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DETERMINANTS THAT INFLUENCED THE USAGE OF INTERNET TECHNOLOGY

Introduction

The Internet has brought a huge change in the way we do things (Salman et al.,2013). The usage and diffusion of the internet has not been at the equal level and equal pace across the world (Dholakia et al., 2004). Most of the internet usage is attributed to the industrialized and devoted nations in contrast to the diffusion in the developing and underdeveloped nations. Obviously, a small number of countries use most of the internet, and a large number of countries have adopted a small proportion of the internet (Dholakia et al., 2004). Since majority of the world population resides in the developing and underdeveloped world, there are multiple levels of the technological and economic perspectives on the directions and magnitudes (Baliamousen-Lutz, 2003). This dual structure implies a national level diversity in the internet diffusion.

The diversity is associated with multiple factors that are enablers or inhibitors to internet diffusion in some countries or the others. From macro perspectives (Goodman et al., 1994), most of the factors converge to three main abstractive variables influencing the internet diffusion: economic factors, social-cultural factors, and political factors (Dholakia et al., 2004).

The economic factors influence the internet diffusion through the cost and price structure of the hardware and the access cost (Kshetri, 2002). Obviously the economically prosperous nations are likely to be able to afford and acquire the hardware and the subscription to the software and the internet. This plays an important rule in the usage of the internet. Nevertheless, the cost structure at micro level is one side of the coin, the cost of the infrastructural development and provision is the other. The former reflects the user's ability and the latter the public (state's) ability. Therefore, one of the most crucial factors in the internet diffusion is the economic factor which refers to the ability aspect of the diffusion.

However, despite abilities (economic provision) it is also likely that internet usage and diffusion may be influenced for better or worse. Social and cultural dimensions are known to have influenced the diffusion of any innovation in general (Fleron, 1977) and of the internet in the contemporary times in particular (Schneider, 1997). Social and cultural issues may hamper or expedite the access, adoption and the diffusion of the internet for one reason or the other (Roger, 1995). For instance,

norms and cognitive frames may differently influence the adoption and usage of the net in different cultural and social settings. The cultural setting is proximal to the understanding and the qualitative usage of the internet, while the normative setting may constraint or enables the diffusion. Institutional and cultural dimension reflect national level factors that provide infrastructural ability (Bourreau & Dogan, 2001) and institutional willingness (Kishetri, 2002).

In addition to the ability (economic) and willingness (socio-cultural) factors, there is a third kind of factor is generally associated with political dimensions of a region or nation (Fleron, 1977). More often, these political and national level factors are associated with the policies and institutional settings (Goodman et al., 1994). Related to the policy perspectives, the reserchers borrow the concept of the distributive capabilities (Sen, 1979) as a factor for internet diffusion (Sen, 1985, 1999). According to the distributive capabilities, mere abilities (economic resources) and willingness (social desire) are insufficient to explain the multiple diversities among and between nations (Sen, 1985). The distributive capabilities are the proactive structures, policies, roles and provision of the abilities and the willingness from the public policy to the private domain (Sen, 1985). Along this line, the distributive capabilities (public policies) are antecedent to the other factors in the context of the internet adoption and usage. In other words, national public policy leverages the ability (by reducing cost and increasing speed) and willingness (content and quality). The Internet was introduced in Saudi Arabia in 1994 for state academic, medical and research institutions. The Internet was officially made available Kingdom wide in 1997 and was accessible to the public by 1999 (CITC, 2013). Generally, there are two competing views on the internet diffusion (Kim, 2003). One view suggest that there are some common frames for the analysis on the diffusion (Goodman et al., 1994). The other views suggests differential treat to the factors in each context (Nguyen & Alexander, 1996). The Internet is quickly spreading in Saudi Arabia Figure 1. Illustrate the internet users in Saudi Arabia (CITC, 2012)

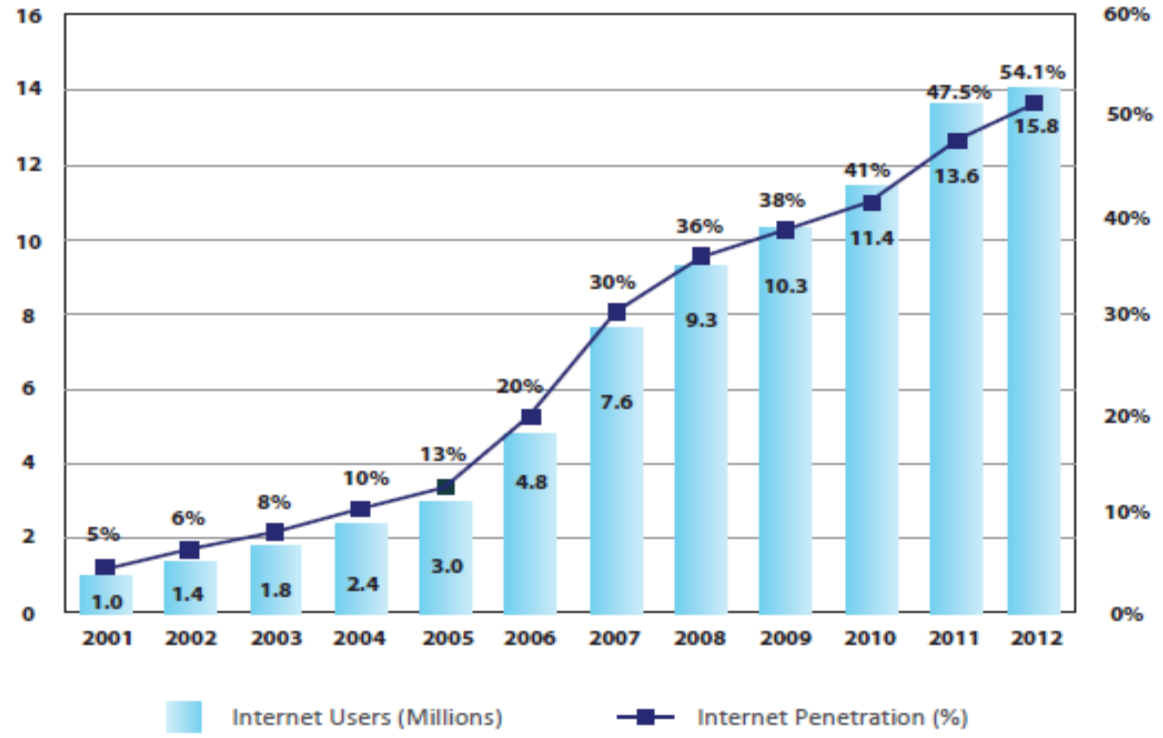

Figure 1: Internet Market Growth in Saudi Arabia

Although the internet diffusion has been at slower pace relative to the rate of diffusion in the advanced countries, the diffusion has been faster than most of the Kingdom's economic and regional peers. Saudi public technology policy has been consistent in promoting and managing the facilitation of the private and public sector adaptation of the technology through its proactive science and technologies policies. Several steps have been taken including economic, social and cultural factors. Accordingly, the public policy has been viewed an enabler (distributive capabilities) rather than inhibitor.

Given these distributive policy initiatives, the question then ushers from the internet users' perspectives: what specific economic (cost), quality (speed), and provision (access and contents) have influenced the usages of the internet in the Kingdom of Saudi Arabia. To answer this question, this paper explores whether the above three policy factors— cost, quality, and provision —have enabled or hampered the usage and diffusion of the internet in order to predict the likely effect of each of the above policies issues to be able to shape research and policy focus.

To explore and understand the internet existence as an espoused factor, and actual usage and diffusion as an emergent factor (Mintzberg, 1994) is important because presupposed assumptions that the merely available of a technology may be sufficient to the adoption for its efficient and effective attributes. There are plenty of arguments against the espoused view of the diffusion (Davenport, 1997). Some behavioural scholars suggest that it is even dangerous

practice and impose old assumptions on an emerging reality (evidences) (March & Olsen, 1989). Accordingly, it is important to explore whether there convergence between the espoused policy and emerging evidences.

In this exploratory attempt, the next section formally introduces the background of the hypotheses. The following section will highlight the method for the secondary data collection. The final section briefly provides the conclusion.

Referring to the policy factors and focusing on the infrastructural development in the Kingdom of Saudi Arabia for the provision, development, diffusion and management of the internet, three main areas stand out for the attention in the initiatives taken by the public agencies: cost, quality (speed) and provision. These are somewhat consistent with the prior literature that economic factors on the one hand and socio-political factors on the other hand influence the diffusion of the internet (Boymal et al., 2007; Kim, 2003). The economic factor is proximally used with the cost of the internet; the socio-political factor is proximally used with the quality and access of the internet.

It is generally understood that despite there are regional, cultural and national differences, internet in some ways is a common phenomenon (Nguyen, 1996). Anyone willing and able to access and the public and private information available on the internet can access anytime anywhere (Kim, 2003). Although there are some reservations about the effects of the macro factors, macro level measures on the diffusion of the internet, international agencies and particular countries are eagerly focusing on reducing cost, providing high speed and extending the access to the internet at globe level (Dholakia et al., 2004). These fundamental and concrete infrastructural and institutional policies are consistent with generally accepted factors associated with the enabling or hampering the diffusion of the internet (Bidgoli, 2004).

Following the general literature and specific policies in the Kingdom, three provisional hypotheses are developed to explore and predict the link between the policy initiatives and the internet usage by the public in the country. These three propositions reflect the on going policies and distributive capabilities concepts on the public policy dimension. These three infrastructural factors are given in three hypotheses:

Hypotheses 1. Provision is positively associated with the usage and diffusion of the internet in Saudi Arabia

Hypotheses 2. Cost reduction is positively associated with the usage and diffusion of the internet in of Saudi Arabia

Hypotheses 3. Quality is positively associated with the usage and diffusion of the internet in Saudi Arabia

Methods

Data will be gathered from the public press and media. The data sources are the public media in hard and soft publication. Such sources are have been referred to in the context of the e-government (Yldiz, 2007). The former refers to the news papers, magazines and business press. The latter refers to the news, surveys and the opinion polls on the internet with specifics to the Kingdoms policies and the usage of the internets. The observations reflect public policy agencies, the government long term science and technology policies and other institutional contexts. It has been recognized in the scientific literature that in information technology research, contextually embedded data obtain through different sources is equally valid and useful (Bauer & Scharl, 2000) useful (Gummesson, 1988). In addition to the public policy agencies, there are public opinions on multiple websites, consulting firms' predictions, and the academic research in terms of articles and press releases by individual companies and collective organizations. Each press release or a piece of the specific textual content will be treated.

Initially, the coverage to the internet was limited, and so were the press and public media attention to this phenomenon. By 2000 when the internet bubble was bursting at the global level, the attention to the internet has decreased, and the media and press coverage has followed on the internet related activities in Saudi Arabia. However, after peaking out in 2000, it decreased in 2001 for next two years. It increases in 2002 more than in 2001, but it drops by a huge numbers by 2005. In the subsequent years, 2006 and 2007, the coverage has increased with an upward trend.

In terms of the variables, there is one dependent variable—the internet usage. If there are symbols or semantic references to the internet usage (whether increased), it is code =1, else the observation is coded = 0. On the independent side of the variables, there are three focal variables and multiple other independent variables. The focal variables are cost, speed/broadband, and content access/provision. The peripheral independent variables included number of years. These variables will be treated control variables to see the effects of the focal variables in the focal links.

In terms of other independent but peripheral variables, they are analytically used as control variables in the analysis (Aneshensel, 2002). Among those control variables, there are

variables representing years. These variables will be included in the analysis for time effects. Other control variables are sectors and functions.

Conclusion

Saudi Arabian public policy on internet diffusion among general public is proactively facilitating the spread of internet usage for better information, knowledge, technological development and therefore for social and economic progress. This research study was motivated by theory and policy perspectives However, given that there is no single theory because of the differences in national contexts, the focus was on the policy factors. Following the general literature and specific policies in the Kingdom, three factors have identified in this study: provision, cost, and quality to explore and predict the link between the policy initiatives and the internet usage by the public in Saudi Arabia.

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SIMULATION TRAINING: TRANSFORM KNOWLEDGE INTO CLINICAL PRACTICE WITH NEW TEACHING MODEL

Introduction

Simulation training with scenario-based education has changed dramatically as the educational intervention in this area of clinical simulation becomes more mature over the time, and nowadays is widely used globally in healthcare and nursing education. It is important to have studies to determine what constitutes quality teaching and learning from the use of simulation-based clinical educational training. There are many research efforts have been explored, verified and/or proposed in this area of interests to promote simulation based clinical education. Withersty (2012) reviewed that many literatures suggested the more realistic the situation, the better information and skills can be transferred into the clinical setting. With the rise of technological advances, clinical simulation training has been used widely in recent years to provide instructions and opportunities for students to practice the clinical skills. Simulation is an attempt to replicate, to varying degrees of different clinical situations with knowledge integration for the training in practice.

The key characteristics of simulation in nursing education and practice in the present day is focused in the use of simulation training for students' skill development in a context of patient care that requires the use of clinical reasoning with scenario-based approach, together with needs to be strategic thinking in illustrating and practicing the required competencies. Areas of practice across different life span and continuum of care can be designed and chosen such as in medical, surgical, pediatrics, obstetrics and geriatrics, etc. And the scope of practice can be pre-set in the simulations to guide every aspect of the required learning skills. Tschannen et al. (2012) also reinforced that use of simulation has been identified as an integrative strategy to bridge theory to practice as well as the need in educating nurses in the future. Ricketts (2011) coincidentally found the role of simulation training is also to improve patient safety while to help the student nurse achieve their required competence, linking their theoretical knowledge with clinical practice by providing simulated practices, In addition, Ericsson (2004) reinforced that research has also shown that for

mastery of any clinical skill or behaviour, deliberate practice is required, as it correlates theory and practice.

The value of this type of simulation training is unquestionable as a substitute for actual clinical experience to teach or assess healthcare and nursing clinical skills. The integration of theory and practice should be based on a technique and focused on transforming students' learned knowledge and theories into clinical practices through this avenue of educational technology in simulation-based training. Gaba (2007) also defined simulation as a technique, not a technology, to replace or amplify real experiences with guided experiences, often immersive in nature, that evoke or replicate substantial aspects of the real world in a fully interactive fashion.

Jefferies (2005, p.97) outlined that the description of Simulation is an "activities that mimic the reality of a clinical environment and are designed to demonstrate procedures, decision-making, and critical thinking through techniques such as role playing and the use of devices such as interactive videos or mannequins". For instance, Human Patient Simulation Manikins that specifies simulations are manikin based, as opposed to actors or virtual reality. There are different types of simulations that can be categorizes as: Manikin based, Actor based, Hybrid, Laboratory, Health Care facility and In situ as well as Virtual reality, all of these allow the learner to interact with computer based world.

Waxman (2010) states that clinical simulation has been recognized as a teaching method using learning exercises that closely mimic real-life situations, and therefore the development of evidence-based clinical simulation scenarios and guidelines for students is an important step in ensuring the integration of the literacy of educational practice as proposed in my new Teaching Model, which integrated 'Three Constructs' into 'Six Domains', together with the guiding educational principles and needs for the five aspects of underlying learning skills requirements, which all embraced into this conceptual framework as the complete solution for the retainability of simulation training to transform knowledge into clinical practice for the 21st Century nursing education.

Concept of Simulation Training and its Practical Attributes

Beaubien and Baker (2004) described there is different degree to which the simulation mimics reality. Usually, there are different levels of fidelity that refers to different degree of realism which can be achieved by the choice of different types of simulations. Integrated simulators are defined as low, moderate and high fidelity model simulations, with brief descriptions as:

1. Low fidelity model simulators are used to instruct psychomotor skills, such as task

trainers.

2. Moderate fidelity simulators allow for students to listen for breath sounds, heart sounds, and even feel some pulses but do not show any movement such as chest movement when listening to breath sounds.
3. High fidelity simulators as described by Nehring (2010) that are computerized, full body manikins which then could provide real-time physiological and pharmacological parameters of persons of both genders ferrying ages and with different health conditions; in addition, this type of high-fidelity simulators may also be instructor-driven or model-driven, whenever being set for the running of a particular scenario.

Rudolph, Simon, and Raemer (2007) further redefined the definition of fidelity in three ways or modes as humans think about reality, in terms of (i) physical, (ii) conceptual, and (iii) emotional and experiential modes. In general, multi-fidelity simulators are the most complex design that can be combined to form integrated or full-scale scenarios to train interdisciplinary teams as supported by many previous studies (Beaubien & Baker, 2004; Issenberg et al., 2005), and can simulate with high-function critical learning tasks such as simulated patient as in the operating theater. However, the works of Levett-Jones, Lapkin, Hoffman, Arthur and Roche (2011) found that the overall students' knowledge acquisition scores were not influenced by the levels of manikin fidelity and there is no differences on the impact of high and medium fidelity simulation experiences on their overall scores, and therefore raised questions about the value of investing in expensive simulation modalities. Studies by Tschannen et al. (2012, p.15) also supported that "students participating in virtual simulations were able to transfer the knowledge learned in the classroom better than those not participating in the virtual simulations". They concluded that the use of a virtual environment may provide greater access to practice opportunities at a much lower cost than high fidelity simulators (Tschannen et al., 2012).

In summary, simulation in all of various forms, does allow students to take an active role in practicing clinical nursing skills. Hicks, Coke and Li (2009) indicated that simulation has been an important aspect of nursing program curriculums for decades, with which the art and science of recreating a clinical scenario in an artificial setting that in turn has allowed deliberate practice in a controlled environment, and students are able to practice a procedure prior to perform on a live patient. Simulation-based education do not necessarily to be involve with high end and very expensive computer platforms, in fact, some research studies supported even low end or low fidelity simulations can be used to provide effective teaching and learning approaches and experiences as the works suggested by Medley and

Horne (2005). The attributes of clinical simulation training is to facilitate technology-based learning that can be strengthened through a process of capacity building in the application of scenario-based creation for the simulated learning.

Conceptual Framework of this proposed Teaching and Learning Model

The impact of simulation-based training on clinical skill performance still remains a significant challenge (Medley and Horne, 2005; Nehring, 2010; Rudolph et al., 2007). As a way to maintain the functionality of such usage of "sim-platform" for transforming knowledge into clinical practice by using my newly proposed "365" Model for Teaching and Learning via simulation training is meant to provide a continuum and continuity to blend the teaching and learning strategies into an integrative manner through this supportive conceptual framework as a vehicle to enable teaching and learning to in line with the required and intended learning outcomes in the clinical practices. Since nursing practice in a real setting is very complex and dynamic, and this proposed new Teaching Model as a way of solution for the educational interventions, to help students to strengthen their essential abilities of performing clinical skills and engaging in simulated training activities with this proposed scenario-based simulation education, under the conceptual framework of integrating the three important constructs into six domains of learning and performance path for students' understanding development in practicing the five aspects of required underlying learning skills, which are derived from the educational principles and needs for nursing education.

These new teaching and learning model provides a means for promoting the retainability of simulation training and acts as the integrative educational tools and functional catalyst to further support the knowledge transformation into clinical practices in using this simulation-based educational training. It is recommended that the scenario-based simulation education should be incorporated into the curriculum of nursing education thoughtfully and carefully plan, in order to optimize the functionalities of features of learning with real capability of transforming usable knowledge into real clinical practices with true integration of theory into practice in focus as the new trends in learning and training.

An opportunity to improve training consistency by combining the conceptual demand and guidance projected therewith in the simulated-based training, with the creation of realistic patient scenarios to give the nurse learners the simulated-practices to master the required clinical training, as developed from the *Five* aspects for educational principles and needs for the underlying learning skills with justifiable clinical reasoning, to boost the performance outcomes obtained in the path as described under *Six* domains for reflecting and consolidating

these knowledge applications that connected through the concepts of *Three* essential constructs in the processes of simulation training for clinical practices. Justifiable clinical reasoning can be incorporated and retained in performing clinical practices through the learning skills required in simulation training that embraced with the strategies by reinforcing the catalyst tools as in the concepts invented under these "Three Essential Constructs".

Conceptual components of this "365" Model

The conceptual framework of this proposed "365" Model for teaching and learning in clinical simulation training is based on a set of quality indicators from three inter-related constructs – which are listed in the following 'category A' for the core components of the "Three constructs" that included (i) concept of 'knowledge about knowledge', (ii) scenario-based approach with the use of Nursing Process, and (iii) an Inventive Simulation Evaluation Rubrics as the guiding indicators and approach, together with 'category B' of the "Six domains" for learning and performance path in understanding developments for the underlying learning skills required as derived from the educational principles and needs for nursing education, which is under 'category C' for these "Five aspects". An overview of these core components of this "356" Teaching and Learning Model are as follows:

Category A: THREE constructs ("3")

1. Concept of 'Knowledge About knowledge'
2. Scenario-based approach with the use of Nursing Process
3. Inventive Simulation Evaluation Rubrics

Category B: SIX domains of learning path for understanding development ("6")

i. Knowledge obtained
ii. Comprehension developed
iii. Application practiced
iv. Analysis made
v. Synthesis generated
vi. Evaluation reflected

Category C: Five aspects of the underlying learning skills required with justifiable clinical reasoning ("5")

✓ Cognitive skill – Critical thinking with Clinical Reasoning
✓ Psychomotor skill – skills in performing clinical procedures
✓ Affective skill – how appropriate student relate to patient and its subsequent clinical care

- ✓ Ability to maintain a safe environment for patient safety
- ✓ Performing clinical care by incorporating required skills, as mentioned above with justifiable clinical reasoning that incorporates affective, cognitive, and psychomotor skills

This conceptual framework is developed to ensure the clinical mastery in performance paths for the outcomes of patient care in healthcare settings can be reassured through the enhancement of learning and performance path for understanding development as encompassing in the Six domains in order to facilitate the learning of required underlying skills with justifiable clinical reasoning that is being embraced under the Five aspects as educational principles and needs, which are then delivered via the teaching and learning strategies as proposed under the Three constructs that further serve as catalyst to connect and incorporate this necessity of integrations between theory and practice in nursing education. The conceptual framework of this newly proposed "365" Model of Teaching and Learning for Simulation Training is further elaborated sequentially from the focuses of the following perspectives.

The First Construct – Concept of 'Knowledge about Knowledge'

In support of the ultimate educational goal, the basic and balanced flows from different levels and aspects of knowledge learning is an important determinants in mounting the concept of "Knowledge about knowledge" as an interventional strategies, namely with the components as focused on the areas in the following dimensions (Li, 2014):

- Declarative knowledge(knowledge-zero)
- Cognitive knowledge (know what)
- Procedure knowledge or Applied skill (know-how)
- Reason knowledge or Systematic understanding (know-why)
- Condition-knowledge (know-when)
- Relation-knowledge (know-with)
- Affective knowledge (ways to learn knowledge)

According to Hunt and Furustig (1989) identified that this line of thought leads to the concept of "usable" knowledge. Hunt (2003) further clarified that "usable" means a learner is sufficiently sure of the correctness of the knowledge or belief so that it will be used to make decisions, to solve problems and to select and execute actions. Different dimensions and levels of knowledge, in fact, serve different meanings in students' learning path of understanding developments before becoming their "usable" knowledge, and those terms in different dimensions can be further described as examples taken, for instance in:

- ✓ Declarative knowledge – also named as 'Descriptive' or 'Propositional' knowledge, is the type of knowledge by its very nature, expressed in declarative sentences or indicative propositions, which is different from 'Procedural knowledge' (know-how), and especially how best, to perform some tasks.

- ✓ Cognitive knowledge – Cognitive abilities are brain-based skills we need to carry out any task from the simplest to the most complex. They have more to do with the mechanisms of how we learn, remember, problem-solve, and pay attention rather than with any actual knowledge.

- ✓ Reason Knowledge – Reason is absolute and only through clear, reasoned thinking, and then we can gain knowledge and understanding about reality in practice. Reason yields the performance clarity in practice. And therefore, Reason knowledge is the intelligibility in the process of critical thinking, which is the means of integrating the reality from the learned knowledge, of which its base is perception, with furtherance of gaining knowledge of entities to form into the concepts through this integration.

There is also a growing appreciation amongst both cognitive scientists and philosophers, of the importance of simulation to human cognition (Shanton & Goldman, 2010), as Hunt (2003) emphasized that high-level mind reading is more complex than low-level mind reading, as it tends to involve propositional attitudes and typically requires guidance by information that already stored in our long-term memory. And therefore, any simulation-based education should be aware the taught process should be involved the input of knowledge-based information to the students before any simulation-based education taken place. Whereas, the aspect of 'Personal creativity motivation' or termed as 'Affective knowledge' that tends to compel nursing students to be self-motivated to learn clinical skills, as the ways to learn knowledge and that would have an impact and effect on the learning comprehension, which incorporating with the six necessary domains in students' understanding developments for nursing knowledge transforming into clinical practice, with the help of teaching and learning strategies of the three essential constructs to improve students problem solving and critical thinking skills for justifiable clinical reasoning reflected-in-action.

The Second Construct – Scenario-based approach with the use of Nursing Process

The issues combined theory with practice by developing scenarios are expected to benefit

students' simulated practice on pre-set case-scenario, and it must be developed simultaneously for students perceive the reality of practice by using the pre-set case-scenario, so that such scenario-based approach would be useful in achieving the interventional goals for quality of patient care in accordance with the intended clinical learning objectives as quality standards in the referenced-criteria from the syllabuses, and which also embraced with the use of Nursing Process that is logical, consistent and similar to those curricula been designed, structured and already widely used in most of well-established programs as supported by many research studies in this area for decades (Kim & Min, 2013; Waxman, 2010). This second construct of scenario-based approach with the use of nursing process is specifically designed as integral part of teaching and learning strategies to interlink the development of evidence-based practice for facilitating the holistic clinical care with steps as illustrated in the well-established structural theory of the Nursing Process.

In this sense, the scenario-based approach with the use of Nursing Process provides a practice-basis with pre-set case-scenario for students performing reflected-in-action by practicing the implementation of nursing process together with justifiable clinical reasoning required, which can in turn to optimize students' creativity and critical thinking in these areas for integrating their learned knowledge and skills to transform into the clinical practice on the pre-set case-scenario. This reinforces the emphases on the premises of: When a learner can certain enough for a belief that been learned to make decisions, perform tasks and solve problems. If this belief is correct and justified, then it would qualify as 'usable' knowledge, which is incorporating into the form of 'certainty' as reference-criteria of students' learned knowledge and skills that further indicate the level of perceptions and concepts developed for the clinical care, as also well-defined under the Nursing Process in each aspects of: Health Assessment, Nursing Diagnosis, Planning for care, Nursing Interventions for implementations, and Evaluation of care outcomes.

The purposes of this approach in practice can assist students to describe, explain and predict experiences that required formulating nursing care plan with the provisions of rationales and clinical reasoning that are essential for effective decision making and implementation of nursing interventions for patient care, with these prescribed functional bases of using standardized nursing terminologies. Hack Tutors (2010) illustrated that the uses of nursing process provides a common language, such as in the form of nursing diagnosis for clinical practice and unifies the nursing profession with this well-defined system that clearly communicates the plan of care to healthcare team and nursing colleagues, as well as patients for their continuity of care towards expected goals, with which it further aids the development

of nursing standards in patient care.

Educators as the learning facilitators of simulation-based training have to assess whether the intended learning outcomes and the learner's performance matched or in line with the specified scenarios for simulated clinical training. As it is important to guide the students' learned theoretical knowledge with integration into the clinical practices and the expected outcomes of care, as in accordance with the required educational principles and needs under the underlying learning knowledge and clinical skills attainments. According to the studies by Kim and Min (2013, p.77), they will "apply the simulation-based curriculum and these scenarios for each year in the program accordingly and analyze how to enhance problem solving skills, clinical skills and nursing knowledge". Withersty (2010) reinforced that for learning to occur, experiences must be transformed and in simulation the extension is the experience within the simulation based on a scenario. Waxman (2010, p.29) also stated that "Nurse Educators should write an objective-driven scenario to set the stage for each training module or simulation experience to facilitate students in achieving learning outcomes". Therefore, this second construct can project a general focus to offer a systematic approach to identify the practice as do situation-specific as going through the steps in nursing process, which also served as procedural rules/guidelines or principles help to standardize nursing practice and in turn, it assists to organize the purposive care methodologically for the identified individual needs to deliver patient care accordingly.

The Third Construct – Inventive Simulation Evaluation Rubrics

It is very important to determine if the simulation training does provide an effective learning to students in acquiring and integrating theoretical knowledge, practical clinical skills and critical thinking, together with clinical reasoning as the demonstrated understandings in their simulation training, as clinical reasoning is the thought process that guides practice (Rogers, 1983). This inventive simulation evaluation rubric designed to reflect upon students' effectiveness of outcomes performance and detailed feedback and hence this inventive simulation evaluation rubric serves an importance as the reflective evaluation that can further incorporate into students' future activities of simulated training as integral part of debriefing for their subsequent quality improvement in either simulated practice or even at the actual clinical practicum.

Hicks et al. (2009, p.14) found that "all of the students either agreed or strongly agreed that the simulation experience provided them with opportunities to improve learning, the feedback received from the instructor during the simulation was helpful to learning and the simulation scenarios exposed them to cases with increasing levels of difficulty", which can also allow

them to improve and master the demanded clinical skills gradually. In addition, this Construct of an Inventive Simulation Evaluation Rubrics is used to differentiate the outcome performance of students consistently and concisely as in line with the Intended Learning Outcomes in the curriculum. Nehring (2010) also supports skills assessment as integral part of quality indicator for measuring performance outcomes, and states that "it is again time for nursing to consider expanding the measure of competence to include an assessment of skills" (Nehring, 2010, p.5), as students' overt behaviours during simulation training can in fact be observed and measured under this Third Construct of an Inventive Simulation Evaluation Rubrics.

Withersty (2010) pointed out Benner's novice to expert theory that examined nurses' competencies from being a beginner to an expert. In fact, when a learner moves from the magnitude of novice to expert, of which this process is characterized by a transformation from rules and behaviors to intuitive, contextually determined behaviour. In Kolb's experiential learning theory, simulation is an experiential and transformational process (Kolb, 1984). He asserted that it is through the experience that an individual learner learns. Kolb continued this suggestion and asserted it is only after the experience that an individual learner develops comprehension through abstract conceptualization. For that reason, these three important constructs are also integrated into six domains of learning and performance path for understanding developments, and which will be further discussed in the following section.

SIX domains of learning and performance path for understanding developments

i. Knowledge obtained
ii. Comprehension developed
iii. Application practiced
iv. Analysis made
v. Synthesis generated
vi. Evaluation reflected

From classroom learning of theoretical knowledge to perform the required clinical skills practice is always an important function in nursing education. Under these six domains of learning and performance path, in terms of (i) obtaining knowledge, (ii) developing comprehension, (iii) practicing application, (iv) making analysis, (v) generating syntheses and (vi) reflecting performance outcomes from the evaluation are the essentials for the fulfillment of transforming knowledge into clinical practices. Consequently, these six domains of understanding developments are linked into the conceptual framework of the previously discussed three important constructs, as further guiding indicators to reflect the

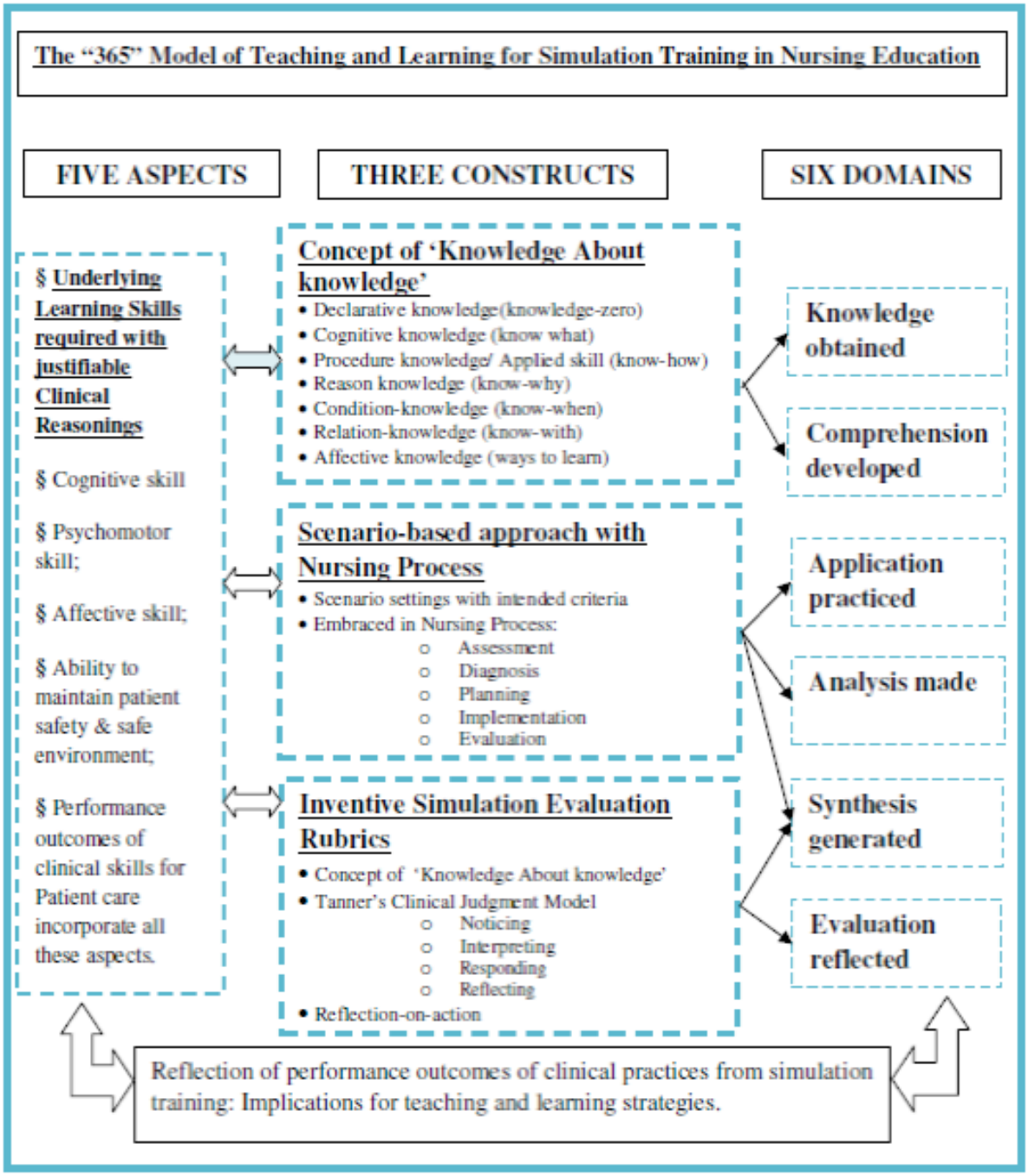
performance outcomes of the simulated clinical practices, with linkages to the Five aspects of underlying learning skills required under the education principles and needs in nursing education.

Five aspects of underlying learning skills required with justifiable clinical reasoning

- ✓ Cognitive skill – Critical thinking with Clinical Reasoning
- ✓ Psychomotor skill – skills in performing clinical procedures
- ✓ Affective skill – how appropriate student relate to patient and its subsequent clinical care
- ✓ Ability to maintain a safe environment for patient safety
- ✓ Performing clinical care by incorporating required skills, as mentioned above with justifiable clinical reasoning that incorporates affective, cognitive, and psychomotor skills

Clinical reasoning is being formed by having the required underlying skills being learned as indicated in the Five aspects in this "365" Model. Eva (2004) discuss his research study regarding the significance to enable students to marshal reasoning processes in a flexible and context-specific manner, which also demonstrated in most of research studies that suggested clinical teachers should stress the importance of clinical reasoning as well as capable of performing all the tasks with justifiable clinical reasoning (Eva, 2004; School of Nursing & Midwifery at University of Newcastle, 2009); and this paper has also echoed to such important aspects of underlying learning skills, as grouped under the Five aspects in this Third construct of the proposed Model, as part of the referenced-criteria for the competencies of performing all required tasks for nursing practice in simulation clinical education.

In sum, this conceptual framework of "365" Model posits a new Teaching and Learning concepts for the retainability of simulation training that serves as a catalyst set of interrelated concepts in nature for transforming knowledge into clinical practice by utilizing the interlinked conceptual framework and its strategies as projected explicitly in the 'Three Constructs' linked into 'Six Domains' of learning and performance path of understanding developments in facilitating the fulfillment of the educational principles and needs of the required underlying learning skills as intended in nursing education under the 'Five Aspects'. For the ease reference in this proposed Model with built-in "*3* Constructs", "*6* Domains" and "*5* Aspects", therefore it is titled as "365" Model of Teaching and Learning for Simulation Training in Nursing Education. The following Diagram 1 has shown its inter-components of this newly proposed "365" Model of Teaching and Learning for Simulation Training in Nursing Education.



This "365" Model supports the teaching and learning strategies for simulation training as well as the educational principles and needs for the 21st century nursing education and the purpose of simulation training is to achieve specific goals related to clinical learning with valid and reliable evidential outcomes that can also be verified from the specific evaluation through the 'Third Construct' of the 'Inventive Simulation Evaluation Rubrics', which allows for the assessment and evaluation of students' skills performance. This framework is an organized and systematic formulation with a set of networked perceptual and conceptual logical and consistent articulations generated in line with the purposive basis to further provide a specific

teaching and learning platforms, to integrate the learned knowledge with the required underlying skills for the exponents of transforming knowledge into clinical practices by using the effective strategies as specified in the "3 Constructs" for understandings developments as indicated in the "6 Domains" of performance and learning path to enhance the mastery of underlying skills as required learning under the "5 Aspects".

Conclusion

Learning is complex and teaching and learning is potentially a complex adaptive system, this proposed "365" Model present a significant challenge for fostering the retainability of simulation training by integrating with students learned knowledge and skills transform into a form of "usable" knowledge in clinical practice. Confucius (551 BC 479 BC) stated that "不聞不若聞之， 聞之不若見之， 見之不若知之， 知之不若行之; 學至於行之而止矣", which translated as "I hear and I forget, I see and I remember, I do and I understand". This, yet again, implied 'Understanding' is a practical way to measure a learner's knowledge, together with the embracement of the 'Retainability' in performing or practicing the tasks and skills. This paper proposed a conceptual model of "365" that is specifically designed to capture the full range of crucial dimensions in simulation training, with emphasis on the capacity to transform knowledge base learning into skill-based practice as the intertwined strengths for teaching and learning strategies in students' understanding developments for nursing education, which also serves as an innovative ways to accelerate nurses to better incorporate and transform their learned knowledge into the usable form for clinical practice. The concept of simulation training and its functional attributes for the quality improvements of clinical learning are embedded into this "365" Model for teaching and learning that pertains to promote the retainability of simulation training through the integration of students' learned knowledge and theories into clinical practices.

The concept of 'Knowledge About Knowledge' reinforces the development of this essentially required knowledge from different dimensions that incorporated and connected amongst the educational principles and needs of 5 aspects of underlying learning skills required and the other two constructs as well as the six domains in performance paths under this conceptual model of knowledge transformation into clinical practice for nursing education. It further reinforces the real capability of transforming knowledge into the usable form of learning is through the mastery of understanding, with which this proposed Teaching Model is the framework for ensuring the quality of learning by transforming the theoretical knowledge into clinical practices through the learning path of understandings developed during the simulation

training practices.

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ANALYSIS OF MULTI-LEVEL STEGANOGRAPHY SYSTEM FOR DATA SECURITY

Introduction

In this highly digitalized world, the Internet plays an important role in data transmission and sharing. However, due to its open nature, some confidential data might be stolen, copied, modified, or destroyed by an attacker. Therefore, security became pertinent to prevent confidential data from being detected during transmission. Encryption is a well-known procedure for secured data transmission. Although encryption achieves certain security of data, they make the secret messages unreadable and unnatural [1], and the protection offered by encryption can be broken with enough computational power. An alternate approach to encrypting data would be to hide the data and the existence of its communication. This way, only intended recipient would realize its true content [2].

Steganography

Steganography involves hiding data in such a way that it is difficult for an attacker to detect the existence of a secret message in the carrier file. One of the reasons that makes intruders to be successful is that most of the information they acquire from a system is in a form that they can see, read and sometimes comprehend. Therefore, intruders may reveal the information to others, modify it to misrepresent an individual or organization, or use it to launch an attack. One solution to this problem is, through the use of steganography [3].

Steganography is the art and science of writing hidden messages in such a way that no one apart from the intended recipient knows of the existence of the message. In contrast to cryptography, where the enemy is allowed to detect, intercept and modify messages without being able to violate certain security premises guaranteed by a cryptosystem, the goal of Steganography is to hide messages inside other harmless messages in a way that does not allow any enemy to even detect that there is a second message present [3].

This involves selecting an appropriate carrier file such as an image, text or audio file, removing the less important information from that file and injecting the hidden message in its

place. When the cover message and the secret message are combined, a stego image is created. Figure 1. illustrates a typical steganography system. Steganographic messages may be encrypted before they are inserted into the cover image for increased security. Only when the receiver knows the technique used to encrypt the message before he can recover the message [3],

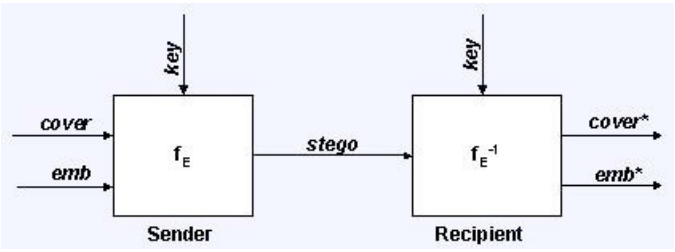

Figure 1. Graphical Version of the Steganography system [4].

The purpose of steganography is not to keep others from knowing the very existence of the information. If a steganographic method causes someone to suspect the carrier medium, the method has failed [5]. Although messages embedded into an image are often imperceptible to the human eye, they often disturb the statistical nature of the image [6]. The choice of the cover image in steganography is very important as it influences the security of the technique in a huge way.

The cover-object (cover) is a carrier or medium to embed a message (emb). There are several suitable medium that can be used as cover-objects such as network protocols, audio, file and disk, a text file and an image file. Message is the data that the sender wishes to keep confidential and will be embedded into the cover-object by using a stego-system encoder. It can be a plain text, a ciphertext, an image, or anything that can be embedded in a bit stream such as a copyright mark or a serial number. A key (stego-key) is a password, which ensures that only the recipient who knows the corresponding decoding key will be able to extract the message from a cover-object. The output of the stego system encoder is known as the stego-object.

A stego system encoder (f_E) can be represented by using the following relation:

$$I' = f_E(I, m, k) \qquad (1)$$

where I' is the stego-object, I is the cover-object, m is the message and k is the stego-key.

Principles of Steganography

Three principles can be used to measure the effectiveness of a steganography technique. The principles are amount of data, difficultly of detection and difficulty of removal [7].

Amount of data suggests that the more data you can hide the better the technique.

Difficulty of detection relates to how easy it is for someone to detect that a message has been hidden. Once you increase the amount of data hidden in a file, the risk that someone will be able to detect the message also becomes higher.

Difficulty of removal suggests that someone intercepting your file should not be able to remove the data easily.

Types of Steganography

Three steganography protocols exist namely; Pure Steganography, Secret Key Steganography and Public Key Steganography [8]. In Pure Steganography, the embedding and extraction algorithms should only be known by the message sender and the intended receiver.

With Secret Key Steganography, it is assumed that a party other than the sender and intended receiver knows the embedding and extraction algorithms. The sender embeds a message in a cover object using a secret key known as a stego key. If a third party intercepts the stego object and extracts the information, the result will be scrambled. Only the intended receiver who possesses the same stego key can extract the original message [8].

Public Key Steganography is based on the principles of Public Key Cryptography. In Public Key Steganography both a public key and a private key are used. The public key is used in the embedding process and the private key is used in the extraction process. This allows the sender and the receiver to avoid exchanging a secret message which might be compromised. However, this method is susceptible to a man-in-the-middle attack [8].

Steganography Image

This refers to the cover objects that steganography uses during transmission. They include images, texts, audio, and video, among others.

a. Steganography in Images

Coding secret messages in digital images is by far the most widely used of all methods in the digital world of today [9]. Digital images take advantage of human limited visual perception of colour. This field is expected to continually grow as computer graphics power also grows [10]. In a computer, images are represented as arrays of values or numbers that represent light

intensities at various point or pixels (these pixels make up the images raster data). These values represent the intensities of the three colours red, green and blue where the value of each of the three colours describes a pixel [11]. These pixels are represented horizontally row by row. The number of bits in a colour scheme, called the bit depth, refers to the number of bits used for each pixel [12]. The least number of bits in a current colour scheme is eight which means 8-bits are used to describe the colour of each pixel [12]. Monochrome and grey scale images use 8-bits for each pixel and are able to display 256 different colours or shades of grey [12]. Digital colour images are typically stored in 24-bit files and use the RGB colour cube [12]. The RGB Colour cube is illustrated in Figure 2

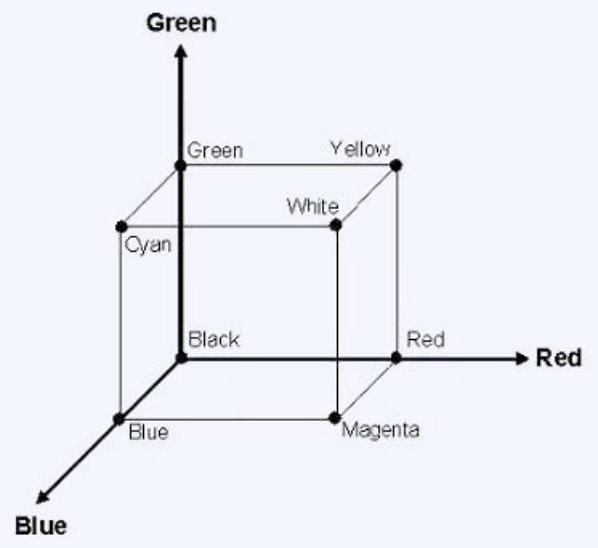

Figure 2. RGB Colour Cube [12]

b. Steganography in Audio

In a computer-based audio steganography system, secret messages are embedded in digital sound. The secret message is embedded by slightly altering the binary sequence of a sound file. Messages can be embedded in WAV, AU, and even MP3 sound files [13]. When hiding information in an audio file, the technique which is commonly used is Low Bit Encoding which is similar to Least Significant Bit Insertion used in image steganography. The problem with Low Bit Encoding is that it is generally noticeable to the human ear, so it is a risky method to use for masking information inside an audio file [13].

Spread Spectrum is another method used to conceal information inside of an audio file. The method spreads the secret message over the sound file's frequency spectrum, using a code that is independent of the actual signal. As a result, the final signal occupies a bandwidth in excess of what is actually required for transmission [8]. Echo Data Hiding is another method of

hiding information in an audio file. This method uses the echoes in sound files in order hide information. By simply adding extra sound to an echo inside an audio file, information can be concealed. The advantage of this method is that it can actually improve the sound of the audio file [13]. Due to the range of the Human Auditory System (HAS), data hiding in audio signals is challenging. The HAS perceives over a range of power greater than one billion to one and range of frequencies greater than one thousand to one [14]. The auditory system is very sensitive to additive random noise. However, while the HAS has a large dynamic range, it has a very small differential range – large sounds tend to drown quiet sounds [14]. When performing steganography in audio files, the steganographer must exploit the weakness of the HAS while being aware of the extreme sensitivity of the human auditory system [14].

c. Steganography in Video

When information is hidden inside a video, the steganographer will usually use the DCT (Discrete Cosine Transform) method [14]. DCT works by slightly changing each of the images in the video, only so much that it will not be noticeable to the human eye. DCT alters the values of certain parts of the images, usually rounding up the values [14]. Steganography in videos is similar to that of steganography in images apart from the fact that information is hidden in each frame of the video. As with image steganography, the less information that is hidden in the video, the chance that someone will notice is less and the more information you hide, the higher the risk of discovery.

d. Steganography in Documents

The use of steganography in documents works by simply adding white space and tabs to the end of the lines of a document. This type of steganography is very effective because the use of white space and tabs is not noticeable to the human eye. White space and tabs occur naturally in documents; therefore this method of steganography will not arouse suspicion [13].

The authors in [3] discussed the use of the implementation of this work focused on Least Significant Bits. In their work, the size of image and the message must be defined by the system. This is important to ensure the image can support the message to be embedded. The ideal image size is 800x600 pixels, which can embed up to 60kB messages. This process simply embedded the message into the cover-image without supplied any password or stego-key.

At the sender side, the data is converted into the bytes that is, each character in message is converted into its ASCII equivalent. Then the message bit is embedded in the digital image, each pixel of the image typically has three numbers associated with it, one for red, green and blue intensities, and these value often range from 0 – 255. In order to hide the message, the

data is first converted into byte format and stored in a byte array. Then each bit is embedded into LSB position of each pixel position.

The weakness in their work is that, an attacker can easily destruct the message by removing or zeroing the entire LSB plane with very little change in the perceptual quality of the modified stego-image. This may cause someone to suspect something hidden in the stego-image.

The authors in [15] messages were hidden in the least significant bits of the 8-bit binary strings representing the color numbers; it only consider grayscale image as the cover image. Each character in a message is converted into bits which denote the binary representation under the ASCII character system, which assigns characters with integer values between 0 and 255. In this work, each bit of the message is mapped to a single pixel of image. The remaining bytes from the image pixel are used to encode the length of the message. Hence in this work, to hide an N length message, the image must have $8 * N + 16$ pixels.

The limitation of their work is that the resulting image will still look mostly like the original except that a few points seem little out of place if it is examined very closely.

The authors in [16] implemented a model that combines cryptograph and steganography along with an extra layer of security were imposed in between them.

Their work deals with the security of text messages at the time of sending it over the network. In their algorithm, they used asymmetric key cryptography which means different keys are needed to encrypt and decrypt the data. They divided the domain of the key selection into different sub domains (a random prime number, a randomly generated number, decimal value of the pixel (only R) from the cover picture). In their approach they had given strength on division of the domain together with the key length. According to their concept, they encrypt the original text message letter by letter applying a function which involves certain mathematical operations using corresponding letters and also numbers from the original image. Then, they used two public keys and one private key for encryption and decryption. These keys are generated randomly following some constraints and equations.

In their method, they used code_matrix mapping method where the encrypted code is first broken digit by digit and converted into binary matrix having size DP (Depth of the cover image). After which they used matrix_pix mapping method where the matrices obtained previously are mapped into zone of pixels having area DP and then using least significant bit to modify the image pixel bytes.

This work developed a steganography system with an introduction of another level of security layer that make the existing technique a stringent one.

The author in [17] introduced a new method to steganography, White processing Picture in Three Colours (RGB).

In his work, hiding message involves embedding the message into digital image. Each pixel of the image typically has three numbers associated with it, one for each red, green and blue intensities, and these value often ranges from 0 – 255. In order to hide the message, the data is first converted into byte format and stored in a byte array. The message is then encrypted and then embeds each bit into the LSB position of each pixel position. It uses the first pixel to hide the length of message (number of character). They will use four colors in two pixel to store 8 bits character The first color in first pixel: r7 r6 r5 r4 r3 r2 r1 r0, the second color in first pixel: g7 g6 g5 g4 g3 g2 g3g2, the third color in first pixel: b7 b6 b5 b4 b3 b2 b5b4, the first color in second pixel: r7 r6 r5 r4 r3 r2 r7 r6.

Their algorithm measure the intensity of the pixel and then hides data by random pixel selection with a goal to hide maximum data in each pixel without creating extra unnatural noise. To perform the operation and find pixels whit higher intensity, they obtains average color elements in this image. The number is a boundary to determine the elements with higher intensity; these are elements that have greater average color intensity. Thus the intensity of pixels in the image which are selected and scatter in a pixel selection is created. In order to perform this algorithm, they find the total number of pixels and that number of pixels is marked to determine pixel with more intensity

This work creates a cross platform that effectively hide message inside a digital image file.

Authors in [18] discussed A New Efficient Approach towards Steganography.

In their work, every character in the text (message) is converted into its integer value and that integer value is mapped to the single pixel value of the image. Index array are the only information required to recover the message back from the image. There is absolutely no change in the image quality because they are not changing any pixel value of the image. They used MATLAB for their simulation, encoding is done at the sender end using encoding module and the information is sent to the receiver on the basis of which the receiver using decoding module to retrieve the original message from the key.

In their encoding procedure, firstly, they read the image file and then read the text file. Convert the text file into ASCII values. It then checks the length of the message and save it as any variable name it as length and so on. Start a loop and open the image file in an array format. It will then search for the ASCII value in the matrix of the grey image by increasing the index location. When the character is found in any location, it saves the location in a variable known as index. And in case when loop part is completed with length variable

becomes zero, it then find the mean of all index values and save in last position after dividing index values with mean. It now saves index variable with 'info.mat'. Thus 'info.mat' file is used for decoding process.

Using image as a key has an advantage that, they can use image of indefinite size.

The limitation of their work, It only allows the use of grey image as the cover object. Also the sender and receiver must use the same grey scale image

Authors in [19] discussed Hybrid Domain in Lsb Steganography.

In their work, the payload (message data) is embedded into the cover image by segmentation, they used DCT/DWT to generate the stego image for secret information to be transported to the destination over communication channel confidentially. Then the cover image (CI) and payload (PL) are divided into two cells of desired dimension (segmentation). The RGB components are separated in the cover image and payload cells in order to preserve the statistical characteristics of the color image after manipulating CI and PL. The RGB components of cover image cell I are individually transformed from spatial domain to frequency domain using DCT and DWT whereas the components of cell II of cover image are being retains zed in spatial domain itself (transformation). The embedding process requires the four MSB bits of each pixel in the payload cell 1 and cell 2 to be embedded in the second and fourth LSB positions of cover image cell I and cell II respectively to increase the security of the payload and generate stego image in transform domain. The stego image in the transform domain after embedding payload into the cover image is converted into spatial domain by changing cell I from transform domain into spatial domain. The final stego image in spatial domain is obtained by combining cell I and cell II [19].

Their work provides a model that has better PSNR and security as compared to existing techniques.

The limitation of their work is that the message (payload) to be sent is in image format always.

The authors in [20] Designing Some Imperceptible Data Hiding Methodologies Using Steganographic Techniques.

In their method, the message if first encrypted which gives an extra layer of protection. After which they will proceed to cover image and secret data analysis, the size of the data is checked and based on that they moved to different steps. Since their main aim is to conceal large amount of data with very negligible visual changes of cover image. Analyzing and finding different portion of cover image where they can directly store the data. This direct replacement of the pixel value to the corresponding secret data gives a freedom to store three

characters in one pixel whereas, the LSB methods require nine pixels to store same three characters. The portion selection can be either manually or through selection technique. The manual selection of image portion depends on the user. The marked area is taken as good place for direct storing of the secret data. The alternative selection process starts with the formation of histogram. The image histogram is a valuable tool used to view the intensity profile of a cover image; the histogram provides information about the contrast and overall intensity distribution of a cover image [20].

It develops steganographic system that can embed large data with very small changes in respectively small cover image.

Authors in [21], discussed Moderate Bit Insertion for Hiding Crypto-Data in Digital Image for Steganography.

In their work, message ciphering and embedding starts with reading the secret message character-wise starting from with the first character from a saved text file. Then they encrypt each character into eight crypto-bits using flexible matrix and they repeat this process for all characters of the saved text file to obtain a series of crypto-bits. Each pixel of the cover image is read starting from the pixel $Z(i,j)$ where $i = 1:256$ and $j = 1:256$. They now convert each pixel into equivalent eight-bit binary number. Embed one cipher-bit of message into the fourth LSB of pixel of the cover image. And they repeat the last two steps until all the cipher message bits are embedded into the cover image [21].

Post pixel adjustment is done by checking if the encrypted embedded data bit equal to the fourth LSB of pixel of cover image then no pixel adjustment is required and go to next pixel, If the encrypted embedded data bit is one, not equal to the fourth LSB of pixel of cover image then modify the pixel by $Z(i, 1\ to\ 3)$ If the encrypted embedded data bit is zero, not equal to the fourth LSB of pixel of cover image then modify the pixel by $Z(i, 1\ to\ 3) = 1$

They developed model with a new type of crypto-data hiding method with some distortion tolerance in moderate significant bit.

Future Work

Having gone through what presently exist in data security using Steganography system and the various weaknesses in the present system, there is need to design and implement a new model (secured multi-level steganography system) with compression techniques to increase the amount of information that can be hidden and the quality of the reconstructed (stego) image.

The system will have the ultimate objectives of undetectability, robustness and high capacity of the hidden data that has been a great concern in steganography research. This method will improve on the security usually exhibited by previous steganography system designs.

Conclusion

In this paper, we have analyzed the steganography algorithms presently in used. The importance, effectiveness, advantages and weaknesses of some of the steganography algorithms were discussed.

This analysis will result in the design of a secure multi-level steganography system with the ultimate objective of undetectability, robustness and high capacity of the hidden data that has been a great concern in the steganographic research, and the application system will improved the security usually exhibited by previous steganography system.

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CONSTITUTIVE EQUATIONS OF MITRAL VALVE LEAFLET TISSUES INTERMS OF PRINCIPAL STRETCHES

Introduction

A strain energy function which depends on five independent variables that have immediate physical interpretation is proposed for finite strain deformations of transversely isotropic elastic solids. Three of the five variables (invariants) are the principal stretch ratios and the other two are squares of the dot product between the preferred direction and two principal directions of the right stretch tensor. The set of these five invariants is a minimal integrity basis. A strain energy function, expressed in terms of these invariants, has a symmetry property similar to that of an isotropic elastic solid written in terms of principal stretches. Ground state and stress–strain relations are given. The formulation is applied to several types of deformations, and in these applications, a mathematical simplicity is highlighted. The proposed model is attractive if principal axes techniques are used in solving boundary-value problems. Experimental advantage is demonstrated by showing that a simple triaxial test can vary a single invariant while keeping the remaining invariants fixed. A specific form of strain energy function can be easily obtained from the general form via a triaxial test. Using series expansions and symmetry, the proposed general strain energy function is refined to some particular forms. Since the principal stretches are the invariants of the strain energy function, the Valanis–Landel form can be easily incorporated into the constitutive equation. The sensitivity of response functions to Cauchy stress data is discussed for both isotropic and transversely isotropic materials. Explicit expressions for the weighted Cauchy response functions are easily obtained since the response function basis is almost mutually orthogonal.

A commonly used strain energy function for transversely isotropic elastic solids is of the form written explicitly in terms of the invariants [1]. The invariants [1],

$$I_1 = \operatorname{tr} C,\quad I_2 = \frac{1}{2}\left((\operatorname{tr} C)^2 - \operatorname{tr} C^2\right),\quad I_3 = \det C,\quad I_4 = a \bullet Ca,\quad I_5 = a \bullet C^2 a, \tag{1.1}$$

are commonly used in the literature, where C is the right Cauchy-Green deformation tensor, tr denotes the trace of a second order tensor and a is the preferred direction in the reference configuration. The variables $\sqrt{I_3}$ and $\sqrt{I_4}$ represent the volume change and the stretch in the preferred direction, respectively, of a deformed material. However, the other three invariants do not have immediate physical interpretation. A strain energy function written in terms of the invariants given in Eq. (1.1) is not experimentally friendly. For example, a simple isochoric deformation such as uniaxial stretch in the preferred direction, perturbs the invariants I_1, I_2, I_4 and I_5 and a pure dilatation deformation perturbs all of the invariants. These deformations are not ideal in obtaining the functional form of a strain energy function if the functional form is determined by doing tests that hold four out five invariants constant so that the dependence in the remaining invariant can be identified. There are several sets of invariants proposed for transversely isotropic that appeared in the literature, see e.g., the works of [2], [3] and [4]. These sets are equivalent (in the sense of one to one correspondence) to the set of invariants given in Eq. (1.1) and are formulated to serve some purposes; there is no set which is generally suitable for all purposes.

In isotropic elasticity, strain energy functions that depend explicitly on the physically interpreted principal extension ratios λ_1, λ_2 and λ_3 have been widely and successfully used in predicting elastic deformations [5] and in terms of such variables the stress-deformation relations take on a concise and transparent mathematical form. In this paper, we extend this principal-ratio dependent to model strain energy functions of transversely isotropic elastic solids. Hence, we introduce a strain energy function which depends on five variables that have immediate physical interpretation. Three of the variables are the principal extension ratios $\lambda_i > 0$ $(i = 1,2,3)$ and the other two are $\zeta_1 = (a \bullet e_1)^2 > 0$ and $\zeta_2 = (a \bullet e_2)^2 > 0$, where e_1 and e_2 are any two of the principal directions of the right stretch tensor U. The physical meaning of λ_i is obvious and it is clear that $a \bullet e_i$ $(i = 1,2)$ is the cosine of the angle between the principal direction e_i and the preferred direction a. In addition to the simple and direct physical interpretation of our invariants, our model has an experimental advantage where a triaxial test can vary a single invariant while keeping the remaining invariants fixed. In view that 9 out of 10 inner products of our response terms vanish, and the response terms are nearly orthogonal, the Cauchy stress response functions (defined in Section 4) can be

explicitly expressed in terms of stress and deformation. This offers an advantage over many previous constitutive equations in the sense that a specific strain energy function for a particular material can be obtained with mathematical rigour; previous specific forms are generally obtained, heuristically. The form of strain energy function written in terms of the proposed variables enjoys a symmetrical property almost similar to the symmetry possessed by a strain energy function of anisotropic elastic solid written in terms of principal stretches.

Physical Invariants and Strain Energy Function in terms of Stretch Ratio

We first recall some essential kinematics of finite deformation of an orthotropic elastic solid. Consider a body occupying the region B_0 in some reference configuration. Let $\boldsymbol{F}$ be the deformation tensor and $\boldsymbol{X}$a position vector of a point in B_0. Under this deformation the point moves to a new position $\boldsymbol{x}(\boldsymbol{X}) \in B$, where B is the current configuration of the deformed body. The principal stretch $\lambda_i (i = 1, 2, 3)$ is given by

$$\lambda_i = \sqrt{e_i \bullet U^2 e_i} \qquad (2.1)$$

where $\boldsymbol{U}^2 = \boldsymbol{F}^T \boldsymbol{F}$. In this communication all subscripts i and j take the values 1, 2 and 3, unless stated otherwise.

In this paper we only consider an orthotropic material with preferred orthogonal directions $\boldsymbol{a}$ and $\boldsymbol{b}$. Following the work of Spencer (1984), the mechanical behaviour of an orthotropic solid can be characterized by a strain energy function

$$W_e = \hat{W}(\boldsymbol{U}, \boldsymbol{A}, \boldsymbol{B}), \qquad (2.2)$$

where the tensor $\boldsymbol{A} = \boldsymbol{a} \otimes \boldsymbol{a}$($\otimes$ denotes the dyadic product) and the tensor $\boldsymbol{B} = \boldsymbol{b} \otimes \boldsymbol{b}$.

Since

$$\boldsymbol{U} = \lambda_1 \boldsymbol{E}_1 + \lambda_2 \boldsymbol{E}_2 + \lambda_3 \boldsymbol{E}_3, \qquad (2.3)$$

where $\boldsymbol{E}_i = \boldsymbol{e}_i \otimes \boldsymbol{e}_i$, we can express

$$\hat{W}(\boldsymbol{U}, \boldsymbol{A}, \boldsymbol{B}) = \bar{W}(\lambda_1, \lambda_2, \lambda_3, \boldsymbol{E}_1, \boldsymbol{E}_2, \boldsymbol{E}_3, \boldsymbol{A}, \boldsymbol{B}). \qquad (2.4)$$

$\bar{W}$ is an isotropic invariant of $\boldsymbol{E}_1, \boldsymbol{E}_2, \boldsymbol{E}_3, \boldsymbol{A}$, and $\boldsymbol{B}$ i.e.,

$$\bar{W}(\lambda_1,\lambda_2,\lambda_3,\boldsymbol{E}_1,\boldsymbol{E}_2,\boldsymbol{E}_3,\boldsymbol{A},\boldsymbol{B})$$
$$= \bar{W}(\lambda_1,\lambda_2,\lambda_3,\boldsymbol{Q}\boldsymbol{E}_1\boldsymbol{Q}^T,\boldsymbol{Q}\boldsymbol{E}_2\boldsymbol{Q}^T,\boldsymbol{Q}\boldsymbol{E}_3\boldsymbol{Q}^T,\boldsymbol{Q}\boldsymbol{A}\boldsymbol{Q}^T,\boldsymbol{Q}\boldsymbol{B}\boldsymbol{Q}^T) \qquad (2.5)$$

for all proper orthogonal tensors $\boldsymbol{Q}$. Taking note that $tr\boldsymbol{E}_i = tr\boldsymbol{A} = tr\boldsymbol{B} = 1, \boldsymbol{E}_i = \boldsymbol{E}_i^2 = \boldsymbol{E}_i^3 = \cdots$, $\boldsymbol{A} = \boldsymbol{A}^2 = \boldsymbol{A}^3 = \cdots$, $\boldsymbol{B} = \boldsymbol{B}^2 = \boldsymbol{B}^3 = \cdots$ and $\boldsymbol{E}_i\boldsymbol{E}_j = 0$, $i \neq j$, using the results of Spencer (1971) for five matrices, it follows that W_e can be expressed as

$$W_e = W_f(\lambda_1,\lambda_2,\lambda_3,\zeta_1,\zeta_2,\zeta_3,\xi_1,\xi_2,\xi_3), \qquad (2.6)$$

where the invariants $\zeta_i = tr(\boldsymbol{E}_i\boldsymbol{A})$ and $\xi_i = tr(\boldsymbol{E}_i\boldsymbol{B})$. We call ζ_i and ξ_i "invariants" because they are invariants of the tensors involving $\boldsymbol{E}_i, \boldsymbol{A}$ and $\boldsymbol{B}$, although some of them do not have unique values if two or three eigenvalues of $\boldsymbol{U}$ have the same value. However,

$$\zeta_3 = 1 - \zeta_1 - \zeta_2 \text{ and } \xi_3 = 1 - \xi_1 - \xi_2. \qquad (2.7)$$

Hence, we can omit ζ_3 and ξ_3 in the arguments given in (2.6) and we have,

$$W_e = \widetilde{W}(\lambda_1,\lambda_2,\lambda_3,\zeta_1,\zeta_2,\xi_1,\xi_2)$$
$$= W_f(\lambda_1,\lambda_2,\lambda_3,\zeta_1,\zeta_2,1-\zeta_1-\zeta_2,\xi_1,\xi_2,1-\xi_1-\xi_2). \qquad (2.8)$$

The invariant set $\{\lambda_1,\lambda_2,\lambda_3,\zeta_1,\zeta_2,\xi_1,\xi_2\}$ is a minimal integrity basis with a syzygy (Spencer, 1971) (see Appendix A).

The function W_f enjoys the symmetrical property

$$W_f(\lambda_1,\lambda_2,\lambda_3,\zeta_1,\zeta_2,\zeta_3,\xi_1,\xi_2,\xi_3)$$
$$= W_f(\lambda_1,\lambda_3,\lambda_2,\zeta_1,\zeta_3,\zeta_2,\xi_1,\xi_3,\xi_2)$$
$$= W_f(\lambda_3,\lambda_1,\lambda_2,\zeta_3,\zeta_1,\zeta_2,\xi_3,\xi_1,\xi_2) = \text{etc.} \qquad (2.9)$$

To prove the above symmetry we consider an arbitrary proper orthogonal tensor $\boldsymbol{Q}$ written in the form $\boldsymbol{Q} = \widehat{\boldsymbol{Q}}\boldsymbol{Q}_0$, where $\boldsymbol{Q}_0$ is a proper orthogonal rotation tensor (rotation of $\frac{\pi}{2}$ about $\boldsymbol{e}_3$) having the properties $\boldsymbol{Q}_0\boldsymbol{e}_1 = \boldsymbol{e}_2, \boldsymbol{Q}_0\boldsymbol{e}_2 = -\boldsymbol{e}_1, \boldsymbol{Q}_0\boldsymbol{e}_3 = \boldsymbol{e}_3$ and $\widehat{\boldsymbol{Q}}$ is an arbitrary proper orthogonal tensor. The function $\widehat{W}$ have the property

$$\begin{aligned}&\widehat{W}(\boldsymbol{U},\boldsymbol{A},\boldsymbol{B})\\&=\widehat{W}(\boldsymbol{QUQ}^T,\boldsymbol{QAQ}^T,\boldsymbol{QBQ}^T)\\&=\widehat{W}\left(\lambda_2\widehat{\boldsymbol{Q}}\boldsymbol{E}_1\widehat{\boldsymbol{Q}}^T+\lambda_1\widehat{\boldsymbol{Q}}\boldsymbol{E}_2\widehat{\boldsymbol{Q}}^T+\lambda_3\widehat{\boldsymbol{Q}}\boldsymbol{E}_3\widehat{\boldsymbol{Q}}^T,\widehat{\boldsymbol{Q}}\boldsymbol{Q}_0\boldsymbol{A}\boldsymbol{Q}_0^T\widehat{\boldsymbol{Q}}^T,\widehat{\boldsymbol{Q}}\boldsymbol{Q}_0\boldsymbol{B}\boldsymbol{Q}_0^T\widehat{\boldsymbol{Q}}^T\right).\end{aligned}\tag{2.10}$$

Since the above equation is true for all proper orthogonal $\widehat{\boldsymbol{Q}}$, and in view of

$$\begin{aligned}&tr(\boldsymbol{E}_1\boldsymbol{Q}_0\boldsymbol{A}\boldsymbol{Q}_0^T)=\zeta_2,\quad tr(\boldsymbol{E}_2\boldsymbol{Q}_0\boldsymbol{A}\boldsymbol{Q}_0^T)=\zeta_1,\quad tr(\boldsymbol{E}_3\boldsymbol{Q}_0\boldsymbol{A}\boldsymbol{Q}_0^T)=\zeta_3\\&tr(\boldsymbol{E}_1\boldsymbol{Q}_0\boldsymbol{B}\boldsymbol{Q}_0^T)=\xi_2,\quad tr(\boldsymbol{E}_2\boldsymbol{Q}_0\boldsymbol{B}\boldsymbol{Q}_0^T)=\xi_1\ \text{ and }\ tr(\boldsymbol{E}_3\boldsymbol{Q}_0\boldsymbol{B}\boldsymbol{Q}_0^T)=\xi_3\end{aligned}$$

we have,

$$\begin{aligned}W_s&=W_f(\lambda_1,\lambda_2,\lambda_3,\zeta_1,\zeta_2,\zeta_3,\xi_1,\xi_2,\xi_3)\\&=W_f(\lambda_2,\lambda_1,\lambda_3,\zeta_2,\zeta_1,\zeta_3,\xi_2,\xi_1,\xi_3)\end{aligned}\tag{2.11}$$

The remainder of Eq.(2.9) follows in a similar fashion.

If the two families of $\boldsymbol{a}$and $\boldsymbol{b}$ fibres are *mechanically equivalent*, then $\widehat{W}$ must be symmetric with respect to interchanges of $\boldsymbol{a}$ and $\boldsymbol{b}$. Hence we have the symmetry

$$\widetilde{W}(\lambda_1,\lambda_2,\lambda_3,\xi_1,\xi_2,\zeta_1,\zeta_2)=\widetilde{W}(\lambda_1,\lambda_2,\lambda_3,\zeta_1,\zeta_2,\xi_1,\xi_2)\tag{2.12}$$

The commonly used invariants mentioned in Section (?) can be written explicitly in terms of the physical variables, i.e.,

$$\begin{aligned}&I_1=\lambda_1^2+\lambda_2^2+\lambda_3^2,\quad I_2=\lambda_1^2\lambda_2^2+\lambda_1^2\lambda_3^2+\lambda_2^2\lambda_3^2,\quad I_3=(\lambda_1\lambda_2\lambda_3)^2,\\&I_4=\lambda_1^2\zeta_1+\lambda_2^2\zeta_2+\lambda_3^2\zeta_3,\quad I_5=\lambda_1^4\zeta_1+\lambda_2^4\zeta_2+\lambda_3^4\zeta_3,\\&I_6=\lambda_1^2\xi_1+\lambda_2^2\xi_2+\lambda_3^2\xi_3,\quad I_7=\lambda_1^4\xi_1+\lambda_2^4\xi_2+\lambda_3^4\xi_3\end{aligned}\tag{2.13}$$

Note that, for a particular value of $\boldsymbol{C}$, where two or more of the principal stretches have the same value, some of the tensors $\boldsymbol{E}_1$, $\boldsymbol{E}_2$ and $\boldsymbol{E}_3$ are not unique; however, it can be easily shown via Eq. (2.13) that the classical invariants have unique values for the corresponding non-unique values of $\zeta_1,\zeta_2,\xi_1$and ξ_2. In view of this non-unique property, care must be taken in formulating the strain energy function (an example is given in Section 5.1). However, if a strain energy function is written in terms of combinations of variables, such as that given in (2.13), then automatically, it has a unique value for a particular value of $\boldsymbol{C}$. The inverse of Eq. (2.13) is given in the Appendix B.

For an incompressible material, $\lambda_1\lambda_2\lambda_3=1$, the number of variables is reduce to 6 and we can express

$$W_e = W(\lambda_1, \lambda_2, \zeta_1, \zeta_2, \xi_1, \xi_2) = \tilde{W}\left(\lambda_1, \lambda_2, \frac{1}{\lambda_1 \lambda_2}\zeta_1, \zeta_2, \xi_1, \xi_2\right) \tag{2.14}$$

$$W_e = \sum_{i=1}^{3} \hat{f}(\lambda_i, \xi_i) + \hat{g}(\lambda_1, \lambda_2, \xi_1, \xi_2) + \hat{g}(\lambda_1, \lambda_3, \xi_1, \xi_3) + \hat{g}(\lambda_2, \lambda_3, \xi_2, \xi_3),$$

Experimental Advantage

In a triaxial test of an incompressible solid, where $W_e = W(\lambda_1, \lambda_2, \xi_1, \xi_2)$, the principal stretches λ_1 and λ_2 can be varied independently. The invariants ξ_1 and ξ_2 can be varied independently by taking different samples, of the same material, with different preferred directions (relative to a principal direction (say)). Hence, it allows us to determine the functional form of W by doing tests that holds three out four invariants constant so that the dependence of W on the remaining invariant can be identified. We note in passing that the invariants I_1, I_2, I_4 and I_5 cannot be varied independently during a triaxial test. In addition to this, inview of the orthogonal properties given in Section 4, a response function can be explicitly expressed in terms of stress and deformation.

Hence, the functional form of W can be easily obtained by integrating expressions in Equation (20). The constitutive equation can be derived and predicted the result from the experiment. We note that for a strain energy function expressed in terms of the invariants I_1, I_2, I_4 and I_5, explicit expressions for the extra Cauchy stress response functions is complicated to be solve.

Uniqueness Properties of the Strain Energy Functions

Using series expansion techniques, the strain energy function can be written as

$$W_e = \sum_{i=1}^{3} \hat{f}(\lambda_i, \xi_i) + \hat{g}(\lambda_1, \lambda_2, \xi_1, \xi_2) + \hat{g}(\lambda_1, \lambda_3, \xi_1, \xi_3) + \hat{g}(\lambda_2, \lambda_3, \xi_2, \xi_3), \tag{4.1}$$

where $\lambda_3 = \dfrac{1}{\lambda_1 \lambda_2}$, the function $\hat{g}$ has the symmetry $\hat{g}(x, y, \phi, \varphi) = \hat{g}(y, x, \varphi, \phi)$· A special case of (21) is the augmented form

$$W_e = W_{iso}(\lambda_1, \lambda_2, \lambda_3) + W_{trn}(\lambda_1, \lambda_2, \lambda_3, \xi_1, \xi_2, \xi_3), \tag{4.2}$$

where

$$+ \bar{g}(\lambda_1, \lambda_2) + \bar{g}(\lambda_1, \lambda_3) + \bar{g}(\lambda_2, \lambda_3),$$
$$+ g(\lambda_2, \lambda_3, \xi_2, \xi_3),$$
$$= \sum_{i=1}^{3} f(\lambda_i, \xi_i) + g(\lambda_1, \lambda_2, \xi_1, \xi_2) + g(\lambda_1, \lambda_3, \xi_1, \xi_3) \tag{4.3}$$

g has the same symmetric property as $\hat{g}$ and $\bar{g}(x, y) = \bar{g}(y, x)$. W_{iso} is a strain energy function for anistropic material. A special form of the augmented strain energy with its isotropic base taking the Valanis & Landel form, is the semi-linear form

$$W_e = \sum_{i=1}^{3} \mu_T (\lambda_i - 1)^2 + 2(\mu_L - \mu_T) \sum_{i=1}^{3} \xi_i (\lambda_i - 1)^2 + \frac{\beta}{2} \sum_{i,j=1}^{3} \xi_i \xi_j (\lambda_i - 1)(\lambda_j - 1). \tag{4.4}$$

For mathematical simplicity, we proposed the special form of W_e which is linear in its parameters, i.e.,

$$W_e = \sum_{i=1}^{3} \mu_T r(\lambda_i) + 2(\mu_L - \mu_T) \sum_{i=1}^{3} \xi_i s(\lambda_i) + \frac{\beta}{2} \sum_{i,j=1}^{3} \xi_i \xi_j t(\lambda_i) t(\lambda_j), \tag{4.5}$$

For an incompressible material, we have

$$\sigma_{11} = \lambda_1 \frac{\partial W}{\partial \lambda_1}, \qquad \sigma_{22} = \lambda_2 \frac{\partial W}{\partial \lambda_2}, \qquad \sigma_{12} = 2\left(\frac{\partial W}{\partial \xi_1} - \frac{\partial W}{\partial \xi_2} \right) \frac{\lambda_1 \lambda_2 e_1 \bullet A e_2}{\lambda_1^2 - \lambda_2^2},$$
$$\sigma_{13} = 2\left(\frac{\partial W}{\partial \xi_1} - \frac{\partial W}{\partial \xi_3} \right) \frac{\lambda_1 \lambda_3 e_1 \bullet A e_3}{\lambda_1^2 - \lambda_3^2}, \qquad \sigma_{23} = 2\left(\frac{\partial W}{\partial \xi_1} - \frac{\partial W}{\partial \xi_2} \right) \frac{\lambda_1 \lambda_2 e_1 \bullet A e_2}{\lambda_1^2 - \lambda_2^2} \tag{4.6}$$

where $A = a \otimes a$, $\sigma_{12} = \sigma_{13} = \sigma_{23} = 0$ since $e_1 \perp e_2$, $e_1 \perp e_3$, $e_2 \perp e_3$. Preferred direction a is perpendicular to e_3, we have $\xi_3 = 0$ and $\xi_2 = 1 - \xi_1$ where $\xi_3 = 1 - \xi_1 - \xi_2$. The strain energy function can be expressed as

$$W(\lambda_1, \lambda_2, \xi_1, \xi_2)$$
$$= f(\lambda_1)\left[\mu_T + 2(\mu_L - \mu_T)\xi_1 + \frac{\beta}{2} \xi_1^2 \right] + f(\lambda_2)\left[\mu_T + 2(\mu_L - \mu_T)\xi_2 + \frac{\beta}{2} \xi_2^2 \right]$$
$$+ f(\lambda_3)\left[\mu_T + 2(\mu_L - \mu_T)\xi_3 + \frac{\beta}{2} \xi_3^2 \right]$$
$$+ \frac{\beta}{2}\left[2\xi_1 \xi_2 s(\lambda_1) s(\lambda_2) + 2\xi_1 \xi_3 s(\lambda_1) s(\lambda_3) + 2\xi_2 \xi_3 s(\lambda_2) s(\lambda_3) \right] \tag{4.7}$$

with $\lambda_1 \lambda_2 \lambda_3 = 1 \Rightarrow \quad \lambda_3 = \dfrac{1}{\lambda_1 \lambda_2}$.

For σ_{11},

$$\frac{\partial W}{\partial \lambda_1} = f'(\lambda_1)\left[\mu_T + 2(\mu_L - \mu_T)\xi_1 + \frac{\beta}{2}\xi_1^2\right] + f'(\lambda_3)\left(-\frac{1}{\lambda_1^2\lambda_2}\right)\left[\mu_T + 2(\mu_L - \mu_T)\xi_3 + \frac{\beta}{2}\xi_3^2\right] +$$

$$\beta\left[\xi_1\xi_2 s'(\lambda_1)s(\lambda_2) + \xi_1\xi_3\left(s'(\lambda_1)s(\lambda_3) + s(\lambda_1)s'(\lambda_3)\left(-\frac{1}{\lambda_1^2\lambda_2}\right)\right) + \xi_2\xi_3 s(\lambda_2)s'(\lambda_3)\left(-\frac{1}{\lambda_1^2\lambda_2}\right)\right] \quad (4.8)$$

$$\sigma_{11}$$

$$= \lambda_1 \frac{\partial W}{\partial \lambda_1}$$

$$= \lambda_1 f'(\lambda_1)\left[\mu_T + 2(\mu_L - \mu_T)\xi_1 + \frac{\beta}{2}\xi_1^2\right] + \lambda_1 f'(\lambda_3)\left(-\frac{1}{\lambda_1^2\lambda_2}\right)\left[\mu_T + 2(\mu_L - \mu_T)\xi_3 + \frac{\beta}{2}\xi_3^2\right] +$$

$$\beta\left[\xi_1\xi_2\lambda_1 s'(\lambda_1)s(\lambda_2) + \xi_1\xi_3\left(\lambda_1 s'(\lambda_1)s(\lambda_3) + \lambda_1 s(\lambda_1)s'(\lambda_3)\left(-\frac{1}{\lambda_1^2\lambda_2}\right)\right) + \xi_2\xi_3\lambda_1 s(\lambda_2)s'(\lambda_3)\left(-\frac{1}{\lambda_1^2\lambda_2}\right)\right] \quad (4.9)$$

Substitute $\lambda_3 = \frac{1}{\lambda_1\lambda_3}$,

$$\sigma_{11}$$

$$= \lambda_1 \frac{\partial W}{\partial \lambda_1}$$

$$= \lambda_1 f'(\lambda_1)\left[\mu_T + 2(\mu_L - \mu_T)\xi_1 + \frac{\beta}{2}\xi_1^2\right] - \lambda_3 f'(\lambda_3)\left[\mu_T + 2(\mu_L - \mu_T)\xi_3 + \frac{\beta}{2}\xi_3^2\right] + \beta\left[\xi_1\xi_2\lambda_1 s'(\lambda_1)s(\lambda_2)\right.$$

For σ_{22},

$$W(\lambda_1, \lambda_2, \xi_1, \xi_2)$$

$$f(\lambda_1)\left[\mu_T + 2(\mu_L - \mu_T)\xi_1 + \frac{\beta}{2}\xi_1^2\right] + f(\lambda_2)\left[\mu_T + 2(\mu_L - \mu_T)\xi_2 + \frac{\beta}{2}\xi_2^2\right] + f(\lambda_3)\left[\mu_T + 2(\mu_L - \mu_T)\xi_3 + \frac{\beta}{2}\xi_3^2\right]$$

$$+ \frac{\beta}{2}\left[2\xi_1\xi_2 s(\lambda_1)s(\lambda_2) + 2\xi_1\xi_3 s(\lambda_1)s(\lambda_3) + 2\xi_2\xi_3 s(\lambda_2)s(\lambda_3)\right]$$

$$\frac{\partial W}{\partial \lambda_2}$$

$$= f'(\lambda_2)\left[\mu_T + 2(\mu_L - \mu_T)\xi_2 + \frac{\beta}{2}\xi_2^2\right] + f'(\lambda_3)\left(-\frac{1}{\lambda_1\lambda_2^2}\right)\left[\mu_T + 2(\mu_L - \mu_T)\xi_3 + \frac{\beta}{2}\xi_3^2\right] + \beta\left[\xi_1\xi_2 s(\lambda_1)s'(\lambda_2) +\right.$$

$$\sigma_{22}$$

$$= \lambda_2 \frac{\partial W}{\partial \lambda_2}$$

$$= \lambda_2 f'(\lambda_2)\left[\mu_T + 2(\mu_L - \mu_T)\xi_2 + \frac{\beta}{2}\xi_2^2\right] + \lambda_2 f'(\lambda_3)\left(-\frac{1}{\lambda_1\lambda_2^2}\right)\left[\mu_T + 2(\mu_L - \mu_T)\xi_3 + \frac{\beta}{2}\xi_3^2\right] +$$

$$\beta\left[\xi_1\xi_2\lambda_2 s(\lambda_1)s'(\lambda_2) + \xi_1\xi_3\lambda_2 s(\lambda_1)s'(\lambda_3)\left(-\frac{1}{\lambda_1\lambda_2^2}\right) + \xi_2\xi_3\left(\lambda_2 s'(\lambda_2)s(\lambda_3) + \lambda_2 s(\lambda_2)s'(\lambda_3)\left(-\frac{1}{\lambda_1\lambda_2^2}\right)\right)\right]$$

$$= \lambda_2 f'(\lambda_2)\left[\mu_T + 2(\mu_L - \mu_T)\xi_2 + \frac{\beta}{2}\xi_2^2\right] - \lambda_3 f'(\lambda_3)\left[\mu_T + 2(\mu_L - \mu_T)\xi_3 + \frac{\beta}{2}\xi_3^2\right] + \tag{4.13}$$

$$\beta\left[\xi_1\xi_2\lambda_2 s(\lambda_1)s'(\lambda_2) - \xi_1\xi_3\lambda_3 s(\lambda_1)s'(\lambda_3) + \xi_2\xi_3\left(\lambda_2 s'(\lambda_2)s(\lambda_3) - \lambda_3 s(\lambda_2)s'(\lambda_3)\right)\right]$$

For preferred direction a parallel to e_1 (direction of fiber) and perpendicular e_2, and for equibiaxal $\lambda_1 = \lambda_2 = \lambda$ and $\lambda_3 = \frac{1}{\lambda_1\lambda_2} = \frac{1}{\lambda^2}$. Therefore,

$$\sigma_{11} = \lambda f'(\lambda)\left[\mu_T + 2(\mu_L - \mu_T)\xi_1 + \frac{\beta}{2}\xi_1^2\right] - \left(\frac{1}{\lambda^2}\right)f'(\frac{1}{\lambda^2})\left[\mu_T + 2(\mu_L - \mu_T)\xi_3 + \frac{\beta}{2}\xi_3^2\right] +$$

$$\beta\left[\xi_1\xi_2\lambda s'(\lambda)s(\lambda) + \xi_1\xi_3\left(\lambda s'(\lambda)s(\frac{1}{\lambda^2}) - \left(\frac{1}{\lambda^2}\right)s(\lambda)s'(\frac{1}{\lambda^2})\right) - \xi_2\xi_3\left(\frac{1}{\lambda^2}\right)s(\lambda)s'(\frac{1}{\lambda^2})\right] \tag{4.14}$$

Since $\xi_1 = a \bullet e_1$, $\xi_2 = a \bullet e_2$ and $\xi_3 = a \bullet e_3$ where $a // e_1$, $a \perp e_2$, $a \perp e_3$. Then, $\xi_1 = 1$, $\xi_2 = 0$ and $\xi_3 = 0$.

$$\sigma_{11} = \lambda f'(\lambda)\left[\mu_T + 2(\mu_L - \mu_T) + \frac{\beta}{2}\right] - \left(\frac{1}{\lambda^2}\right)f'(\frac{1}{\lambda^2})\mu_T \tag{4.15}$$

$$\sigma_{11} = \mu_T\left[\lambda f'(\lambda) - \left(\frac{1}{\lambda^2}\right) f'(\frac{1}{\lambda^2})\right] - \lambda f'(\lambda)\left[2(\mu_L - \mu_T) + \frac{\beta}{2}\right] \tag{4.16}$$

parallel to the fiber direction.

Similarly for σ_{22},

$$\sigma_{22} = \lambda f'(\lambda)\left[\mu_T + 2(\mu_L - \mu_T)\xi_2 + \frac{\beta}{2}\xi_2^2\right] - \frac{1}{\lambda^2} f'(\frac{1}{\lambda^2})\left[\mu_T + 2(\mu_L - \mu_T)\xi_3 + \frac{\beta}{2}\xi_3^2\right] +$$
$$\beta\left[\xi_1\xi_2\lambda s(\lambda)s'(\lambda) - \xi_1\xi_3\left(\frac{1}{\lambda^2}\right)\lambda_3 s(\lambda_1)s'(\frac{1}{\lambda^2}) + \xi_2\xi_3\left(\lambda s'(\lambda)s(\frac{1}{\lambda^2}) - \left(\frac{1}{\lambda^2}\right)s(\lambda)s'(\frac{1}{\lambda^2})\right)\right] \tag{4.17}$$

$$\sigma_{22} = \lambda f'(\lambda)\mu_T - \frac{1}{\lambda^2} f'(\frac{1}{\lambda^2})\mu_T \tag{4.18}$$

$$\sigma_{22} = \mu_T\left[\lambda f'(\lambda) - \frac{1}{\lambda^2} f'(\frac{1}{\lambda^2})\right] \tag{4.19}$$

Perpendicular at the fiber direction, therefore:

$$\sigma_{11} - \sigma_{22} = \lambda f'(\lambda)\left[2(\mu_L - \mu_T) + \frac{\beta}{2}\right] \tag{4.20}$$

Then,

$$\sigma_{11} = \sigma_{22} + \lambda f'(\lambda)\left[2(\mu_L - \mu_T) + \frac{\beta}{2}\right] \tag{4.21}$$

a is a preferred direction, σ_{11} is parallel to fiber and σ_{22} is perpendicular to fiber. Maple and standard least square method has been used to fit the theoretical curve to experiment data [10].

Parallel to the fiber direction,

$$\sigma_{11} = \mu_T\left[\lambda f'(\lambda) - \left(\frac{1}{\lambda^2}\right) f'(\frac{1}{\lambda^2})\right] - \lambda f'(\lambda)\left[2(\mu_L - \mu_T) + \frac{\beta}{2}\right] \tag{4.22}$$

Application to Mitral Valve Leaflet

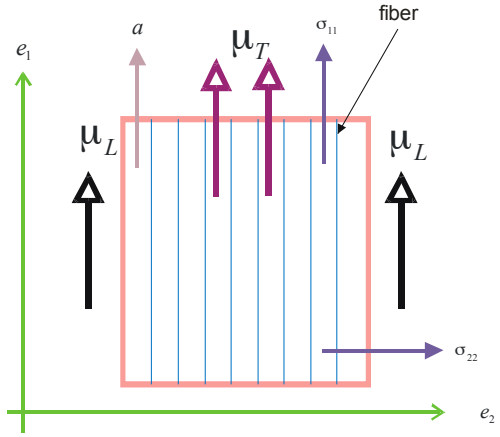


Figure 5.1: Physical diagram of a, σ_{11}, σ_{22}, μ_L and μ_T.

where

a is the preferred direction,

σ_{11} is the stress parallel to the preferred direction,

σ_{22} is the stress perpendicular to the preferred direction,

μ_L and μ_T are the constant from the shear stress represent the elastic moduli at the ground state.

We proposed the stress perpendicular to the fiber direction as

$$\sigma_{22} = \mu_T \left[\lambda f'(\lambda) - \frac{1}{\lambda^2} f'(\frac{1}{\lambda^2}) \right] \tag{5.1}$$

and the stress parallel to the fiber direction as

$$\sigma_{11} = \sigma_{22} + \lambda f'(\lambda) \left[2(\mu_L - \mu_T) + \frac{\beta}{2} \right] \tag{5.2}$$

Hence, we only use five parameters, α, β, λ μ_T and μ_L to predict the experiment. We propose the specific constitutive equation as $\lambda f'(\lambda) = x(x-1)^{\alpha} e^{\gamma x}$ for parallel to the fiber and . $\lambda f'(\lambda) = x(x-1)^{\alpha}$ To verify the material model, the tissues was subjected to biaxial strain conditions replicating experiments run by May-Newman and Yin (1998). When the curve fitting is imposed using Maple ,we found the result as follows

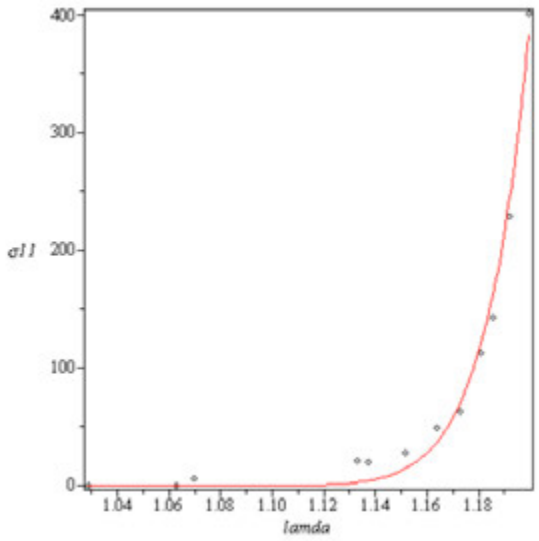
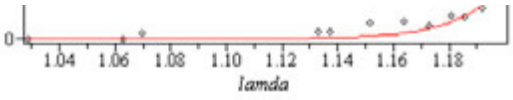


Figure 5.2: The stress in the direction parallel to the fiber is plotted against the streach in the fiber direction.

Figure 5.3: The stress in the direction perpendicular to the fiber is plotted against the stretch perpendicular to the fiber.



Result and Conclusion

The assumption that we make is all the parameters are positive and $\mu_L > \mu_T$. From the curve fitting process we found that the result as $\alpha = 9, \gamma = 12, \mu_T = 30.9399$ and -208.6077 (rejected), $4\mu_L + \beta = 653.7718$. The results are acceptable since the material constants are within range to the experiment by May-Newman and Yin [12], 1998. It is clear from Figure 5.2 and Figure 5.3 shows that our strain energy functions in terms of principle stretches compare well to the experiment.

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COSTING AND QUANTUM ANALYSIS ON UTILIZATION OF RE-USABLE SOLID WASTE AS CONSTRUCTION MATERIAL IN INDIA

Introduction

Affording a decent house at reasonable price has become a major talk of the 21st century in developing nations like India. But with rapid increase in population, the world saw an imbalance in proportion of people versus housing development due to several factors. In the decade 1991-2001, informal sectors in urban areas of Indian cities, had increased due to the increase in marginal workers from 2.2% in 1991 to 7.9% in 2001 (Government of India, 2007). But during 2001-2011 the decadal growth of India's urban population grew with 32 percent rising from 285 million to 377 million (Census 2001 & 2011; KPMG & NAREDCO, 2012). With such magnitude of high density rise in urban areas, shortage of housing is now taking its toll in the face of government policies. 99% of this shortage pertains to Economically Weaker section (EWS) and Low Income Groups (LIG) sector (Government of India, 2007). It's also evident that financial constraints have been the main factor for unaffordability in India. Some lowly paid workers end up living in slums, illegally encroaching over restricted areas (Pati, Iki & Homma, 2014).

Background

According to the Housing Policy 2007, the government focuses on facilitating accessibility to serviced land and housing for EWS and LIG and also increasing the supply of land (Government of India, 2007). Yet, there seems to be least concerns about the affordability rate by EWS and LIGs due to price rise of materials for the construction of building. In India, the cost of cement during 1995 was Rs. 1.25/kilogram while in 2005 the price increased around three times, but currently the average price is Rs. 5.6/kg. Similarly, in case of bricks, the price was Rs. 0.66 per brick in 1995, Rs. 1.9 in 2005 (Pappu, Saxena & Shyam, 2007) and the

present rate is Rs. 5 per brick. High transportation cost has also affected the people at the outskirts or periphery of towns / cities. In view of saving energy and conservation of resources, it is necessary to look into application of alternative construction material with extensive research work; which can help reduce major cost.

Solid Waste Generation And Its Effect

Human activities create waste. In urban areas, especially in the rapid urbanizing cities of the developing world, problems and issues of Municipal solid waste management (MSWM) are of immediate importance (Zhu, Asnani, Chris, Anapolsky & Mani, 2007). With around 48 metric tonnes (MT) of Municipal Solid Waste (MSW) being generated annually, it is believed that by the year 2047, MSW generation in India, is expected to reach 300 MT and land requirement for disposal of this waste would be 169.6 km^2 (Pappu, Saxena & Shyam, 2007). Despite many attempts to solve the problems towards Solid Waste Management (SWM), many municipalities are still stuck with storage, collection, and segregation and disposal method of management. Of late, recycling of non-bio-degradable waste such as plastic, glass and other waste has become a major solution of tackling SWM problems however, according to Central Pollution Control Board (CPCB) emission of toxic gases still takes place during the process of recycling which could pose a threat to health of those who dwell around the industry (CPCB, 2000).

Research Methodology

In order to understand the nature of this research, it is necessary to review previous studies on possible use of Plastic-Glass-Metal (PGM) waste as alternative construction materials. An extensive literature review and analysis was conducted in this research to consider the use of Plastic bottle waste as a replacement to brick.

Objectives

i. To find the quantum of plastic waste bottles that can be used for constructing a standard dwelling unit.
ii. To compare the cost between buildings constructed by conventional materials and solid waste.

Limitation

This research relies on data available as per the latest survey and other sources. The research analysis is limited to only Plastic waste bottle masonry. Earthquake mitigation research has been kept out of scope in this article.

Solid Waste As Resource for Alternative Construction Material

Researchers of today are trying to find more effective way of handling the solid waste in construction methods. For example: plastic shreds used for road construction, glass powder used as an alternate ingredient to the aggregates in making building blocks, incineration of waste, use of ash to make fly-ash brick and so on.

It is a fact that these solid wastes have no commercial values after being discarded. Thus using solid waste as a part of building construction including wall, roof and adobe, without labour cost will evidently reduce the overall cost of construction by at least 50% as compared to conventional method of construction and simultaneously reduce the bulk of waste to landfill (Valencia, Perez, Cortes & Froese, 2012).

Literature Review

Recently, there have been applications of waste PET (polyethylene)/plastic bottle, waste glass bottle and waste metal cans in building construction in different parts of the world as a replacement to traditional masonry (Pati, Iki & Homma, 2014; Inspiration Green, 2015). Plastic bottle waste has been genuinely utilized in Pilot project for Rural Housing in Honduras, requiring only 8 trained farmers of the local area (Andreas Froese, 2014) as shown in figure 1. Other NGOs has been using thrown out PET bottles as construction materials for a school in Lake Atitlan, Guatemela (Eyes of Gaia, 2015). It is evident that such buildings are strong and durable. Similarly, Glass bottle waste and metal can waste has been used as a replacement to the conventional building block as shown in Figure 2 and Figure 3. Though there is no accurate amount of number of solid waste used in any of the construction, yet it has given evidence about being affordable to urban poor due to its low-cost benefit.

Application method of PET / plastic bottles in construction

Discarded PET / plastic bottles are filled with dry soil and air-tightened with its cap as shown in Figure 4. Dry soil can come from construction waste, excavated soil etc., provided that they are sieved and free from pebbles and other aggregates which exceeds the required size.

They are laid alongside the layout in the same manner as the bricks are laid (Eco-technologia, projects, 2014) (Figure 5). Cement and sand are most appropriate materials for binding. Other locally available binding materials can also be of great help in reducing cost. To strengthen the structure of the construction, a Biomimetisches 4 Punkt Verknüpfung System shortly called as Bi4PVS, is used as shown in Figure 6. In this technique, a nylon rope is tied to each bottle-neck to avoid the collapse or inclination of the structure (Eco-technologia, projects, 2014). This technique gives better result when stacked alternatively above each other. According to several researchers, compressive strength is one of the most important properties of masonry in structural design (Kalumire, 2011). An unit compressive strength test analysis carried out by Kalumire K. from Uganda Martyrs University, June 2011, revealed that Plastic bottles has the unit compressive strength varying between 10.9 N/mm^2 and 23.1 N/mm^2 (Kalumire, 2011); whereas, the unit compressive strength of brick falls in the range between 3.5 N/mm^2 to 10.5 N/mm^2 (The Construction Civil, 2015). Thus, it shows that the former is still applicable for the construction purpose.

Quantification and Estimation

Planning: According to new scheme under Jawaharlal Nehru National Urban Renewal Mission (JNNURM), the carpet area of dwelling units (DUs) for EWS category can be taken between 21-27 sqm and 28-60 sqm for LIG categories (MHUPA, 2013). Thus, assuming a 37 sqm carpet area for a family of 4, a plan was drafted with minimum basic space requirement that includes: One Living room, one Bedroom, one bathroom and kitchen with dining space as shown in Figure 7, thus satisfying the requirement for LIG with above given categories.

Costing - Considering the materials to be conventional and traditional method of construction; a fair draft of cost and estimation was carried out provided all the cost of materials to be as per the market price. In this research, the cost of superstructure / masonry has been the main focus of study. Table 1 shows the part of costing and estimation of cement work. Total cost of cement concrete works was Rs.1,82,264 (USD 2958). Taking the average cost of the brick of (25 x 12 x 8) cm size for the construction and other necessary ingredient the approximate cost of brick masonry was found to be Rs.2, 49, 206 i.e. USD 3941.

Similarly, for the estimation of Bottle masonry construction, keeping all the materials as per the data; brick estimation was replaced with bottle estimation using 1.5 Litre capacity bottles of length = 30 cm and diameter = 9 cm each. Considering the cost of the waste bottle to be Rs.0, the approximate cost of the masonry was found to be Rs.2, 14,388 (USD 3480).

Quantity – The only advantage of brick is the manufacturing continuity in the industry and its availability in bulk, unlike Plastic bottle waste, which depends on the quantity of the discarded items by the households, commercial and other institutional places. Hence, it is important to calculate the total number of waste bottle that can be used in the given plan of the dwelling unit. The laying of the bottles is same as brick laying with the shorter side of the bottle along the length of wall. The number of bottle is calculated on the basis of 1m x 1m square portion of a wall in which around 110 bottles can be stacked as shown in Figure 8. Taking similar action on all sides of the wall, the total number of waste bottles was calculated.

Result and Discussion

Quantity - Excluding the area of staircase, door, windows and ventilator, the total number of waste bottle that can be used in a dwelling unit with an area of 37 m^2 was found to be 8286.

Benefit - Mathematically, the percentage decrease between the two methods of construction was found to be around 14%. The other item of work like self-labour and local available materials can play an important role in reducing the cost (Valencia, Perez, Cortes & Froese, 2012). Considering the self-employment, labour cost was taken as Rs.0, which resulted in the total cost of bottle work masonry to be Rs. 1,98,652 (USD 3233) ; and the percentage decrease was found to be 20%. Moreover, the wooden planks which are used for centring and shuttering of formwork can be replaced by disposed pipes or metal boards, as they can be re-used for several times compared to the traditional method.

This research has dealt with only cyclone and storm resistant aspect of structure. The nature of double floor is unknown yet due to lack of structural experiment.

Conclusion

The challenges imparted in both - housing affordability and solid waste management; can also be tackled with sustainability in the form of Re-usability of discarded resources. This research has attempted to highlight the potential of the waste container like plastic bottle, glass bottle and Metal Cans that can be used in many purposes.

The waste material varies with different cities depending on the type of raw material used by the households, commercial and industries. Waste glass bottles and metal container can also be re-utilized in a similar manner instead of applying the high-cost materials.

The number of discarded containers (plastic, glass and metal) that can be used for building a unit will vary according to the size of the material. Availability of such materials would differ from city to city according of the lifestyle of inhabitants.

Simplified method of construction can help the weaker section to encourage self-employment where little or no skill is required.

Future scope of study:-

i. Quantum of plastic bottles, glass bottles and metal cans waste generation
ii. Cost-benefit through construction using plastic bottle, glass bottles and metal cans waste.

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Table 1:

Cost analysis of concrete works

CONCRETE WORKS ON SUPERSTRUCTURE					
Sl.no	**Description of items**	**Quantity**	**Unit**	**Rate**	**Amount**
1	*Rigid and smooth centering and shuttering for R.C.C works including false works and dismantling the after casting including cost of materials.*				
a	Column & Floor Beam	6.958	Sqm	Rs.322.00	Rs.2,240.41
b	Lintel	2.507	Sqm	Rs.152.00	Rs.381.11
c	Roof Slab, Chajja	462.333	Sqm	Rs.225.00	Rs.1,04,024.87
d	Steps from entrance	2.473	Sqm	Rs.259.00	Rs.640.52
2	*R.C.C Work of Proportion (M20)*	8.242	Cum	Rs.4,566.00	Rs.37,631.74
3	*Straightening,cutting,bending,binding bent or coiled M.S/Tor Steel bars*	8.892	Qtls	Rs.4,200.00	Rs.37,345.56
Total cost of cement concrete works					**Rs.1,82,264.23**

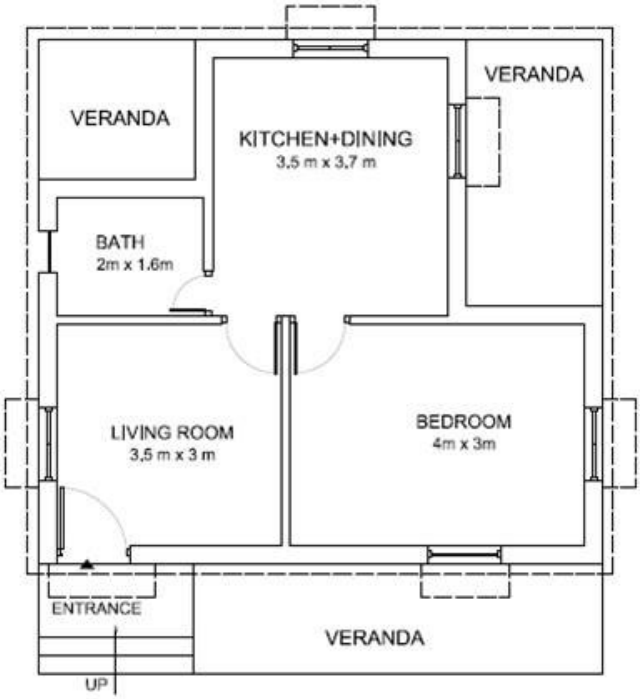

Figure.2 – Prince Edward Island Bottle House *ing empty Beer bottles (Inspiration Green, 2015)*

Figure.3 *– Using Aluminium Tin Cans for wall construction (Middle Earth Home, 2015)*

Figure.4 *– Plastic bottles filled with dry soil (Samarpan foundation, 2014)*

Figure.5 *– Plastic bottles being laid for wall construction (Volker et al., 2012)*

Figure.6 *– Plastic bottles tied with nylon rope and binded with construction waste and other local binders (Eco-technologia, projects, 2014)*

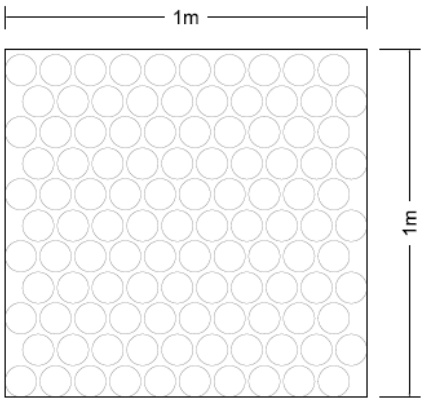

Figure.7 *– Plan of a single dwelling unit of 37m^2 area for a family of four [Auto-cad drafting]*

Figure.8 *– Elevation of the wall portion of 1m x 1m size [Auto-cad drafting]*

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SOURCES OF BACTERIAL CONTAMINATION IN READY-TO-EAT SALAD VEGETABLES SOLD WITHIN BAUCHI METROPOLIS

Introduction

Food outlets are places where different types of food are prepared and served to paying guest. These outlets usually congregate in areas where there is high number of potential customers (Alexander, *et al*, 2001). They play an important role as they provide a source of inexpensive nutritious meal for a large number of people (Alexander, *et al.,* 2001). Although most of the customers are usually concerned with the price of the food rather than its safety and hygiene (Bryan, *et al.,* 1988), a growing body of data from food borne disease outbreaks and studies of sporadic gastrointestinal disease of various aetiologies suggest that eating foods prepared in restaurants may be an important source of infection (Fredrick and Timothy, 2004). According to the research conducted by Guzewich and Ross (1999) on food borne disease outbreaks caused by food workers, through 1975-1998, about 89% of the outbreak occurred at food service establishments such as restaurants and cafeterias. They further stated that the majority of the foods types involved in the outbreaks include salads and sandwiches.

Salads are mixtures of minimally processed, ready-to-eat vegetables with or without dressing. They are good sources of nutrients especially vitamins (Arab and Lenore, 2006). Sources of salad contamination may result from the environment, the food handlers, the sources of the food, and the food itself. Due to the fact that salad is one of the foods that is served without further washing, cooking or additional preparation by the consumers or by the food establishment and is reasonably to be consumed in such manner, or simply as ready-to-eat. It may serve as a vehicle in transmitting pathogens owing to their potentials for cross contamination during processing (Tood and Narrod, 2006), or poor personal hygiene (Schmitz and Hoyle, 2006).

Contamination of food and produce, including salad, may be prevented to the barest minimum, and minimize the source of contamination of food by simply adopting the five keys

to safer food, guidelines for food safety, recommended by World Health Organization (WHO 2003).

Due to the fact that salad can easily became contaminated especially during preparation and the fact that salads are eaten raw this project is aimed at:

(1) Identifying the various sources of bacterial contamination of ready-to-eat salad sold at food outlets within Bauchi metropolis..

(2) Isolating and identify the organisms involved in the contamination.

(3) Making possible recommendations so as to cope with the contamination as much as possible.

(4) Determining the wholesomeness or otherwise of these salad.

Materials and Method / Collection of Samples

A total number of forty (40) samples were collected from five (5) different food outlets. These include: Ten (10) ready-to-eat salad samples, ten (10) water samples, ten (10) utensils swab samples, and ten (10) raw salad vegetables samples.

An interval of two weeks was given between each samples collection. The samples were collected during the month of April to June (2013). A total of five (5) of each of the food outlet making five at a time. Each sample was collected in duplicate.

The preserve water that the outlet used in washing the produce was collected in a sterile test-tube, the water sample were collected around mid-day. Utensil swab sample were collected by swabbing the inner surface and crevices of the bowls and plate. Raw salad vegetables and ready-to-eat salad samples were collected in a clean polythene bags using their spoons.

The tubes were inoculated and incubated. After incubation at $37^{o}C$ for 24 hours, the growth bottles were sub cultured on Mac Conkey agar and deoxycholate citrate agar (DCA). The sub cultures plates were incubated at $370^{o}C$. After 24 hours, the growth bottle was then subculture on Mac Conkey agar and deoxycholate citrate agar (DCA). MacConkey agar and (DCA) were prepared as directed by the manufacturer. 52g of the Mac Conkey agar powder was measured using a digital weighing balance and aseptically dissolve in one liter of sterile measuring cylinder containing 1000ml distilled water. The mixture was then transferred to 750ml and 50ml sterile comical flask and sterile as above. As medium cooled it was then poured into sterilized Petri dishes (about 25ml). The medium was allowed to sterile aseptically. DCA was prepared by weighing 46g of the powder and prepared as a Mac Conkey agar except autoclaving. DCA was only heated to boil on a hot lat. The subculture plates were then incubated at $37^{o}C$ for 24 hours.

Results

Total Microbial Count (Tmc)

The TMC for the outlet (as shown in figure 1 below) shows that City Restaurant has the highest microbial count with a mean value of $2.98x10^7$ cfu/g. It was then followed by Rahma Restaurant with a mean value of $2.53x10^7$ cfu/g. Aroma Restaurant has the least count with a mean value of $1.57x10^7$ cfu/g it was then followed by Paradise Kitchen and Sauki Restaurants having the values of $1.68x10^7$ cfu/g and $2.10x10^7$ cfu/g respectively. This is shown in table 2 below.

Table 2: Mean Total Microbial Count for Each Food Outlet

Food outlets	Total Range (cfu/g)	Mean (cfu/g)
Paradise Kitchen	$1.85x10^7 – 1.50x10^7$	$1.68x10^7$
Aroma Restaurant	$1.77x10^7 – 1.36x10^7$	$1.57x10^7$
Sauki Restaurant	$2.27x10^7 – 1.92x10^7$	$2.19x10^7$
City Restaurant	$22.96x10^7 – 3.0x10^7$	$2.93x10^7$
Rahma Restaurant	$2.94x10^7 – 2.12x10^7$	$2.53x10^7$

Physiological and biochemical tests for identification of isolates. The result of physiological and biochemical tests for the characterrisation and the identification of the isolate were giving in appendix 1. The isolate were identified as Bacillus spp. *Enterobacter aerogenes, Pseudomonas spp. Staphylococcus aureus, staphylococcus sp, Micrococus spp, Escherichia coli, Corynebacterium spp, Proteus mirabilis, Serratia marccescens, Arizona spp. citrobacter freundii, enterrococci spp* and *Klebiella pneumonia.*

Frequency of Occurrence Of Bacteria

The frequency of occurrence of bacteria isolated from all the samples were shown in the figures below. In water sample (figure 2), *micrococcus spp* has the highest frequency of occurrence, followed by *corynebacterium spp* and *Bacillus. Escheichia coli* have the least frequency of occurrence.

In the utensils swab samples (figure 3), *Micrococcus spp* has the highest frequency of occurrence, followed by *staphylococcus spp, corynebactrium spp* and *staphylococcus aureus.*

In the raw vegetables salad (figure 4), *Bacillus spp* has the highest frequency of occurrence, followed by *Micrococcus spp, staphylococcus aureus.*

Proteus mirabilis, Escherichia coli, Corynebacterium spp, Pseudomonas spp and *Enterobacter aerogenes* bear the least occurrenasaa.

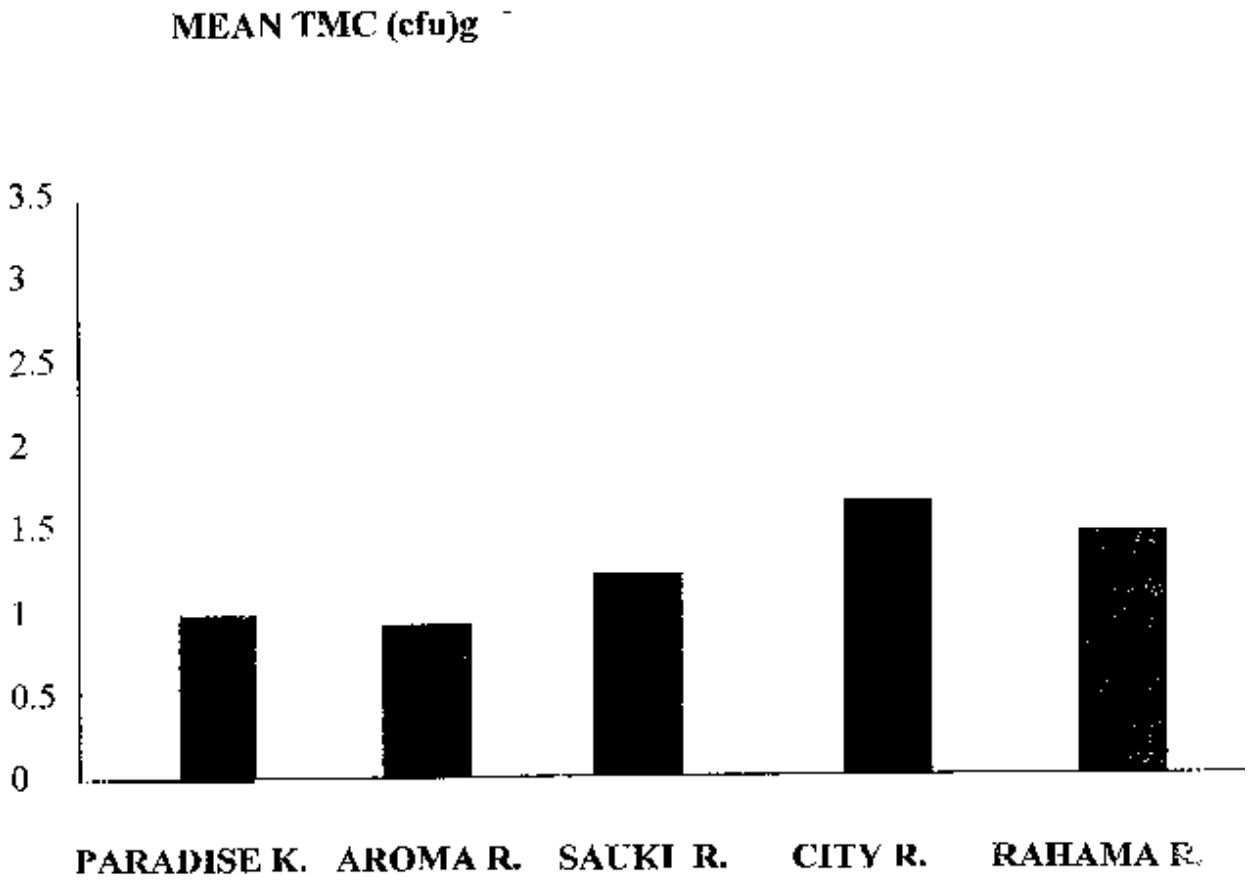

Fig. 1: Total microbial count for each food outlet.

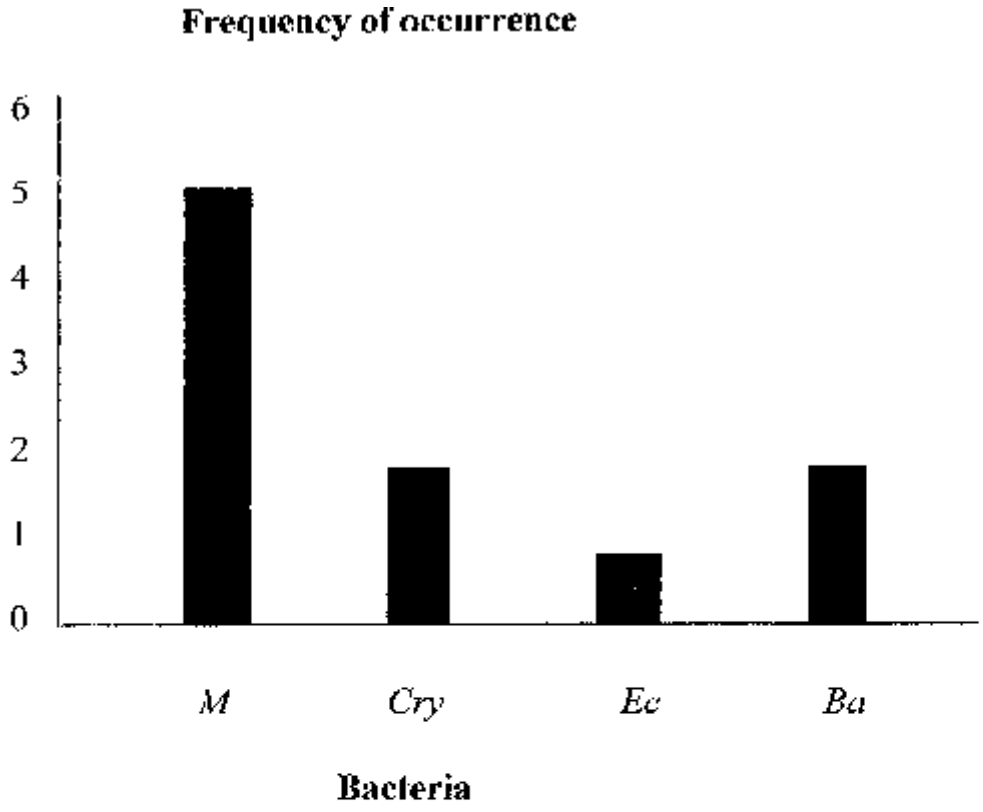

Fig.2: Frequency of occurrence of Bacteria isolated from water sample.

KEY:

Mc - Micrococcus spp

Cry= Corynebacterium spp

Ec =Enterococcus spp

Ba=Bacillus sp

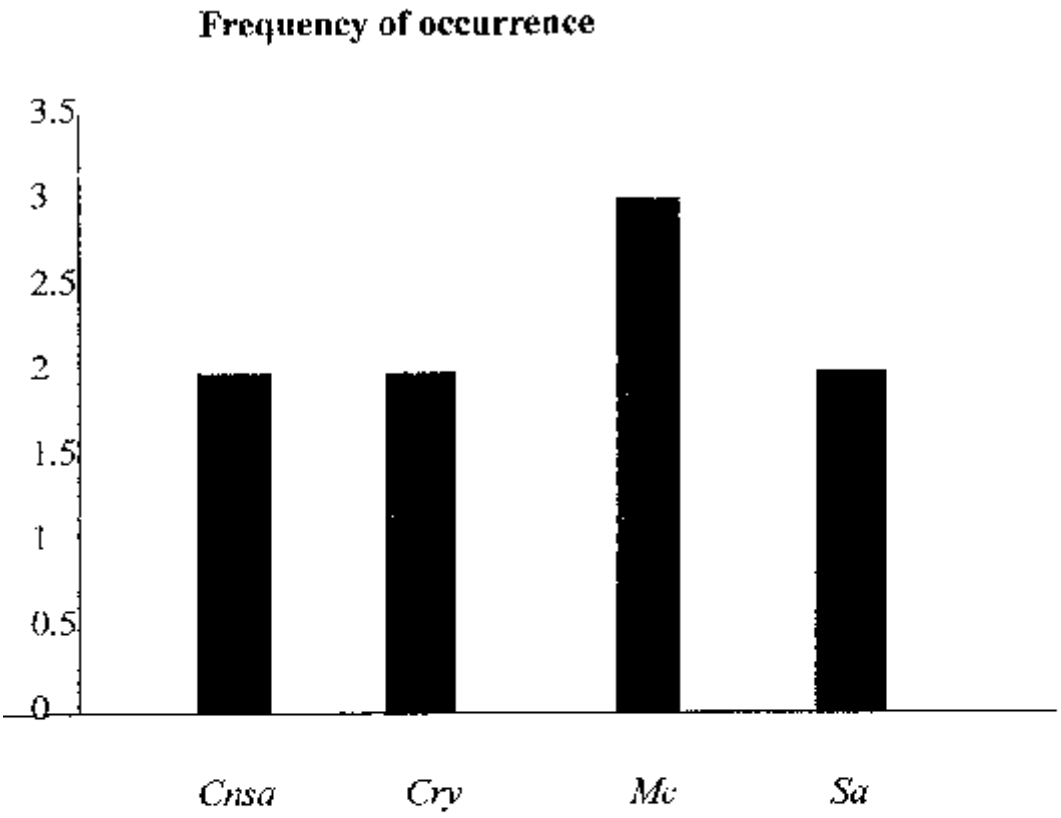

Fig . 3: Frequence of bacteria isolated from utencsil swab samples

KEY:

Cnsa= Coagulasc – negative staphylococcus aureus

Sa= Staphylococcus aureus

Mc = Micrococcus spp

Cry = Corynebacteriun spp

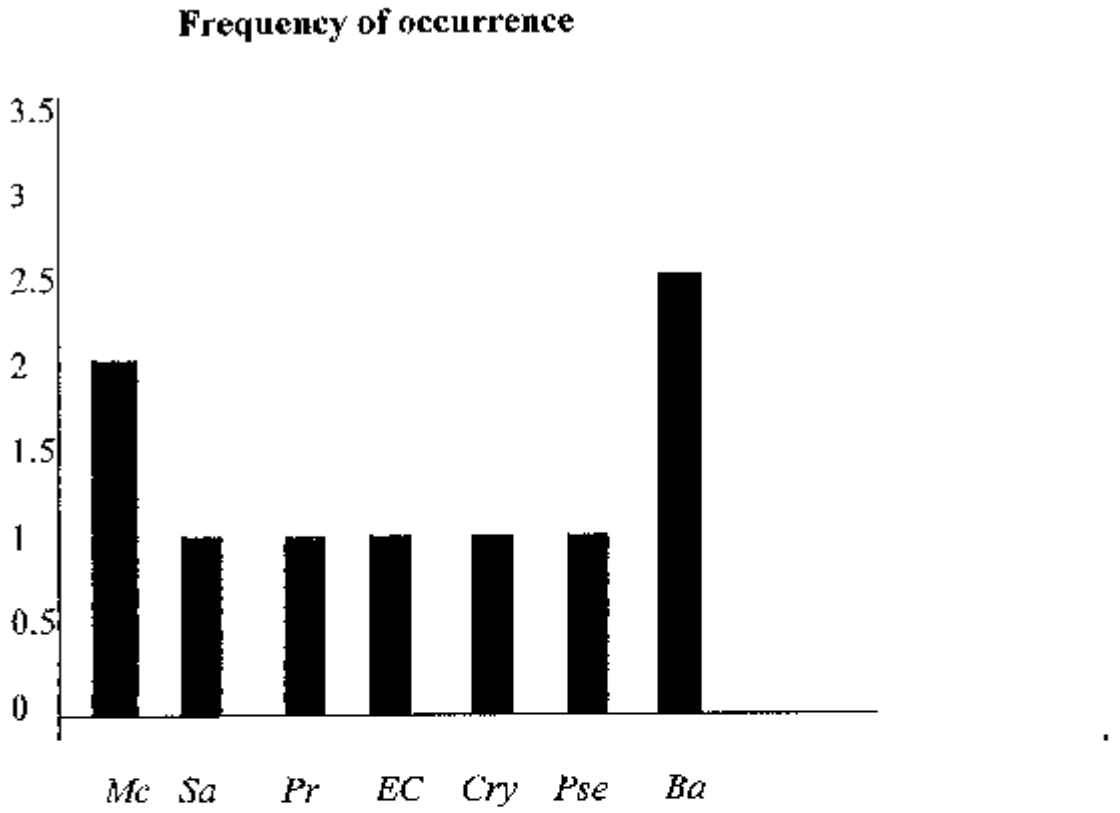

Fig 4: frequency of occurrence of bacteria isolated from raw salad vegetables.

Key:

Pr = Proteus spp

Pse = Pseudomonas spp

Mc = Micrococcus spp

Sa = Staphylococcus aureus

Ec = Enteroccoccus spp

Cry = Corynebacterium spp

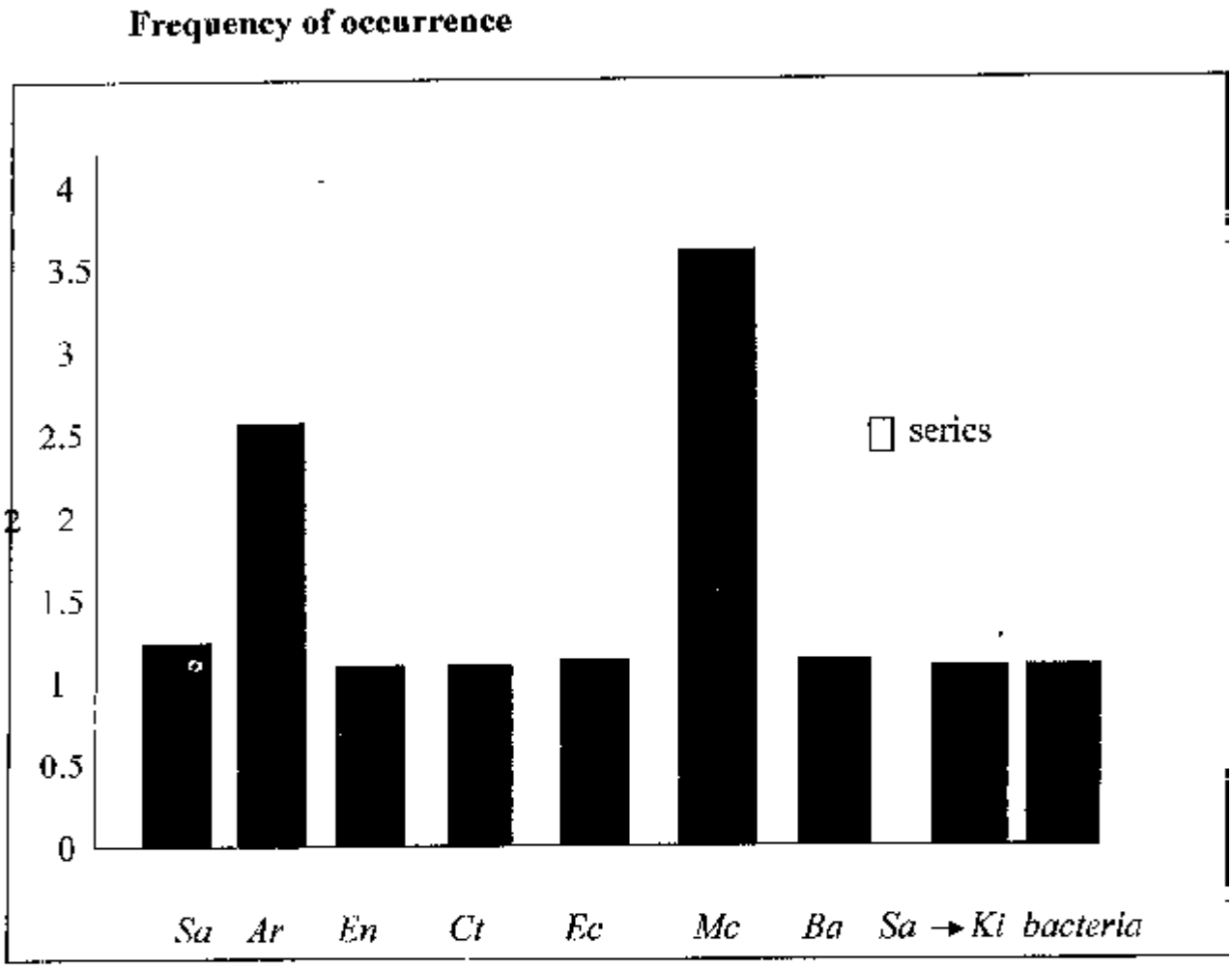

Fig.5: Frequency of occurrence of bacteria isolated from ready to eat salad samples

Key:

Se –Serratia spp

Ar =Arizona spp

En = Enterobacter spp

Ctr = Citrobacter spp

In ready to eat salad (figure 5), Bacillus spp has the highest frequency of occurrence, followed by *Arizona spp, Serratia marcescens, aerogenes, Citrobacter freundii, Enterococci spp. Bacillus spp, Staphylococcu aureus* and *klebsiella pneumonia* bear the least frequency of occurrence.

Discussion

Micrococcus spp had the highest frequency of occurrence, appearing in all the sample and ready-to-eat salad samples. This may be due to the fact that *micrococcus spp* are saprophytes (boron, et al, 1993), and its occurrence on vegetables is not uncommon (Fennera, 1993). *Micrococcus spp* are not associated with fob-born disease, their present indicate contamination either from the utensils by dust or as part of flora of the vegetable.

Bacillus spp was isolated from the water sample, raw vegetable sample and ready-to-eat salad sampole. Bacilli are soil micro-organisms (Cheesebrough, 2000). Presence of *Bacillus cereus* in vegetables were reported by U.S. FDA (1997). Therefore the presences of *Bacillus spp* in the salad indicates either contamination from the water used in washing the produce or is part of flora of the vegetables.

Staphylococcus aureus is a resident flora of human and other mammalian skin (C.D.C., 2005). It has been shown to be associated with wide range of food (including salad) (C.D.C. 2005). Presence of *Staphylococcus aureus* in food suggest contamination by the handlers. The bacteria causes food poisoning (intoxicating type) (cheese rough, 2000).

Serratia macrcescens, Arizon spp, Escherichia coli, Enterrobacer aerogenes, Enterococi spp, Citrobacer freudii and klebsiella phenumoniae belong to the family *Enerobacteriaecceae.* Most of them are coliforms and commonly associated with soil, and are naturally part of microbial population found on roots, leaves, flowers and fruits of produce as well as edible crops grown in home garden (Louis, 2006). It was suggested that the presence of coliform bacteria on produce does not necessarily indicate that it was not grown, held or processed under unsanitary conditions nor do they indicate any specific food risk (Louis, 2006). Therefore isolation of *Micrococcus spp* from the water and utensils, *staphylococcus aureus* and *Staphylococcus spp* from the utensils; and *Bacillus spp* from the water sample indicates that water, and utensils may be a good source of salad contamination in the food outlets.

All the organisms isolated from the different samples can be grouped as saprophytes, and *Enterterobacteria* (including the coliforms), except Staphylococcus *aureus and coaulase-negative* Staphylococcus spp, their presence in ready-to-eat salad does not signal any food safety risk (Louis, 2006), but only increase microbial load on the produce. The result of TMC count shown that there is a difference in the microbial count between these five food outlets. These differences may largely depend on the ability for each outlet to carryout quality control on the produce from point of acquisition to processing to table. These microbial counts do not necessarily indicate a significant impact on quality or tested and certainly are not predictive of a safety risk (Louis, 2006), and important to note is that coliform standards for water, dairy and other foods cannot be meaningfully applied to flesh cut produce (Louis, 2006).

Conclusion

From the result obtained the following conclusion could be drawn;

1. Water and utensils are the most likely sources of contamination of ready to eat salad sold at Restaurant selling outlets.
2. The bacteria associated with the contamination are mostly saprophytes and coliforms.
3. Handlers may be a source of contamination of the salad.
4. Salad sold in Restaurant outlets needs hygiene improvement especially during processing.

Limitations

This work has several limitations which includes:

1. The result obtained is restricted only to the food outlet outlined.
2. Contamination may come from other sources than these three sources.
3. Sample from the handlers was not collected.
4. Anerobic bacteria were not considered.

Recommendations

1. During purchase the product should be inspected to ensure that there are no signs of contamination or damage to the raw vegetables.
2. If not processed promptly, the vegetable should be stored at chilled temperature 0^oC – 4^oC) to prevent the growth of harmful bacteria.

3. The vegetables should be washed thoroughly using tap water and replace at sufficient frequency to prevent spreading of microbial contaminants. Use of disinfectants, e.g. hypochlorite, is essential to reduce microbial load while washing.
4. Salad dressing should be stored at 4^{o}C below once their packages are opened.
5. Equipments and utensils should be kept clean and in good condition, e.g. by keeping utensils in cupboards after they are washed and air dried.
6. Separate equipments and utensils should be used to handle ready-to-eat and raw vegetables to avoid cross contamination.
7. Good personal hygiene e.g. washing hands and wearing globes, wearing protective glass clothes, at all the time.

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FREE VIBRATION OF SYMMETRIC ANGLE-PLY LAMINATED TRUNCATED CONICAL SHELLS USING SPLINE APPROXIMATION

Introduction

Truncated conical shell finds wide ranging of engineering applications. They are used in space crafts, robots, shelters, domes, tanks, nozzles and in machinery devices. Thus, the study of their vibrational characteristics has long been of interest for the designers. The use of the lamination for the structures leads to design with the maximum reliability and minimum weight. Moreover, the study of free vibration of laminated conical shells has been treated by a number of researchers. Irie *et al.* (1982) studied free vibration of conical shells with variable thickness using Rayleigh-Ritz method of solution.

Wu and Wu (2000) provided 3D elasticity solutions for the free vibration analysis of laminated conical shells by an asymptotic approach. Wu and Lee (2001) studied the natural frequencies of laminated conical shells with variable stiffness using the differential quadrature method under first-order shear deformation theory (FSDT).

Tripathi et al. (2007) studied the free vibration of composite conical shells with random material properties of the finite element method. Civalek (2007) used the Discrete Singular Convolution (DSC) to investigate the frequency response of orthotropic conical and cylindrical shells. Sofiyez et al. (2009) studied the vibrations of orthotropic non-homogeneous conical shells with free boundary conditions. Ghasemi et al. (2012) presented their study of free vibration of composite conical shells which was investigated under various boundary conditions using the solution of beam function and Galerkin method. Viswanathan et al. (2007, 2011) studied free vibration of laminated cross-ply plates, including shear deformation, symmetric angle-ply laminated cylindrical shells of variable thickness with shear deformation theory using the spline collocation method.

In the present work, free vibration of symmetric angle-ply laminated truncated conical shells is analyzed and displacement functions are approximated using cubic and quantic spline and

collocation procedure is applied to obtain a set of field equations. The field equations along with the equations of boundary conditions yield a system of homogeneous simultaneous algebraic equations on the assumed spline coefficients which resulting to the generalized eigenvalue problem. This eigenvalue problem is solved using eigensolution technique to get as many eigenfrequencies as required. The effect of circumferential mode number, length ratio, cone angle, ply angles and number of layers under two boundary conditions on the frequency parameter is studied for three- and five- layered conical shells consisting of two types of layered materials.

Formulation of the problem

The coordinate system and the geometry of the shell are shown in Figure 1. From the figure, r_a and r_b are the radii of the cone at its small and large ends, α is the semi-vertex angle and ℓ (= b-a) is the length of the cone along its generator. The wall thickness is denoted by h and the coordinates x, θ and z are longitudinal, rotational and transverse coordinates. u, v and w are longitudinal, circumferential and transverse displacements.

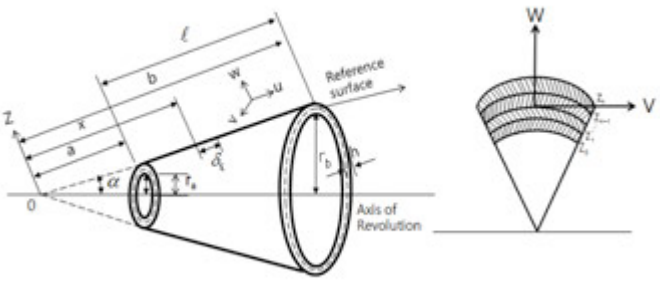

Figure 1. Geometry of a layered truncated conical shell

The stress resultants N_{ij} and moment resultants M_{ij} are defined as

$$\left(N_x, N_\theta, N_{x\theta}\right) = \int_z \left(\sigma_x, \sigma_\theta, \tau_{x\theta}\right) dz,$$

$$\left(M_x, M_\theta, M_{x\theta}\right) = \int_z \left(\sigma_x, \sigma_\theta, \tau_{x\theta}\right) z\, dz. \tag{1}$$

The stress-strain relations of the k-th layer by neglecting the transverse normal strain and stress. The materials are oriented at an angle θ with the x-axis, the transformed stress-strain relations are

$$\begin{pmatrix} \sigma_x^{(k)} \\ \sigma_\theta^{(k)} \\ \tau_{x\theta}^{(k)} \end{pmatrix} = \begin{pmatrix} \bar{Q}_{11}^{(k)} & \bar{Q}_{12}^{(k)} & \bar{Q}_{16}^{(k)} \\ \bar{Q}_{12}^{(k)} & \bar{Q}_{22}^{(k)} & \bar{Q}_{26}^{(k)} \\ \bar{Q}_{16}^{(k)} & \bar{Q}_{26}^{(k)} & \bar{Q}_{66}^{(k)} \end{pmatrix} \begin{pmatrix} \varepsilon_x^{(k)} \\ \varepsilon_\theta^{(k)} \\ \gamma_{x\theta}^{(k)} \end{pmatrix}, \tag{2}$$

where $Q_{ij}^{(k)}$ and $\bar{Q}_{ij}^{(k)}$ are given in Viswanathan and Lee (2007).

Strain-displacement relation are defined as follows

$$\kappa_x = \frac{\partial \psi_x}{\partial x}\ ,\ \kappa_\theta = \frac{1}{x\sin\alpha}\frac{\partial \psi_\theta}{\partial \theta} + \frac{1}{x}\psi_x\ ,\ \kappa_{x\theta} = \frac{1}{x\sin\alpha}\frac{\partial \psi_x}{\partial \theta} + \frac{\partial \psi_\theta}{\partial x} - \frac{1}{x}\psi_\theta,$$

$$\varepsilon_x = \frac{\partial u_0}{\partial x} + z\frac{\partial \psi_x}{\partial x},\ \varepsilon_\theta = \frac{1}{x}u_0 + \frac{1}{x\sin\alpha}\frac{\partial v_0}{\partial \theta} + \frac{1}{x\tan\alpha}w + z\left(\frac{1}{x\sin\alpha}\frac{\partial \psi_\theta}{\partial \theta} + \frac{1}{x}\psi_x\right),$$

$$\gamma_{x\theta} = \frac{1}{x\sin\alpha}\frac{\partial u_0}{\partial \theta} + \frac{\partial v_0}{\partial x} - \frac{1}{x}v_0 + z\left(\frac{1}{x\sin\alpha}\frac{\partial \psi_x}{\partial \theta} + \frac{\partial \psi_\theta}{\partial x} - \frac{1}{x}\psi_\theta\right),$$

$$\text{and}\quad \psi_x = -\frac{\partial w}{\partial x},\ \psi_\theta = \frac{1}{x\tan\theta}v_0 - \frac{1}{x\sin\alpha}\frac{\partial w}{\partial \theta} \tag{3}$$

Substituting Eq. (3) into Eq. (2), and then into the equilibrium equations of conical shell, the equations of stress-resultants and moment resultants are obtained as

$$\begin{pmatrix} N \\ M \end{pmatrix} = \begin{pmatrix} A & B \\ B & D \end{pmatrix} \begin{pmatrix} \varepsilon \\ \kappa \end{pmatrix} \tag{4}$$

Here A, B and D are extensional rigidities, the bending-stretching coupling rigidities and the bending rigidities, respectively. The displacement components were assumed as follows

$$\begin{aligned} u(x,\theta,z,t) &= u_0(x,\theta,t) + z\psi_x(x,\theta,t) \\ v(x,\theta,z,t) &= v_0(x,\theta,t) + z\psi_\theta(x,\theta,t) \\ w(x,\theta,z,t) &= w(x,\theta,t) \end{aligned} \tag{5}$$

where u, v, and w are the displacement functions in x, θ and z directions, respectively, u_0, v_0, and w are the displacements of the middle surface of the cone

In the case of symmetric angle-ply lamination, the laminate stiffnesses $A_{16} = A_{26} = B_{16} = B_{26} = D_{16} = D_{26} = 0$ are identically zero and applying this condition to Eq. (4) then substituting into the equilibrium equations of conical shell we get the governing differential equations of a conical shell. The displacements are assumed in the separable form given by:

$$\begin{aligned} u(x,\theta,t) &= U(\mathrm{X})\cos n\theta e^{i\omega t} \\ v(x,\theta,t) &= V(\mathrm{X})\sin n\theta e^{i\omega t} \\ w(x,\theta,t) &= W(\mathrm{X})\cos n\theta e^{i\omega t} \end{aligned} \tag{6}$$

Here x and θ are in the longitudinal and rotational coordinates, t is the time, ω is the angular frequency of vibration and n is the circumferential mode number. The non-dimensional parameters are as follows

$X = x - a/\mathrm{l}$, $a \le x \le b$ and $X \in [0,1]$

$\lambda = \omega \mathrm{l} \sqrt{\rho h / A_{11}}$, frequency parameter,

$\gamma = h / r_a$, ratio of thickness to radius

$\gamma' = h / a$, ratio of thickness to length,

$\beta = a / b$, length ratio (7)

Using Eq. (6) and Eq. (7) in the governing differential equations, the resulting equations in the matrix form is written as:

$$\begin{bmatrix} L_{11} & L_{12} & L_{13} \\ L_{21} & L_{22} & L_{23} \\ L_{31} & L_{32} & L_{33} \end{bmatrix} \begin{Bmatrix} U \\ V \\ W \end{Bmatrix} = 0 \tag{8}$$

The differential equations on the displacement functions derived in the last section contain derivatives of third order in U, second order in V and fourth order in W. However, they are not amenable to the solution procedure. We proposed to adopt some modification in these equations. So, we obtained the new set of equations in which the derivatives of U and V are order of 2, and W is of order 4 given by the matrix form as:

$$\begin{bmatrix} L_{11} & L_{12} & L_{13} \\ L_{21} & L_{22} & L_{23} \\ L^*_{31} & L^*_{32} & L^*_{33} \end{bmatrix} \begin{Bmatrix} U \\ V \\ W \end{Bmatrix} = 0 \tag{9}$$

Spline collocation method

The spline collocation method is adopted in which the displacement functions *U(X), V(X)* and *W(X)* are approximated by cubic and quintic splines as

$$U(X) = a_0 + a_1 X + a_2 X^2 + \sum_{j=1} b_j (X - X_j)^3 H(X - X_j)$$

$$V(X) = c_0 + c_1 X + c_2 X^2 + \sum_{j=1} d_j (X - X_j)^3 H(X - X_j)$$

$$W(X) = e_0 + e_1 X + e_2 X^2 + e_3 X^3 + e_4 X^4 + \sum_{j=1} f_j (X - X_j)^5 H(X - X_j) \tag{10}$$

Here $H(X - X\,j)$ is the Heaviside step functions, and N is the number of subintervals into which the range of X [0,1] is divided. The collocation points are the knots of the splines at $X = X_s = s/N$, where $s = 0, 1, ..., N$. Imposing the condition that the differential equations given by Eq. (9) are satisfied by these splines at the (N + 1) points, a set of 3N +3 homogeneous

equations in $3N + 11$ unknown spline coefficients. The Clamped-Clamped (C-C) boundary condition is used to analyze the problem.

Imposing the boundary conditions, we get 8 more equations on spline coefficients. Combining them with those obtained earlier, we get $3N + 11$ homogeneous equations, with the same number of unknowns. Thus, the system of equations can be written in the form of

$$[P]\{q\} = \lambda^2[Q]\{q\} \tag{11}$$

where $[P]$ and $[Q]$ are square matrices and $\{q\}$ is a column matrix. This is a generalized eigenvalue problem in which λ^2 is the eigenparameter, and $\{q\}$ is the eigenvector.

Results and Discussion

In this paper, free vibration of symmetric angle-ply laminated truncated conical shell is studied. Three and Five layers of shells are considered arranging in the order of 30°/0°/30°, 45°/0°/45°, 60°/0°/60°, 30°/45°/0°/45°/30°, 45°/30°/0°/30°/45°, 60°/30°/0°/30°/60° and 30°/60°/0°/60°/30°. Two types of layer materials are used called S-Glass Epoxy (SGE) and High Strength Graphite (SGE). Variation of frequency parameter are analyzed with respect to the circumferential mode number (n), length ratio (β), cone angle (α), different ply angles and different number of layers under two boundary conditions. The orders of materials used are as follows:

(i) Three layers: SGE/HSG/SGE,
(ii) (ii) Five layers: SGE/HSG/SGE/HSG/SGE

Convergence studies are carried out for clamped-clamped (C-C) boundary conditions to establish the number of subintervals N of the range X [0, 1]. The trial runs of the computer program are extensively developed starting from $N = 2$ onwards. The general criterion for convergence study is to assure the accuracy in the resulting solutions. In order to warrant this, N values are increased until no significant variations are observed. The computed values of λ are improved with increasing of N but the improvement came down steadily. It can be seen that the choice of $N = 16$ is adequate since for the next value of N, the percentage change is very small.

Figure 2 shows the effect of circumferential mode number (n) on the frequency parameter (λ_m) ($m = 1, 2, 3$) under C-C boundary conditions using the materials of SGE/HSG/SGE. This figure describes 30°/0°/30° ply angles with fix values of semi-cone angle, $\alpha = 30°$, length

ratio, β = 0.05, and ratio of thickness to radius, γ = 0.05. We consider n = 1(1)10. From the figure, we can see that λ_m decrease for certain values of n and then increase until n = 10. For m = 1, the values of λ_m decrease up to n = 5 and then increase afterwards. For m = 2, λ_m decrease until n = 4 and then increase. For m = 3, the values of λ_m follow the same pattern as m = 1 and 2 where they decrease and increase, but the turning point happens earlier at n = 2. The percentage differences between initial and final values of λ_m are 20.76%, 34.28% and 37.11% for m = 1, m = 2 and m = 3, respectively.

Figure 3 shows the influence of circumferential mode number (n) on the frequency parameter λ_m (m = 1, 2 and 3) for 45°/0°/45° ply angles. The curve of the graph shows that it decrease up to some values of n and then increase. The λ_m for m = 1 and 2 values decrease up to n = 5 and n = 4, respectively while for m = 3, the values decrease until n = 2 and increase until n = 10. The percentage differences between initial and final values of λ_m are 23.17%, 37.89% and 41.77% for m = 1, 2 and 3, respectively. The values of λ_m are higher for this case compared to 30°/0°/30° ply angles and so do the percentage differences.

Figure 4 shows the effect of circumferential mode number (n) on frequency parameter (λ_m) for 30°/45°/0°/45°/30° ply angles under C-C boundary conditions which made up of SGE/HSG/SGE/HSG/SGE materials. In this case, we fix the values of semi-cone angle, α = 30°, length ratio, β = 0.05 and ratio of thickness to radius, γ = 0.05. The fundamental frequency (m = 1) has the least value among all. For all modes (m = 1, 2, 3), the λ_m values decrease with n for some values of n and then increase until n = 10. The turning points for all m are different. The turning point seems to be happened at a greater value of n for lower mode. For m = 1 and 2, λ_m values decrease up to n = 5 and then increase with increasing values of n. For m = 3, the values decrease until n = 2 and increase afterwards. The percentage differences are 19.68 %, 35.83% and 39.30 for m = 1, 2 and 3, respectively. From these results, we can say that more layer give a greater value of λ_m.

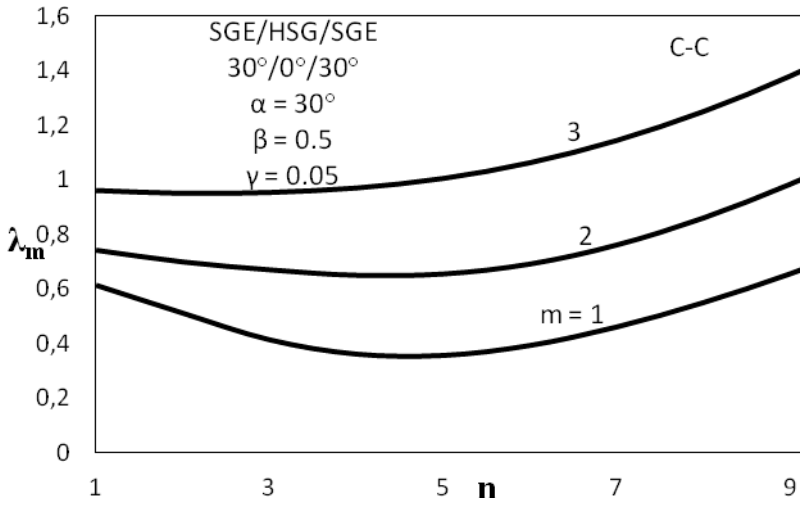

Figure 2. Effect of circumferential mode number on frequency parameter (30°/0°/30°)

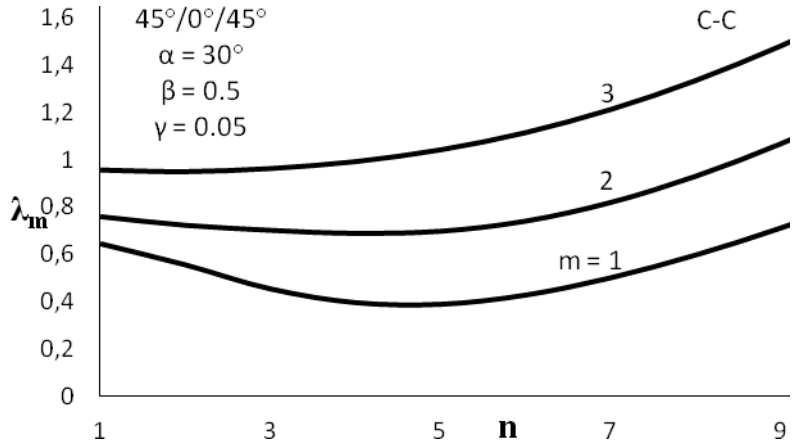

Figure 3. Effect of circumferential mode number on frequency parameter (45°/0°/45°)

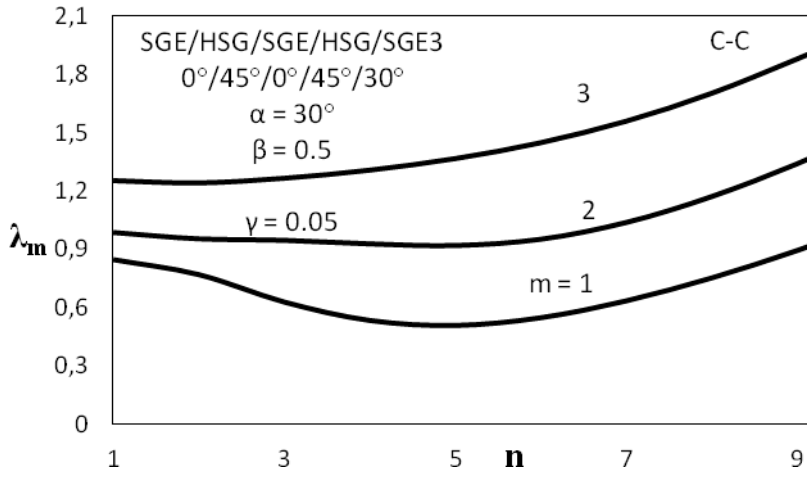

Figure 4. Effect of circumferential mode number on frequency parameter (30°/45°/0°/45°/30°)

Figure 5 shows the effect of the circumferential mode number (n) on frequency parameter (λ_m) for ply-angles arrangement of 60°/30°/0°/30°/60°. The values of λ_m decrease for certain values of n and then start to increase with increasing n values. The λ_m values decrease until n = 5 for m = 1, n = 4 for m = 2 and n = 2 for m = 3. The percentage differences are 25.02%, 39.05% and 41.75% for m = 1, 2 and 3, respectively.

Figure 6((a) – (c)) describe the influence of length ratio (β) on the variation of angular frequency (ω_m) for 30°/0°/30°, 45°/0°/45° and 60°/0°/60° ply angles under C-C boundary conditions. We are using the materials of SGE/HSG/SGE. Here, we study the relationship between ω_m (m = 1, 2, 3), the angular frequency and β since the frequency parameter λ is a function of the length ℓ of the shell. Thus, it may not be meaningful to study the variation of λ with respect to β. The values for circumferential mode number (n), cone angle (α) and ratio of thickness to radius (γ) are fixed to n = 2, α = 30° and γ = 0.05. It is seen from the figures that the frequencies increase with increasing in β (decreasing in cone length). Also, it is expected from the figures that the frequencies are very high for very short shells ($\beta > 0.8$).

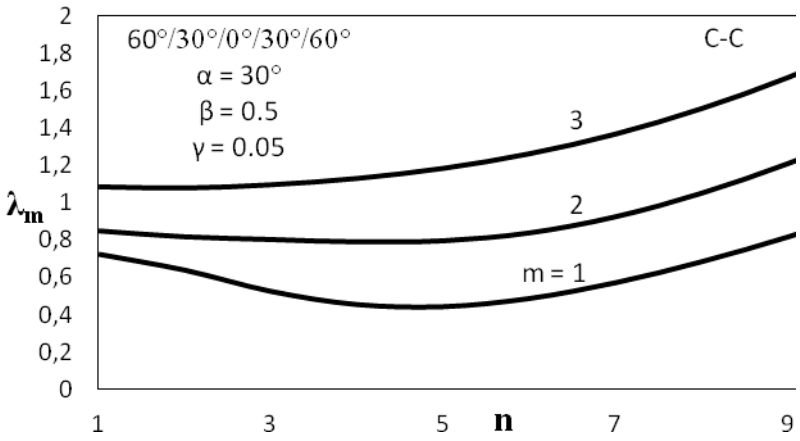

Figure 5. Effect of circumferential mode number on frequency parameter (60°/30°/0°/30°/60°)

Figure 7((a) and (b)) show the variation of the angular frequency (ω_m) with respect to length ratio (β) for 45°/30°/0°/30°/45° and 30°/45°/0°/45°/30° ply angles under C-C boundary conditions with fix values of n, α and γ. The graphs show an increase with increasing number of β (short shell). It can be shown that the angular frequencies will be very high for higher values of β ($\beta > 0.8$). Thus, we can say that as we shorten the shell, the angular frequencies will be higher.

Table 1 shows the influence of cone angle (α) on the variation of frequency parameter (λ_m) under C-C boundary conditions using the materials of SGE/HSG/SGE. When the cone angle (α) varies, $r_a = a\sin\alpha$ also varies and hence $\gamma = h(a)/r_a$ cannot be held constant. Instead, another parameter of $\gamma' = h(a)/a$ is considered. Here, we fix the values of β, γ' and n to 0.5, 0.5 and 4, respectively. Clearly, we can see that, for all values of λ_m, they are decreasing with increasing α.

The effect of cone angle (α) on frequency parameter (λ_m) for ply arrangements made up of SGE/HSG/SGE/HSG/SGE materials under C-C boundary conditions can be seen in Table 2. There is a sudden decrease in λ_m for all m from $\alpha = 10°$ to $\alpha = 30°$. As α further increases, the values of λ_m decrease and becoming almost constant. The results from Tables 1 and 2 indicate that cone angle can greatly affected the values of λ_m.

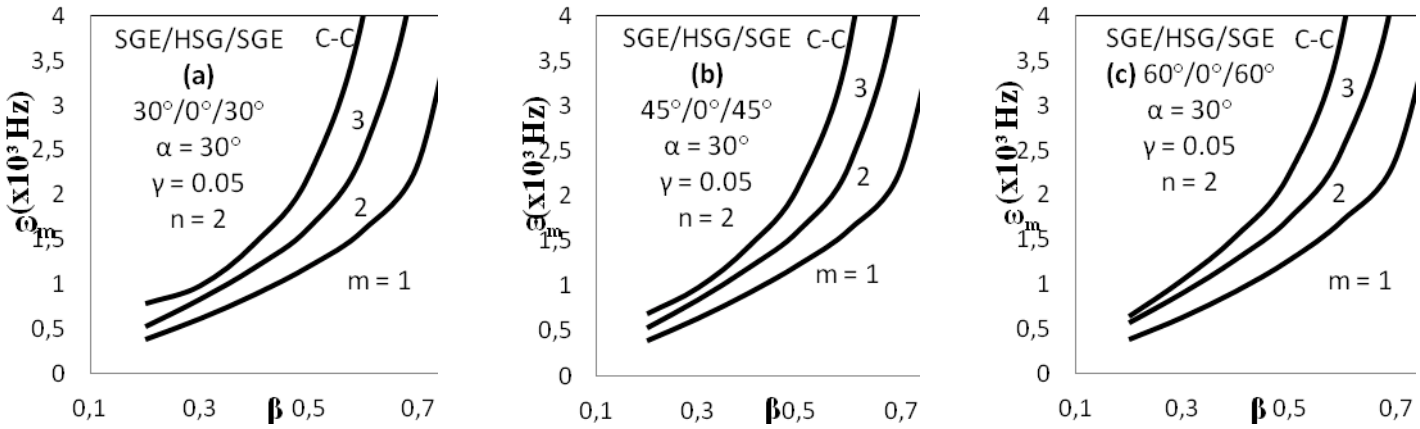

Figure 6. Effect of length ratio on angular frequency (3 layers)

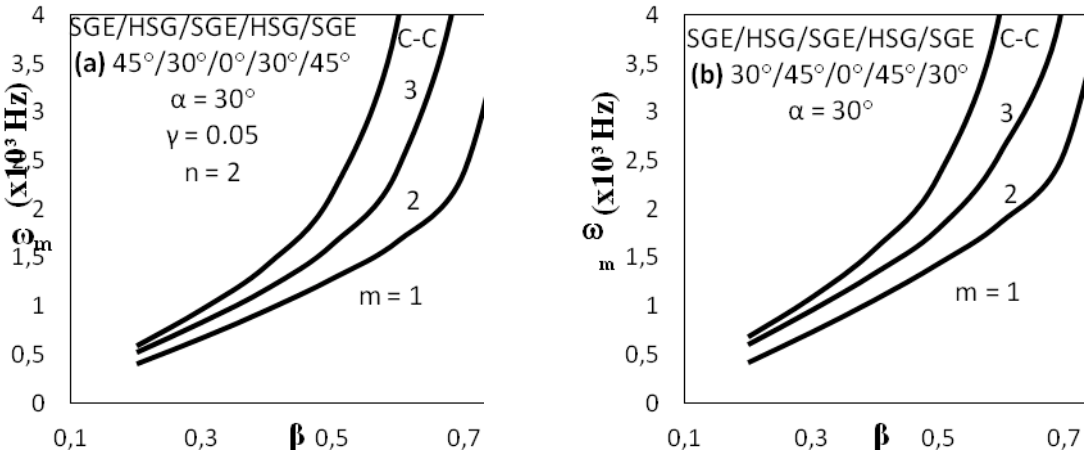

Figure 7. Effect of length ratio on angular frequency (5 layers)

Table 1

Effect of Cone Angle on Frequency Parameter (30°/0°/30°)

α	λ_1	λ_2	λ_3
10	6.342233	7.612428	9.284464
30	2.605953	3.118723	4.484285
50	2.21518	3.11695	4.472641
70	1.999122	3.000015	4.354941
90	2.012976	3.029701	4.349857

Table 2

Effect of Cone Angle on Frequency Parameter (30°/60°/0°/60°/30°)

α	λ_1	λ_2	λ_3
10	9.869728	11.453022	14.823069
30	3.648063	4.878838	6.265273
50	3.414289	4.537918	6.281428
70	3.268163	4.226445	5.892592
90	3.328428	4.235246	5.892081

Conclusions

The effect of circumferential mode number (n), cone angle (α), length ratio (β), ply angles and number of layers under C-C boundary conditions on the frequency parameter (λ_m) is analyzed. From the variation of λ_m with respect to n under C-C boundary conditions, λ_m decreases for certain values of n and then increases until n = 10. The values of λ_m are higher in the case of 45°/0°/45° ply angles compared to 30°/0°/30° ply angles. Adding more layers does not introduce differences in the characteristic pattern of these curves but results in increase in λ_m values. The ply arrangements have considerably affected the values of λ_m.

By increasing β (decreasing in cone length), the values of ω_m are increased. The values are expected to be very high for very short shell ($\beta > 0.8$). The results show the same pattern for five layers cases for all m with a greater values of ω_m. The frequencies are least influenced by the ply arrangements.

The manner of variation of λ_m with respect to α indicates that the values of λ_m decrease very rapidly from α = 10° to α = 30° for both three and five layers cases. Five layers case possesses higher values of λ_m. From α = 30° onwards, λ_m decreases steadily and becoming almost constant. We can say that, the values of λ_m are least affected when α increases from 30° onwards.

The effect of using higher ply angles, more layers, shorter shell and C-C boundary conditions are to increase the frequencies whereas increasing cone angle results in their decrease.

Acknowledgement

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ANDROID BASED INTELLIGENT SOFTWARE FOR REAL TIME ANTI-THEFT (LOCATION TRACKING AND DEVICE SECURITY)

Lierature Review

Cellular phones are widespread and omnipresent telecommunication devices. Global exchange of information has become more prominent through technologically advanced mobile communication devices in addition to just conversation. This technology has laid a foundation to overcome the traditional desktop based approach of obtaining information. Research has shown that there are over 2 billion cell phones worldwide (Durresi, Paruchuri, Mimoza Durresi & Barolli, 2007).

Different type of applications such as games, social networks, and health care has developed to meet the user's requirements. Users may also interact with the mobile devices for building their own customizable applications. To meet the requirements of every user, Google convened a pioneering product called as "ANDROID", which is open source operating system, middleware, and user-interface Android phones gave a new mark to the utility of mobile phones for the users. Apart from basic functionality such as instant messaging, calling services, image, and video capturing, smart phones laid a way to impersonate a personal computer by providing operating systems and applications which developed to meet the various features. Global positioning system (GPS) tracking is one of those advances (Gozalvez & Javier, 2008; J.P Conti, 2008).

In Global tracking systems GPS is commonly used to provide location along with time information (Ghahramani et al., Sabaghi & Shams Oskouie3, 2012, pp.70-74). Tracking devices can be used for outdoor activities like driving a car, hiking and for personal safety, and device security. Use of GPS technology has increased at incredible rate. Methodology for tracking can be done using a GPS receiver which is an additional hardware integrated in most of mobile equipment (Ramalingam1, Dorairaj & Saranya Ramamoorthy3, 2012).With the advancement of

mobile operating systems such as those of Apple and Android, secrecy of user requires more security measures(Das, Pere & Franklin W, 2011).Confidentiality is required to prevent unauthenticated access user-location information(Chung, Singh, Myllyla & Lim, 2006). European Community Data Retention uses location information gathered through mobile services for reducing the rate of crime (Rechert, Meier, Wehrle & Albert, 2011).

Different applications have utilized GPS system for providing security and tracking proficiency. Ananya S, Venkatalakshmi B (Ananya S & Venkatalakshmi B , 2011) in "Location Based Intelligent Mobile Organizer" has put forth major challenges in daily routine task management by developing an unified application that will expedite user with location knowledgeable services. Publication of retail discount information is done on the system website. Most of the mobile devices have a GPS receiver as supplementary hardware which is used for tracking. User interface with easy-to-use customized features is provided that enable users to enter tasks associated with any location. Alerts are provided to retrieve details about tasks such as discount, retail information etc in accordance to current location by this intelligent observer module.

Luís C. M. Varandas, Joel J. P. C. Rodrigues (Varandas ,Vaidya & Rodrigues, 2010) in "mTracker: A Mobile Tracking Application for Pervasive Environment" proposed solution for device tracking in pre-defined radius. This system also detects and informs the insertion of un-authorized sim in the cellular device by sending a message to pre-defined number. It uses simple mobile systems with GPS receptors and GSM technology.

Ganesh, B. Balajiand Varadhan (2011) in "Anti-Theft Tracking System for Automobiles (AutoGSM)" band-aid vehicle hi-jack. The system is put to task when it receives a message from the user, which is during a vehicle hi-jack. This triggers the microcontroller in switching OFF the engine or it stimulates the module in forwarding the location or both. Uses only GSM technology (Rechert, Meier, Wehrle & Albert, 2011)in "Location Privacy in Mobile Telephony Networks – Conflict of Interest Between Safety, Security and Privacy" have outlined conflicts of interest between safety, security and privacy. A case study is conducted on GSM networks by using a logger device and implementing cluster algorithm. By increasing time intervals between location updates, the purpose is to increase user security to destroy observing adversary. Mobile Stations update user with all location data and users can select the imperious service provider with less frequent location updates to prevent future risks.

Hoeyand Favela (2012) in ”LaCasa: Location And Context-Aware Safety Assistant” effectively handled the major challenges for people suffering from Alzheimer’s disease. Alzheimer’s victims wander at some places more frequently and may suffer from severe injuries or death. By characterizing wandering behaviors location-aware application is made. The person location is converted into a set of discrete locations. Statistical clustering methods or Bayesian methods are utilized in this phenomenon. It keeps a database of known locations with pictures and user’s current location relative to pre-defined home location is determined with wifi connectivity. If fails to find, then they are likely to be in danger.

Takata, Jianhua Ma and Apduhan (2006) in ”A Dangerous Location Aware System for Assisting Kids Safety Care”, focuses on pervasive kids safety concerns. Using satellite-based GPS position sensing, kids as well as parents are provided alerts and location updates to ensure kids safety. When kids are near a danger site, voice message alert is generated. Similarly parents have updates with kid’s current location as well as surrounding information to help them avoid accidents.

Priyanka Shah, Gadgil and Tamhankar (2012) in ”Location Based Reminder Using GPS For Mobile (Android)”, limelights on communication in relation to location-based services. Reminders are specified to the locations supporting users in adjusting their daily routines. In augmentation to location updates to remote parties, it helped in assigning effective functionalities with the user actions. For example, while driving user can automatically turn off instant messaging etc. GPS is serving the purpose.

Sadagopan, Rajendran and Francis (2011) in “Anti-Theft Control System Design Using Embedded System ” infrastructured a system that used an embedded chip with a sensor. As the key is inserted in the vehicle, a message is delivered to user mobile phone indicating that the vehicle is being accessed. On the other hand, the vehicle has security system that requires password entry on key insertion. If the user fails to enter correct password in three trials, the vehicle location is informed to police along with the vehicle number using GPS module. The fuel injector of the car has disband.

Thus we focus this research in designing a system to track user’s location anytime to inform specified contacts about his current position while travelling etc. In emergency scenario, user

interacts with the mobile device (pressing a button etc),it automatically generates the geographical information, and current location is send to remote user in conjunction with an exigency message to pre-stored number. Another preliminary research of this application is device safety, it will assist you in protecting your phone, and locate it if it has been lost or stolen. Works everywhere, even without an Internet connection using satellite-based GPS navigation systems. A secret snapshot of suspicious malevolent is taken whenever the device usage is attempted. An email of your device location along with the user time stamped picture of the is provided on the system website. Call recording and message storage proficiency is also assumed in this system. Moreover, to improve security measures, this anti-theft system is also capable to detect an unauthorized subscriber identity module (SIM) card in the device, and then send a warning via short message service (SMS) with the current Global System for Mobile Communications (GSM) cell and GPS position.

System Functionality

Problem statement:

Now-a-days mobile theft is one of the major issues with the growth and exploration of IT world. In this research paper we have discussed different scenarios that require consideration and research for user security and safety. How can we access thief if he changes the SIM inside the phone? If alleged perpetrator tries to access user phone how can we come to know? If battery drains out and we want to contact user, how we come to know that he is not in emergency but the battery is zero? How can we access user current location without getting in contact with them? And the last if user is actually in emergency, how can he tell us about current position?

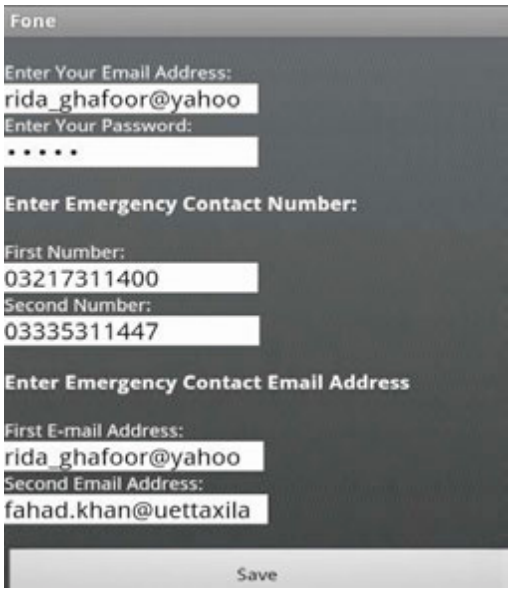

Fig1: User Interface

SIM Change Scenario:

This scenario deals with a person whose cell phone is lost. The first thing normally a perpetrator do is change the sim so that he may not be located. Our application detects SIM change. So that perpetrator data could be easily obtained.

Implementation and Validation

In working model, SIM International Mobile Subscriber Identity (IMSI) number is retrieved and stored in shared preferences. Whenever boot is completed, it matches the stored IMSI number with the current retrieved IMSI number. When new SIM is inserted, the current IMSI number dismatches with the stored one. Here automatically a message is send to authenticated pre- defined number indicating "NEW SIM IMSI NUMBER". In other case i-e sim is not changed but the cell completes boot, the match indicates same IMSI number, so message is not delivered.

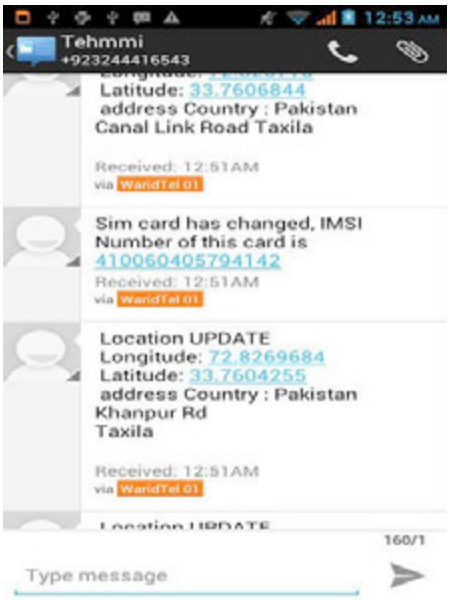

Fig2: SIM Change Detected

Null Battery Scenario

Security threat can occur anywhere at any time. Here we discuss that battery level problem. In smartphones, battery draining is major issue. Battery drains and we become unable to contact user. It leads to misunderstanding regarding user safety normally. To overcome this, our application informs null battery indication.

Implementation and Validation

Null battery value when retrieved is indicated to pre-stored number as an SMS ensuring that user is unable to contact but is not in emergency. This works through a timer in our application. It retrieves battery level every 5 hours and if battery level is zero, automatic message is transferred to pre-defined number that user is safe but not in reach.

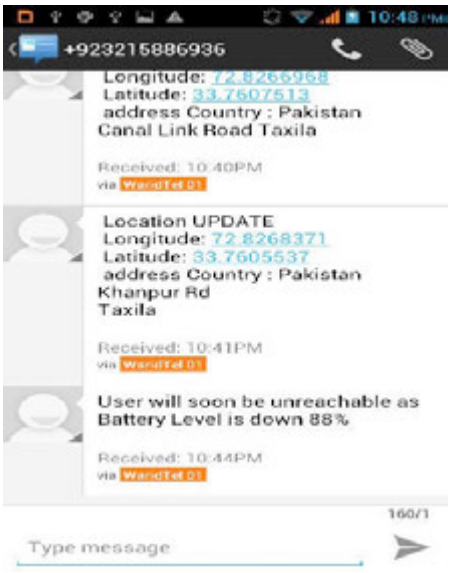

Fig3: Low Battery Detected

Password fail scenario

The design of this project module deals with unauthorized mobile access. Anyone who enters wrong password three times, his picture is taken.

Implementation and Validation

Whoever tries to access the mobile, when enter the wrong password and fails 3 times, programmatically the camera starts and take the picture without preview so that user is unaware that his picture is taken. Picture automatically saves in sd card of mobile phone as well as sent as an email to email IDs specified by the owner. By using which person identity can easily be obtained.

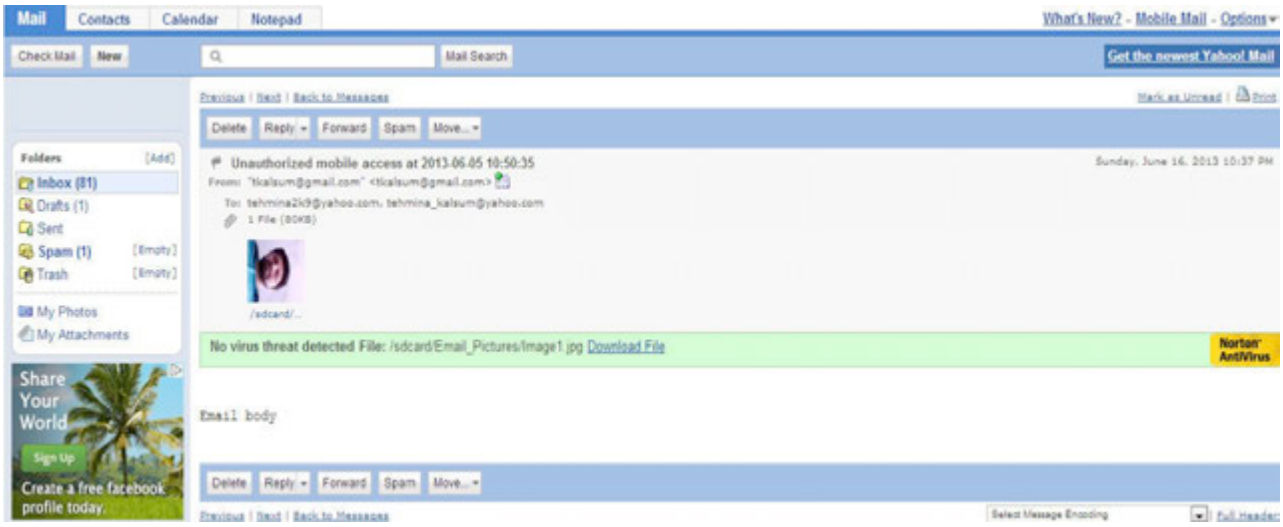

Fig 4:Email to Emergency Contact

Fig 4.1: Picture received in email carrying unauthorized access

Emergency message with current location Scenario

The design of this project module deals with the emergency situation. Whenever the user is in emergency, he will have to press the specific button “9” as a result of which their current location along with the longitude and latitude is send to the predefined store number.

Implementation and Validation

When the person is in emergency, he will be able to send his current information to other person by just dialing a button “9”.When user dials the button, location information including country, city, road name along with longitude and latitude obtained from location manager and Geocoder is attached to the pre-defined emergency message and is automatically transferred to pre-defined numbers through GPS or Wifi.

Fig 5: Emergency Message

Alerts about user location after specific interval scenario

The design of this module deals with the situation when the user allow the other known person to get his location information after a specified interval of time to know about the user updated location.

Implementation and Validation

Whenever user wants to tell his current location to other person after a specified interval of time then he enable the alerts ON. In this way, if the user travels somewhere and wants to tell his current location to the closest ones, he will be able to send by just enabling this option. When the user enables the alerts the location information including current longitude and latitude stored is send it to the predefined number through GPS and WiFi.

Fig 5.1 User location update alerts

Conclusion

In this paper, we presented the design, implementation, and evaluation of context-aware the safety of Android mobile users (Ganesh, B. Balaji & Varadhan, 2011). The system architecture was discussed in detail in terms of security-related context information processing. Our work seems to be the first research aimed at building a unique system to provide help for the safety and security of cell phones and users (Takata, Jianhua Ma & Apduhan, 2006). Battery consumption of a device by using a single background service for this application (Chon, Talipov, & Hojung Cha, 2012).The main objective of this system is to send remote user location by Just pressing a button as an SMS to an emergency contact which is pre-stored number. Take **secret snapshot** of the alleged perpetrator as they attempt to use device and mail it to user account. Similarly send SMS of SIMIMSI number if an attempt is made to change. Anti-theft application includes several features like regular location notification at specific interval and SMS to pre-stored number whenever battery drains out assuring user safety. Anti-theft system is user-friendly, thus it does not require advance knowledge or an experience to deal with it.

Emergency situation is well sensed. Therefore, Android once again proved to be a progressive, forward-looking mobile operating system which allowed us to influence various integral features of an Android mobile which made us to develop an intelligent application called "Android based intelligent software for real time anti-theft (Location tracking and device security)" (Ramalingam1, Dorairaj & Ramamoorthy3, 2012).

Future Works

Location Detection(along with voice and video in case of emergency) and use of other Location-based services like tracking via Bluetooth is our objective in future updates.

Acknowledgement

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POWER SPECTRUM ANALYSIS OF EEG FOR SCHIZOPHRENIA DURING RELAXED CONDITION WITH EYES CLOSED

Introduction

Schizophrenia is a mental disorder having some specific characters like a breakdown of thought processes, poor emotional responsiveness etc. The symptoms of schizophrenia are auditory hallucinations, paranoid or bizarre delusions, disorganized speech and thinking. These symptoms are accompanied by occupational dysfunction[1]. The diagnosis of Schizophrenia is based on the World Health Organization's International Statistical Classification of Diseases and Related Health Problems, the International Classification of Diseases -10[2].These criteria state that the diagnosis of schizophrenia is based on their self-reported experiences of the person and behaviour abnormality. After so many years of research, the person who first described the schizophrenia stated that the brain abnormalities are connected to the causes of Schizophrenia[3].In order to study the brain activity of the people diagnosed with schizophrenia, Functional Magnetic Resonance Imaging (fMRI) and other brain imaging technologies are used[3,4].

Electroencephalography (EEG) is the recording of electrical activity along the scalp. EEG measures voltage fluctuations resulting from ionic current flows within the neurons of the brain. Diagnostic applications generally focus on the spectral content of EEG[5]. In neurology, the main diagnostic application of EEG is finding epilepsy, detecting coma, and brain death. Scalp EEG activity shows oscillations at a variety of frequencies[6]. Several of these oscillations are associated with different states of brain functioning[6]. EEG can be used to monitor the depth of anaesthesia

in intensive care units for brain function monitoring[6].Since EEG is less expensive, has high temporal resolution and non invasive in this present work, it is decided to use EEG as a pre screening tool for identifying Schizophrenia.

There are some studies based on the analysis of EEG for diagnosis of Schizophrenia. The analysis of EEG in patients with Schizophrenia using bipolar montage shows less alpha and beta power for acute schizophrenic condition and chronic schizophrenic group has an excess delta power[7]. But this study shows the change being confined largely to temporal area. Some of the researchers stated that the Schizophrenia subjects have more slow activity and less alpha activity in their EEG compared to normal subjects[8].A theory reported that the EEG data of Schizophrenia subjects has increased delta activity and they defined that it is not specific to frontal regions[9]. In some of the reports, the study of EEG for schizophrenia disease has been made during information processing and has found considerable power changes in the 0.5-3.4Hz and 10-13.5 Hz frequency band, only on left fronto-parietal lead position[10].Some studies reported that EEG for negative symptoms are associated with reduced alpha power and less alpha coherence[11].In order to provide a measure of functional correlations between two EEG signals, some studies have been conducted at rest and photic stimulation. They obtained higher coherence for delta band using rest EEG[12].Some of the examination results show that there is an abnormality in slow bands with either β increase or α increase for Schizophrenia subjects and their results are correlated with MRI[13].Many of the researchers used 16 channel EEG band power as a feature for classifier and achieved 90% classification accuracy while classifying schizophrenic group[14]. This paper analyses the power spectrum of EEG for Schizophrenia subjects in comparison with normal subjects. The results are helpful as a support for clinical feature finding in order to treat Schizophrenia subjects.

Materials and Methods

Analysis of EEG in frequency domain plays an important role in finding many features. It contains many frequency components which carries information about the function of the brain[1]. In this study we try to bring out some features from the frequency components of EEG for finding neuronal behaviour of schizophrenia subjects.

Subjects

For this work, the EEG is acquired from 87 subjects. Among them 57 are Schizophrenia patients (20 women and 36 men of average age 42.78), remaining 30(13 women and 18 men of average age 42.1) are normal subjects. The Schizophrenia patients are diagnosed according to ICD-10 criteria by doctors and all of them have undergone Mental State Examination. All subjects are incidentally right handed and informed consent is obtained. All Schizophrenia subjects who are participating in this study are taking antipsychotic medications.

EEG Recording

EEG is recorded using a 23 channel Brain Clarity –Brain Tech+40 equipment at electrodes FP_2, F_4, C_4, P_4, F_8, T_4, T_6, O_2, FP_1, F_3, C_3, P_3, F_7, T_3, T_5 and O_1 position of International standard 10-20 system using mono polar montage with linked ear as reference. The sampling frequency of EEG is kept at 256Hz.The subjects are asked to sit in a chair in a relaxed position. They are instructed to close their eyes while recording EEG. EEG is recorded using much number of tasks. EEG recordings are visually inspected by a physician to avoid eye blink, movement and sweat artefacts. In order to remove power line interference, notch filter (50Hz) is kept on in the equipment.EEG signals are filtered by a band pass filter with upper and lower cut off frequencies of 0.1Hz and 70Hz respectively. The sensitivity of the equipment is set to 7.5μv/mm. For the power spectrum analysis presented in this paper only, 10 seconds epoch of artefact free recording with eyes closed condition is considered, in order to carry out the analysis.

Feature Extraction

Generally EEG signal contains α wave, β wave, δ wave and θ wave. Each wave occupies a specific portion of frequency[5].In this paper, power in various bands of EEG is considered for analysis. For each band namely delta, theta, alpha and beta, the absolute and relative power values are considered. Along with these, the total power is also taken into account. Hence totally nine features are selected for this study.

Absolute Power Analysis

The power which is calculated from the EEG signal is termed as Absolute Power. To determine this, the EEG signal obtained from various electrode positions mentioned above are used. Under

this methodology, we extract two sets of features; these are Total Band Power and Individual Band power

Total Band Power

The calculations of band power are carried out as follows. Let x[i] be the 10s epoch of EEG sequence of length N. Since EEG waves are non stationary, it is essential to consider stationarity in order to avoid misleading results[15]. So 2s epochs are considered as a stationary wave [16]and windowing technique is done with Hamming widow and it is also used to control the abruptness of the transition to zero[11,15]. In this study, we carry out modified periodogram estimate using Welch method with 50% overlap using hamming window of 512 sample point length. It is performed as follows[15].The EEG sequence is denoted as x[n]. The sequence x[n] is windowed by window sequence w[n] with R overlapping portions of length M. Let the overlap between adjacent samples be K samples. Then the windowed r^{th} segment of the data x[n] is

$$x^r[n] = x[n + rK], 0 \leq n \leq M - 1, 0 \leq r \leq R - 1 \quad (1)$$

The Fourier transform of each segment is represented by $X^r(e^{jw})$ and its periodogram is given by $P^r xx\left(e^{jw}\right)$. The Welch estimate is then given by the average of all R periodogram using the equation

$$Pxx(w) = \frac{1}{R}\sum_{r=0}^{R-1} P^r xx\,(e^{jw}) \quad (2)$$

The Absolute Band power is estimated using the equation (2) and it is expressed in $\mu v^2/Hz$. This power value is verified by calculating the power at time domain by using the equation (3)

$$P_x = \frac{1}{N}\sum_{n=0}^{N-1} |X^2[n]| \quad (3)$$

As per the method specified above, the total power at each channel is calculated for all subjects, and it is averaged using equation (4) where L is the total number of subjects. This is treated as Total Power in this study

$$Total\ \ Power_{per\ channel} = \frac{1}{L}\sum_{0}^{L-1} Pxx_{per\ channel}(w) \quad (4)$$

Individual Band Power

In order to calculate the power at each individual band of EEG, the signal is filtered with Butterworth FIR Band Pass Filters of order 7 with appropriate pass bands as follows. Each band

has lower and upper cut off frequencies and in this study we have chosen the EEG band as δ band (1-4Hz), θ band (4-8Hz), α band (8-13Hz) and β band (13-32Hz) to avoid boundary conflict [16].

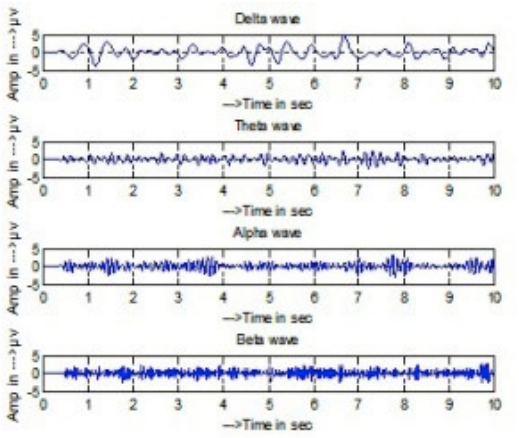

Fig.1.a.EEG bands for normal subjects

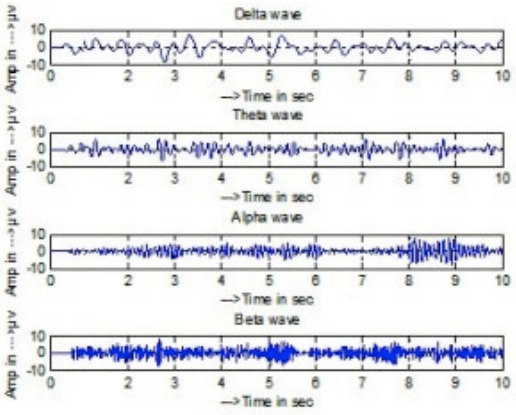

Fig.1.b.EEG bands for schizophrenia subjects

Fig.1.EEG bands

Each individual band is extracted from one of the channels of EEG which is shown in figure (2).The power at each band, for example $\delta\ band$ is calculated using the equation (5)

$$(BP|\delta\ band) = \frac{1}{no\ of\ sub} \sum_{0}^{no\ of\ sub-1} Pxx_{\delta\ band} \qquad (5)$$

where $Pxx_{\delta\ bands}$ is the $power\ values\ for\ each$ 2s epoch of δ band. Similarly the Power estimation is done for all 16 channels of both the groups. The Individual Band Power for all subjects in each case is calculated. Similar analysis is done for remaining 15 channels.

Relative Power Analysis

In an attempt to refine the work, this analysis has been focused for examining the slow and fast activity of schizophrenia subjects compared to normal subjects. In order to observe the proportion of each individual band power with respect to the total power contribution, individual band power is divided by the total band power generated in absolute power analysis method in section 3.1.1. The power ratio calculated by this method is considered as Relative power (Rp).This estimation is made for delta, theta, alpha and beta band powers.

Experimental Results

Individual Band Power Analysis

The individual band power is calculated as discussed in section 3.1.2 and it is shown in figure (2).This analysis provides information about how each band power varies for both groups. From the figure (2), we observe that the absolute and relative power of delta for Schizophrenia subject is more than that normal subject and this is proved already by several studies[8,9,17,18,19]. In this study there is no significant difference in absolute and relative theta power between schizophrenia subjects compared to normal subjects. It is evident that the alpha band power should be dominant during rest stage for normal subjects[20], our findings also shows similar alpha power changes. The results shows that beta power level is slightly more for schizophrenia subject than normal subjects and this statement is true for every individual channel.

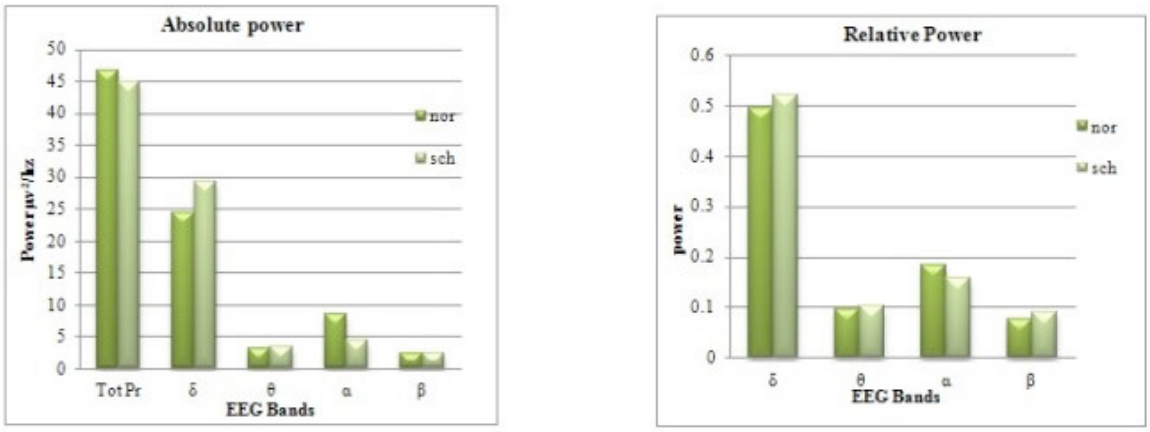

Figure (2).Absolute and Relative Power

The increase in delta should occur only during developmental disorder and pathologic conditions[20]. Since schizophrenia subject is having some form of the developmental disorders, the result produced for delta power may be true. This result also correlates with the result obtained by some other research[9,13]. The relative power of alpha for schizophrenia subjects is less compared to normal subjects in this power analysis. These findings are correlated with John et al[21], as they reported relative alpha 2 power decreases for schizophrenia subjects due to brain perfusion. The minimal increase in beta power might happen due to panic condition even in resting state with eyes closed[6]. However, schizophrenia subjects have no significant difference in theta and beta power value. These power findings inspired us to extend this study by considering the power in different lobes of the brain.

Band Power Analysis in Lobe

The power calculations are segregated according to five lobes and each lobe power calculations are made as below. For the frontal lobe power calculations, the average of 6 channels such as F_{P2}, F_{P1} F_8, F_3, F_7, F_4 is computed. For the central lobe power, the average value of power at C_3 and C_4 are taken into consideration. In order to compare the parietal lobe power, P_4 and P_3 channel power are averaged. The average of T_6, T_4, T_3 and T_7 channel power are considered for temporal lobe analysis. Figure (3) shows the absolute and relative power level at various lobes. We observe that the Schizophrenia subjects have more absolute and relative delta power compared to normal subjects in frontal, parietal, temporal and occipital lobes compared to normal subjects. There is no greater difference in θ band power when we get focused into lobe wise analysis

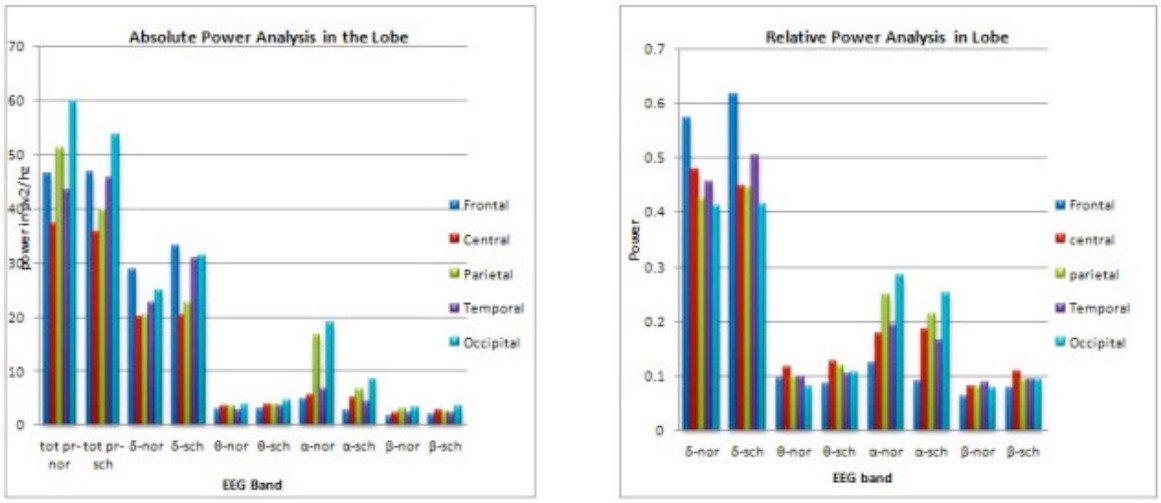

Figure (3). Power Analysis in various Lobes

But the power of alpha is less for schizophrenia subjects at all the lobes in our study. The major difference occurs in the alpha activity at the parietal and occipital lobes. This is due to the fact that alpha wave is dominant in the posterior part of the brain and this may be due to mental concentration, anxiety etc even in the relaxed condition[6]. In comparison of relative β band power of schizophrenia subjects with normal subjects, considerable power change occurs only in central lobe.

Some studies also reported that the schizophrenia subjects produced more delta power almost in all lobes[9,22]. As John et al[21] reported, the increase in alpha value shows decreased cortical functions under resting stage for normal subjects. And also the values of alpha power value at

occipital region is high compared to all other lobes[6] and this is due to resting state of the schizophrenia and normal subjects with closed eyes condition. Similar beta power result is already proved by many of the researchers[9,17,18]. The high level of beta wave may be there when the subject is in panic state and it can also be enhanced around tumour region[6]. Therefore increase in beta at the central lobe may not be considered as a major distinguishing feature between the two groups. In summary, δ power value at frontal, temporal and occipital lobe, α power values at occipital and parietal lobes provide major difference between the two groups.

Analysis of Delta power and Alpha Power between Hemispheres of Brain

Since the previous analysis on power values shows that there is difference between the delta and alpha band power of schizophrenia subjects compared to normal subjects, it is decided to analyze the delta and alpha powers between different lobes on the two hemispheres of the brain. So the focus is now the band power analysis into two hemispheres. The average value of absolute power in right frontal (FP_2, F_4 and F_8) and left frontal (FP_1, F_3 and F_7) electrodes are considered to represent right and left frontal power values which is shown in figure (4). It represents the average value of absolute power in right and left hemisphere of all lobes. It is obvious that the left hemisphere produced more power than right hemisphere for both schizophrenic and normal subjects and this is may be due to the fact that all subjects are incidentally right handed.

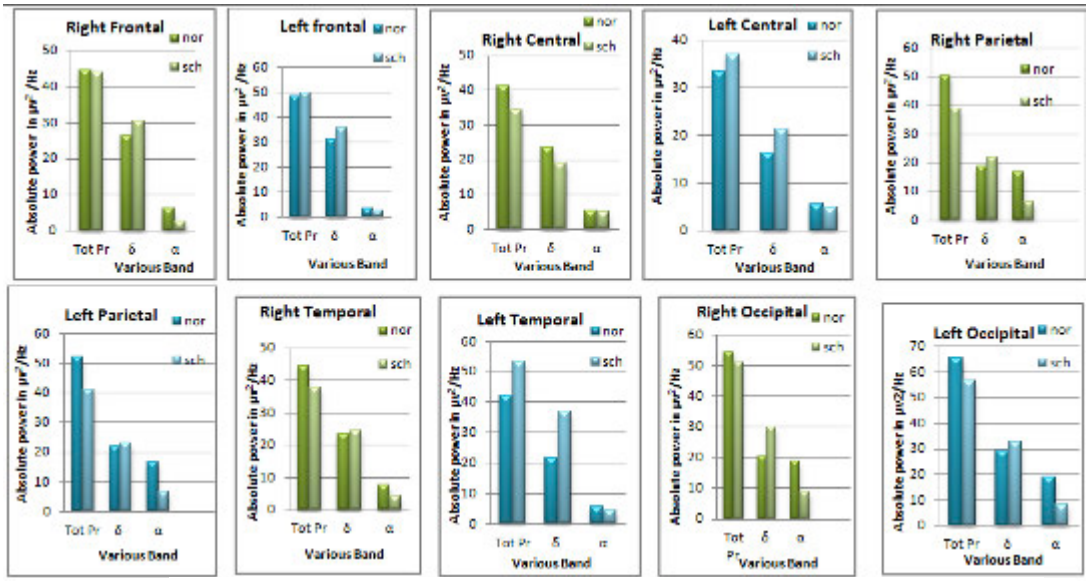

Figure (4).Absolute Power values in left and Right Hemisphere of all Lobes

Figure (4) clearly shows that the schizophrenia subjects have high total power only in the left side of all lobes except at parietal and occipital lobes compared to normal subjects. This might cause due to alpha power reduction more in those area for schizophrenia subjects. The delta power value is more for schizophrenia subjects compared to normal subjects on both hemispheres of all lobes except at right central. The functional neuroimaging studies show increase in delta caused by electrophysiological correlate of metabolic activity[21]. The alpha power is found to be less on the left region compared to the corresponding right part and this is due to the fact that the power of alpha is the mark of anxiety[6], and also left side of the brain is the origin of language and thought process[23]. Normally posterior dominant rhythm amplitude is lower in the left hemisphere than right, this asymmetry may not be treated as major difference between the two cases[24]. The alpha power value does not exhibit major difference between the hemispheres for schizophrenia groups, but normal subject shows very big difference in alpha power values between the two hemispheres. But to find the reason for getting high absolute delta power and low alpha power for schizophrenia subjects, we get narrow down our analysis only on those two power values at various frontal electrodes position, since frontal lobes are responsible for cognitive dysfunction.

Power Analysis at Frontal Electrodes Position

The absolute and relative power values for frontal electrode positions are shown in figure (5). Moreover the absolute power value at the channel, F_8, F_{p1} F_3 and F_7 is more for Schizophrenic cases. However, the relative and absolute power values of delta at all electrodes positions are high compared to normal subjects. The excessive delta at frontal regions for schizophrenic subjects is already reported with many imaging methodologies[3,4]. Our delta findings at frontal electrode positions are also similar to the results obtained by other imaging techniques, since the schizophrenia is associated with hypo activation of frontal functions[18,21]. The power finding at the electrode positions F_8, F_7 and F_{P2} are similar to the results which have been already demonstrated by Ying-jie et al[25]and John et al [21].Though there is no significant difference in absolute alpha power values between the two groups, the relative alpha power values of schizophrenia subject is low in all frontal electrode position compared to normal groups.

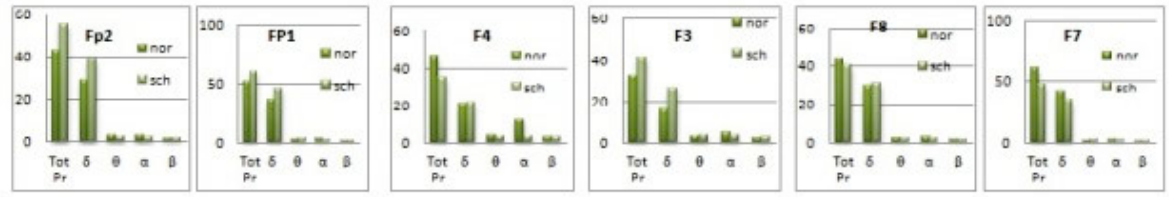

Figure (5).a. Absolute Power at FP2, FP1,F4, F3,F8 and F7 electrode positions

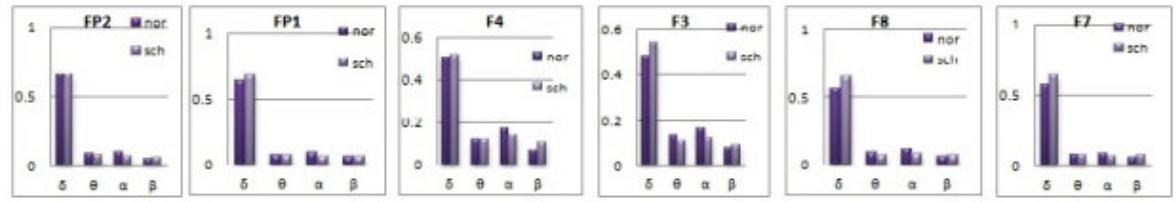

Figure (5).b. Relative power FP2, FP1,F4, F3,F8 and F7 electrode positions

Hence the results show that the relative and absolute power values of delta is high and alpha power is less compared to normal subjects' at all frontal electrodes position when resting condition with eyes closed

Conclusions

The calculations of power are made only under resting condition. In this study, the Schizophrenia subjects are not grouped according to their symptoms, gender, duration of illness, onset of disease and classification of diseases. There is no consideration for drug usage of subjects when the data is collected from subjects. However, some significant difference in EEG is seen between normal and Schizophrenia subjects. It is concluded that the Band Power of EEG is abnormal in patients with Schizophrenia subjects compared to normal subjects. In detail the absolute and relative delta power are very high for Schizophrenia subjects. The schizophrenia subjects have slightly high theta power compared to normal subjects in both the analysis. In the fast activity, beta power is more for schizophrenia subjects compared to normal subjects and alpha power is very less for schizophrenia subjects. Thus the Delta and alpha band power of schizophrenia subjects can also be an indicator and EEG can be applied as a diagnostic tool. This study demonstrates the possibility of identifying Schizophrenia using spectral EEG.

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Figure Legends

Figure 1.a.EEG bands for Normal Subjects

Figure 1.b.EEG bands for Schizophrenia Subjects

Figure 1.EEG Bands

Figure 2. Absolute and Relative Power

Figure 3. Power Analysis in Various Lobes

Figure 4. Absolute Power values in left and Right Hemisphere of all Lobes

Figure 5 .a. Absolute Power at F_{P2}, F_{P1},F_4, F_3,F_8 and F_7 electrode positions

Figure 5 .b. Relative Power at F_{P2}, F_{P1},F_4, F_3,F_8 and F_7 electrode positions

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ORGANOPHOSPHATE AND CARBAMATE ACCUMULATED IN SOIL AND FRUITS SAMPLES AT KALASIN PROVINCE, THAILAND

Introduction

Organophosphates have been used as insecticides worldwide for more than 50 years. The use of these agents has declined in the last 10 to 20 years, in part due to the development of carbamate insecticides, which are associated with similar toxicities. Organophosphates and carbamates exhibit similar clinical manifestations with toxicity and require similar management following overdose. (Rotenberg M, Shefi M, Dany S, et al., 1995) Organophosphate and carbamate compounds are broad-spectrum insecticides used for crop protection to control agricultural pests, such as insects, acarids, nematodes, and allied organisms. The primary toxicity of these compounds results from irreversible inhibition of a key nervous system enzyme, acetylcholinesterase**.** (Yazal et al., 2001) Organophosphates and carbamates are potent cholinesterase inhibitors capable of causing severe cholinergic toxicity following cutaneous exposure, inhalation, or ingestion. Although structurally distinct. (Rotenberg M, Shefi M, Dany S, et al., 1995)

The pesticides undoubtedly has contributed to pest control and increase in crop yields. However, extensive use of pesticides has caused many toxicological and environmental problems such as unbalancing the equilibrium of ecological systems, contamination of farm products, leading to adverse effects on human health Organophosphate and carbamate (OP/C) insecticides have been heavily used during the past decades because of their high efficacy on numerous pests. The mode of action of OP/C insecticides is mainly based on the inhibition of acetylcholinesterase (AChE) that catalyzes the hydrolysis of the neurotransmitter acetylcholine (Mileson, Chambers, & Chen, 1998). Although the production and usage of some highly toxic organophosphate insecticides, such as methamidophos, parathion, methyl-parathion, phosphamidon and monocrotophos, have been gradually prohibited in some countries, the worldwide incidence of OP/C poisoning is still high because of the easy availability and misuse (especially in developing countries) of these

insecticides. Pesticide poisoning, especially OP/C, has caused an estimated 175,000 deaths per year in China. (Ting Xu, et al 2012).

Kalasin Province had many agriculture sites, such as cassava, sugar cane, rubber tree, chili, cow pea and rice, etc. Almost farmers have used pesticides in their farms then there were rick contaminated in soils and environments, so this research was to study the contamination of organophosphate and carbarmate pesticides.

Materials and Methods

Soil Sampling

Grab soil samples from cassava, sugar cane, rubber trees, chili, beans and rice farms at Namon District, Kalasin Province around Kalasin rajabhat University. (Figure 1)

Figure 1 Soil sampling sites

Fruit Sampling

The method was sampling all 11 kinds from 2 fruits shops in Kalasin Rajabhat University. There were mandarin orange, long-kong, dragon fruit, guava, sweet mango, mango, yam bean, mango teen, pomelo, pineapple and watermelon. GT-Test Kit test were used to test the contamination of organophosphate and cabamate in 11 fresh fruits. (Figure 2)

Figure 2 sampling sites

Chemicals, material and instruments

1. GT –Test
2. Test tube
3. Rang
4. The small hose and pump
5. Hood
6. Water Bath

Figure 3 Chemical of GT –test

Extracting samples process

1. Add soil sample weighed 5 grams in test tube.
2. Add solvent 1 as 5 ml and shake for 5 minutes, then leave about 10 to 15 minutes.
3. Pipet solution in the second as 1 ml then add solvent 2 1 ml into test tube .
4. Then remove the top solution by blow with small rubber tube (Do in hood).

(Figure 3)

Detection process

This step must be done in a warm water bath temperature 32-36 celsius.

1. (**Judge Tube**) Added 0.25 ml of solvent 2 , GT1 of 0.5 ml , GT2.1 of 0.75 ml , GT 3.1 1 mL, GT 4 of 0.5 ml and 0.5 ml of GT5, respectively.

2.(**Control Tube**) Add 0.25 ml of solvent 2 , GT1 of 0.5 ml , GT2.1 of 0.25 ml , GT 3.1 1 mL , GT 4 of 0.5 ml and 0.5 ml of GT5, respectively.

3. (**Samples Tubes**) Add solution sample tube 0.25 mL , GT1 of 0.5 ml , GT2.1 of 0.75 ml , GT 3.1 1 mL, GT 4 of 0.5 ml and 0.5 ml of GT5, respectively.

Detection Limit: the test is at 5mg/kg.

4. If the colors of samples tubes weakest than judge tube and control tube, the soil samples were without contaminated with organophosphate and carbamate.

5. If the colors of samples tubes deeper than judge tube but weaker than control tube, the soil samples were contaminated with organophosphate and carbamate. (≤ 5 mg / kg).

6. If the colors of samples tubes deepest than judge tube and control tube, the soil samples were contaminated with organophosphate and carbamate. (≥ 5 mg / kg).

Figure 4 Test soil samples by GT –test kid

Results Discussion and Conclusion

The results found that soil samples for grow sugar cane, chili, cow pea and rice farms were contaminated with organophosphate and carbamate pesticide exceed 5 mg / kg. Soil samples in cassava farms found contamination below 5 mg / kg and rubber tree frams not detected contaminated with organophosphate and carbamate in (Table 1) .

Table 1 Soil samples sites diction of oranophosphate and carbarmate pesticides at Kalasin Province.

Soil samples sites	*Not detection*	*≤ 5mg/kg*	*≥5mg/kg*
Sugar cane			√
Cassava		√	
Chili			√
Cow pea			√

Rubber tree	√
Rice	√

The results showed that all fresh fruits samples were contaminated with Organophosphate and Carbamate (detection limit ≥ 5 mg/kg).

Toxicity generally results from accidental or intentional ingestion of, or exposure to, agricultural pesticides. (Eddleston M, Phillips MR.,2004) Other potential causes of organophosphate or carbamate toxicity include ingestion of contaminated fruit, flour, or cooking oil, and wearing contaminated clothing (Watson WA, Litovitz TL, Rodgers GC Jr, et al. 2002)

Specific agents linked to human poisoning include both carbamate (methomyl and aldicarb) and organophosphate (parathion, fenthion, malathion, diazinon, and dursban) insecticides. Chlorpyrifos, the organophosphate agent of dursban, is found in some popular household roach and ant sprays. The United States Environmental Protection Agency (EPA) banned many household uses of chlorpyrifos in 2001, and has restricted its use on certain crops including tomatoes, apples, and grapes (United States Environmental Protection Agency. Organophosphate pesticide information, 2005).

The conclusion could explain in Figure 4, the soil samples were contaminated with organophosphate and carbarmate ≥ 5mg/kg as 66%, ≤ 5mg/kg as 17% and not detect as 17%, respectively. The vegetable farms (chili and cow pea) and plant farms (consumers take such as rice, sugar cane, cassava) found contaminated of organophosphate and carbarmate. Except placement farm (rubber tree) not found contaminated of organophosphate and carbarmate pesticide.

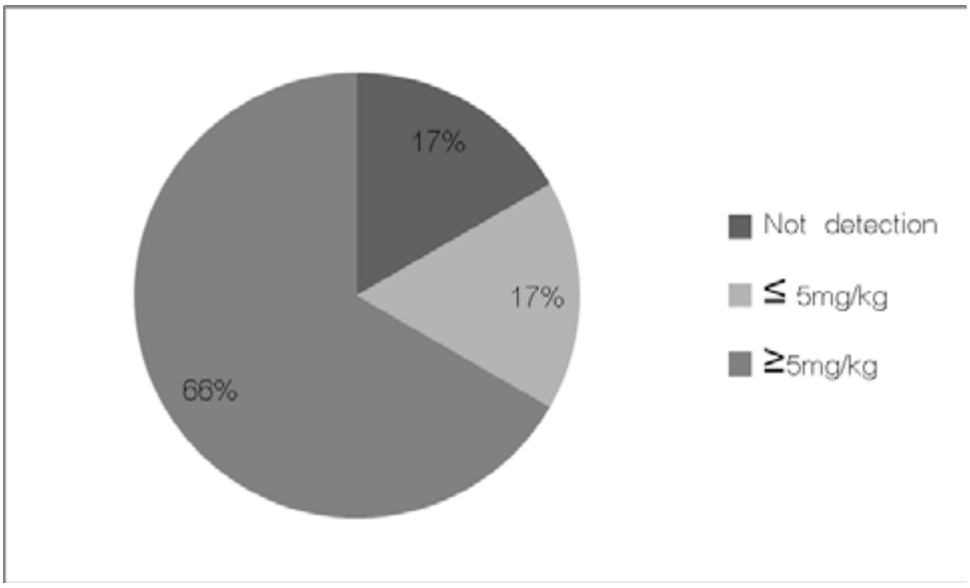

Figure 4 Percentages of soil samples contaminated with oraganophosphate and carbarmate pesticide at Kalasin Province

Therefore, we should provide knowledge to the farmers with the dangers of pesticides, and always monitoring contaminated with organophosphate and carbarmate pesticides in farms. The United States Environmental Protection Agency (EPA) banned many household uses of chlorpyrifos in 2001, and has restricted its use on certain crops including tomatoes, apples, and grapes (United States Environmental Protection Agency. Organophosphate pesticide information, 2005).

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DEVELOPMENT OF ENERGY CONSCIOUS FAÇADE DESIGN FROM 1966 TO 2011: CASE STUDIES FROM THE CAMPUS OF RWTH AACHEN UNIVERSITY, GERMANY

Introduction

In the last 20 years building envelope design has become far more advanced and complex than it was in the contemporary era. There have been continuous researches to address the challenges posed by the construction industry for sustainability. The campuses are sought as the experimental grounds by the researchers for the testing of the new approaches of sustainability (Trust, 2007). Therefore the approach of designing energy efficient and comfortable building envelope is best suited for campus buildings (BRECSU, 1997), where we get the opportunity to witness multiple functions, work schedules, occupants etc. and it gives a better chance to test our approaches for building envelope design or facades (CBE, 2011).

Case Studies

Four North-West European buildings were selected from the campus of RWTH Aachen University, Germany for the building envelope/facade case studies. The case studies illustrate the range of facade depending on the function of the buildings. The case studies presented illustrate the benefits as well as the challenges seen in specific solutions with respect to the energy use, comfort and operation and maintenance.

Figure 4 Library building

The multiple case study method is an effective way of understanding concepts and finds casual links between them that helps to generalize or analyse a pattern or strategy (Hausladen, DE

Saldanha, & Liedl, 2008). In this research the case studies were selected belonging to the same campus but of different decades to understand the transition in approach of building facade design and find the underlying concepts that make these buildings successfully complete their age. For better understanding the surveys were conducted to collect data on these case studies (University, Annual Energy Report , 2011).

Following Case Studies were done during the course of this research:

1. Super-C, Templergraben 57, RWTH (Student Center)

2. Hoschulbibliothek, Templergraben 61, RWTH (Library)

3. Seminargebäude, Wullnerstr. 5b, RWTH (Seminar Building)

4. E.ON Energy Research Center, Mathieustraße, RWTH (Research Center).

2.1. *Case 1: Hoschulbibliothek (Library)*

Figure 2 Interior view of the window

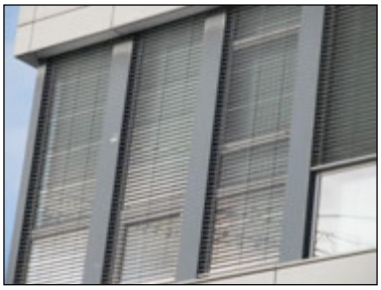


Figure 3 Use of external louvers for shading

The library (fig.1) was meant to provide a structured location for the growing RWTH Aachen University but at the same time during 60's it was difficult to provide technologically advanced solutions for building the library. The building does not have any efficient measures to improve the energy efficiency. It certainly has the exterior and interior shading devices which are sufficient to control the sunlight and glare. The loss of energy is more through the building envelope due to inefficient glazing system which does not have any protective coatings as it belongs to the 60's architecture. Although the double glass concept for glazing with an air gap was evident during those times have been used here. The high WWR ratio is sufficient for transparency and visibility of the occupants. But during summers it was reported by the occupants that internal comfort reduces due to SW orientation of the façade.

The key objective in design was certainly to design a façade which limits the conductive and radiant heat losses and gains maximizing daylight for the readers in the library and simultaneously controlling the direct sun. The building has unitized façade system as in fig.1 with

operable windows and the use of wood for window framing inside as in fig. 2 and metal frame outside to reduce conductive heat transfer had been done which does not offer efficient air sealing hence loss of energy is prominent in the building. The interlocking metal cladding over insulation is somehow helpful in maintaining the heat losses and gains. The constant change in the internal layout of the building demanded differential level of sunlight and heating. The ground and the first floor have double height windows to ensure maximum lighting inside the building as the issue section and the reading rooms are located on these floors. The concept of floor plate dept is very evident as the requirement of daylight is of prime importance in such institutional buildings.

2.2. *Case 2: Seminargebäude (Seminar Building)*

Figure 4 Interior view of the facade

Figure 5 Seminar building

The RWTH Aachen University in its expansion mode constructed the seminar building in 1970 as a part of new development phase. It was targeted for the expansion of student learning facilities near the department of mechanical engineering and other sciences. There are several façade design strategies that indicate the minimization of heating loads and provide comfort to the users in the building, which include the use of exterior and interior venetian blinds for sun protection as in fig 4. The use of operable windows equipped with double glazing, however it does not have any coating to prevent radiation. The insulation and the concrete grit panels provide efficient thermal insulation to the building façade but with ageing the building appears dirty and less pleasing. The provision of vents over the windows provides thermal comfort to the occupants in summers as in fig. 4. In an interview with the building manager, it was said that the building lacks natural light near the core and stale air circulates in many rooms because the depth of the floor plate is around 25m. Due to high compartmentalization of the interior areas the loss of heat is less during winter therefore the heat energy consumption is quite less. The façade lacks visual connection with the outside

environment due to small windows and less glazed area, thereby making occupant feel uncomfortable to work for longer durations.

2.3. *Case 3: Super- C (Student Center)*

Besides the main building, the new building Super-C of the RWTH (fig.6) consolidate all student services at a central location and provide a common forum for the university, the city of Aachen, and the economy. The building's design was born from the idea to get a free space for public activities and to design the building as a great showcase closed thermoelectric power umbrella over the forecourt in front of the closed wall of the plant. The roof spans like an and takes up the flight of the adjacent main building. The prominent cantilevered floor (fig.7) of the building not only protects the forecourt, but also helps to optimize the energy of the building: in the summer, it offers sun protection for the southern glass façade. In winter and the transitional seasons reached the low sun, the facade and the rooms are heated by passive solar energy. In the areas to the east and west side, which is for main land energetically more problematic is the development of the building. The energy concept of the building is based on first to use the environmental resources and natural processes, and only under extreme load peaks use of conventional cooling, heating or mechanical ventilation systems. Apart from the meeting halls, the rooms in the building can be naturally ventilated. The southern facade is equipped with casements, which support natural ventilation efficiency. The automated horizontal blinds are used on the façade to block the direct sunlight at various places. The heating energy is provided by the innovative geo-thermal heating system designed for the building.

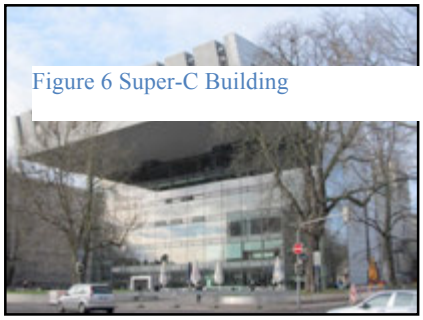


Figure 6 Super-C Building

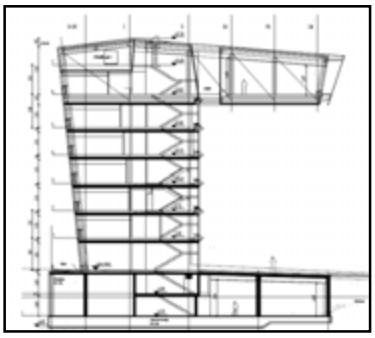


Figure 7 Section of Super-C

2.4. *Case 4: E.ON Energy Research Center*

Figure 8 E.ON. Energy Research Center

RWTH Aachen has recently added a new building E.ON Energy Research Center as a research institute. The building has 5 research institutes which comprise of workshops, seminar halls, labs and meeting rooms etc having kitchenettes at all the floors with the interaction areas and discussion spaces for studies and for visitors. The façade is designed in a grey-black metallic coating with a unitized curtain walling. The all over appearance is simple and quite artless but representative and presentable.

Figure 9 Facade Ventilation Units

The design constraints for the energy concept are kept with thermal comfort following EN 13779, indoor air quality 2 (IDA 2), with a temperature spread between 20 and 26 °C, which must not be exceeded for more than 50 hours per year (University, 2011).

The façade had specifically developed façade ventilation units for the project and secondarily promote the outside air requirement is based on the basis of the current indoor air quality and have an adaptive heat recovery system. The integrated design approach towards façade design is evident with advanced envelope systems being adopted. There is an integration of functions like ventilation, cooling and heating through the FVUs being installed in the building section. These FVUs take advantage of the waste heat recovery through the exhaust air which is simultaneously used for pre heating the fresh air supply. It is also noticeable that the façade is fixed with the systems to provide direct and indirect lighting in the internal spaces of the building.

Analysis

Case study analysis

There have been many key basic design strategies determined from case studies such as orientation, natural ventilation, building mass, transparency and solar control. The façade design strategies ranged from the very simple passive to highly complex active designs such as WWR to FVUs (Façade Ventilation Units) that are used to improve the performance of the building but

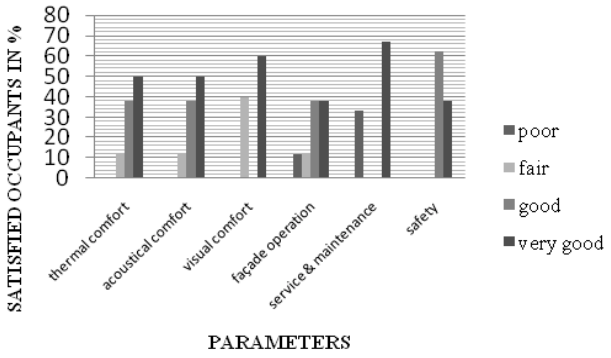
require high maintenance along with the advanced glazing systems. The building envelope is no more only uni-functional but multi functional, performing various functions from various layers which is observed as the building technology became more advanced in European buildings (Knaack, Klien, Bilow, & Auer, 2008). The use of passive energy measures along with the active systems revealed good results in energy consumption pattern of Super-C and E.ON Energy Center. Narrow floor plates were responsible for high energy savings in terms of light energy. The table 1 data matrix shows the energy saving pattern due to the adoption of design strategies for energy conscious design.

Survey analysis

The survey revealed that the parameters of comfort varied from past to present generation facades. It is important to consider that the performance of façade which depends heavily on the occupants and their interaction with them, which are evident under facade operation in figures 10, 11, 12 & 13. Facades are the systems of the building on which the visual and thermal comfort depends as well and they are connected to the user very effectively, therefore variable results are observed in the survey, were modern facades are more effective in ensuring the comfort in the buildings- Super-C and E.ON Energy Research Center due to innovative facade technologies.

Figure 10 Satisfied Occupants- Super-C

Figure 11 Satisfied Occupants- Library



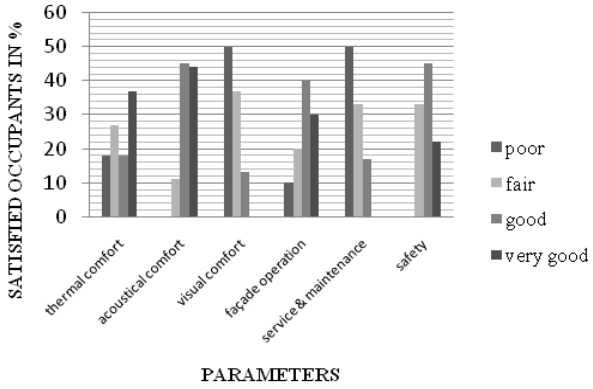


Table 1

Data matrix for case studies analysis

	Case 1 **Library (Hoschulbibliothek)**	*Case 2* **Seminar Building (Seminargebaüde)**	*Case 3* **Super C**	*Case 4* **E.ON Energy Research Center**
Year of completion	1966	1970	2008	2011
Campus	Middle	Middle	Middle	Melaten
Type of building	Library	Lecture Halls/Departments	Administrative/International Office	Research Center
Project size	7,200 m^2	6,600 m^2	4,600 m^2	7,800 m^2
Total floors	12	7	8	4
Annual heating energy consumption	532 Mwh	458 Mwh	251 Mwh	200 Mwh
Annual electrical energy consumption	969.5 Mwh	497 Mwh	307 Mwh	244 Mwh

Orientation of building	NW-SE	NW-SE	NE-SW	NE-SW
Energy use intensity (kwh/m^2)	210	150	121.3	57
Type of facade	System Facade	Load Bearing Facade	Post And Beam Facade	Unit System Facade
Height of the building	33.0m	30m	27.76m	15.77m
Floor depth	15.0 m (average), typical	25.0 m typical	15.0 m (average), typical	35m (internal court)
External shading devices	External horizontal blinds	External horizontal blinds	None	None
Internal shading devices	Vertical blinds	Horizontal Blinds	Horizontal Blinds	Horizontal Blinds
Type of glass in facade	Double glass panes with spacer	Double glass panes with spacer	Double glass unit (air gap)	Double glass unit (argon)
Type of louvers	None	None	None	None
WWR	45% (S-W)	50% (N & S)	35% (N-W)	50% (N-W)
Natural ventilation techniques	Casement windows	Casement windows	Casement windows	Ventilation louvers at ceiling level
Ratings	Assessment in process	Assessment in process	Assessment in process	Assessment in process

Passive energy measures	Solar panels	None	Geo-thermal heat exchangers	Geo-thermal heat exchangers, solar panels
Special features	-	-	-	Facade ventilation units, extensive monitoring system

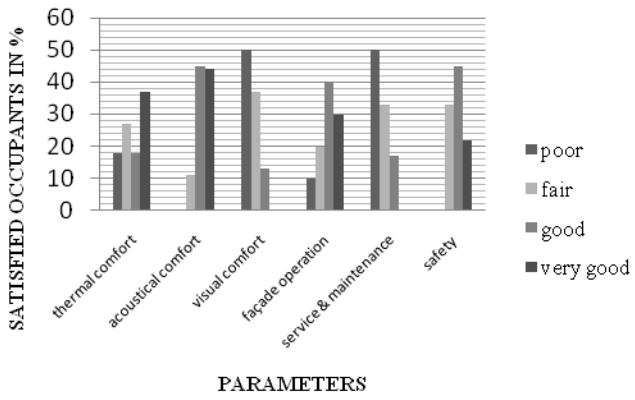


Figure 12 Satisfied Occupants- E.ON Energy Research Center

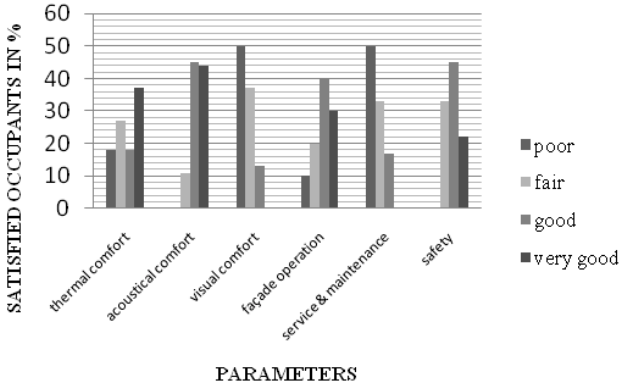


Figure 13 Satisfied Occupants- Seminar Building

Conclusions

The analysis of the primary data collected for the four case studies highlighted several aspects that explain a lot about the building envelope from the perspectives of the user. It helps highlight and to understand that how the building is performing and give ideas to improve upon such situations through strategic development the design. The buildings belong to the duration of 1960-2011, which shows how much development has taken place in façade design and

continuous improvement is under research. To maintain a comfortable indoor climate, fixed and operable shading systems are used in north-west Europe to limit solar gain and operable windows are implemented to allow for natural ventilation. European buildings typically have narrow floor plate which enhances the effectiveness of natural ventilation and day-lighting and reduces the need for cooling and electrical lighting. The prevalence of narrow floor plates among European buildings can be explained by combination of factors: working condition standards, economics and cultural expectations in terms of access to daylight and cooling systems. The building facade research in Europe is leading to the high standards of facade design and greater efficiency in terms of energy and integrated systems. The examples can be best found in research campuses of Europe and can be studied for better understanding.

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EFFECT OF MULTIWALL CARBON NANOTUBES ON THE THERMAL STABILITY OF POLYPROPYLENE TERNARY NANOCOMPOSITES

Introduction

Research on polymer nanocomposites has been receiving great attention over the years due to the discovery of some nanomaterials that are capable of improving the properties of wide range of polymers. A lot of polymers with different properties have been studied as base matrix in the preparation of wide range of polymer composites. Polypropylene-layered silicate nanocomposite for example, has been credited with improved mechanical properties, increased heat distortion temperature, improved thermal stability, decreased gas/vapour permeability and reduced flammability (Alexandre and Dubois, 2000). Polyamide 66/montmorillonite also has displayed a very good thermal and flammability stability when compared to pure polymer (PA66) and its nanocomposite performed better in terms of thermal stability when compared to microcomposite (Qin *et al*, 2003). Many other nanomaterials such as nanosilical, carbon nanotubes, nanographite as well as carbon nanofibres have been used for property enhancement in polymers and their degree of improvement reported (Wu and Ke, 2006). Among all the nano materials, carbon nanotubes have attracted more attention due to their multifunctional properties such as high mechanical and electrical properties (Bao and Tjong, 2007) and ability to reinforce polymers if well dispersed due to their high aspect ratio (Salawudeen *et al.*, 2008).

With the discovery of carbon nanotubes some decades ago, a lot of research works have been published on its reinforcement properties (Rupeshi and Suryasarathi, 2005; Yusof *et al.*, 2007). Carbon naotubes has been described as the strongest material in nature with a tensile strength ranging between 11 to 63 GPa that is 10 to 100 times greater than the strongest steel at a fraction of the weight (Fakhru'l-Razi *et al.*, 2006; Treacy *et al.*, 1995). Carbon nanotubes (CNTs) are highly resilient, flexible and due to its high aspect ratio, hence have found applications in

polymer composite. Such composite are credited with high potential in air and space craft technology. In addition CNTs has both metallic and semiconducting properties and have found application in electronic devices (Michael, 2006).

With the introduction of ternary nanocomposite (Salawudeen *et al.*,2013) that comprises of both modified nano clay and multiwall carbon nanotubes (MWCNTs) in a single polymer matrix with a target of exploiting the intrinsic properties of both fillers in a matrix, the findings have shown that one filler element may affect the other thereby resulting to a property trade off. For example, Polypropylene layered silicate nanocomposites have been credited with good thermal stability (Huaili *et al*, 2005) among others. However with the addition of the third party (MWCNTs) it is envisage that the properties imparted by Clay may be distorted. Therefore, this research work aimed at investigating the effect of MWCNTs addition on the thermal property of polypropylene ternary nanocomposites. This will enable an easy assessment of the extent at which the nanotubes have affected the thermal property of the composites. Hence an appropriate recommendation could be given in terms of its use.

Materials

The ternary nanocomposite was prepared by using the following materials: polypropylene homopolymer (Polypropylene Malaysia SDN BHD), MWCNT (Zyvex Instrument, Germany), Maleic anhydride grafted polypropylene (POLYBOND 3200), chemically modified polyolefin compatibilizer (Uniroyal Chemical Company, Inc, Middlebury), and bentonite clay (MNC) (ACROS ORGANICS, USA).

Nanocomposites Preparation

The ternary nanocomposite samples (PP-Clay-MCNTs) and the binary precursor (PP/Clay) nanocomposites were prepared according to Salawudeen *et al,* 2013; Phan & Nguyen, 2006 inthe presence of appropriate stabilizers. The samples were labeled as: Sample 1 (0.17% MWCNT), Sample 2 (0.45% MWCNT), Sample 3 (0.61% MWCNT) and Sample 4 (PP/Clay) which represents the intermediate master batch with a fixed percent (3%) of modified nanoclay.

Characterization

The nanocomposite thermal stability was examined using thermogravimetric analyzer (TG-DTA EN 55011) under air. This is to subject the composite samples to natural environment during thermal degradation. The effect of heat on the weight loss of the nanocomposite was examined at a heating rate of $10^{o}C\ min^{-1}$ from $30^{o}C$ to $700^{o}C$. Simultaneously, differential thermal analysis test was conducted to examine transitions and reactions which occur on the order between seconds and minutes. This will give the idea of isotherm and transition temperatures. For example, if a sample S (nanocomposite) and inert substance I are placed in an oven that has the ability to raise its temperature linearly with two thermocouples connected opposite to one another such that no voltage is measured as long as S and I are at the same temperature, the difference in the temperature ΔT will be:

$$\Delta T = T_S - T_I = 0 \quad (1)$$

where T_S and T_I represent temperature of sample S and I respectively. However, if a transition or a reaction occurs in the sample at a temperature, T_C, there will be heat loss or gain, in this case,

$$\Delta T \neq 0 \quad (2)$$

This thermal disturbance is used in predicting the information about the reaction temperature (T_R) or simply about the existence of temperature from the given curve (Osswald & Menges, 2003).

TGA Results

Additions of clay into the polymer matrix have been reported to enhance its thermal stability by acting as a superior insulator and barrier to volatile materials during polymer decomposition (Nguyen and Thai, 2006). The effect of multiwall carbon nanotubes on the thermal stability of ternary nanocomposites was investigated by means of thermogravimetric experiments carried out under air in order to subject the nanocomposites to natural oxidative condition. Figure 1 shows the TGA plots of the three ternary nanocomposite samples (samples 1, 2 and 3), PP/Clay Intermediate master batch (sample 4) and pure unblended polypropylene (sample 5) heated at a heating rate of $10^{o}C$/min under air. From the thermogravimetric curve, it can be observed that both the pure polypropylene and its composites showed a relatively good thermal stability up to temperature of $250^{o}C$ since no remarkable weight loss occur at this temperature. However, at temperature above $250^{o}C$ pure polypropylenes (sample 5) showed a sharp thermal degradation and completely burnt off around $400^{o}C$. Polypropylene nanocomposites (samples, 1, 2, 3 and 4) however, experienced a

little shift in the initial temperature to higher degrees between 280 and 300^{o}C in terms of weight loss compared to pure propylene. This is traceable to the presence of nanoparticles (MNC and MWCNTs) in the matrix. This stability could be explained in terms of barrier effect attributed to both the clay and carbon nanotubes (Vassiliou *et al.*, 2007) and hence, degradation did not commence until they reach temperature around 300^{o}C, or even higher, depending on the composition in terms of substituent (Zhang, *et al*., 2008).

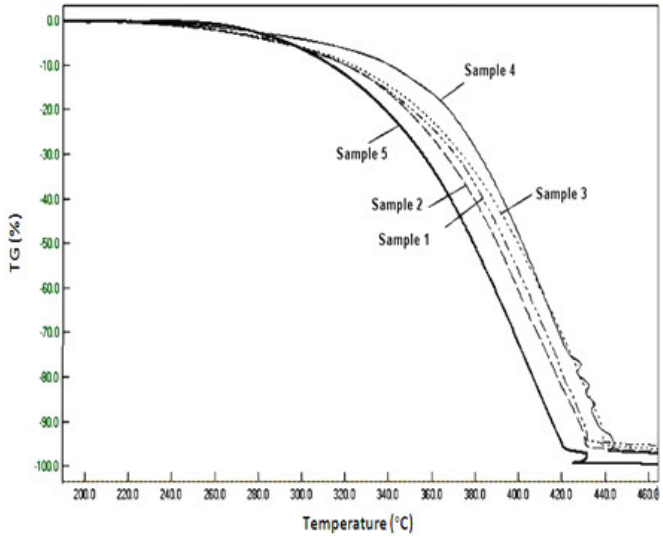

Figure 1. TGA Curve for Sample 1 (0.17% MWCNT), Sample 2 (0.45% MWCNT), Sample 3 (0.61%MWCNT), Sample 4 (PP/Clay) and Sample 5 (Pure PP)

Comparing the thermal stability of the three samples with varied percentage of multiwall carbon nanotubes, it can be seen from the plot that after the initial degrading temperature, sample 3 overlapped with polypropylene clay and completed its degradation at the same temperature around 438^{o}C and percentage degradation of 94% similar to the binary composite. Sample 1 and 2 completed their degradation at a temperature 8^{o}C lesser than that of Sample 3 with percentage degradation also around 93%. These observations show that MWCNT did not affect the decomposition mechanism but only the decomposition rate with a slight shift in decomposition temperature depending on the percent composition of nanotubes. Similar result was obtained by (Chrissafis *et al*., 2007) in their study with polyϵ-caprolate. But on the overall assessment, layered silicate has more contribution to the thermal stability of the composites than MWCNT, however no stability tradeoff was observed irrespective of the percentage composition of nanotubes in the

composites. Hence, ternary nanocomposite of polypropylene will have in addition to its high chemical resistance and good tensile properties, a very good heat resistance which makes it a good candidate for material of construction in high temperature processing equipment.

Differential Thermal Analysis Results

Figure 2 shows the DTA thermographs of polypropylene nanocomposites: Sample 1 (0.17% MWCNT), Sample 2 (0.45% MWCNT), Sample 3 (0.61% MWCNT) and Sample 4 (0.00% MWCNT). All contain 3% of modified nanoclay (MNC). Following the explanation given above, it is obvious from the thermographs that transition temperature T_C is located at around 400^{o}C for all samples while a characteristics endoderm common to all appears around 180^{o}C due to loss of physically bonded water.

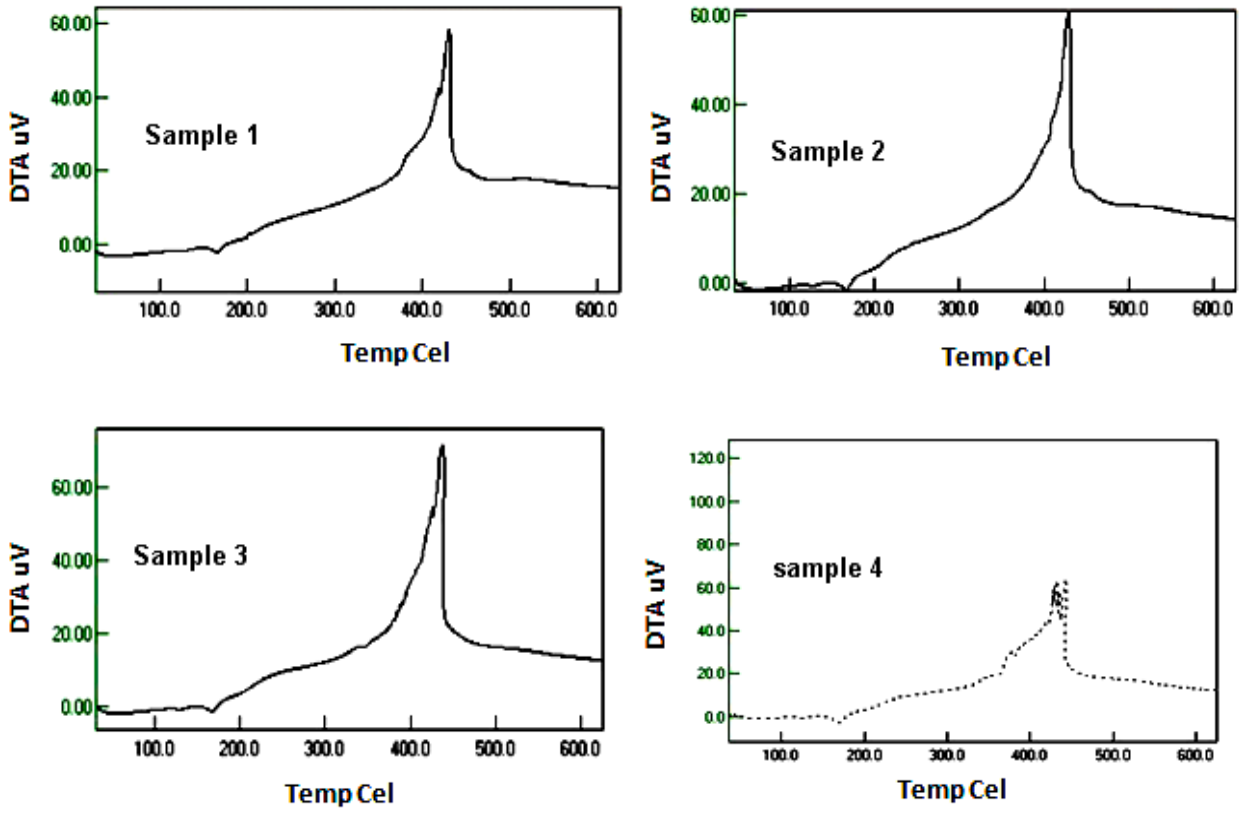

Fig. 2 DTA thermographs of polypropylene nanocomposites Sample 1 (0.17% MWCNT), Sample 2 (0.45% MWCNT), Sample 3 (0.61%MWCNT), Sample 4 (PP/Clay)

The behavior of nanocomposite samples on the DTA thermographs on the basis of percentage MWCNT in samples 1, 2 and 3 indicated that increase in MWCNT reduces the onset

temperature. For example at T_{20} on the DTA axis, the corresponding onset temperatures are 385, 380 and 350^{o}C for 0.17, 0.45 and 0.61% MWCNT respectively. While that of sample 4 (PP/Clay) remain at 385^{o}C. This is an indication that once the carbon nanotubes are applied within the optimum range (≤ 0.2%) (Salawudeen *et al*, 2013), thermal stability cannot be disturbed in the ternary system. However, once the percentage MWCNT is above the optimal value, other properties such as tensile strength, elastic modulus and gas/vapor permeability may be enhanced but at a loss in thermal stability.

Conclusion

Polypropylene ternary nanocomposites prepared at optimum percentage composition of 3% nanoclay and varying percentages between 0.1 and 0.62% multiwall carbon nanotubes were subjected to thermal degradation using TGA. It can be concluded based on the results that the presence of carbon nanotubes has no significant effect on the thermal stability of PP/Clay composites, but only the decomposition rate with a slight shift in decomposition temperature depending on the percent composition of nanotubes were affected.

Acknowledgement

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STUDY AND ANALYSIS OF A POPULAR SOLAR HOME SYSTEM FOR RURAL ELECTRIFICATION IN BANGLADESH

Introduction

Bangladesh, a developing country of south-east Asia with large population, has agricultural economy. The gas is the main fuel for electricity generation which is depleting very quickly. In recent days government has implemented high cost imported liquid fuel based electricity generation as a short time measure. At present the peak power demand [1] is about 8500 MW and the generation is less than 6300 MW. Bangladesh has area of 147,570 sq. km and about 152 million population i.e. about 28 million house hold. Nearly 75 percent population lives in rural areas and 30 percent has access to electricity. Most of the power is supplied to urban areas. Per capita power consumption is only 292 kWh. Fifteen million household [2] of off-grid areas (total 17 million households) live in rural areas.

The country is situated between 20.30-26.38˚ north latitude and 88.04 -92.44˚ east longitude, with average solar radiation between 4 and 5 kWh/m^2/day, is ideal location for solar energy harvesting. Solar Home System in many countries with abundant sunshine had not been successful due to various reasons, like bad quality equipments and system, specifically the batteries, and the inability to repay the loan or monthly installment. For example, in some parts of Africa, it is difficult to do SHS maintenance due to remoteness of the area and bad road system. Government policy like the imposition of customs and tax is also a hindrance for the development of SHS [3]. Solar Home System program of Bangladesh with micro financing for rural electrification has gained worldwide recognition. In Bangladesh strong micro financing system [4] and good after sales services and loan recovery system are some of the reasons for the success and sustainability of rural electrification by solar PV. A Renewable Energy Policy of a government is very important for success of rural energy access. Such policy of Bangladesh [5] allows 0% tariff on RE products. Bangladesh has developed one of the most successful market based program with a social objective for popularizing SHS including other renewable energy technologies to millions of rural people.

History of Solar Home System in Bangladesh

The main application of PV technology in rural Bangladesh is the SHS. The use of SHS for rural off-grid electrification has become very popular during the last years. Following the initial experience from a French-funded pilot project in Narsindi implemented by the Rural Electrification Board (REB) in 1997, several initiatives for the large-scale promotion of the SHS technology were launched. Through REB's follow-up projects 'Diffusion of Renewable Energy Technologies' and "Rural Electrification through Solar Energy" about 13,000 SHS were disseminated using the 'fee for service' model.

Encouraged by the success of the REB pilot project in Narsindi, NGOs soon went ahead with their own SHS dissemination programs.

First commercial activities with SHSs were initiated by Grameen Shakti (GS) in 1997 following 'cash sale' and 'credit sale' approaches.

A new phase of SHS promotion started in 2002 with the implementation of the 'Rural Electrification and Renewable Energy Development Project' (REREDP), which is jointly financed by the International Development Association (IDA), Global Environment Facility (GEF), German KfW and GIZ over year 2002 to 2009.

Infrastructure Development Company Limited (IDCOL) was established in 1997 by the Government of Bangladesh (GOB). The Company was licensed by Bangladesh Bank (Central Bank) as a Non-Bank Financial Institution (NBFI) on 1998. Since its inception, IDCOL is playing a major role in bridging the financing gap for developing medium and large-scale infrastructure and renewable energy projects in Bangladesh. The company now stands as the market leader in private sector energy and infrastructure financing in Bangladesh.

IDCOL supports to disseminate SHSs through 47 Partner Organizations (POs), namely experienced NGOs such as Grameen Shakti (GS), the Bangladesh Rural Advancement Committee (BRAC), Rural Services Foundation (RSF), SolarEn, (together disseminating about 90% of the overall number of SHSs) as well as a number of smaller NGOs and private enterprises.

The POs sell the SHSs to households and small businesses mostly through 'cash sale' and micro credit schemes following to the Grameen Shakti. IDCOL provides refinancing facilities to the

POs and channels grants to reduce the cost of the systems therewith making them more affordable to rural customers.

Furthermore, some portion of the grants is used to support the institutional development of the POs. Besides giving financial support, IDCOL sets technical specifications for the solar equipment, provides technical, logistic, promotional, and training assistance to the POs and monitors the PO's performance.

IDCOL's initial target was to disseminate 50,000 SHSs by the end of June 2008. However, due to unexpected high SHS sales this target had already been achieved in September 2005, three years ahead of schedule and US$ 2 million below estimated project costs. As the popularity of SHSs continues, IDCOL had set a new target of 200,000 SHSs to be sold by 2009. With more than 2.3 million SHSs sold by October 2013, the IDCOL program is one of the fastest growing renewable energy programs in the world.

Analysis of 20 Wp System

Grameen Shakti, the leading NOG in Bangladesh has installed 276,549 SHSs in 2013. In this year out of 10 packages (Appendix-A) with different combination of lights and LCD/LED TV (load), 20 Wp system is the most popular (sales figures are: total installed SHSs 276,549, 20Wp 140,206 nos., 30Wp 55,064 nos. and 50Wp 55,064 nos.). In this paper lighting loads of 20 Wp system are compared with different lights sources and financial analysis is done using RET Screen [6] software.

Financial Analysis

All the POs of IDCOL use a unified payment method since last year. The Payment options available to the customers are rationalized through the country and are:

1. The customer has to pay a minimum 15% of the total price as down payment. The remaining 85% of the price is to be repaid within (maximum) 36 months with 12% (flat rate) service charge.

2. For worship places (Mosque, Temple, Church etc) user has to pay 15% as down payment. The remaining price is to be repaid within 12 months with no service charge.
3. 4% discount is allowed on printed price in full (100%) cash payment.

In the financial analysis using RET Screen the cost of the system is considered US$ 160 [Appendix-A]. The battery, lights and charge controller replacements are considered every 5 years. The fuel cost escalation rate, rate of inflation and discount rate are considered as 5, 6 and 8 percent respectively. The equity payback period calculated from the program comes out to be 2.4 years and simple payback period as 2.6 years. The cash flow graph is shown in Fig.1.

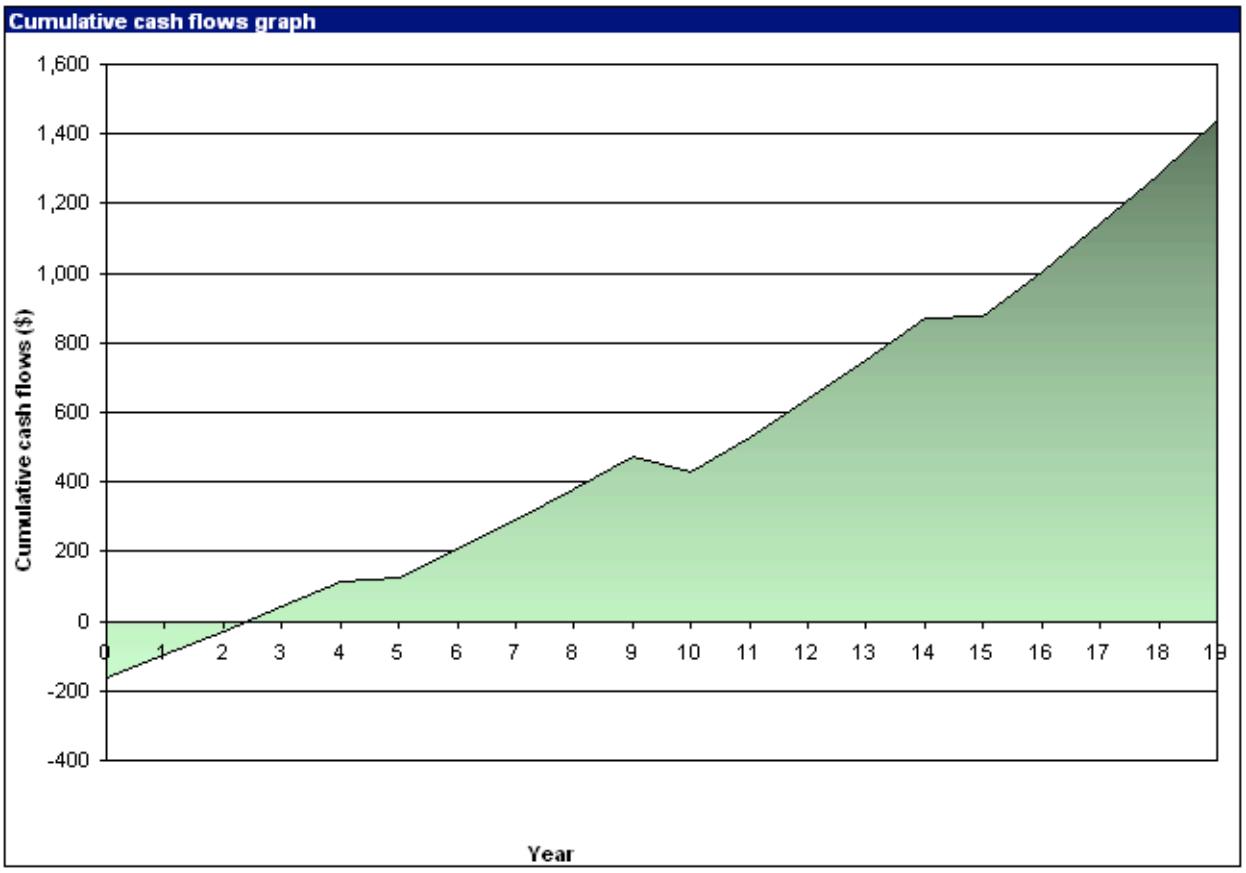

Fig.1 Cash flow graph of a 20 Wp System.

From figure 1 it can be seen that payback period is 2.4 years and there are some flats and dips in the graph i.e. the time when the lights, battery or charge controller are required to be replaced. At the end of nineteenth year cash flow is US$1438.

Technical Analysis

In 20 Wp system GS uses 3 SMD (Surface Mount Device) LED (Light Emitting Diode) of 3 Watt each. It is the 2nd generation LED light and illumination level is higher than the first generation, which used individual LED lights. SMD lights can be made in strips containing many individual lights (LEDs). Like many developing countries poor families usually use kerosene lamps and lanterns in off-grid areas of Bangladesh. The brightness of different types of light sources is shown in Table 1. The total amount of Lux in this 3 light system is 240 Lux, whereas 3 kerosene lamps is 2.7 Lux or 1 lantern and 2 lamps will produce only 3.1 Lux. Moreover, kerosene lamps produce bad smell, soot and also cause health hazards. There is possibility of fire in case the lamps fall down.

Table 1 Comparison of brightness of different light sources

Light Source	Kerosene Lamp	Hurricane Lantern	3W CFL	3W LED (Used by GS)	3W LED
Pictures					
Brightness in Lux	0.90	1.30	32	80	90

*This experiment was done in dark room with Photo Meter at 1 meter (3.28′) distance from light source.

It is estimated that about 0.05 l/hr of kerosene is consumed [7] by a lamp. Current price of one liter of kerosene is Tk. 70. With this price and one kerosene lamp per family, the cost (Fig. 2) of kerosene over the whole period of this SHS comes up about Taka 96,000. For solar PV it is Tk. 38,800.

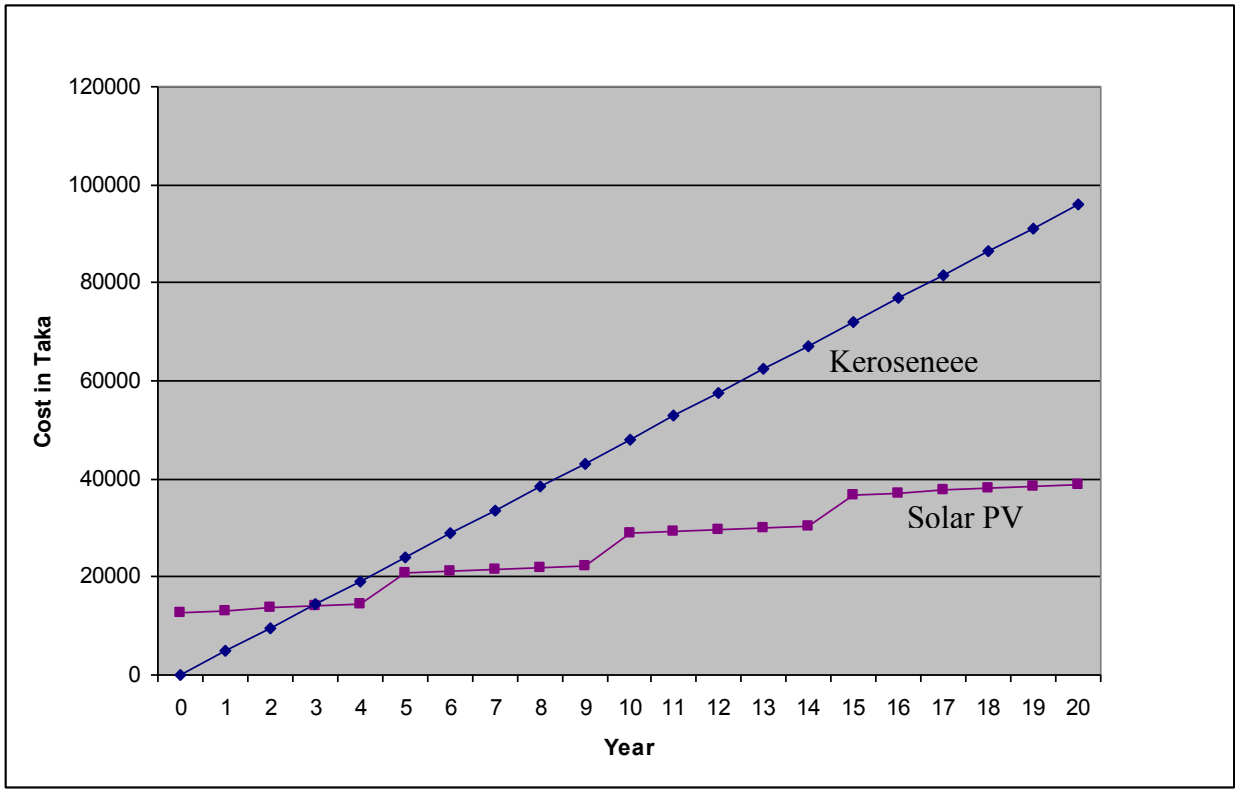

Fig. 2 Cumulative cost comparison of Solar PV system and kerosene lamp

According to a Grameen Shakti in house study the CO_2 emission is calculated as 0.232 ton per household per year. With this base line data this system will save 4.64 tons of CO_2 emission in its life time of 20 years.

Conclusions

This study of 20 Wp system shows that small solar home system improves the quality of life of rural people of off- grid areas. From this study it can be said that solar PV electricity is affordable, viable and cost effective. Solar energy is always environment friendly and reduces GHG emission. The SHS revolution is reducing over 100,000 tons of CO_2 annually and it will also produce thousands of Green Jobs in Bangladesh. The sustainable SHS is empowering the rural people and thus contributing to the socio-economic development of the country.

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Appendix-A: Different SHS Packages offered by Grameen Shakti

*USD 1=BDT 80

Sl.	System Capacity, Wp (Watt)	Loads can be used	Equipments supplied by Grameen Shakti	Package price in BDT (BDT)	Package price in USD* (USD)
1	10	2 x 2.5 watt LED light	A 10 watt panel, 2 x 2.5 watt LED light, a 15AH battery, a charge controller, a frame and cables	7,500	94
2	20	3 x 3 watt LED light	A 20 watt panel, 3 x 3 watt LED light, a 30AH battery, a charge controller, a frame and cables	12,800	160
3	30	3 x 3 watt LED light and a 16″ LCD/LED TV	A 30 watt panel, 3 x 3 watt LED light, a 40AH battery, a charge controller, a frame and cables	17,000	213
4	30	5 x 3 watt LED light	A 30 watt panel, 5 x 3 watt LED light, a 40AH battery, a charge controller, a frame and cables	18,200	228
5	40/42	5 x 3 watt LED light and a 16″ LCD/LED TV	A 40/42 watt panel, 5 x 3 watt LED light, a 55/60AH battery, a charge controller, a frame and cables	25,000	313
6	50	7 x 3 watt LED light and a 16″ LCD/LED TV	A 50 watt panel, 7 x 3 watt LED light, a 80AH battery, a charge controller, a frame and cables	31,500	394
7	60	8 x 3 watt LED light and a 16″ LCD/LED TV	A 60 watt panel, 8 x 3 watt LED light, a 80AH battery, a charge controller, a frame and cables	34,500	431
8	63/65	9 x 3 watt LED light and a 16″ LCD/LED TV	A 63/65 watt panel, 9 x 3 watt LED light, a 100AH battery, a charge controller, a frame and cables	36,500	456
9	80	10 x 3 watt LED light and a 16″ LCD/LED TV	A 80 watt panel, 10 x 3 watt LED light, a 130AH battery, a charge controller, a frame and cables	40,000	500
10	83/85	12 x 3 watt LED light and a 16″ LCD/LED TV	A 83/85 watt panel, 12 x 3 watt LED light, a 130AH battery, a charge controller, a frame and cables	44,500	556

Warranty for different parts of LED Solar Home System:

- Solar Panel : 20 Years
- LED Lamp : 5 years
- 15 AH Battery : 3 Years
- 30-130 AH Battery : 5 Years
- Charge Controller : 3 Years

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