making them suitable for use in different situations.

There are two categories of CHP engine; combustion-based technologies such as reciprocating engines, Stirling engines, gas turbines and Rankine cycle engines, and electromechanical based technologies for example, fuel cells [1]. This section will evaluate and compare the common prime movers currently available in the market, as summarised in table [2].

- **Reciprocating internal combustion engines (RICE)**

A reciprocating engine is one of most popular technologies in use for CHP systems, also known as a piston or IC engine. This type of engine converts pressure to a rotational motion, using a piston placed in a cylinder, where chemical reactions resulting from fuel combustion take place. There are two types of internal combustion engine. The first is a spark engine which can use many different types of fuel such as natural gas, propane, gasoline and landfill gas. The second is a compression ignition engine which uses diesel fuel or heavy oil [2]. RICE are acknowledged as having many advantages such as ready availability in the market, low cost, a good response with variable loads, exceptional efficiency, part load flexibility and a very short start up time. However, RICE also produce high emissions, excessive noise, much mechanical vibration and need regular maintenance [4].

- **Gas turbines (GT)**

This type of engine is a well-established technology, especially in large scale power generation because it is highly power efficient, between 70 and 90% [4]. GT's have a flexible design which works well with a wide range of local energy systems and are typically low maintenance. They have a highly efficient engine comparator which is cost effective, generating electricity and heat in parallel (36% efficiency). It has a quick response to fluctuations in electricity demand which makes it more reliable and more effective than LES. Nevertheless, limitations include the need for a high-quality fuel e.g. diesel. It can also be inefficient with a poor economic performance under part loading.

Regarding greenhouse emissions, a gas turbine can dramatically reduce CO2 and NOx emissions per kilowatt-hour.

- **Stirling engines (SE)**

The Stirling engine is a reciprocating engine with a closed cylinder and separate combustion chamber. There are two types of Stirling engine, namely the Kinematic Stirling engine and the Free-Piston Stirling engine. These types of engine can run on almost any kind of fuel, such as gasoline and natural gas. Importantly, SEs can also be run on renewable energy e.g. solar PV, meaning that SE's can have very low greenhouse emissions.

However, SE's present several challenges in operation such as low specification power output when compared with the same size IC engine. Other drawbacks include high capital costs and poor weight to power ratio [1,2,5,6,7].

- **Fuel cells (FCs)**

Fuel cell engines convert electrochemical energy to electrical power through a chemical reaction with oxygen and oxidizing agents. FC engines usually have three primary components, the first being the reformer which extracts hydrogen from gaseous fuel. The second is the fuel cell stack which is an electrolyte material placed between oppositely charged electrodes, the last being the inverter, the

function of which is to convert DC electrical power output from the stack to AC electrical power.
The engine generating power methodology is very similar to that of producing DC power by electrochemical processes. Because of this, FC's are considered as the cleanest method to generate electricity. FC engines are also one of the more reliable engines because of fewer moving parts and constant power production.

One of the important problems with the FC engine is that although it is highly efficient, reaching approximately 55%, this target is sometimes impossible to attain because of the amount of heat produced. It also has high initial capital and ongoing costs. On the positive side, it has low operating costs and is highly efficient over a range of loads. While FCs also have a low environmental impact with respect to greenhouse emissions, this type of technology is in need of more development [2,3,4,8,9,10,11,12].

- **Organic Rankine Cycles (ORC).**
There are two main types of ORC systems: a steam Rankine system using water as the working fluid, and an organic Rankine system working with organic fluid. ORC engines have many advantages including high flexibility and durability, cost effectiveness and low operational temperature and pressure. Their simplicity and proven levels of safety make them highly rated. Organic Rankine cycle engines can use heat from many different sources for example sources of low temperature energy including waste water, biomass and solar thermal energy. In contrast, the organic Rankine system has very low efficiency with reference to electricity, having an average efficiency between 6% to 19%. On the other hand, it is highly efficient in winter. [1,3,13,14,15,18,19].

V. Local energy system technology: Reliability and Availability when paired with CHP

Every local energy system must address issues around reliability and availability. There is the need to ensure that the system will operate continuously and supply energy when required while still achieving the best economic and environment results.

The following section reports on the reliability and availability for a system working with CHP technology across three different research papers:

- In [34], th
- e researchers used the state-space method (SSM) and the Markov model to calculate the reliability and availability of a CHP system suppling power and energy to a building, comparing these results to a separation production system (SP). They found that the systems' reliability was 99.63% for electricity, 94.30% for heating and 99.97% for cooling.
- Reza and Manbachi [36] also used state-space and Markov methods to test system reliability in 3 different user-cases (Island, Standby and Parallel), the results in Table [1] :

Table 1: Reliability in case studies

case	R electrical	R thermal
island	95.6662%	98.221%
standby	99.6301%	98.8221%
parallel	99.6395%	98.8221%

The results above were calculated when the hot-water network reliability was assumed at 100%. However, they show the HWN reliability at 94% meaning a decrease in CHP thermal reliability of 6% in each case. The thermal reliability with HWN is 92.8928%, 92.8928% and 92.8928% for Island, Standby and Parallel, respectively.

- The UK government produced a report on CHP technology in 2015 [35]. The reliability and availability section shows that CHP systems have to have 94.95% guaranteed reliability and 90.21% guaranteed availability for 8760 hours. The formulae below explains how reliability and availability were calculated:
Reliability = T – (S+U) / T – S *100%
Availability = T – (S+U) / T *100%
where:
S = maintenance schedule (hours / year).
U = unscheduled shutdown (hours / year).
T = the time planet working and suppling energy (hours / year).
The report also recommends the maximum time schedule required for maintenance is 438 hours per year while the shutdown schedule is 420 hours per year.

Table 2: comparation of prime movers

	Low capital cost. Rapid start.	Regular maintenance. Loud noise. Very high emission rates.	Up to 650

	Good response with load fluctuations. High reliability.		Up to 10
	High efficiency and cost effective. Quick response to load fluctuations. Low maintenance costs.	Inefficient with part loads. Economically poor for small scale use. Needs high quality fuel. Elevated noise levels.	580-720 0.1-0.5
	Safe with low noise. Low maintenance requirements. Easy to control.	Poor weight to power ratio. Expensive materials. Long time needed to start up.	672 0.23
	Low operation costs. Low environmental impact. Low noise levels. High efficiency levels. High reliability.	Very high capital costs. Requires hydrogen for storage.	430-490 0.005-0.01
	High flexibility and simple design. Low operational pressure and temperature. Wide range of fuel.	Low electrical efficiency.	Depends on fuel

VI. *Local Energy Control systems*

This section will review the background literature, identifying the latest technology available to provide a rationale for the current research: the control and operation of local energy systems (LES) using CHP technology.

➢ Operation strategies for a local energy system using CHP technology

Operation strategies are defined as the way of operating a local energy system, or a building, with CHP technology, controlling the flow of thermal and electrical energy from the CHP engine and inside the LES. The main aim of controlling a LES with a CHP engine is to achieve a specific beneficial target such as minimal operational costs, a reduction in carbon emissions, minimising the amount of energy imported from the National Grid or an increase in efficiency. However, many CHP and micro-CHP systems are limited due the prime mover and balance of the LES [31]. Operation strategies can be divided into two main categories: conventional and non-conventional.

➢ Conventional Operation Strategies (COS):

Conventional operation strategies for LES or CHP systems are relatively straight forward and easily implemented, controlled through conventional techniques. This type of COS focuses on a specific benefit for either electricity or heat or both [37,38]. There are many different types of COS as detailed below.

➢ Heat Lead Operation Strategy (HLOS):

The main aim of this strategy is operating the CHP engine to meet the heat demands of a system or a building. If there is any deficit, it will be met by other sources of heat, e.g. a gas boiler [39,40]. The amount of electricity generated will supply the system or be exported to the National Grid [41]. But it is not guaranteed that the National Grid will be able to absorb a cumulative amount of excess electricity which means that some amount will have to be wasted to keep the control system operational [42,43,44]. This system operation is not effective in summer because there is not enough demand for heat from the system. HLOS usually use Stirling engines based on CHP technology because of its high heat to electrical power ratio [45,41,37].

➢ Electricity-Led Operation Strategy (ELOS):

This type of operation strategy aims to meet the maximum demand for electricity by the local energy system or consumers [46,41]. If there is a shortage in the supply, this will be fulfilled be another power supplier [47]. The ELOS needs to be integrated with a form of energy storage, thermal energy storage or electrical storage, to store heat energy or electricity generated by CHP engine when there is no heat demand, re-pumping it back into the system when the CHP engine does not meet the heat demand [39]. This strategy is based on use of a full-cell CHP engine because the heat ratio is lower than the electricity ratio [31].

➢ Reducing Emission Operation Strategy (REOS):

This is a new strategy which has been developed because of international concerns regarding climate change and emissions [50]. The CHP system operates to minimize emissions regardless of operational costs or other conditions. The decision to operate the CHP system or import electricity from the National Grid to meet the scheduled amount of heat and electrical energy required by the local energy system is dependent on estimated CO2 emissions. Gas emissions are estimated according to the emission factor when burning fuel to its output. The ratio for the emission is:

ER = EP1/EP2

Where, EP1 represents the pollution emitted by the building when using an external energy source, EP2 the amount of pollution from the same building or system when using CHP technology. If ER is equal or greater than 1, the CHP system should keep operating otherwise the system will shut down and use another source of energy or import energy from the National Grid [37].

VII. Non-conventional Operation Strategy:

The main aim of this type of operating strategy is to search for the optimal, or near optimal, strategy for the system at different periods which could be in terms of carbon

emissions, operating costs or efficiency of energy use [51]. Non-conventional operational strategies for energy systems are classified into two types:

- **Operational strategy based on optimization:**

System operation optimization techniques use a fixed demand profile so that a global optimal solution can be determined [52]. This type of optimisation works to find the best solution available. There are various ways to apply optimization techniques including dynamic programming (DP), linear programming (LP) and non-linear programming (NLP). DP is a very effective method for offline system operational strategies but not as suitable for micro combined heat and power systems; LP working with linearization of relationship is more suitable for this. NLP works with more complicated maths e.g. non-linear equations, but is slower [54, 55, 37, 56]. There are also many popular optimization technique methods for example, like Genetic Algorithm, Evolutionary Programming, Particle Swarm Optimization, Grey Wolf optimization, Fuzzy optimization and Gradient Techniques [53, 54, 57, 58, 59, 60, 61, 62]. Some researchers have tried new methods and algorithms to optimize schedules for example, Wang [64] used the Kuhn-Tucker Algorithm while Maruichi [65] used the logic Token-Ring model to reduce operation costs. Regardless of method, the optimum solution will be guaranteed if the optimization curve is convex. In convex optimization problems, the choice of optimization method will be influenced by computation time, case of implementation and possibly aim constraints. That said, solving non-convex optimization problems is more complex. The poetization method is very important because it needs a specific type of optimizer to match the problem and find the best results for it [54]. Choice of an optimizer or an algorithm may affect the results and quality of the solution, for instance Wang et al. [66] proved the optimal solution using a Particle Swarm technique, getting better results by about 1% in comparison to using a genetic algorithm.

VIII. A specific control system:

Very few researchers have tried to find a specific control strategy to control a local energy system based on CHP technology. Such a method of control could manage and optimize the system without demand scheduling or guessing the amount of energy produced by renewable energy and could deal with any unexpected disturbance load or amount of energy generated. This controller should follow the set points or instructions it has been given to achieve the best results from the CHP system and local energy system.

Brinkmann and Viedenz [67] designed a practical control box for a hybrid system consisting of a PV-plant linked to a steam engine for combined heat and power, as a self-sufficient energy supply for domestic buildings which allows the best possible use of renewable energy. The control box works with a μ-Controller. Karmacharya [31] used a Fuzzy logic control method for a micro-combined heat and power system to manage the energy generated by the engine and supplied to the distribution network. Zhang [68] developed a multivariable control system for a waste heat recovery system, operating on an Organic Rankine Cycle (ORC), using a generalized predictive control strategy (GPC). This type of control is suitable for a micro CHP system working with an Organic Rankine Cycle (ORC). Allison and Counsell [69] used a multi-input multi-output (MIMO) feedback control strategy to control a CHP system with renewable energy sources and energy storage. They used a multi-input multi-output (MIMO) based inverse dynamics control strategy, with CHP technology, to minimize imports from the national grid to the building. Finally, Allison [70] developed a robust, non-linear, multi-input-multi-output (MIMO) controller for micro-CHP systems. An inverse dynamics theory was applied as the main method to control the energy system, at the same time using PD and PDF control algorithms to compare them and to find the best approach. The local energy system model consisted of a micro-CHP unit, solar PV and battery storage integrated with single building single zone. The main aim of his research was to minimise electrical grid utilisation and fulfil the thermal energy demand. This research work is summarised as follows:

The control system has two sources of input; amount of gas injected to the CHP engine and a battery, and two outputs; building temperature and local electrical grid. The system is thermal led. The air temperature was controlled inside one zone on one cold bright day (24 hours).He compared 3 control algorithms, NI, PDF and PD, to identify the best approach.

The controller showed that only NI and PDF algorithms are able to control the system; PD does not work. Secondly, if the battery losses its power, the system cannot be controlled. The results are only applicable for one, 24 hour period in winter capturing daily and seasonal energy demand and reveal that there was a shortage in the supply of heat and no other heat source to recover the shortage.

IX. Modelling of CHP systems with local energy demand, energy thermal storage and renewable energy:

Modelling CHP systems has received much attention but mainly with reference to proton exchanger membrane fuel cells [71,72,73], solid oxide fuel cells [74] and reciprocating Joule-cycle engines [75].

Some models however, used different CHP and micro-CHP technology to examine CO2 emissions and cost [76,77,41,82,49]. Lombardi for example, presented details of a semi-empirical dynamic model for a domestic scale micro-CHP Stirling engine [78]. Some researchers have modelled CHP systems with heat storage to show how much this impacts on system efficiency and emissions [79, 80, 81, 83, 85]. At the same time, there has been a reasonable amount of attention paid to renewable energy with micro-CHP technology, specifically with Photovoltaics, because it is suitable for use in residential areas. Renewable energy sources help the system to reduce fuel consumption leading to a reduction in CO2 emissions and cost [26, 21, 24, 84, 23].

Very few researchers have worked on dynamic simulation models, specifically focusing on the detailed dynamic response to local heating and electricity demand, to consider environmental conditions and controlling the temperature inside plants or zones. Drer and Weber designed simulation models to compare two types of fuel cells [86]. Onovwiona, Ugursal and Fung used a simulation program called TRNSYS to simulate an internal combustion engine and Stirling engine based on micro-CHP systems to demotic scale [63]. However, the majority of models are designed to examine micro-CHP for dwellings and residential houses; not enough attention is given to CHP design with multi-zones which can respond to many zones or building energy demands simultaneously. Furthermore, no attention has been paid to system energy balance modelling components and sub-systems. For example, controlling the temperature inside the building is a big problem because most operators and designers do not have a specific method to control temperatures inside zones. In addition, there is a lack of research on small but very important details which impact on heat demand e.g. number of people inside the building, amount of glazing in the building, single or double glazing, building ventilation, amount of heat generated by appliances, building structure, type of wall and construction material and furniture. These parameters impact substantially on the temperature inside the building and the amount of heat required to give the desired temperature to keep residents comfortable. There are also very few models that can export or import from/to the with National Grid at a set point or when the system requires energy in an emergency.

Most simulations models collect data at time intervals of less than 15 minutes [31] which is enough to capture daily and seasonal energy demands and the system performance. However, these fail to capture smaller effects such as the dynamic relationship between local energy demand and the local electrical grid.

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Textile-Based Sensing System for Sleep Apnea Detection

Mary S. Ruppert-Stroescu, Minh Pham, Bruce Benjamin

***Abstract*—**Sleep apnea is a condition where a person stops breathing and can lead to cardiovascular disease, hypertension, and stroke. In the United States, approximately forty percent of overnight sleep apnea detection tests are cancelled. The purpose of this study was to develop a textile-based sensing system that acquires biometric signals relevant to cardiovascular health, to transmit them wirelesly to a computer, and to quantitatively assess the signals for sleep apnea detection. Patient interviews, literature review and market analysis defined a need for a device that ubiquitously integrated into the patient's lifestyle. A multi-disciplinary research team of biomedical scientists, apparel designers, and computer engineers collaborated to design a textile-based sensing system that gathers EKG, Sp02, and respiration, then wirelessly transmits the signals to a computer in real time.

The electronic components were assembled from existing hardware, the Health Kit which came pre-set with EKG and Sp02 sensors. The respiration belt was purchased separately and its electronics were built and integrated into the Health Kit mother board. Analog ECG signals were amplified and transmitted to the Arduino™ board where the signal was converted from analog into digital. By using textile electrodes, ECG lead-II was collected and it reflected the electrical activity of the heart. Signals were collected when the subject was in sitting position and at sampling rate of 250 Hz.

Because sleep apnea most often occurs in people with obese body types, prototypes were developed for a man's size medium, XL, and XXL. To test user acceptance and comfort, wear tests were performed on 12 subjects. Results of the wear tests indicate that the knit fabric and t-shirt-like design were acceptable from both lifestyle and comfort perspectives. The airflow signal and respiration signal sensors return good signals regardless of movement intensity. Future study includes reconfiguring the hardware to a smaller size, developing the same type of garment for the female body, and further enhancing the signal quality.

***Keywords*—**Sleep apnea, sensors, electronic textiles, wearables.

Mary Ruppert-Stroescu, Ph.D. was with Oklahoma State University, Stillwater, OK, and is now with Washington University in St. Louis, St. Louis, MO, 63112, USA (phone: 573-424-1634; e-mail: mrupper@wustl.edu).

Minh Pham, M.S. is a doctoral candidate at Oklahoma State University, Stillwater, OK, 74078, USA (phone: 415-306-4055; e-mail: minh.pham@okstate.edu).

Bruce Benjamin, Ph.D. is with with Oklahoma State University, Stillwater, OK, USA (phone: 918-561-1222, e-mail: bruce.benjamine@okstate.edu).

Surface Modification of Titanium Alloy with Laser Treatment

Nassier A. Nassir, Robert Birch, D. Rico Sierra, S. P. Edwardson, G. Dearden, Zhongwei Guan

Abstract**—** The effect of laser surface treatment parameters on the residual strength of titanium alloy have been investigated. The influence of the laser surface treatment on the bonding strength between the titanium and poly-ether-ketone-ketone (PEKK) surfaces were also evaluated and compared to those offered by titanium foils without surface treatment to optimize the laser parameters. Material characterization using an optical microscope was carried out to study the microstructure and to measure the mean roughness value of the titanium surface. The results showed that the surface roughness shows a significant dependency on the laser power parameters in which surface roughness increases with the laser power increment. Moreover, the results of the tensile tests have shown that there is no significant dropping in tensile strength for the treated samples comparing to the virgin ones. In order to optimize the laser parameter as well as the corresponding surface roughness, single-lap shear tests were conducted on pairs of the laser treated titanium stripes. The results showed that the bonding shear strength between titanium alloy and PEKK film increased with the surface roughness increment to a specific limit. After this point, it is interesting to note that there was no significant effect for the laser parameter on the bonding strength. This evidence suggests that it is not necessary to use very high power of laser to treat titanium surface to achieve a good bonding strength between titanium alloy and the PEKK film.

Keywords**—** Bonding strength, laser surface treatment, PEKK, titanium alloy.

I. Introduction

FIBRE metal laminates (FMLs) are high performance structures, developed by the Delft University of Technology. FMLs consisting of alternating stacking layers of fiber reinforced composites and metal alloy offer a great promise as fatigue resistance materials. Based on the reinforcement of the polymer composite, these laminates can be GLARE (glass reinforced metal laminate), CARALL (carbon reinforced metal laminates), and ARALL (Aramid reinforced metal laminates). GLARE FMLs are the most commonly used to manufacture the upper fuselage of the A380 Airbus aircraft [1], [2]. FMLs combine the high toughness and impact energy offered by metals and the high specific properties associated with fiber reinforced composite. It has been demonstrated that FMLs have superior in-plane tensile strength and tension fatigue properties compared to those for aluminum alloys [3]. In recent years, a number of researchers have investigated the response of aerospace fiber laminates under different load conditions[4]–[7]. The mechanical properties of FMLs of Aluminum layers and tough glass fiber reinforced polypropylene was investigated by Reyes et al[4]. Their results indicated that incorporating surface roughness on aluminum layers and inserting resin film at the interface between the aluminum and composite plies lead to increase the fracture energy of these laminates. The response of glass fiber reinforced epoxy and aluminum FMLs under low velocity impact was investigated by Jan et al.[6]. The results showed that the impact resistance of FMLs is high compared to the plain composite. The results also indicate that the specific energy absorption of FMLs can be increased by increasing the plies number of metal and composite. Titanium –based FMLs combine the advantage of titanium sheets and high temperature fiber reinforced composites. These hybrid laminates offer the good mechanical advantages of the traditional fiber metal laminates and it can be used at high temperature applications. However, the bonding strength between the titanium and the polymeric materials is still a major challenge which limit their applications and needs to be solved[8]. The literature showed that the nature of the surface treatment of titanium has a significant effect to improve the bonding strength of these hybrid laminates. In the recent years, a variety of surface treatments were conducted with different degrees of success to enhance the surface of titanium alloys prior to bonding, and these being mechanical, chemical, and electrochemical, plasma and laser surface treatment[8]. Although these pre-treatment processes showed good bonding behavior, it is not environmental friendly. Laser surface treatment demonstrates a good joining strength resulted from good surface roughness, formation of a thin oxide layer, good surface cleaning and modification. The aim of this study is to investigate the influence of the laser treatment on the titanium foils in terms of surface roughness, residual tensile strength and bonding strength.

II. Experimental Procedure

A. Manufacturing procedure

The lap shear specimens examined in this study were based on 0.14 mm thick layers of titanium 15-3-3-3-β alloy foil from TICOMP (California, USA) and A 50 μm film of PEKK (ARKEMA, France) was placed between foils of titanium alloy to ensure good bonding between the constituent materials. Prior to manufacturing, titanium alloy sheets were cut as sheet and

Nassier A. Nassir is with the School of Engineering, University of Liverpool, Liverpool L69 3GH, UK .and Department of Materials Engineering, University of technology, Baghdad, Iraq, (phone: 447417413264; e-mail: N.A.N.Almtteri@liv.ac.uk).

Robert Birch is with the School of Engineering, University of Liverpool, Liverpool L69 3GH, UK (e-mail: rsb123@liverpool.ac.uk).

D. Rico Sierra, S. P. Edwardson, G. Dearden are with Laser Engineering Group, School of Engineering, University of Liverpool, L69 3GQ, UK

Zhongwei Guan is with the School of Engineering, University of Liverpool, Liverpool L69 3GH, UK, and from School of Mechanical Engineering, Chengdu University, Chengdu 610106, China (e-mail: zguan@liverpool.ac.uk).

subjected to laser treatment to enhance the surface roughness as well as the interface bonding strength.

The testing specimens were manufactured by stacking a pair of surface treated titanium stripes which adhesively bonded using PEKK film (0.1 mm) with an overlapping area of 23 x 5 mm2 as shown in Fig. 1. Then, the samples were inserted between two metal sheets. The mold was then heated in a Meyer hydraulic hot press to 330 °C at a heating rate of about 3 C/min, maintained at this temperature for 30 min before cooling to room temperature. A pressure of 2 bars was applied to the laminates during the processing cycles.

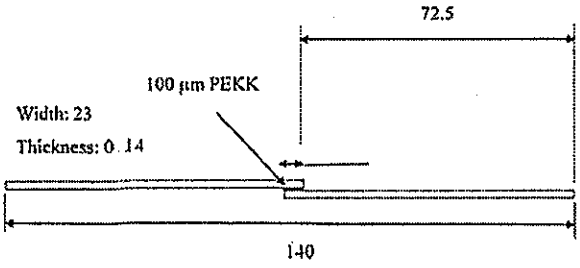


Fig. 1 Lab shear specimens (dimensions in mm)

B. Laser surface treatment

Laser pre-treatment of titanium surface was carried out using different power parameters of laser to investigate the influence of these parameters on the surface roughness, residual tensile strength of titanium alloy and metal-resin bonding strength. Firstly, titanium alloys were cut to required sizes and cleaned with acetone previously to the laser treatment. A nanosecond pulsed laser (SPI 20W G4 HS L Type), was used to modify the surface microstructure of the material. The laser pulsed system works with 1064 nm wavelength, a variable pulse width of 9 – 200 ns, 20 W of maximum output power, and a pulse repetition rate of 25 – 500 kHz. The spot size of the focused beam is 45 µm. A line pattern microstructure was created; the space between the lines was set as 29 µm. The processing area was treated with the parameters on Table 1. The parameters were used in order to create overlap between the laser pulses modifying the roughness of the surface, an example of the scanning technique is showed in the Fig. 2. After that, surface was characterized by an optical profiling system (Wyko NT1100) to measure the mean surface roughness. Fig. 3 shows the influence of laser power on the surface roughness of titanium alloy.

TABLE I
Laser treatment parameters used for titanium alloy.

Laser fluence	4.09, 4.54, 5 and 5.45 J/cm^2
Repetition Rate	70 kHz
Pulse Length	200 ns
Scan Speed	2.380 mm/s

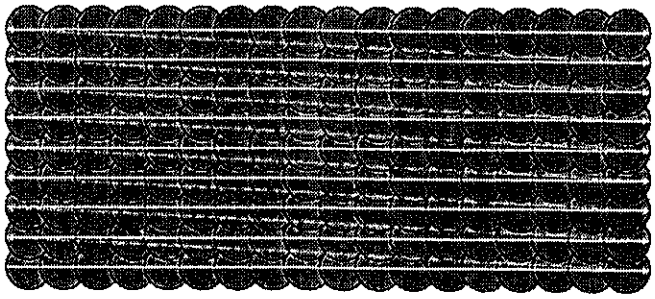


Fig.2 Scanning path of the laser, horizontal distance between pulses of 34 µm, and a vertical distance between lines of 29 µm.

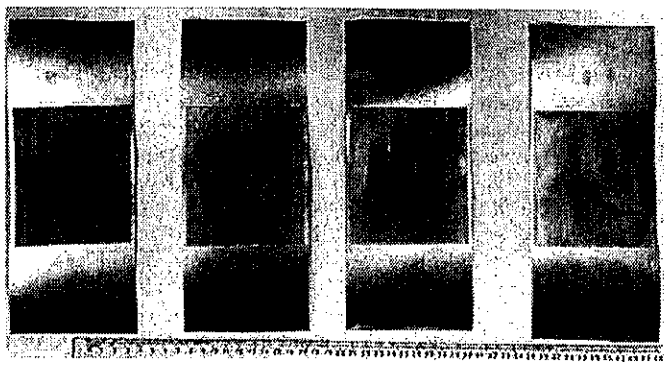


Fig.3 The effect of the parameter of the laser treatment on the surface roughness of titanium alloy.

C. Tensile test

Tensile tests were conducted to investigate the influence of laser treatment on the residual tensile strength of titanium alloy. The tests were undertaken using Intron 3369 testing machine. An extensometer with 25 mm gauge length (GL) was attached to the coupons in the middle to measure the sample displacement. The specimen's geometry and dimensions are shown in Fig. 4. Tests were undertaken at a constant crosshead speed of 0.5 mm per minute.

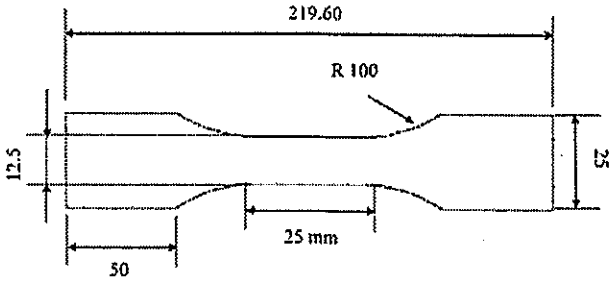


Fig.4 Specimen geometry (dimensions in mm) [9]

D. Lab shear test

Single-lab shear tests were performed to examine the shear strength between PEKK film and modified surface titanium alloy. Here, shear tests were conducted on the specimens described in Fig. 1. The maximum shear (bonding) was measured using an Instron model 3369 universal testing

machine equipped with a load cell with capacity of 50 kN, as shown in Fig. 5. The tests were carried out at a constant loading rare of 1 mm/min. Three samples were tested for each laser parameter and the average values were obtained.

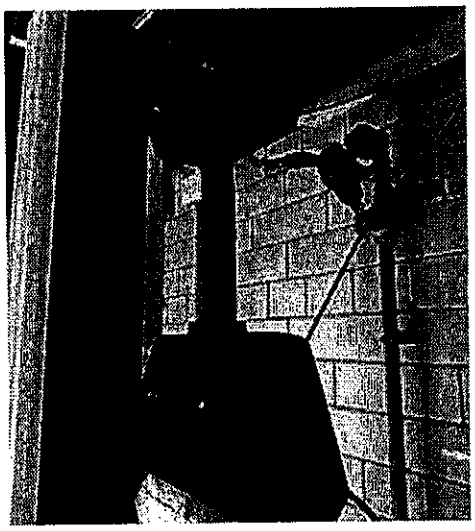


Fig.5 Single-lab shear test setup

III. RESULT AND DISCUSSION

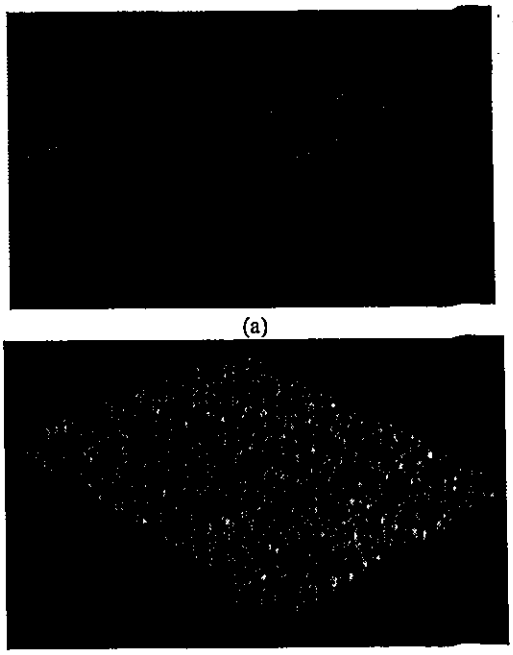
The influence of the laser treatment with various power parameters on creating rough structure on the surfaces of the titanium alloy samples was illustrated in Table 2. The figure has shown that a relatively smooth surface of 0.309 microns without hierarchical structure was observed on the as-received samples compared to 1.72 microns to those treated with laser fluence of 5.45 J/cm^2. Here, during laser process, the materials surface will be moved and removed by the laser throughout melting and evaporation, resulting significant increment of the surface roughness [10]. In the other word, the change in the surface roughness is due to the laser interaction with the material, this creates a microstructure with material removed due to the laser ablation and the re-deposition of the molten material due to the thermal component of the nanosecond pulse. The melting of the material creates a structure in the borders of the spot size helping to increase the roughness of the material. Increasing the fluence on the laser increases the ablation rate and the amount of molten material in the surface.

TABLE II

Mean roughness of titanium surface against laser fluence.

Laser fluence (J/cm^2)	Mean Roughness (μm)
Untreated Surface	0.309
4.09	1.19
4.54	1.43
5	1.63
5.45	1.72

The measurement of the surface roughness was performed on separate specimens for each laser power parameters to characterize the surface texture of pristine titanium foils and after laser treatment using different parameters of laser fluence. Fig. 6 shows the three dimension (3D) profile of titanium foils treated under different laser power parameters. Clearly, Different rates of laser power led to different roughness on these sample surfaces. Here, higher laser power let to coarser texture on the sample surface compared to as –received one. As mentioned previously with increasing the laser power, the material removal and the depth of the micro pits increased.



(a)

(b)

Fig.6 3D profile of a titanium surface under different power parameters, (a) as received surface, (b) surface treated with laser fluence of 4.54 J/cm^2.

The next part of this study was to investigate the influence of the laser surface roughness on the residual strength of the titanium alloy. Here, tensile tests were undertaken on titanium (0.14 mm thick) foils treated with various laser fluence of 0, 4.09, 4.54, 5 and 5.45 J/cm^2. Here, zero value correspond to the virgin specimens. Fig. 7 shows the variation of the tensile strength as a function of the surface roughness. An examination of this bar chart indicates that the tensile strength values are varying between 1122 MPa for untreated specimens with surface roughness of 0.309 micrometers and 1069 MPa for specimens with roughness of 1.72 micrometers. The evidence presented in Fig. 7 indicates that there is no significant change in tensile strength after laser treatment. This is a useful observation, suggesting that laser treatment parameters can be optimized based on better bonding strength between modified titanium alloy and PEKK film.

Fig. 8 shows the variation of the metal-resin bonding strength with surface roughness at different laser power parameters. Clearly, the curve can be divided into two regions, i.e. the linear proportional one (I) in which the bonding strength between the titanium alloy and PEKK film increased with increasing the surface roughness increment to a specific roughness due to formation of the microporous structure on the treated surface

which filled with the resin resulting good metal-resin bonding strength. After this point, it is interesting to note that there is no significant effect for the laser power parameters on the bonding strength (II). The above results suggest that the surface treatment with laser influence of 4.54 J/cm^2 seems to be an optimum parameter in which good bonding strength can be achieved. Therefore, this parameter will be used to treat all the titanium foils investigated in this study.

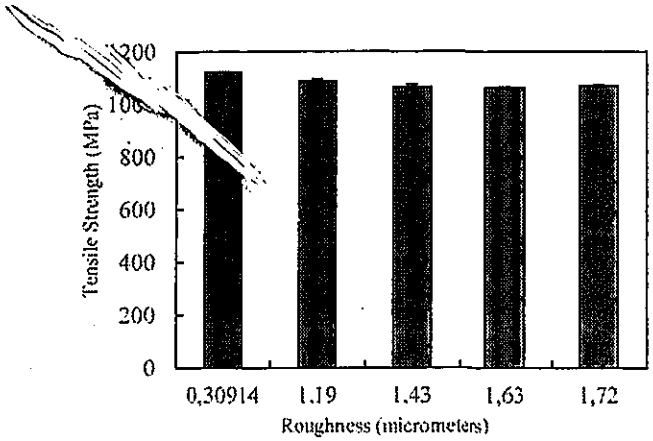


Fig.7 Surface roughness versus tensile strength of titanium alloy foils.

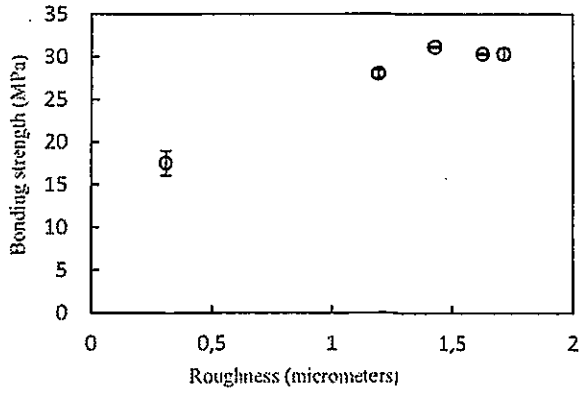


Fig.8 The value of the shear strength as a function of the surface roughness for the titanium alloy.

IV. Conclusion

The influence of the laser treatment parameters on the residual strength of titanium alloy and on the bonding strength between titanium alloy and PEKK film have been investigated. Tests on titanium alloys that treated with different laser power parameters under tensile loading showed that there was a low reduction in the residual tensile strength between 3 and 5 % for laser treated specimens. For the metal-resin adhesion tests, laser power parameter of 4.54 J/cm^2 was selected to give an optimum bonding strength between the titanium alloy and plain composite.

Acknowledgment

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Manufacturing Process of S-Glass Fiber Reinforced PEKK Prepregs

Nassier A. Nassir, Robert Birch, Zhongwei Guan

Abstract—The aim of this study is to investigate the fundamental science/technology related to novel S-glass fiber reinforced poly-ether-ketone-ketone (GF/PEKK) composites and to gain insight into bonding strength and failure mechanisms. Different manufacturing techniques to make this high-temperature pre-impregnated composite (prepreg) were conducted i.e. mechanical deposition, electrostatic powder deposition, and dry powder prepregging techniques. Generally, the results of this investigation showed that it was difficult to control the distribution of the resin powder evenly on the both sides of the fibers within a specific percentage. Most successful approach was by using a dry powder prepregging where the fibers were coated evenly with an adhesive that served as a temporary binder to hold the resin powder in place onto the glass fiber fabric.

Keywords— Dry powder technique, PEKK, S-glass, thermoplastic prepreg.

I. Introduction

THE future aircraft, such as Airbus A350XWB and Boeing 787, will likely use far more than 50% (by weight) advanced composite components. Thus, the manufacturing process of these composites needs to be improved to satisfy the future requirements of the new generation of aircraft. Reinforced composites made with thermoplastics (TP) as matrix materials in conjunction with glass fiber (GF), carbon fiber (CF), natural fibers (NF) have increasingly found their uses in the aerospace, automotive and renewable energy sectors due to their nature properties such as light-weight construction potential, integral design and good impact properties [1]–[5]. These advanced materials were introduced in the form of prepregs (pre-impregnated fiber or fabric in a flat form). Prepregs have been used extensively due to their low cost, ease of processing, consistent quality and higher volume capability. The mechanical properties of prepregs over a wide range of temperature are better than those from wet layups, as the resin is applied in uniform and exact quantities and an optimum fiber/resin ratio is attained. In addition, prepregs reduce the health and safety risk associated with handling resin. Thermosetting (TS) prepregs such as epoxy prepregs are used in a wide variety of applications such as automotive, construction and aerospace industries. However, these prepregs have limited shelf life due to their cross-linking degree in B-stage. These materials have to be kept in freezers at around -18°C [6]–[9] to prevent the cross-linking polymerization reaction taking place at ambient temperature. The major problems in the aerospace applications where FMLs are extensively employed for fuselage, currently utilizes thermoset epoxy based prepregs. Low viscosity, low fabrication temperature and good resin/fiber wettability are the major reasons for use the epoxy based composites. However, these kinds of prepregs exhibit poor hot/wet stability, high cost of manufacture, low combustibility leading to fire at elevated temperatures, generating smoke and toxic fumes which pose a serious health hazards [10]–[14]. Thermoplastic matrix are good alternative for advanced structural composite system due to their substantial advantages over thermoset matrixes, such as improved fracture toughness, fire/smoke resistance, high hot/wet stability, recyclability and rapid processing due to shortened curing cycles. Thermoplastic prepregs can be stored in any ambient environment with infinite shelf life unless they contain solvent which may limit their shelf life [4]. Thermoplastic matrix systems also present a stimulating and promising opportunity for the automotive sector and have a potential to bridge between the lightweight and reprocessable high strength composite materials in mass production [15]. The most attractive feature of fiber reinforced thermoplastic matrixes is their ability to welding at elevated temperatures thus, making them suitable for high speed production such as thermoform and allowing the applications of novel joining techniques such as ultrasonic and induction welding [16]. However, many challenges still remain in these materials that need to be solved to realize their ultimate potential. Despite the several advantages offered by the traditional thermoplastic matrixes, their usage has been limited due to their low moduli, poor chemical resistance, low glass transition temperature and low thermal stability at elevated temperatures [17]. The development of multi-functional thermoplastic matrix based on aromatic polymer has an ability to address all these limitations. The use of matrix materials, such as Poly-ether-ketone-ketone PEKK, and ply-ether-ether-ketone (PEEK), have demonstrated excellent mechanical barrier, exceptional impact resistance, vibration damping and thermal properties at high temperatures, especially when reinforced with high performance fibers [18]. As high temperature – high performance (HTHP) thermoplastics, PEKK and poly-ether-ether-ketone (PEEK) [19], [20] are considered to be the most favorite matrix systems in the aerospace industry to satisfy the need of light-weight, low cost primary load bearing structures and high temperature FMLs [21]–[23].

The impregnation of thermoplastic matrix is crucial due to their

Nassier A. Nassir is with the School of Engineering, University of Liverpool, Liverpool L69 3GH, UK .and Department of Materials Engineering, University of technology, Baghdad, Iraq, (phone: 447417413264; e-mail: N.A.N.Almtteri@liv.ac.uk).

Robert Birch is with the School of Engineering, University of Liverpool, Liverpool L69 3GH, UK (e-mail: rsb123@liverpool.ac.uk).

Zhongwei Guan is with the School of Engineering, University of Liverpool, Liverpool L69 3GH, UK, and from School of Mechanical Engineering, Chengdu University, Chengdu 610106, China (e-mail: zguan@liverpool.ac.uk).

higher viscosity and processing temperature, resulting poor composite properties. Normally, thermoplastic resin is combined with fibers to make prepregs throughout a variety of manufacturing processes, which can be divided into the following categories, i.e. (1) solution dip prepregging, (2) hot melt prepregging, (3) film calendaring, (4) dry powders, and (5) aqueous suspensions. Each process has its own requirements and process variables that affect the quality of the finished product. In the solution dip prepregging, the solution is obtained by dissolve the thermoplastic resin with solvent in order to reduce the viscosity enough to allow impregnation of the polymer. Although high pressure facilities are not required in this technique, the relatively high solvent resistance of advanced composites makes it difficult to remove toxic and organic solvents with high boiling points from the composite during consolidation [24], [25]. In the hot melt method, the fiber bundles are impregnated with molten polymer. Once a molten thermoplastic polymer is provided by an extruder to a melt pool, the fiber bundle is pulled into the molten over number of spreader pins [26]. High melt viscosities are the main problem of the hot melt impregnation which leads sometimes to fiber breakage [24]. The film stacking is a standard technology for producing thermoplastic composites for a long time, in which different layers of reinforcing fibers are laminated between layers of thermoplastic polymer film by applying heat and pressure. The pressure needs to be sufficient to force the polymeric melt to flow into the reinforcement. Although the difficulty of forcing a highly viscous resin through the gaps between fibers that are normally in micron is overcome by applying pressure, this also forces the fibers together, packing them in such a way as to make infiltration by the resin more difficult [27], [28]. The difference between these methods is the way of matrix particle deposition on the fibers and the bonding force between particle and fiber, which is responsible for their adhesion to each other [29]. Several advantages can be obtained using the dry powder prepregging including wide range of high melt viscosities used with elimination of the solvent removal or hot melt problems, thus providing an increase in polymer selection [30]. Due to the advantages of dry powder prepregging technique over other methods, this method is utilized in the current work. PEKK is one of the future polymers that can be used for structural applications in high temperature environment. In addition, the processing temperature of PEKK is lower than PEEK and its mechanical properties are higher than those of PPS and PEI [3]. Therefore, a novel high temperature — high performance glass fiber reinforced thermoplastic prepreg was manufactured using a dry powder technique. Here, S glass woven which is known for its high strength and impact resistance properties is used as a reinforcement and PEKK as matrix. It can be seen from the review that data of S-glass fiber reinforced poly-ether-ketone-ketone is limited and there is no previous work has been done to manufacture and evaluate its properties under various test conditions. Therefore, the primary aim of this work is to investigate the fundamental science/technology related to novel GF/PEKK composites and to provide experimental data for numerical modelling validation and further for assisting design prepreg materials.

II. Experimental Procedure

A. Poly-Ether-Ketone-Ketone thermoplastic resin (PEKK)

Poly-ether-ketone-ketone (PEKK) is a high temperature high performance thermoplastic material that belong to the poly aryl ether ketones (PEAKs) family in which family members are different from each other according to the ratio of ketone-ether groups. These resins are semi-crystalline aromatic which exhibit low melt viscosity, excellent thermal stability, low moisture absorption, high toughness and tensile modulus, good chemical resistance and good flammability resistance. The glass transition temperature (Tg) of PEKK polymer is 165 °C. In this research, PEKK resin was provided by ARKEMA France in a powdered form with particle size of 50 microns. The product is marketed by the trade name of Kepstan.

B. Reinforcement

S- Glass fibers have high tensile and compressive strengths, high temperature resistance, and good impact resistance. S-Glass woven type (124 gsm (4oz) plain weave 30 Aerialite was used in the present work. The S glass fibers were obtained from East Coast fiberglass Supplies (UK).

C. Manufacturing of S- glass fiber reinforced PEKK thermoplastic composite

The first part considers the preliminary manufacturing processes have been undertaken to make a thermoplastic prepreg of poly-ether-ketone-ketone (PEKK) reinforced with S-glass fiber using a prototype lab scale prepregging equipment which has been developed in the school of engineering, center for material and structures laboratory at University of Liverpool as shown in Fig. 1.

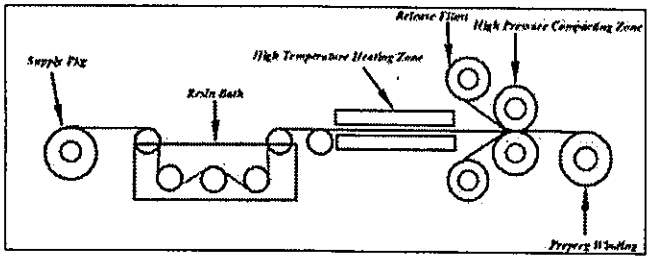

Fig.1 Thermoplastic prepregging rig.

D. Dry powder prepregging technique

In dry powder prepregging, the resin powder is deposited directly on the woven glass fiber. The resin powder can be applied on the fibers in different techniques as following;

1. Mechanical technique

Fig. 2 shows the setup of this technique in which PEKK powder is deposited on woven glass fiber using metal bars. These bars were designed to have depths with different dimensions in order to control the powder proportion on the fibers. The advantage of this technique is that uniform powder distribution can be obtained by using a proper depth. However, it was too difficult to coat the rear fiber face. Moreover, the penetration of the PEKK resin within the fibers caused a severe

damage in the fiber as a result of the high viscosity of PEKK resin, as shown in Fig. 3.

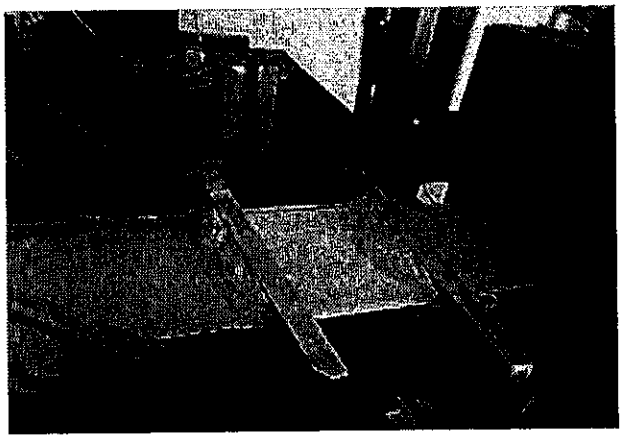

Fig.2 Powder deposition setup.

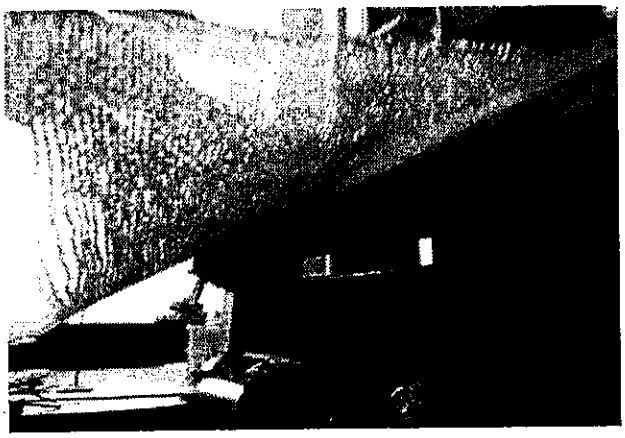

Fig.3 Fiber damage.

2. Electrostatic powder deposition

An electrostatic power deposition technique is also utilised in this project as a developed powder impregnation process to charge and deposit PEKK powder onto a woven S-glass. In this process PEKK powder is charged by using high voltage source up to (30 KV) in order to deposit on grounded part which is woven glass fibre tape. Preliminary work has been done to make the prepregs as shown in Fig. 4. The results showed that the deposition of PEKK powder on woven s-glass fibre tape was not sufficient and the amount of deposited powder was not enough to give prepreg with good quality.

Fig.4 Electrostatic setup.

Therefore, the prepregs of the PEKK resin and woven s-glass fiber were made manually as an alternative approach.

E. Sample preparation

The manufacturing process of S-glass fiber reinforced PEKK resin can be divide into two parts. The first one was to manufacture the prepregs, after that these prepregs were stacked together to make the composite panels.

1. Prepregs manufacturing Process

Here, a dry powder prepregging technique was utilized to make a prepreg of PEKK and woven S-glass fiber, in which dry powder of PEKK resin was deposited onto the fibers as shown in Figure 5. The manufacturing processes of the GF/PEKK prepreg are listed in the following steps:

- The woven S-glass fiber was cut into square pieces (250 mm x 250 mm). Then, the glass fiber was weighed using a high resolution scale.
- Adhesive of 3M Multipurpose Spray was sprayed evenly on the fiber and the weight of the fiber plus the adhesive was recorded. Here, the adhesive works as a temporary binder to hold the resin powder on the glass fiber.
- The fibers were then dipped inside a powder tank, and the weight was recorded at each dipping time until the target percentage was obtained.
- The glass fiber with desired amount of powder attached was placed between two molds (300 mm x 300 mm) and heated to 330 °C inside the hot press. A high temperature release agent (Frekote) was used between the mold and the prepreg to ensure easy removal after the consolidation. The processing cycles in terms of holding time and pressure to make these prepregs were 10 min and 6 bar, respectively.

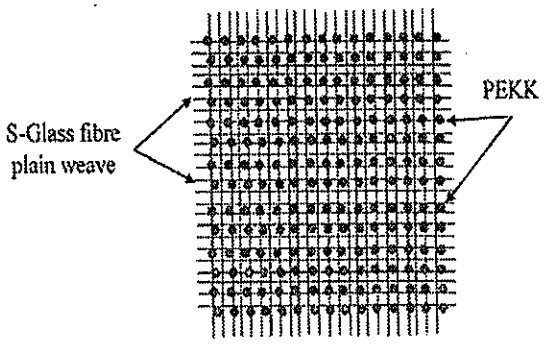

Fig.5 Schematic diagram showing the deposition of the

thermoplastic resin (PEKK) on the plain weave S-Glass fiber.

F. Preparation of composite laminates

In this part, the composite laminates were manufactured by stacking an appropriate number of approximately 0.125 mm thick ply in a mold. Then, the resulting stack was heated to a temperature of 330 °C at an approximate heating rate of 5 °C per minute. The laminates with dimensions (125*125 mm) were cured under a pressure of 3 bars for 30 minutes prior to cooling at rate of 2 °C/ minute. The processing parameters of the composite laminates are illustrated in Fig. 6. After cooling, the pressure was released and the laminates were removed from the mold and inspected for defects.

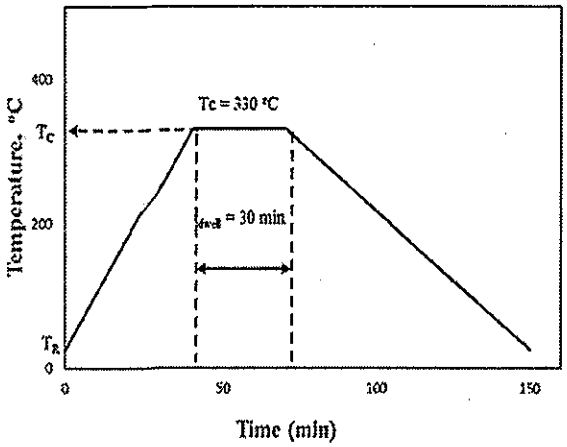

Fig.6 curing process curve and stacking configuration of GF/PEKK.

III. Result and Discussion

A. The effect of the binder between the thermoplastic powder and the fiber on the perforation resistance of the laminated composites

The investigation was initially focused on the influence of the binder between the thermoplastic powder and the fibers on the mechanical properties of the GF/ PEKK laminates. The investigation based on making four ply composite panels with and without binder. Fig. 6 shows load-displacement traces following quasi-static perforation tests on panels with and without the binder. An examination of the figure indicates that both panels exhibit the similar trend at the beginning. However, the critical force value of the latter laminated panels is much higher than the former panels, i.e. more than twice. It could be argued that the higher value of the critical force for the treated panels is due to the better adhesion between the resin powder and glass fibers, which leads more PEKK power attached to fibers with more uniform distribution.

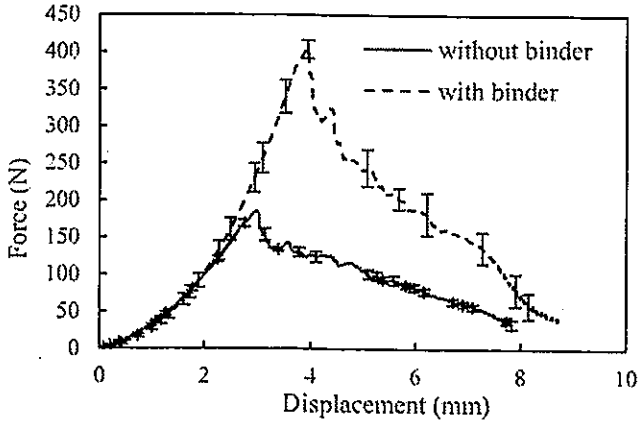

Fig.7 Load-displacement traces following perforation tests on the 4- ply PEKK/GF composite with and without adhesive applied to the fibers.

B. The effect of the binder between the thermoplastic powder and the fiber on the tensile properties of the laminated composites

Further investigation was undertaken to assess the influence of the fiber treatment with the binder spraying on the tensile strength of GF/PEKK samples. The effect of the fiber treatment on the tensile properties of GF/PEKK laminates with a fixed thickness of 0.47 mm (4 ply) is illustrated in Fig. 7. As noted previously, the treated laminates have over twice tensile strength of the untreated ones. To summarize that, the mechanical properties of treated laminates with binder was higher than those untreated ones due the powder distribution associated with good bonding strength of the treated laminates.

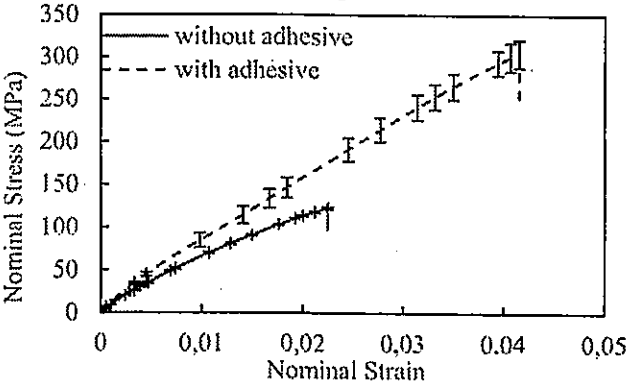

Fig.8 Nominal stress-nominal strain curves for the 4 ply PEKK/GF composites (with and without fiber adhesive treatment).

IV. Conclusion

The possibility of making a novel prepreg of woven s-glass fiber as reinforcement and poly-ether-ketone-ketone as matrix have been investigated. The results of the preliminary manufacturing processes have shown that more experimental works are needed to improve the depositions of the thermoplastic powder resin on the fiber.

The results of the mechanical properties such as tensile tests and quasi-static perforation tests on the result prepregs have shown that the binder between the fiber and the power resin play a vital role in improving the quality of the prepregs.

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An Analysis of Instruction Checklist based on Universal Design for Learning

Kim, Yong-Wook

Research Institute of Korea Special Education

Daegu University

yongkim@daegu.ac.kr

< Abstract >

The purpose of this study is to develop an instruction analysis checklist applicable to inclusive setting based on the Universal Design for Learning Guideline 2.0. To do this, two self-validation reviews, two expert validity reviews, and two usability evaluations were conducted based on the Universal Design for Learning Guideline 2.0. After validation and usability evaluation, a total of 36 items consisting of 4 items for each instruction was developed. In all questions, examples are presented for the purpose of reinforcing concrete. All the items were judged by the 3-point scale. The observation results were provided through a radial chart allowing SWOT analysis of the universal design for learning of teachers. The developed checklist provides a description of the principles and guidelines in the checklist itself as it requires a thorough understanding by the observer of the universal design for learning through prior education. Based on the results of the study, the instruction criteria, the specificity of the criteria, the number of questions, and the method of arrangement were discussed. As a future research, this study proposed the characteristics of application of universal design for learning for each subject, the comparison with the observation results through the self-report teaching tool, and the continual revision and supplementation of the lecture checklist.

Key Words : universal design for learning, UDL based instruction, instruction analysis checklist

I . Introduction

Ford et al. (1992) suggested that all children should pursue four educational achievements as follows: cognitive skills, self-development, democratic citizenship, and community participation., As the level of achievement is different depending on the characteristics of each child, it emphasizes that there is no reason to educate the learners physically according to their characteristics. Gardner and Edyburn (2000) noted that effective instruction should be fairly applied in all situations, with or without disabilities. This means that not only the physical integration of students with disabilities in education but also the right to learn through pedagogical integration should be guaranteed.

The right to study is a right based on the human nature of learning and intellectual inquiry, the right to human growth and development, the right to cultural survival, and the right to realize the principle of national sovereignty. Such learning rights are not only recognized by the prestigious rules of the Constitution but also constitutional freedoms recognized in the Constitution as fundamental rights to education (Noh, 2008). People with disabilities also have the right to receive the necessary education according to the type and degree of disability to develop their abilities as citizens of a country. The state has the right to individualize the personality, to have the independent qualities of life and democratic citizenship It is imperative to provide appropriate educational opportunities to lead a human life(Chung, 2007).

Discussions on universal learning design aimed at training learners ultimately are being actively developed not only in special education but also in general education, by guaranteeing all learners' right to learn. The universal learning design has been proposed as a way for learners with heterogeneous characteristics to access, participate in, and advance the general education process and to improve the outcomes of the students by providing the necessary intervention for all children to successfully access the general education curriculum Emphasize (Kim & Woo, 2016; Kim, Kim & Woo 2016; Beard, Carpenter, & Johnston, 2011). In order to overcome the limitations of concrete, Han(2012) and So(2015) have been carrying out empirical studies on the validity of the philosophy or principle of universal learning design. However, these studies showed most teachers who are supposed to play an integral role in the universal learning design-based lessons do not fully understand most of the concepts, principles, and methods of universal learning design. Therefore, in order to implement the universal learning design, it is necessary to change the teaching activities of the teacher through the formulation of theory or principle.

Teaching is the core of educational activities that take place in schools (Seo, 2008), which is implemented through complementary relationships between teachers, students, textbooks, and environments for educational purposes. Class is influenced by various factors and has very dynamic characteristics (Gagne et al., 2005). In order to change the class, basically we need to understand the learner, abundant knowledge about the contents of the lesson and the teaching techniques, how to utilize this knowledge, and how to reflect on his / her class and cooperate with others. Class analysis activities have been recognized as a key element in improving teacher professionalism to improve instruction (Chung & Chung, 2011). In the same context, it is more effective to provide a practical framework of teaching analysis rather than over-emphasizing the validity of ensuring all students' learning rights to implement and spread the universal learning design. The results of the analysis of the lessons provide opportunities for reviewing theories (principles), as well as providing a direct basis for realizing the instructional design based on universal learning design principles through the improvement of the teachers' class. Therefore, it is required to develop a teaching analysis tool that strengthens the concrete (applicability) while maintaining the original validity of principle in place of universal learning design guideline with high abstraction.

Ⅱ. Method

The purpose of this study is to develop a checklist of instructional analysis based on Korean universal learning design which is faithful to the principles of universal learning design and each guideline constituting it. In order to accomplish this research purpose, the research was carried out through four steps as follows.

1. Step 1: Preparing the checklist form and contents draft through literature review

1) Collecting Data

To develop a universal learning design - based instructional analysis checklist, research papers were collected on universal learning designs. The data collection process is as follows.

First, 'universal design for teaching', 'universal design for teaching', 'universal design of teaching' in scholastic research information service, national e - library, national digital library, DBpia, Korean academic information, Universal education design 'and so on. UML, UDI, UDE, Universal Design for Learning, Universal Design in Education, and Universal Design for Instruction were collected and analyzed by EBSCOhost. This method of extracting related documents by parallel combination of key words minimizes the subjective judgment intervention when selecting a document, thereby enhancing the reliability of the document and efficiently collecting necessary data in a short time (Ahn, 2014).

Secondly, literature research and trend research which are inconsistent with the subject of this study, such as the development of checklists for teaching analysis, among the documents retrieved through parallel combination, were excluded. The elements of the checklist should be included in the checklist by examining the principles of universal learning design, guidelines, specific examples, class evaluation, and class observation tables.

Third, universal learning design is centered on the educational environment in the United States. In terms of learners, it is based on universality of learner diversity and general education approach rather than special class, special school, And that the right to learn is guaranteed. In this paper, we review whether teachers' needs, validity, and applicability of reality are included in the previous study (Park, 2014; Lee, 2011; Chung, 2014)

Through such a series of data collection and analysis processes, the preliminary assessment elements and evaluation items of the Korean version of the universal learning design-based instructional analysis checklist were extracted (see Table II-1).

<Table Ⅱ-1> Literature source for checklist development

Area	Contents	Source
Development principle deduction	· 2011 Universal Learning Design Guidelines 2.0	Bowe(2010) Burgstahler(2015) CEC(2006) CAST(2011) Hall et al.(2012) Meyer et al.(2014) Nelson(2014) Novak(2014) Ralabate(2016) Rapp(2014) Rose et al.(2011) Spencer(2015)
Universal Learning design Item development	• eliminating barriers to access rather than eliminating academic challenges • Universal learning design is not a problem of teaching materials. · Finding application examples according to the guidelines for universal learning design guidelines 1.0 · There may be guidelines that are excluded in accordance with subject characteristics. • There may be guidelines that are excluded depending on the inclusion of students with disabilities. · Discovery of the inclusion of principles or guidelines of universal learning design through arbitrary interpretation · Find teaching methods that support universal learning design principles without applying specific guidelines · The case of selecting the main object of universal learning design as a student with disability · Provide a plan to remove potential learning disabilities · Technology is a very important factor in implementation but not a necessary condition. • Universal learning design is not a checklist for creating a learning plan. • Does not mean compliance with all the guidelines contained in the guidelines. • There is universal design and universal learning design, but the principles are different.	Kwon(2012) Kim(2015) Park(2013) Son & Kim(2010) Shin(2009) Lee(2013) Lee(2011) Han(2014) Nelson(2014) Novak(2014) Ralabate(2016) Rapp(2014)

Item Selection Review	· Review of the validity and applicability of universal learning design standards · Development of design principles for universal learning design based digital textbooks · Recognizing the importance of pre-service teachers for universal learning design	Park(2014) Lee(2011) Chung(2014)

2) Draft checklist

First, the draft checklist was based on the Universal Learning Design Guideline 2.0 proposed by the Center for Applied Special Technology (CAST) in 2011. The principles - guidelines - checkpoints that constitute the guideline were all included in the checklist evaluation items. In order to compensate for the lack of specificity pointed out as a disadvantage of the universal learning design (Han, 2012; So, 2015), CAST (2011) Concrete examples of checkpoints presented in the "Universal Design for Learning (UDL) Guideline: Full-Text Representation" presented were converted into items and presented. The total number of items was 137 items.

Second, based on the results of previous research by Park(2014) among the total 137 items, questions that are less likely to be applied in Korean educational scenes (for example, application of assistive technology and development of classes considering students from multicultural families) .

Third, it applies only to integrated classes considering the fact that students with sensory impairment among the checkpoints (1.2 Providing alternatives to auditory information and 1.3 Providing alternatives to visual information) are less likely to be applied in general classes And the other is a supplementary question. Therefore, 87 items and 2 additional items, which were arranged in order according to the guidelines, were finally completed.

2. Step 2: Correcting and supplementing through video observation

1) First validity review

In the second stage, we focused on understanding whether the 87 items of the checklist based on the literature study are practically observable and supplementing the items that can be interpreted in multiple ways. For this purpose, three researchers (one professor of special education, one professor of biology education, and one professor of physical education) participated in the video observation and understood the possibility of observing the contents of the question during the class. Due to the difficulty of securing the videos of the entire class, the videos used for the observation and measurement of the checklist items were 20 minutes of math that was published on the website of the Seoul Science Center (www.ssp.re.kr) Science class videos were used. The videos posted through the homepage are edited in 20 minutes, which is evaluated as excellent class in the Math Science Evaluation Forum. There is a limit to check the whole class, but in order to understand whether or not to observe the checklist items within a predetermined range, And the results of this study are as follows. The checklist items were observed by individual researchers. A total of six videos used in the second stage review process are shown in Table II-2.

<Table Ⅱ-2> Review of 1st validity

(Date: 2017. 5. 14. ~ 15.)

step	Researcher (Major)	grade	title
Step 2 First validity review	Researcher A (Special Education)	7th	[Physics] Light coming in side by side with light entering
		8th	[Mathematical] equations of two linear equations
	Researcher B (Biology Education)	8th	[Physics] Refraction of Light Multi Experiment
		9th	[Biology] Comparison of somatic cell division and meiosis
	Researcher C (Physical Education)	7th	[Mathematics] computer-based statistics
		8th	[Chemistry] Creating a bookmark

As a result of the first stage validation of the second stage, screening was made for observable items and unobservable items based on the results of the observations of the three researchers. Due to the nature of the video, teaching strategies for students with sensory impairments were difficult to identify and did not consider additional questions. Therefore, the existing 87 items were reduced to 63 items through intensive confirmation and review process.

2) Secondary validity review

The second stage of the second validation was done by three people, and the first question was confirmed by the researcher. For the items whose observations were consistent, we observed the observation points and judged whether they were judged to be the same. As with the second stage 1 validity test, randomly selected videos not used in the first video were posted on the website of the Seoul Metropolitan Office of Education's Science Exhibition Hall (see Table II-3).

<Table Ⅱ-3> Review of 2nd validity

(Date: 2017. 5. 17.)

step	Researcher (Major)	grade	title
Step 2 Secondary validity review	All researchers (3 people)	7th	[Physics] Reflection of Light
		7th	[Biology] Which patient's urine?

But the specificity is strengthened by giving concrete examples for the items that are observed in the discussion process. In addition, the discrepancy items were supplemented after discussion among the researchers, or the items themselves were deleted. It is also structured so that the observer can easily find and display the relevant items during class observation. In other words, according to the course development process, a series of items were rearranged into 6 items related to introduction, 51 items related to development, and 6 items related to the theorem. Finally, we have replaced or deleted terms with different terms (such as graphic organizers) or unfamiliar terms (eg, 3D models, decimal bars, etc.) by general terms. Through this series of steps, the final checklist in stage 2 was retained for 63 questions, and the scale consisted of N (not observable) and Y (observable).

3. Step 3: Evaluate usability through on-site observation and interview

1)First Usability Assessment

A checklist consisting of 63 items from the second stage was applied to both elementary and middle school classes during May 19th and May 25th, 2017. Teachers who accepted the class participation and observation of the researchers were teachers who had undergone a variety of attempts at teaching methods for less than 5 years. The specific background is shown in Table II-4.

<Table Ⅱ-4> 1st usability evaluation and in-depth interview study subjects

Teacher's name (gender)	School	Class type	Career	Unit	Remarks
Namoo (male)	Gumi oo Elementary	General	5years	Expressing it as a cape	Creative Experience Activity 2 (Observer: researchers A, B, C)
Jungoo (male)	Wonju oo Junior High	General	3years	A speed-changing exercise	Theory Class 1 (Observer: researchers B and C)
Ahnoo (male)	Wonju oo Junior High	General	3years	The sum of two forces acting side by side	Theory Class 1 (Observer: researchers B and C))

In order to make it possible to apply all of the contents regardless of class and activity characteristics rather than dividing the checklist into class characteristics, it is necessary to use both creative experiential activities with the experiment as the main activity of the class and class And applied. In order to understand the validity and applicability of the class analysis tool, the researchers directly participated in the classroom where the class was held and observed. In order to obtain the agreement between the researchers, the camcorder was installed in the front (two) And recorded.

As a result of application to the elementary school creative experiential activity (2nd block time system), which is the priority of the first usability evaluation, adjustment was made on the unobservable

items. "Do you offer a flexible review format to fit your student's characteristics?" "Do you provide sufficient review opportunities?" "Do you offer a model or an example of the learning goal setting process and results?" "Memory training for information transfer and generalization. The questionnaire was completed with a total of 48 questions, including 15 items that included strategies and devices? Are you using various strategies to solve the problem? In the middle school class, which is followed by theory, the lesson is focused on theoretical questions, such as 'Do you introduce information sources that can find various information' through observations and 'Are you suggesting various examples of novel solutions to real problems'? Additional deletion was considered.

In the in-depth interviews of the teachers after the usability evaluation of the analysis tool, not only the opinions on the universal learning design but also the teachers' opinions and opinions about the validity and applicability of the class for all of them in the actual (science) . The interviews proceeded according to the flow and situation in the dialogue process of everyday classroom scenes in a certain order through semi-structured questionnaire (see Table II-5). To this end, the inclusion of contents (type), universal learning design principles, applicability of guidelines or checkpoints, and questions about realistic difficulties led to the study of the validity of systematic analysis and analysis as a whole The results were compared and reviewed.

<Table Ⅱ-5> Contents of semi-structured questionnaire for interview

· Focus on class planning · Tools and teaching strategies for students with varying levels of academic achievement • Tools or teaching strategies that can easily communicate formal or symbolic terms · How to express your opinions and communicate with your friends • How do under-achievers continue to be interested and interested in the classroom situation and how to improve their level of participation? · How to proceed with class based on core concept and class contents • The most difficult part of preparing classes for students with a wide range of cognitive levels · Universal learning design principles The most important factors in implementing the applied class

2) Review of tertiary validity

After the usability evaluation of the analysis tool, the checklist was partially revised and supplemented, and a validity review was conducted for the expert group. The professors who participated in the validity review are those who are more than associate professors of the university, major in curriculum education, have experience in developing class analysis tools or instructional models, and have knowledge of special education and universal learning design (see Table II-6).

<Table Ⅱ-6> Participants who participated in the 3rd validation review

Expert	major	title	
ExpertA	Physics Education	Professor	Developing non-formal science education programs for students with disabilities
ExpertB	Chemical Education	Professor	

ExpertC	Biology education	Associate professor	Development of Teacher Training Program for POCOM Expansion

The review of the expert group first asked us to review the written checklists that we can review through the first usability evaluation in writing and finalize the revisions to the abstract contents. Then, time was decided and a feasibility study result was discussed through a joint meeting with researchers. In order to facilitate the use of the instructional analysis tool and to interpret the results, it is necessary to consider the same number of items for each instruction, to adjust the observation scale, to reinforce the specificity of the item through appropriate examples and inappropriate examples, Restructuring, and so on.

Expert opinions on these analytical tools were gathered and the items presented according to the course development were restructured according to the universal learning design principles. In addition, 4 items were adjusted for each instruction, and 4 items with the same weight were assigned to 3 items, and 33 items were completed. In the process of adjusting the number of questions, similar items were grouped into one question after consultation among the researchers, or the result of the previous study (Lee, 2013) which analyzed the factors of universal learning design. Among the existing 48 items, 21 items that were deleted in consideration of the abstraction of expression, the validity and applicability of the item, and the additional 7 items that were supplemented and the detailed contents of the integrated 4 items are shown in Table II-7. And the evaluation scale distinguishes between NO and YES, and YES is a 4 point scale again.

<Table II-7> Question adjustment details reflecting the results of the 3rd validity test

Delete Question	· Do you create a classroom environment that is receptive and helpful? • Do you present your goals in a variety of ways? • Do you provide guidance on each activity's goals and provide relevant checklists to confirm the progress of each activity? • Does it provide a model or illustration of the learning goal setting process and outcomes? • Do you provide textual explanations when presenting graphic symbols? • Templates. Does it provide a note-taking support "activity sheet" that includes a graphic organizer (schematic) and a conceptual diagram? • Do you use prior organizers (eg, KWL, methods, conceptual diagrams, etc.)? • Do you optimize factors that can divert attention by varying the speed of work, the length of the work process, the absence of breaks, and the duration and sequence of activities? • Do you provide feedback that focuses on the importance of patience, specific support and strategies when you have difficulty, and the development of work efficiency and self-awareness? Do you include new concepts in familiar topics and content to maximize generalization? · Do you approach the concepts in a flexible, easy, and convenient way? · Do you introduce information sources that can find various information? • Does it provide many opportunities to remind key concepts and to think about the relationships of concepts? · Do you use outlines, graphic organizers, unit organizational frameworks, conceptual frameworks, and conceptual frameworks to emphasize core concepts and relationships? • Are there various models that can be imitated? • Do you offer a variety of examples of new and innovative solutions to real-world problems? • Do you provide a checklist and a project plan template that allows you to identify and prioritize problems and create timelines in order and step by step? • Do you ask questions to guide self-examination and reflection? • Does it support activities that clarify individual goals and promote self-reflection? • Does it show progress?

	· Do you provide checklists, score tables, etc. for evaluation?
Integrated Question	· When do I need help with learners? When and how do I tell them to ask for help from a peer or teacher? · Does it provide interaction and assistance with friends? → Does it provide interaction and assistance for friends? (Eg involvement in learning when and how to ask for help from a peer or teacher / peer instruction, cooperative learning, etc.)
	• Does it often, timely, and explicitly provide feedback that emphasizes effort, improvement, and attainment of goals rather than comparing them to other students? • Do you communicate positive feedback in ways that you can accept and practice the feedback given? → Does it provide feedback frequently, timely, and explicitly (eg, in a positive way) that emphasizes effort, improvement, and attainment of goals rather than comparing them to other students?
Add Question	• Does it offer a variety of alternatives to responding physically or selecting activities? · Does the student apply different times, ranges, etc. to manipulate the parish in accordance with the individual characteristics of the student? · Provide parcels for composition and production of works and encourage interaction among students? • Do you vary the degree of difficulty or complexity of the task to the level of the individual student (or group) within which the learning activities in the classroom can be completed? • Do you provide tools, instructions, rubrics, and checklists that include: · Do you provide tools or charts to see if there is a change in your own behavior? • Does the learner support alternative ways of getting, receiving, or understanding the current learning situation?

4. Step 4: Assess usability and finalize

1)Secondary usability evaluation

The second usability evaluation (June 1, 2017) was carried out after the validity assessment of the expert group. In the second usability test, two of the teachers who participated in the first usability evaluation, except the elementary school teachers, participated and were directly observed by researchers B and C. After the direct observation, the revision of the checklist, the supplementary point, and the addition of the items consisting of only 3 items and the evaluation scale were discussed among the researchers.

In order to develop additional items, 4 items of each instruction were completed by reviewing literature and teaching cases. Guideline 1, 'Do you provide appropriate adjustments to the size of visual data such as text, pictures, graphs and tables?' These are the questions such as 'Do you provide expectations and beliefs in optimizing learning motivation?'

In the usability evaluation process, researchers were asked to provide 'diaries' and allow physical manipulation activities ',' one-off teaching events 'in the question' Do they differ in the level of discretion, autonomy, And how to deal with it. For these matters, we added the specificity of the question by suggesting 'exemptions'. For example, we added the phrase 'simply showing dioceses, using individual dioceses, creating individual activities, etc.', which is not applicable to 'providing dioceses and allowing physical manipulation activities'.

In addition, if the likert scale is used, it is suggested that it should be revised as much as possible after observing the whole course of the class rather than immediate display. The rating scale was revised to three points: ① not applying, ② intermittent, and ③ overall.

2) 4th validity review

The fourth validity review was conducted for the expert group who participated in the third validity review. The items used in the validity review were structured 36 items after the second usability evaluation, and each item was designed to be rated at 5 points (very unfavorable - unfavorable - moderate - reasonable - very relevant). E-mail was sent to the expert group for the checklist validity evaluation, and the results were collected by sending them to the researcher.

Expert groups showed less than average responses in three aspects: practical applicability in the classroom situation, principle or guideline, relevance of the question, and ambiguous questions. First, do you provide tools, guidelines, rubrics, and checklists that include the following items in question because of applicability or low specificity in the classroom situation? Do you provide tools or charts to see if there is a change in your behaviors? Do you allow your learner to express your opinion using a medium that is appropriate for you? Second, questions that are not valid due to their relevance to the principle or guideline include "Does the learning content (experience) provide activities related to the real life?" "Do you engage all students in discussion or presentation?" Does the thought process in the problem-solving process apply sound-spoken techniques? Does it offer various alternatives to physically reacting or choosing activities? Thirdly, such as the inaccuracy of the validity of test items means less Does accommodate 'information, or do you vary the font of the printed materials for emphasis?' 'Using a variety of strategies to solve problems the way? Modify the items by collecting concrete opinions on the basis of the above evaluation results through individual interviews with experts, it was complementary, views that are not appropriate in this process were enhanced specificity of the question by proposing to increase the view to be deleted and appropriate.

Secondly, the items of the additional study of visually impaired and hearing impaired students who applied the universal learning design were arranged as the selection items of the guideline 1. In each question, there are alternatives for students with visual impairment or alternative questions for students with hearing impairment. Through this series of processes, the final 36 questions were completed.

Ⅲ. Result

1. Constituting the items of Principle 1 (Representation)

1) Guideline 1: Provide a wide selection of cognitive methods

Learning by information that the learner cannot perceive is impossible, and even if information is presented in a form requiring special effort or help, the learner suffers learning difficulties. Therefore, in order to reduce the barriers to learning, it is important that all learners are able to recognize key information equally. The Universal Learning Design Guideline 2.0 provides three guidelines for providing a variety of choices for cognitive methods: providing a method of tailoring information to learners, providing alternative audiovisual information, and providing alternatives to visual information. Table 3-1 shows the composition and contents of the questionnaire, which more specifies the checkpoints for implementing such guidelines.

<Table Ⅲ-1> The composition and contents of the items in the guideline 1

Q	Contents
1	Do you use color for information or emphasis? · The concept or content to emphasize during the production of PowerPoint is emphasized by using color · Use color chalk (or use asterisks, underline, etc.)
	☞ [Visual Impairment] Does it provide an alternative for students with visual impairments? Provide sufficient verbal explanations at the same time · Provide key visual data showing the concept as a tactile analog · Provide audiovisual information as a visual concept.
2	**Does it change the typeface of the printed material for information or emphasis?**
	☞ [Visual Impairment] Does it provide an alternative for students with visual impairments? · Low vision To increase the readability of students, use Gothic
3	**Do you vary the size and speed of your speech and sounds, taking into account the speed and extent of your learners' learning?**
	☞ [Hearing impairment] Do you provide an alternative for the hearing impaired student? Use similar visual media to express emphasis and rhyme (eg, emoticons, symbols, pictures, etc.) Providing a transcript of video or audio material · Music score · Providing sign language service
4	Does the size of the visual data such as text, pictures, graphs, and tables be adjusted appropriately? · Students in the rear end are presented with enough recognizable size · Presenting students with poor visual acuity enough to see · Adjust the text displayed with the graph or table to a size enough to recognize
	☞ [Visual Impairment] Does it provide an alternative for students with visual impairments? · Present text size of printed matter for students with low vision at least 16 points · Properly adjust line spacing of prints to 1.5 times or more · Describing contents such as text (including braille) or images, graphics, video · Providing expanded textbooks or Braille textbooks

The purpose of this study is to investigate whether the implementation of the guideline 1 is accomplished through the total of four items. In order to determine whether alternatives to auditory or visual information are provided, In other words, all of the four items correspond to the checkpoint 1.1 (providing a method of setting the information presentation method to the learner) and check point 1.2 (providing an alternative to auditory information) and checkpoint 1.3 Providing alternatives to visual information) were presented as options for relevant questions.

2) Guideline 2: Providing a wide selection of languages, formulas, symbols

The learner's verbal and nonverbal skills vary widely. Therefore, inequality occurs when the contents are presented to all learners through a single form of expression. It is desirable for the teacher to apply the instructional strategy to the lesson in order to ensure the understanding of the contents of the lesson as well as the access to the learning through alternative expressions. For this purpose, Guideline 2 defines the meaning of vocabulary and symbols, clarification of structure and structure of text, support of decoding of letters and formulas and symbols, promotion of vernacular understanding, and showing meaning through various media . The applicability of the instructional strategy to ensure the guideline 2 is structured so that it can be grasped through the items in <Table Ⅲ-2>.

<Table Ⅲ-2> The composition and contents of the question in Guideline 2

Q	Contents
5	To provide a clear understanding of words and symbols, does it provide sufficient explanation for unfamiliar expressions in the text? · Full explanation of idioms, academic terms, figurative language, mathematical terms, specific field terminology, gore, spoken language, and dialects. · Various examples to help understanding
6	Does it provide a clear notation for key terms (including formulas and symbols)? · Punishment on the board · Presenting word cards and flash cards
7	Does it provide support for clarifying the concept or content of the term? · Provides additional visual and non-verbal support such as photos and videos · Explanation of multicultural students using their native language · Sign language provision for hearing-impaired students
8	**Do you use illustrations, formulas, maps, charts, etc. to clarify the meaning of the text presented in the text?**

Item # 5 is checkpoint 2.1 (clarify vocabulary and meaning), item 6 is checkpoint 2.3 (to support decoding of letters, formulas and symbols), item 7 is checkpoint 2.4 Finally, item 8 is a checkpoint 2.5 (showing meaning through various media) into question. The results of this study are summarized as follows: First,

Among the items that constitute Guideline 2, "Do you provide assistance to clarify the concept or content of the term?" Includes support for mother tongue language for multicultural students who are said to be unlikely to apply, and sign language provision for students with hearing impairment . In this way, we tried to make a compromise on the applicability and validity of the universal learning design by presenting the concept of the term or the contents as an example without showing the support for the multicultural student and the hearing impaired student as a separate item.

3) Guideline 3: Provide a variety of choices to help you understand

The purpose of education is not to be able to access information, but to teach learners how to translate accessible information into useful knowledge. For future decision-making, learners should learn how to

build knowledge that integrates new knowledge with prior knowledge, classification, etc. in accordance with active "information processing techniques" rather than simply recognizing information.

To this end, Guideline 3 recommends the use of teaching strategies that maximize background knowledge, activate patterns and core parts, emphasize key ideas and relationships, guide information processing and visualization, guide the use of information, and transfer and generalize information . The results of this study are as follows.

<Table Ⅲ-3> The composition and contents of the question in Guideline 3

Q	Contents
9	Do you want to link class content with prior knowledge or do you have classes that activate prior knowledge? · Providing materials for checking the contents of the previous course, questions about the content of the course
10	**Do you emphasize important elements in texts, graphs, charts, formulas, etc.?**
11	Does it clearly indicate the beginning and end of learning activities? · Provide clear clues for learning activities in the corresponding class and then develop the lesson · Provide linguistic clues such as "I have done so far and will do so from now on."
12	**Do you provide enough review and practice opportunities?**

The relationship between the checkpoints developed in the Universal Learning Design Guidelines 2.0 and the developed items is as follows. Checkpoint 3.1 (providing or activating background knowledge) is the 9th question, and checkpoint 3.2 (emphasizing patterns, core parts, key ideas and relationships) is translated into 10 questions. And Check Point 3.3 (to guide the process of information processing, visualization, and use) is in question 11, and check point 3.4 (maximizing information transfer and generalization) is checked through question 10.

2. Constituting the item of Principle 2 (behavior and expression)

1) Guideline 4: Providing a variety of choices according to the way they are represented

Printed textbooks or workbooks allow only limited navigation or physical interaction. The same is true for state-of-the-art interactive training software that has been developed in recent years. The application of limited methods for data retrieval and interaction is an obstacle for learners who need to support executive functions. It is therefore important that all learners provide data that they can interact with.

It is possible to use a variety of teaching strategies, such as diversifying responses and data search methods, and optimizing the use of various tools and assistive technology devices, to provide a variety of choices based on physical expression. <Table Ⅲ-4> presents the final questions and examples that show how such a teaching strategy is being implemented in a classroom.context.

<Table Ⅲ-4> The composition and contents of the question in Guideline 4

Q	Contents
13	Does it offer a variety of choices for the way of physical expression? · It is possible to express the response method in the form of writing, sign language, picture Suggesting alternatives for students who have difficulty writing with a pen or pencil · Suggesting alternatives to computer manipulation · Utilizing various assistive technology devices to supplement and replace physical expression
14	Is the physical environment adjusted to minimize the learner's physical expression burden? · Place students' seats in front of students who have difficulty in expressing physical or physical difficulties to minimize physical effort or movement for presentation · Reduce the burden of expression by placing seats in places where space is easily accessible · Narrow the distance between the learners so that they do not have to work hard due to their physical expression.
15	**Does it apply different times, ranges, etc., to the student's ability to manipulate the parish in accordance with the individual characteristics of the student?**
16	Do you offer a variety of choices about how to use the body to search for data and how to collect data? · Additional data search and collection using computer (Internet) instead of book · Collecting data by photographing instead of data collection by record · Data collection using voice recoghition function · Utilizing various assistive technology devices for data collection

Items 13 through 16 all correspond to questions to observe whether checkpoint 4.1 (diversifying response and data search methods) is performed. As mentioned earlier, checkpoint 4.2 of guideline 4 is intended to optimize the use of various tools and AT devices. However, in the educational scene of Korea, it is possible to witness the intermittent use of assistive technology devices in integrated class or integrated class including students with disabilities, but it is difficult to find cases in general class. In this case, rather than treating it as a question to directly monitor the use of assistive technology devices, it should have the characteristics of a compliant item as a concrete example of each item as shown in item 7 of the guideline 2.

2) Guideline 5: Providing a variety of choices for expression and communication

There is no expression medium that is equally suitable for all learners or for all kinds of communication. Rather, there may be media that are not suitable for certain types of expression and learning. It is therefore important to provide alternative forms for expression so that learners can adequately (or easily) express knowledge, ideas and concepts in the learning environment.

Guideline 5 suggests the use of various media for communication, and the use of various tools for composition and production of works as teaching strategies. It also encourages fluency while gradually reducing support for practice and performance. <Table Ⅲ-5> is the items to grasp practically what the guideline 5 is pursuing, and it can be observed in the actual classroom scene, and it has been shown to be highly valid by the expert group.

<Table Ⅲ-5> The composition and contents of the question in Guideline 5

Q	Conyents
17	Does the learner use his or her own media to express his or her opinions? · Allows you to choose your favorite medium among various media such as text, language, picture, illustration, design, movie, music, dance / movement, visual material
18	Does the teacher accept the original problem solving method of the student rather than the problem-solving method presented in the textbook? · Opportunity for students to freely express their point of view · Acceptance and comparison opportunities of various strategies proposed by students
19	Does it provide a variety of tools for composition and production? · Provided related equipments or tools · Provision of related application or approval
20	Does it act as a mentor to provide feedback to individuals during practice or performance? · Provide appropriate feedback for each individual. · There are various motivation, guidance and feedback methods.

The contents of the checkpoints contained in each item are as follows. Questions 17 through 18 correspond to questions to check whether checkpoint 5.1 (using various media for communication) is implemented. And item 19 reads checkpoint 5.2 (using various tools for composition and production) of the Universal Learning Design Guideline 2.0, checkpoint 5.3 of item 20 (using less tools for practice and performance) And fluency) into observable items.

3) Guideline 6: Providing various choices according to autonomous execution function

The highest level of human competence to act proficiently is the so-called "executive function". Execution capabilities enable humans to overcome impulsive, short-term responses to the environment and establish effective strategies to set long-term goals, reach goals, monitor progress, and modify strategies as needed. Implementation Capabilities To extend competencies, support for low-level technical implementation (scaffolding) minimizes the involvement and progression of execution capabilities and provides support for high-level execution capabilities and strategies (scaffolding) To be more effective and develop.

According to the Universal Learning Design Guidelines 2.0, it is helpful to guide learners in setting appropriate goals, supporting planning and strategy development, facilitating information and data management, and enhancing the ability to monitor learning progress. It is suggested as a method to provide various choices according to autonomous execution function. <Table Ⅲ-6> are questions related to instructional strategy that can provide various choices according to autonomous execution function based on direct observation of class observation and expert validity based on checkpoint of universal learning design guideline 2.0.

<Table Ⅲ-6> The composition and contents of the question in Guideline 6

Q	Contents
21	Does it provide support for students to clearly identify their goals and objectives? · Publish goals, goals, and schedules on the blackboard and keep them visible. · During the class, a reminder is given to remind you of goals, goals, and schedules. · Provides guidance and checklists to help students achieve their goals. · Inadequate Example: If you simply finish and present your class goals, goals, and schedules at the beginning of the class
22	Does the student provide an opportunity to explain the strategies to plan and apply for problem solving? • Explain the student's strategy for solving a given problem and provide feedback · To explain the problem-solving process you want to apply and provide feedback
23	Do you provide the graphical organizer (schematic) or a handout that contains the information necessary to organize and collect information? · Provides reference material that organizes information needed for problem solving Provide handouts with key content to help organize information
24	Does it provide guidance to guide self-examination of quality and completeness of improvement? · Checklist for evaluation, presentation of score standard, etc.

Item 21 is the conversion of checkpoint 6.1 (guidance on setting appropriate goals) into observable questions. The inappropriate examples presented in the question reflected the results of the direct observation of the class. As a result of observing teachers' instruction, most of the teachers were able to confirm that they were referring to the goal, purpose, and schedule of the course in the introduction process. However, the guidance 6 emphasizes the need for constant exposure of the learner's goals, objectives, and schedules in order to improve the learner's performance.

Item 22 is the conversion of checkpoint 6.2 (supporting planning and strategy development), and item 23 is conversion of checkpoint 6.3 (facilitating information and data management), respectively. And item 24 translates to checkpoint 6.4 (to improve the ability to monitor progress).

3. Principle 3 (participation)

1) Instruction 7: Provide a variety of interesting choices

Unrelated to the learner's perception, it is difficult to induce a significant change in perception. Since the presented information is not processed, it can not change the learner's cognitive structure either now or later. Teachers make a lot of effort to induce students' interest and involvement, but they may be different from those students who actually pay attention and interest. It is therefore important to apply a method that reflects the differences between learners.

Checkpoints that incorporate guidance 7 to provide a variety of interesting choices include optimizing individual choices and autonomy, optimizing relevance and value to learners and optimizing reality, and minimizing threats or distractions . <Table Ⅲ-7> shows the items that are designed to be observable in the class by specifying the items presented as checkpoints.

<Table Ⅲ-7> The composition and contents of the question in Guideline 7

Q	Conyents
25	Do they differ in the level of discretion, autonomy, and rewards by presenting options for: · Presentation and selection of challenges by difficulty level · Presenting and selecting the compensation that can be provided when resolving the problem · presenting the time or sequence of completion of sub-element work, selecting
26	**Does it provide active participation, exploration, and experimentation opportunities?**
27	Does it include a process to associate learning experiences with real life? · Present related news · Presenting phenomena observed in everyday life · Present application method in real life · Explain the differences between the contents of learning and actual social phenomena
28	Do you encourage participation by many students by minimizing distractions or disturbing factors? · Teacher's acceptance of students' opinions and behaviors · Not to mention student's past failure experience · Make it possible to predict the day by posting timetables, Provide equal participation opportunities for diverse students • Block or minimize noise sources for attention.

Item # 25 is the conversion of checkpoint 7.1, which is an optimization of individual choice and autonomy, to observable items. Questions 26-27 refer to checkpoint 7.2 (to optimize relevance, value, and reality to the learner) and item 28 to checkpoint 7.3 (to minimize risk and distractions) As shown in Fig.

2) Guideline 8: Provide choices that help sustainability and perseverance

Many kinds of learning, especially technology and strategy-related learning, require constant attention and effort. When synchronized in this way, many learners struggle to maintain the effort and attention

needed for learning. However, it is important to build individual capacities of self-regulation and self-determination, because learners have a significantly different ability to refrain from responding to inappropriate stimuli that interfere with their efforts and attention.

According to the Universal Learning Design Guidelines 2.0, instructional activities that explicitly highlight goals or goals and diversify the needs and resources to optimize difficulty are taught with a universal learning design that provides continuing effort and persistent choice is. This is also the case for teaching activities to foster collaboration and peer groups and to promote mastery-oriented feedback. <Table Ⅲ-8> are the checklist items centered on the description of learning objectives, complexity and difficulty of tasks, interaction, and achievement-oriented feedback.

<Table Ⅲ-8> The composition and contents of the question in Guideline 8

Q	Conyents
29	Do you need to explain or rephrase your learning goals so that learners can clearly recognize your goals? · Explicitly explain the learning objectives and make them understandable. · Reading student's learning goals Ask questions to help students understand their learning goals
30	**Do you vary the degree of difficulty or complexity of the task to the level of individual students (or groups) within the scope of the learning activity in the class?**
31	Does it provide interaction and assistance with friends? Include activities that tell learners how to ask for help when and how they should ask their peers or teachers for help. · Peer education, cooperative learning, etc.
32	Do you frequently, timely, and explicitly provide feedback that emphasizes effort, improvement, and attainment of goals rather than comparing them to other students? · Pass on positive speech

The relationship between checkpoint and individual item is as follows. Checkpoint 8.1 (highlighting goal or purpose clearly) has been translated into question 29. Checkpoint 8.2 (Diversifying Requirements and Materials to Optimize Difficulty) is on page 30 and checkpoint 8.3 (fostering collaboration and peer groups) is on page 31. Finally, checkpoint 8.4 (promoting achievement-oriented feedback) was translated into question 32, so that it could be checked whether it was running during the class.

3) Guideline 9: Provides a choice for self-regulation

It is important to design the external environment to support motivation and participation, but it is also important to develop the learner's intrinsic ability to control his emotions and motivations. In order to effectively manage their participation and influence, they must provide sufficient alternatives to support the learner with a very different aptitude and previous experience.

The Universal Learning Design Guideline 2.0 proposes a pedagogical approach to developing expectations and optimizing learning motivation, promoting beliefs, coping skills and strategies, and developing self-assessment and reflection. <Table Ⅲ-9> are the items made by further refining the abstract expression of the checkpoint in the Universal Learning Design Guideline 2.0.

<Table Ⅲ-9> The composition and contents of the question in Guideline 9

Q	Conyents
33	Does it provide expectations and beliefs to optimize learning motivation? Ask questions about the achievements (goals) that the learner can actually reach. • Setting goals that learners can reach in practice · To act as a mentor so that the learner can consider the strengths and weaknesses of the learner in the process of establishing the goal that is suitable for him / her. · Ask for progress and advise during the process to reach the set goal Encourage learners' efforts to achieve goals
34	Does it provide models, scaffolding, feedback, etc. for self-management? · Describe and show how to control fear or overcome frustration · Describe and show appropriate emotional expression methods · Show videos with actual situations related to self-management technology • Evaluate aptitude and deal with specific phobias appropriately (suggesting, for example, "What should I do in order to do well in my field?" Rather than "I can not do math"
35	Do you provide tools or charts to see if there is a change in your behaviors? · Provide tools and charts that enable learners to collect their own behavior patterns and information. · (Problem) Provide a recording sheet to record the frequency of the behavior by oneself
36	Does the learner support alternative ways of getting or receiving feedback on his current learning situation, such as charts and templates? Ask questions about things you do not know. · Provide a questionnaire to understand the level of understanding of learners · Provides a chart or template to check goals by learning activity and learning stage

The contents of Guideline 9 are said to be difficult to apply to Korean education scene as a whole. However, this problem may be due to the use of abstract terms. Therefore, we have included many examples to help observers comprehend when compared with other items. In addition, there are many cases where these items are not applied in reality, but they are not applicable or have not been shown to be feasible. The relationship between the checkpoint and the question is as follows. Item 33 converts checkpoint 9.1 (to increase expectations and beliefs to optimize learning motivation) and item 34 to checkpoint 9.2 (facilitates coping skills and strategies) into observable questions. And check point 9.3 (developing self-evaluation and reflection) is applicable to the lesson through questions 35-36.

4. Organizing and analyzing observations

Observations were recorded for each principle - by frequency (see Table III-10). The application of principles should be applied in deciding whether universal learning design should be applied, but there is no criterion for the degree of application of the guidelines. Based on the frequency, a polygon distribution diagram (radar chart) is presented as <Figure III-1>, which makes it easier for teachers to analyze the SWOT for universal learning design later.

<Table Ⅲ-10> Result sorting framework

principle	Guideline	①Not applicable	②Intermittent	③Overall
Ⅰ. Symbol	1. Provide a wide selection of cognitive methods			
	2. Provides a wide selection of languages, formulas, symbols			
	3. Provides a variety of choices to help you understand			
	소 계			
Ⅱ. Behavior and Expression	4. Provide a means of physical expression			
	5. Provides a variety of choices for expression and communication			
	6. Provide various choices according to autonomous execution function			
	소 계			
Ⅲ. Participation	7. Provides a variety of exciting choices			
	8. Provides a choice that helps with persistent effort and perseverance			
	9. Provides a choice for self-regulation			
	소 계			

Ⅵ. Discussion and Suggestions

1. Discussion

The purpose of this study is to develop a teaching analysis tool that can effectively grasp the practice of universal learning design principles in classroom instruction. To do this, we developed a learning checklist based on the universal learning design based on the exploration of learning plans and recognition researches related to the universal learning design used in previous studies. Based on the results of the study,

First, checklists based on the Korean - style universal learning design were prepared based on the Universal Learning Design Guideline 2.0. In analyzing a lesson based on universal learning design, the criterion should be based on principles, guidelines, and checkpoints that the guideline suggests.

Second, by providing a concrete example, the criterion of class analysis is more clearly presented. The use of abstract terms is minimized in the process of converting checkpoints into items, and examples of teacher behaviors found in class situations are presented. And the usability evaluation and the validity review were conducted to remove the possibility of double interpretation of the question. In order for

classroom improvement to be effective, the results of class analysis should be accurately presented and feedback should be clear. In order to do so, although the criterion of class analysis must be specific, the existing class analysis criterion is comprehensive, and the results of class analysis are also superficial and formal (Ahn, 2013; Chun, 2008). If we look at the related standards that are used for universal learning design based instruction or recognition, we can see that principles and guidelines of universal learning design, such as 'presentation of information in various ways', 'expression of various methods', 'various participation' , And is designed to autonomously evaluate and describe the lesson from the perspective of the subject. Such an expression through the abstract terminology and the analysis of the researcher's reliance on the research subject may be influenced by the subject's competence or subjective viewpoint, and also affects the results of class analysis. Therefore, systematic and scientific analysis requires the recording and analysis of objective data. For this, specific teaching analysis criteria and standards should be provided (Kim, 2013).

Third, the checklist of the instructional analysis based on the Korean type universal learning design was composed of 36 questions, each consisting of 4 questions for each of nine guidelines constituting the principle of universal learning design. As a tool for analyzing the lesson, 29 items of instructional analysis tools for early childhood science instruction consulting (Ahn, 2014), Classroom Analysis Tools for Good Instruction Activities 68 questions (Kim, 2013), Questionnaire for Special Education Class Assessment Tool 87 (Kim, 2015) when compared, it is judged as appropriate level. Although the class analysis tool is important to analyze the class correctly, it should be able to collect and analyze the analysis efficiently(Kim, 2013), The existing class analysis tools require a lot of time and effort to analyze the class (Lee, 2007). In addition, considering that the school class is based on 40 ~ 50 minutes per class, and when there are a large number of questions, it is necessary to use additional methods such as video shooting for accurate analysis. It can be said that the level can be recorded at the same time or immediately after observation without any special measures.

Fourth, the developed tools suggested the order of principles and guidelines, not the method of analyzing class and the order of proceeding class. Despite the clear purpose and necessity of class analysis, it has been pointed out that it is difficult to realize the purpose of class analysis (Kim, 2013). In this regard, it is pointed out that there are many cases in which the expertise in class analysis is inferior due to lack of systematic education or training on class analysis when class analysis is conducted by a co-worker or self-diagnosis(Chung, 2006; Chung & Kim, 2010). Therefore, the checklist of the instructional analysis based on the Korean type universal learning design has priority to explain the principles and guidelines, and then presents the relevant items. This type of analysis tool minimizes the existing problems by considering sufficient understanding of universal learning design for researchers who will perform class analysis and taking pre - education as an essential element to understand the question.

2. Suggestion

Based on the results of this study and discussions, the following suggestions are made for further study.

First, it is necessary to understand the characteristics of application of universal learning design according to subjects by applying checklists based on Korean - style universal learning design analysis.

Second, it is necessary to grasp the difference between perception and performance by mutual comparison with the characteristic of class analysis by observer through simultaneous use of self - report teaching analysis tool.

Third, it is necessary to elaborate the Korean classical learning design based analysis checklists by constantly revising and supplementing them, as they may contain limitations in the development process and problems in the application process.

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Treatment Impact on Neuropsychological Traits of Female Victims of Sexual Violence with PTSD: A Prospective Study

A. C. F. Mozzambani, M. F. Mello

***Abstract*—**Introduction: Sexual violence occurs throughout the world; however, research on this subject is still scarce, with WHO estimates indicating that 1 in 4 women have experienced sexual violence by their intimate partner, resulting in a major impact on their physical and psychological health as well as on their occupational life. Due to the severity of the violence, there is a high probability that they will develop psychiatric conditions, including Post Traumatic Stress Disorder (PTSD), which compromises neuropsychological functions. Objectives: To evaluate neuropsychological functions in women victims of sexual violence with PTSD in a cohort over time (1 year), through instruments that measure cognitive alterations, clinical symptoms and risk factors. Methodology: Administration of the Clinician-Administered PTSD Scale (CAPS-5) to verify PTSD symptoms and the use of the following neuropsychological tests: Rey auditory verbal learning test (RALVT), concentrated attention test D2, abbreviated Wechsler intelligence scale (WASI), prospective memory subtests of the brief neuropsychological assessment battery (NEUPSILIN), scale digit subtest of the Wechsler intelligence scale for adults – 3rd edition (WAIS-III), Wechsler memory sale-revised (WMS-R), WMSIII spatial span subtest, Wisconsin card sorting test (WCST), Stroop test and the five-digit test (FGT). During the period, all the patients participated in a controlled clinical trial, receiving standard treatment according to the guidelines for conduct of the *Prove* (Violence Care and Research Program). Results: The results showed that there was an improvement in the attentional aspects with $p = 0.005$ in the difference of the digit test, and improvement of the concentrated attention with $p = 0.003$, motor speed with $p = 0.005$, oscillation amplitude with $p = 0.004$, number of errors with $p = 0.004$ in the D2 test. There was also an improvement in the executive functions, as well as a decrease in fatigue symptoms, besides improvement in the inhibitory control abilities in the FDT test with $p = 0.02$; there was also an increase in vocabulary and reasoning ability with $p = 0.005$ on WASI subtests. Conclusion: Sexual violence is a serious public health problem that should be treated as early as possible, in order to minimize the effects of violence and PTSD on neuropsychological functions, thereby providing a better quality of life for the patients.

***Keywords*—**Neuropsychological functions, PTSD, treatment, sexual violence.

Mozzambani A.C.F. Department of Psychiatry - Federal University of São Paulo (phone: 55-11-99919-4868; e-mail: a.mozzambani@uol.com.br).

Mello, M.F. Department of Psychiatry - Federal University of São Paulo (phone: 55-11-998240039; e-mail: feijomellom@me.com).

Neuropsychological Aspects in Adolescents Victims of Sexual Violence with PTSD

F. M. R. G. Silva, A. C. F. Mozzambani, M. F. Mello

***Abstract*—**Introduction: Sexual assault against children and adolescents is a public health problem with serious consequences on their quality of life, especially for those who develop post-traumatic stress disorder (PTSD). The broad literature in this research area points to greater losses in verbal learning, explicit memory, speed of information processing, attention and executive functioning in PTSD. Objective: To compare the neuropsychological functions of adolescents from 14 to 17 years of age, victims of sexual violence with PTSD with those of healthy controls. Methodology: Application of a neuropsychological battery composed of the following subtests: WASI vocabulary and matrix reasoning; Digit subtests (WISC-IV); verbal auditory learning test RAVLT; Spatial Span subtest of the WMS - III scale; abbreviated version of the Wisconsin test; concentrated attention test - D2; prospective memory subtest of the NEUPSILIN scale; five-digit test - FDT and the Stroop test (Trenerry version) in adolescents with a history of sexual violence in the previous six months, referred to the Prove (Violence Care and Research Program of the Federal University of São Paulo), for further treatment. Results: The results showed a deficit in the word coding process in the RAVLT test, with impairment in A3 ($p = 0.004$) and A4 ($p = 0.016$) measures, which compromises the verbal learning process ($p = 0.010$) and the verbal recognition memory ($p = 0.012$), seeming to present a worse performance in the acquisition of verbal information that depends on the support of the attentional system. A worse performance was found in list B ($p = 0.047$), a lower priming effect $p = 0.026$, that is, lower evocation index of the initial words presented and less perseveration ($p = 0.002$), repeated words. Therefore, there seems to be a failure in the creation of strategies that help the mnemonic process of retention of the verbal information necessary for learning. Sustained attention was found to be impaired, with greater loss of setting in the Wisconsin test ($p = 0.023$), a lower rate of correct responses in stage C of the Stroop test ($p = 0.023$) and, consequently, a higher index of erroneous responses in C of the Stroop test ($p = 0.023$), besides more type II errors in the D2 test ($p = 0.008$). A higher incidence of total errors was observed in the reading stage of the FDT test $p = 0.002$, which suggests fatigue in the execution of the task. Performance is compromised in executive functions in the cognitive flexibility ability, suggesting a higher index of total errors in the alternating step of the FDT test ($p = 0.009$), as well as a greater number of persevering errors in the Wisconsin test ($p = 0.004$). Conclusion: The data from this study suggest that sexual violence and PTSD cause significant impairment in the neuropsychological functions of adolescents, evidencing risk to quality of life in stages that are fundamental for the development of learning and cognition.

***Keywords*—**Adolescents, neuropsychological functions, PTSD, sexual violence.

Silva. F.M.R.G. (Department of Psychiatry - Federal University of São Paulo) (Phone: 55-11-98556-0528; e-mail:fgomes.psicologia@yahho.com.)

Mozzambani A.C.F. (Department of Psychiatry - Federal University of São Paulo) (phone: 55-11-99919-4868; e-mail: a.mozzambani@uol.com.br.)

Mello, M.F. (Department of Psychiatry - Federal University of São Paulo) (phone: 55-11-998240039; e-mail: feijomellom@me.com)

The Impact of Childhood Cancer on the Quality of Life of Survivor: A Qualitative Analysis of Functionality and Participation

Catarina Grande, Bárbara Mota

Abstract—The main goal of the present study was to understand the impact of childhood cancer on the quality of life of survivors and the extent to which oncologic disease affects the functionality and participation of survivors at the present time, compared to the time of diagnosis.

Six survivors of pediatric cancer participated in the study. Participants were interviewed using a semi-structured interview, adapted from two instruments present in the literature - QALY and QLACS - and piloted through a previous study. This study is based on a qualitative approach using content analysis, allowing the identification of categories and subcategories. Subsequently, the correspondence between the units of meaning and the codes in the International Classification of Functioning, Disability and Health for Children and Young, which contributed to a more detailed analysis of the impact on the quality of life of survivors in relation to the domains under study.

The results showed significant changes between the moment of diagnosis and the present moment, concretely at the microsystem of the survivor. Regarding functionality and participation, the results show that the functions of the body are the most affected domain, emphasizing the emotional component that currently has a greater impact on the quality of life of survivors. The present study allowed identifying a set of codes for the development of a CIF-CJ core set for pediatric cancer survivors. He also indicated the need for future studies to validate and deepen these issues.

Keywords—Cancer, Participation, Quality of life, Survivor.

Catarina Grande is with the Faculty of Psychology and Education Sciences of the University of Porto (phone: +351 6079700; e-mail: cgrande@fpce.up.pt)

Bárbara Mota, is with the Faculty of Psychology and Education Sciences of the University of Porto (phone: +351 6079700; e-mail: blopesmota@gmail.com).

Representations of Germanophobia during the German Unification and the Euro Crisis: A Comparative Study in the Portuguese Press

Ana Luísa Mouro, Ana Maria Ramalheira

Abstract—The Reunification of Germany, in 1990, was not received with great enthusiasm by other European countries. On the contrary, the union of the two German states was accompanied by great concern towards its possible political and economic consequences. The Europeans had not forgotten Germany's responsibility in the outbreak of the Second World War and many feared that this new nation would again long for a hegemonic role. During the following years, however, the notion of a threatening Germany faded away, giving place to a description of Germany as an economic giant but a political dwarf. Twenty years after the Reunification, with the outbreak of the financial crisis, Germany conquered a key and powerful position at the heart of Europe and Germanophobia started to gain ground again. The present study has been based on the survey, selection and critical analysis of news reporting, opinion articles, interviews and editorials, published in the weekly *Expresso* and in the daily *Público*, during two historical moments: the Reunification of Germany in 1990 and the European Crisis, between 2008 and 2015. The findings of this study will show that Germany's growing influence over the current European economic and political scene woke up old "demons" that had been "sleeping" since 1990.

Keywords—Media and Cultural studies, Euro crisis, German Unification, Germanophobia, Portuguese quality press.

Ana Luísa Mouro is a teacher and a PhD candidate at the University of Aveiro, Portugal (phone: +351 963 726 202; e-mail: anamouro@ua.pt).

Assessing the Social Impacts of Regional Services: The Case of a Portuguese Municipality

A. Camões, M. Ferreira Dias, M. Amorim

***Abstract*—**In recent years, the social economy is increasingly seen as a viable means to address social problems. Social enterprises, as well as public projects and initiatives targeted to meet social purposes, offer organizational models that assume heterogeneity, flexibility and adaptability to the 'real world and real problems'. Despite the growing popularity of social initiatives, decision makers still face a paucity in what concerns the available models and tools to adequately assess its sustainability, and its impacts, notably the nature of its contribution to economic growth. This study was carried out at the local level, by analyzing the social impact initiatives and projects promoted by the Municipality of Albergaria-a-Velha (Câmara Municipal de Albergaria-a-Velha -CMA), a municipality of 25,000 inhabitants in the central region of Portugal. This work focuses on the challenges related to the qualifications and employability of citizens, which stands out as one of the key concerns in the Portuguese economy, particularly expressive in the context of small-scale cities and inland territories. The study offers a characterization of the Municipality, its socio-economic structure and challenges, followed by an exploratory analysis of multiple sourced data, collected from the CMA's documental sources as well as from privileged informants. The purpose is to conduct detailed analysis of the CMA's social projects, aimed at characterizing its potential impact for the model of qualifications and employability of the citizens of the Municipality. The study encompasses a discussion of the socio-economic profile of the municipality, notably its asymmetries, the analysis of the social projects and initiatives, as well as of data derived from inquiry actors involved in the implementation of the social projects and its beneficiaries. Finally, the results obtained with the Better Life Index will be included. This study makes it possible to ascertain if what is implicit in the literature goes to the encounter of what one experiences in reality.

***Keywords*—**Measurement, municipalities, social economy, social impact.

I. Introduction

At present, it is noticeable through the media, in particular, informal documents and debates, a greater emphasis under the themes related to crisis, restructuring, authority, reduction of public expenditures that are prominent in reducing social benefits, unemployment and wage cuts at the level Governmental, private and public-private enterprises [1]. All these concepts are direct consequences of the economic crisis that Portugal has gone through in recent years. This crisis has manifested itself both economically and socially. As a result of the crisis, Portugal and the rest of Europe started to develop companies that are committed to social well-being and are aimed at solving the remaining problems of the crisis. These companies of social nature can be of private or public tutoring.

When analyzing the problem of the emergence of social enterprises, the growth of poverty in Europe is notorious and, initially, the countries did not have the means and tools to give an efficient response to the various problems that the crisis brought about, to promote and guarantee the sustainability of the community [2].

Currently, the social economy is seen as a promoter of improvement in the areas of education, unemployment and/ or social exclusion. The idea of social enterprises prevails in relation to the other typologies of companies, by the concept of heterogeneity and flexibility in adapting to the "real world and real problems", being seen as a point of reference in solving problems of the society [3]. As government institutions are no longer able to respond to social problems, research in the field of social enterprises is becoming increasingly important and how they have become competitive elements in economic growth and maintain social impact. There are a number of organizational characteristics and activities of public interest, previously stipulated [4].

This paper intends to analyze this issue and outline a panorama/trend of social enterprises in services for economic growth, that is, to measure their impact and whether it is significant in the markets; in particular, the study of the impact of these companies/projects on the economic level of municipalities. The municipalities are the governmental structures closest to their community.

The study aims to understand how the projects developed by the Municipality of Albergaria-a-Velha can be seen as "houses of the social economy" [5]; in other words, how social action projects are denominated companies social policies.

Each social action project has its own management, its own budgets and tools to be implemented in the field, having as main objective the satisfaction of a need of the society, namely of the community of Albergaria-a-Velha.

This study is characterized by three distinct moments of evaluation. The first part is the interviews for the analysis of social action projects; the second part is the realization and applicability of a questionnaire to the beneficiaries and their respective project teams and, finally, the adaptation of Index Better Life to the context of the municipalities. It should be noted that due to the diversification of contexts, this study had the need to delimit the study in the areas of employability, education and social welfare.

In view of the above, we intend to answer the following question: How can we measure the social impact of regional services, namely, in the Municipality of Albergaria-a-Velha. Next, the sub-questions inherent in solving the problem

Ana Raquel Monteiro Marques Camões is with the University of Aveiro, Portugal (e-mail: anacamoes@ua.pt).

question will be presented.

- How the SAP (Social Action Project) came about and how it is being implemented on the ground;
- How the techniques responsible for SAP feel and see the sustainability of it;
- How do beneficiaries evaluate the SAP that they enjoy in their quality of life;
- How to frame the SAP with the tools defended in the literature review.

As mentioned, methodologically, the study is divided into three parts, in which the first focuses on the analysis of SAP through interviews, the second part on the applicability of questionnaires to two distinct publics and the third part on the adaptation of the Better Life Index.

II. Theoretical Grounding

In recent years, the concept of social economy has been the subject of intense debate, in order to achieve an objective and clear definition.

The concept of social economy is often related to social intervention activities, such as the "third sector" or solidarity economy. There is currently no exact definition for each element and it is preferable not to differentiate them. What often prevails is the social reality in which the social economy or the third sector is inserted.

The concept of social enterprise has been generating some controversy, so no conceptual definition has yet been reached. Some authors such as Mort; Weerawardena and Carnegie "point to the fact that there is no precise and consistent definition of the term social enterprise" [6].

The terminology of social enterprise emerged in Italy in the late 1980s and began to be used throughout Europe in the 1990s [7]. In a first moment, social enterprises aimed to respond to environmental problems and the challenges and obstacles that non-profit organizations faced [7].

Social impact is a national and international concern, and increasingly, it is an object of study in debates in schools, universities, and communities, in order to determine measures and to define it in a clear and objective way.

The idea of social impact is strictly related to the social value produced by organizations [8], as a result from an activity that can have a negative or positive value.

The social economy begins to have some weight in the economy. According to a recent article in the national press, in Social Economy [9], there is already an awareness about the weight that the social economy can have in Portuguese GDP. "Although the value of the social economy can't be evaluated only by economic - financial criteria, other indicators such as well-being, sustainable development may be appropriate to measure the social economy, which has a dual-purpose operating in the market to achieve social objectives."

The social economy in Portugal in 2013 reflected around 2.8% of national gross value added (GVA), about 5.2% of total employment and about 6.0% of paid employment [10].

The most recent report of the [11], "the remuneration paid by the Social Economy constituted 5.2% of total remuneration, while the average remuneration in the sector corresponded to 86.4% of the average remuneration in the economy as a whole".

In Portugal, there are already a diversified number of organizations that compose the social economy sector. Currently, there are a group of activities such as sports, culture and recreation that represent about 50% of activities in the social economy. Social security, cults, and congregations also play a significant role in the set of social economic activities [11].

The social economy aims to respond to its community and involve it in its projects. The municipalities aim for a sustainable development at the community level, finding ideas, capacities, and experiences appropriate to the surrounding community [12].

The municipalities have to take into account the migration of people, especially from small-scale territories. It is necessary to create an involvement with these people in order to see prospects of continuing in that region [12].

The municipalities have to go beyond their old rural traditions, but meet these new needs imposed by society and the technological development. In this way, municipalities must have infrastructures that support the internet, cultural activities, cable TV installations, drinking water, waste system, public transport, school transport, revitalization of degraded spaces, creation of tourist routes within the municipality, access to doctors, and nurses [12].

In 2013, the European Parliament's Social Economy Framework Law proposes that social economy can be seen as an asset for local initiatives, being seen as an alternative to capitalism in the traditional profit oriented economy, by offering the opportunity to develop innovative initiatives [12].

There is now a need to create synergies between municipalities and its industrial assets and services in order to create "social economy houses" that will provide and offer services and products to their community [12]. Commonly cited examples include the provision of better services at lower prices, and the engagement in local entrepreneurship initiatives, job training centers, incubators, and shelters for the most vulnerable community. In this way, they will help the population to reorganize their lives, providing an increase of their well-being.

The "houses of the social economy" would be an old vision of what the people's home was, providing permanent monitoring of the community, revitalizing the areas lacking employability and economic sustainability [12].

The social economy is one of the essential tools in the aid of new solutions for the municipalities that increasingly face more cases of economic vulnerability of the community [12].

Measuring social impact is an added value to all stakeholders in the organization in order to understand how the organization is and what strengths and weaknesses and opportunities for improvement. According to Nicholls (2009), social impact measurement can help social enterprises establish realistic goals, monitor and improve performance, prioritize decisions and the most competitive access capital markets [13].

But measuring social impact may not be an easy task, an

organization's performance can be difficult as it may be related to various activities other than social [14]. States that "As it can't be effectively measured using traditional indicators"; in this way, the instrument used in for-profit enterprises cannot be applied to social ones.

III. Methodology

Methodologically, the present study is divided into three parts, the first part being interviews and the second part the questionnaire's applicability to the beneficiaries and the respective SAP staff, and the third part the adaptation of Better Life Index. It should be noted that due to the diversification of contexts, this study had the need to delimit the study in the specific areas: employability, education and social welfare.

In view of the above, we intend to answer the following question: How can we measure the social impact of regional services, namely, in the Municipality of Albergaria-a-Velha. Next, the sub-questions inherent in solving the problem question will be presented.

1. How SAPs have emerged and how they are being implemented;
2. How the SAP techniques feel and see the sustainability of it;
3. How do beneficiaries evaluate their quality of life satisfaction?
4. How to frame SAP with the tools defended in the literature review.

As mentioned, the study is divided into three parts.

In order to answer the central question, it is necessary to understand the reason for the appearance of social action projects within the City Hall. Today, the Chambers are close to their community and are the first to feel the difficulties that their community is expressing. Faced with this proximity, the City Councils are the first institution to respond or to direct their community during a process of socio-economic vulnerability.

The town councils are seen as social economy houses, in other words, these may have small social economy companies [14].

In the Municipality of Albergaria-a-Velha there are already several initiatives at a social level to address the failures provided by the crisis and the vulnerability of its surrounding community.

As the literature indicates, there are already some tools to measure social impact; however there is still some resilience in adopting them. Measuring quantitatively the social impact that SAP can have is difficult, although techniques such as certification that allow a more quantifiable assessment through audits and financial accounting already exist.

In terms of well-being and quality of life measurement tools such as Index Better Life already exist. At the literature level there are still not many measurements made at the regional level through social projects. Thus, for the present study, care was taken to study in detail the best way to measure the social impact of SAP.

As social action projects still do not have much information about the measurement theme, it is essential to define the best techniques that allow a more complete and interesting response from the scientific point of view.

A. Interview

The interview was prepared in advance. Before the interviews, each of the SAP that were analyzed was analyzed in order to have a greater knowledge and question the interviewee in a more assertive way, always giving space for it to express itself on their SBP.

In the first phase of the research process that aims to analyze the role of CM - Albergaria-a-Velha in solving problems in the areas of employability, education and social, we used the interview to promote debate and analysis of SAP of the municipality with the various constituent elements of the teams and the direction. Each interview had as its main objective the understanding and analysis of the rationale, the applicability and the opinion of its beneficiaries of the SAP. An analysis grid of SAP was elaborated with the intention of being the basic script of the interview process, in order to direct the key issues for the perception of the theme and its due response. However, during the interview, the various stakeholders have the possibility to encourage new issues in the subject under study.

The selection of the interviewees was based on the fact that they were the coordinators of each SAP and thus had greater knowledge of each project.

During the interviews, care was taken in the conduct of the interviews, providing uniformity and equity during the three interviews. The duration of each interview was approximately 1 hour and each individual meeting was held in each meeting room.

It is noted that the answers given and their opinions were recorded in the SAP analysis grid.

Before conducting the interviews, the "Project Analysis Grid" was sent to each T by e-mail so that they prepared for the type of questions that would be asked.

B. Questionnaire

In order to have a better perception of the reality among the beneficiaries of the social action projects and what the advantages and warnings that the SAP will have with the beneficiary community, a questionnaire, divided by eight sections, was administered in order to evaluate their satisfaction and their level of importance/agreement.

The questionnaire has two different audiences, the beneficiaries of the SAP and the elements of each SAP team. Thus, the initial questionnaire that would only be applied to the beneficiaries was adapted to the coordination teams of each SAP, with the aim of having two different perspectives of who benefits from the social action project and who coordinates it.

The questionnaire is based on de Sousa, being duly adapted to the theme under study and directed to the social economy [15].

It should be noted that the adoption of this method of analysis of customer satisfaction through the SERVQUAL method of the 5 Gaps, from the point of view of research in

Economics, is not used. The SERVQUAL model is used in Management Studies to Evaluate Customer Satisfaction, perhaps the purpose of the study is the social impact assessment and in this case, it can be seen, as the evaluation of its satisfaction in the project(s) social benefit. Measuring your satisfaction through this method allows you to have more reliable results and greater sustainability by checking the impact of SAP on the community that used it.

The questionnaire implemented contains questions that allow the identification of facts, attitudes, satisfaction, opinion and values of the respondents [16].

The types of question that the questionnaire refers to are open and closed questions. The open answer question allows you to get more information and the respondent has complete freedom to express their opinion. However, this type of question has the disadvantage in the subsequent analysis of the questionnaires by the researcher [16]. However, the closed-ended questions are easy to analyze, but the individual is limited to the options [16].

The questionnaire is composed of eight sections, three of which are common in both questionnaires, grouped by criteria to evaluate gaps between importance and satisfaction [17].

To elaborate the questionnaire, we resorted to an adaptation of the SERVQUAL model in order to evaluate the difference that the projects of social action can have.

The SERVQUAL model is based on the dimensions defined by Parasuraman et al.: "tangibility - associated with the appearance of physical and human elements; reliability - ability to provide the service in a dignified and cared manner; responsiveness - availability to help the customer and provide fast service; trust-knowledge of employees, provision of the service without errors and meets the defined dates; empathy - care and attention given to the client " [18].

According to Parasuraman et al., this model, SERVQUAL, based on the 5 Gaps, that is to say, "in the discrepancy between the expectations of the beneficiary of the service, the service that will receive and the perceptions about the service actually rendered" [19].

Given the objective of the research to analyze the impact that SBP beneficiaries have on them, they will present four of the five dimensions model throughout the questionnaire [20].

C. Index Better Life

The index created by the OECD Better Life Index makes it possible to evaluate the welfare of the society of the various OECD countries, in order to create policies for the various actions (education, income, housing, environment, social satisfaction, among others).

This study intends to contribute to the development of the adaptation of the index created by the OECD, at the municipal level, to create policies more directed to the needs of its community.

With the results obtained in the questionnaires, it is possible to create a municipal index, based on the objectives of the Better Life Index. To restrict this index, only the personal satisfaction of the beneficiaries will be analyzed, that is, how much the beneficiaries consider themselves happy, through the criterion "Feel happier".

The index is based on the mean of the criterion responses for each SAP. The adoption of this measure, serves as reference value for the creation of personal satisfaction ranking. Although this tool, in measurable terms, being subjective is, however, an advantageous tool for comparing how SAP contributes to the beneficiary's personal satisfaction.

IV. Results

In general, and as the results obtained are positive through, it can be concluded that the questions were answered as follows:

Through the interviews it was evidenced that SAP came about through governmental regulations that the Chamber accepted and developed, such as the PS-01, others emerged through synergies, such as the Padre António Vieira-Montepio Foundation and the IEFP, namely SAP, PED-01 And PED-02. Other projects have arisen within the scope of the needs of the municipality, with the objective to fill or minimize some problems, such as projects directed to well-being and education.

In view of the second question, the SAP techniques agree that they are sustainable and evidenced both in the interviews and in their questionnaires and the importance they give in the search for improvements in relation to the service rendered.

One of the techniques confirms that there is a desire to grow in social economy and there is already a project under development - "Social housing" - this project involves the restoration of buildings with the purpose of creating social neighborhoods for the economically vulnerable community, where these neighborhoods belong to the Chamber.

In the third question, the beneficiaries are mostly satisfied and confirm that their quality of life has increased, all SAP are an aid to their development and to their economic organization. However, a minority do not agree that their quality of life has increased, either because they have not yet found employment or because they are voluntary and in economic terms their quality of life is stagnant and improved only on a personal level.

To fit the empirical study with the literature it was decided to adapt the Index Better life, instead of being at the country level, to the municipalities and to use it as a development management tool. As evidenced by the literature, this index evaluates several areas allowing the creation of an index and policies to improve them.

In my opinion and as Leite refers, "municipalities are houses of social commendation" and yes, each project can be seen as a social enterprise, there is a need of the population, goals are designed to mitigate or reduce the effects of the problem, specific regulations are drawn up for each project and then the service that meets the needs of the population is elaborated [21].

The impact of regional services can be measured by adopting the questionnaires presented: with the adaptation of the SERVQUAL model and with the dimensions of the quality of the service provided for customer satisfaction. Through the transversally of a management tool it is possible to adapt to

the scope of an economic study.

V. Conclusion

Increasingly, partner companies have emerged within the framework of traditional third sector organizations, in order to respond to the needs of the population and the social repression experienced [22].

Currently, municipalities are looking for sustainable development with concern for socio-economic problems. They are privileged because of the proximity they have in their community, are the main agent of local development, strengthen strategies appropriate to their municipality and surrounding community, creating "a set of local actions taking into account the interests of their community" [23].

The municipality should offer jobs, education and services that meet the needs of its community, finding ideas, capacities and experiences to its community [23].

Social enterprises are essential in helping new solutions for municipalities that are increasingly faced with cases of community economic vulnerability [23]. In this way, it can be concluded that social action projects can be considered as social enterprises within the Chamber.

The growing importance in these new projects of social initiative is an asset, not only for the community that benefits from these projects and initiatives, but also for global and national economic growth.

These social action projects are a "trend", both in the acceptance of society and in the market itself. Nowadays, this new ideology of social projects provided by the City Council is indispensable, as it is the Municipal Councils that are closer to their community and feel their needs the most.

The social action projects in the Municipality of Albergaria-a-Velha are having a positive impact on their community, not only by the citizens who benefit from them, but also the other community that values these types of initiatives.

The City Council goes beyond education and qualifications, safeguarding the well-being of its community mainly from the most economically vulnerable population, assisting in the lease support by providing a monetary fund and contributing to the financing of monthly billing of domestic consumption of water, sanitation and urban waste.

In terms of educational projects, employability and qualifications, the City Council and the IEFP have created a job exchange that directs the citizen to a job more directed to his qualifications and taking advantage of and enhancing his professional and personal qualities, power the community to the entrepreneurship and to create their own employment by providing the business incubator.

At the educational level, the Chamber works together with schools in order to be closer to the younger community, encouraging higher education by offering scholarships, volunteering in the Municipality and for young people who prefer a more the professional, to choose a course with a high level of employability in the companies of the Municipality.

All these actions and social projects are having a high positive impact in the Municipality, reflecting in this way on the well-being and quality of life of the community. Increasingly, there is a greater importance and awareness of what the social economy is and the benefits it offers to society.

The present study entitled "Measuring Social Impact in Regional Services - the case of a Municipality" aims to answer four questions: How did SAP arise and how is it being applied on the ground? How do the techniques responsible for SAP feel and see the sustainability of it? How do beneficiaries evaluate the SAP that they enjoy in their quality of life? And, how to frame the SAP with the tools defended in the literature review. To answer these questions the research was based on three distinct moments: the interviews with SAP techniques, the application of questionnaires to the beneficiaries and the technical team and adaptation of Better Life Index.

Social action projects can be considered social economy enterprises, although they are being developed by the City Council, these projects aim to respond to the needs of their community such as social exclusion, education, employment and poverty. All CM-Albergaria-a-Velha projects aim to reduce or mitigate the problems of your community. SAP are developed in partnership with other entities, either defined by the Government or created by the Chamber itself, in which it creates its project for that specific need of its population.

The three moments of research were essential to answer the questions; however, it is noteworthy that the questionnaires were the tool that could measure the impact through the eight sections that it contained.

The primary results obtained from the beneficiary community are that together, SAP have a positive impact. They are mostly satisfied and claim that their quality of life has improved. The beneficiaries feel more confident and the involvement with the municipality is very important for their reintegration into the community.

The beneficiaries emphasize the importance of the beneficiary-employee relationship throughout the SAP process, as well as the knowledge of the employees according to each project. However, they make some complaints such as: excessive documentation, poor management of SAP delivery and frequent visits to the immediate surroundings of the Chamber. Suggest greater dissemination of the projects.

In the municipality of Albergaria-a-Velha, there are already several social action projects and it is expected to create new projects such as "Social Housing" (creating social neighborhoods for the most vulnerable population) and increasing vacancies for other projects such as the PED-01, and with the increase of the donation of school books, it is possible that higher numbers of the population benefit from these same books- PED-02.

The creation and enrichment of the industrial fabric will be possible with the restructuring of the professional courses and qualification of the unemployed in the areas most enriching the industrial fabric.

It is concluded that social enterprises and social action projects are already a concern for investors and entrepreneurs, but it is important that there is a greater promotion of social projects, with society, demystifying what this new ideology to society, such as increasing their quality of life.

For the development of the Social Economy, and especially

of social enterprises/ projects, it is necessary to resort to the management tools used in the traditional market in order to reduce the fears that researchers and entrepreneurs may have with this new concept.

This study is an example of how a social management tool can be adapted and consolidated with a tool for measuring social impact, in this case, the Better Life Index.

VI. Future Study

As future research work, the continuation of the application of questionnaires is suggested in order to evaluate the impact to other municipalities and in order to prove that the SAP is important for the development of the beneficiary, for the quality of life of the same and for the surrounding community. Adaptation of the Better Life Index is possible, in order to continue with the development and to evaluate other areas such as education and employability of the municipality and the creation of policies for improvement.

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