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Mitigation of Environmental Health Risks Within Safe Openings at Buildings Close To Sanitary Bioreactors

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Abstract

A useful study is made to review safe openings at shear walls for the good operational ventilation at buildings in terms of health - safety in post COVID-19 era for people living at particular community health tourism buildings or other kinds of buildings close to landfill sites. An update of literature review is presented on particular research studies for safe operation of sustainable sanitary landfill designs as well as safe shear wall design with opening so as to mitigate risks of people living within safe community health buildings and qualitative integrated ecological health tourism infrastructures. A useful risk assessment framework is presented for efficient monitoring of community health building facilities and shear walls with openings and associated construction facilities in relation to efficient sanitary engineering designs for particular land uses in terms of health - safety within green circular economy. Useful conclusions are made for efficient safe building designs that are necessary supporting particular construction management facilities at ecological health tourism infrastructures including sports constructions for physical activities providing safe building environments in post COVID-19 era to people living at particular community health tourism buildings or other kinds of associated construction facilities close to landfill sites.

Keywords: safe construction design and environmental health; monitoring schemes; structural health monitoring; health and safety; efficient construction facilities; clean technologies; sustainable architectural openings at building; shear walls; renewable resources; batch sanitary bioreactors; sustainable tourism facilities; crisis tourism management; geoinformation web utilities; public health protection; vocational education; safe openings for indoors ventilation; project management; landfill emissions; risk assessment; COVID-19.

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1. INTRODUCTION

Nowadays, communal building designs and other kinds of buildings are becoming necessary due to the circumstances of post COVID-19 pandemic era in relations to other necessities that has the society within sustainable alternative types of safe health tourism construction facilities as well as proper operational management to serve people with several disorders [5, 27, 29, 32, 33, 34, 87, 88, 89, 90, 91, 92, 93, 94]. However, the World Health Organization (WHO) estimated that approximately 5.8 million people die worldwide each year from injury, accounting for 11 percent of global mortality. This implies that injuries have a significantly impact on the society on a physical, psychological and economical level. The total costs have been estimated at US$518 billion globally, meaning that injuries are a major cause of total health care costs in the world [47].

Nowadays, emerging environmental sanitary batch bioreactor clean technologies are necessary for proper waste treatment, effective landfill biotechnologies with proper reclamation projects, sustainable designs for circular green economy, public health protection and sustainable health tourism at post COVID-19 pandemic era [1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18,19, 20, 21, 23, 24].

Old buildings as well as building monuments can be renewed properly according to local heritage architecture principles following the application of proper construction design principles, efficient seismic resistance, use of right computer simulation tools, proper health-safety regulations, associated engineering regulations, eurocodes, eurocode 6 for masonry design [35, 39, 41, 42, 45, 61, 63, 64, 67, 68, 69, 70, 71, 72, 88]. However, sustainable construction designs could be applied with proper use of materials, manufactures based on their architectural characteristics, properties [45, 46, 53, 54, 55].

Proper combinations of monitoring schemes should exist for buildings that exist at areas close to batch sanitary bioreactors. The produced landfill emissions should be monitored and collected properly for exploitation of renewable resources, sustainability and protection of public health [23, 25, 26, 28, 30, 31, 36, 48]. Moreover, proper openings should exist at communal buildings or other kinds of buildings based on their land uses for qualitative ventilation of them at post COVID-19 era [44, 57, 58, 59, 60].

The latter could be achievable for sustainable tourism facilities that exist next to forests, coasts, lakes, rivers, other associated water resources, upgraded architectures of landscapes at communal building facilities travel destinations as attractions in particular alternative types of safe tourism agri-tourism facilities, sports and health tourism physical activities [23, 27, 28, 48, 50]. The old Xenia hotels in Greece [51, 52] or other similar case studies of closed hotels in Europe due to economic crisis could be renewed properly according to particular eurocodes' standards so as to serve more people at associative sustainable health and sports tourism, other alternative types of tourism facilities at post COVID-19 pandemic era [27, 50].

The proper operational health and safety design is needed at buildings for several land uses taking into account the relative issued E.U's Member States Governmental Laws in relation to E.U issued Directives. Hence, for the case study of Greece there is the issued Greek Governmental Laws Number 1568 at year 1985 (ΦΕΚ 177/A/1985) entitled “Health and safety of workers” as well as the issued Greek Presidential Order 294 at year 1988, in relation to Greek Governmental law ΦΕΚ 138/A/1988 entitled “Minimum working time of technical safety and occupational physician, technical security knowledge and expertise for the undertakings, holdings and operations referred to in Article 1 of Greek Law Number 1568 at year 1985”.

Also there is the issued Greek Presidential Order 17/96, in relation to Greek Governmental law ΦΕΚ

11/A/96 entitled "Measures to improve the safety and health of workers at work in compliance with the E.U relative Directives 89/391/EEC and 91/383/EEC".

Moreover, there is the Greek Presidential order 159/99 in relation to Greek Governmental Law ΦΕΚ157/A/3-8-99 entitled "Measures to improve the safety and health of workers (modification of Greek Presidential Order 17/1996)".

Furthermore, there is the Greek Governmental Law 3144 at year 2003 (ΦΕΚ 111/A/8-5-2003) entitled "Social dialog to promote employment and social protection and other provisions". Moreover, since October 2019 there have been recorded 1.9 million Buildings with arbitrariness and have been registered properly by the engineers at the portal of the Greek Ministry of Energy and Environment according to the relative Greek laws 4014/2011, 4178/2013, 4495/2017, where engineers deserve a big thank you from the Greek state [73].

The above particular issued E.U Directives as well as National laws at several E.U's Member States should be followed properly for the good operational management of construction facilities at indoors and outdoors of buildings and associated construction infrastructures, relative designs at emergencies. Robust civil engineering designs are needed at existing buildings in relation to proper use of efficient utilities for sustainable project management in terms of renew, repair and maintenance of particular infrastructures and constructions facility management that promote sustainable development and protect public health at post COVID-19 era. The relative update of sanitary regulations, proper health – safety measures should be followed properly by stakeholders at post COVID-19 pandemic era especially for relative new types of COVID-19 virus like the new variant that is defined by multiple spike protein mutations (deletion 69-70, deletion 144, N501Y, A570D, D614G, P681H, T716I, S982A, D1118H) present as well as mutations in other genomic regions [74, 75, 76].

The extraordinary nature of the pandemic COVID-19 shock created an equally extraordinary E.U policy response from the European Central Bank, ECB. New opportunities are coming for the E.U's Member States. Therefore has launched the pandemic emergency purchase programme for particular E.U Member States, which includes Greek government bonds, to significantly ease our monetary policy stance and stabilize markets [65, 66].

The pandemic has caused significant disruption and hardship in nearly every aspect of our lives, and it will take time to heal the damage that has been done. The euro area economy has been severely hit. However, in Greece, European and domestic policies have together played a crucial role in absorbing the shock, but further efforts will be needed.

At the same time and as Hippocrates, the father of medicine, once said: "Healing is a matter of time, but it is sometimes also a matter of opportunity". Europe – and Greece in particular – now have such an opportunity. Next Generation EU offers a unique chance to use European funds to recover from the crisis, supported by particular E.U's Member States' national policies. If used well, it will not only help the E.U's Member States' economy to heal after the pandemic: it can also strengthen the country's growth potential in the E.U's regional development. Efficient designs are needed for sustainability, efficient designs within tourism crisis management, safe operations management within food services at indoors, safe mobility access at emergencies and public health protection. In terms of sustainable development future integrated waste management schemes should be located close to particular communal health care construction facilities and associated sustainable health tourism infrastructures.

2. EFFICIENT MONITORING SCHEMES FOR COMMUNAL BUILDING FACILITIES

Nowadays, in 2021 more challenges are coming for E.U through Portugal's Presidency of the Council of the European Union, EU (htpps://www.consilium.europa.eu/en/council.eu) it will be very important to strengthen Europe's resilience and its citizens' confidence in the European social model, promoting a Union based on shared values of solidarity, convergence and cohesion – a Union capable of coordinated action to recover from the crisis. The latter priority work focuses on next three major priorities:

- To promote Europe's recovery, leveraged by the climate and digital transitions
- To implement the Social Pillar of the European Union as a key element for ensuring a fair and inclusive climate and digital transition
- To strengthen Europe's strategic autonomy keeping it open to the world

Therefore, useful sustainable designs are necessary for sustainable development within E.U, health – safety, proper construction facility management, support of tourism facilities in crisis, sustainable health tourism infrastructures at post COVID-19 era and public health protection.

Moreover, integrated communal building health care construction units with relative sports facilities are necessary in order to provide sustainable services. Such building facilities not only should follow properly the health – safety principles for good ventilation operation of buildings' shear wall openings at post COVID-19 era but also to exploit renewable resources from landfill emissions at nearby operation of effective sequential batch bioreactor technologies exploiting properly of produced biogases, leachates within green circular economy and environmental health protection in particular ecosystems using proper methodologies, tools [23, 25, 27, 28, 48, 49, 50, 63, 64, 67, 68, 69, 71, 72].

However, the experimental project of Mid Auchencarroch, (MACH) project, has shown that sequential batch bioreactor sustainable design achieves biomass biodegradation in short time period avoiding long term chemical threats and associative risks to any nearby anthropogenic activities, land uses and particular construction facilities next to landfill sites [24, 25, 26, 28, 48]. The latter could be monitored by relative geo-information web utilities for the right operations management at particular landfill projects protecting environmental health as well as associative sustainable green health tourism construction facilities within circular economy [23, 30, 31, 48].

In Table 1, are presented useful calculated computational results of particular produced landfill emissions at MACH experimental site, during the biogas peak production, biomass temperature reached in time of first 105-day period of waste mass proper treatment since Mid Auchencarroch project was capped [26].

Table 1. Useful Results of Produced BioGas Indexes

Landfill site Case Study	Pressure of landfill gas (N/m^2)	Landfill boundary lateral soil temperature (degrees C)	Landfill production rate (m^3 gas/t waste)
MACH CELL 1	1250	31	33.1
MACH CELL 2	2361	39	37.8
MACH CELL 3	1506	39	32.8
MACH CELL 4	2340	36	36.1

Source: [26]

Moreover, the proper phytobioremediation projects should be followed in time for public health protection supported by proper construction management facilities in terms of efficient drainage systems and maintenance during their operation [3, 4, 12, 13]. Landfill emissions exploitation as well as biofuels proper use could be useful for clean technologies with zero emissions to the environmental resources as well as to public health. However, proper design of openings as well as ventilation designs should exist at particular building facilities supported with UV

technologies so as to mitigate the associative risks from COVID-19 virus at indoors as it is presented in figure 1 [62].

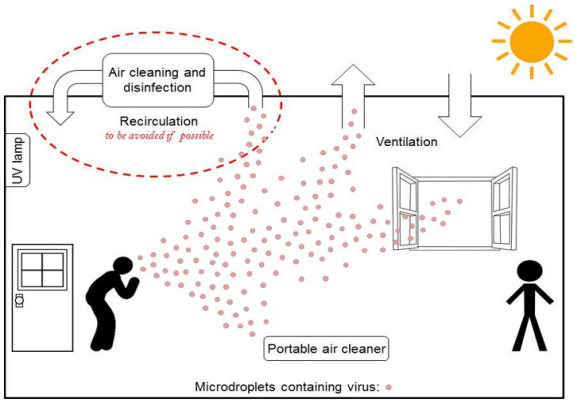

Figure 1. Right operation of openings at building facilities supported with UV technology securing qualitative indoors' environmental health ventilation for public health protection at post COVID-19 era. Taking proper safe engineering level controls to reduce the environmental risks for airborne transmission at indoors.
Source: [62]

The above presented results should be utilized properly in associative monitoring schemes with other collected data of particular landfill gases, leachates produced at locations close to building facilities that are located at nearby distances to landfill sites. Methane and carbon dioxide emissions should be monitored frequently in time taking the right measures for the good operation of particular construction facilities and land uses that take place next to landfills avoiding probable explosions due to methane, fires or other particular risks to associative construction facilities due to landfill emissions [5, 23, 24, 25, 28, 48, 64].

However, based on the above special attention should be taken so as to mitigate associative risks of produced carbon dioxide emissions next to landfills in case of fire events or associated hazards that exists from landfill emissions [23, 48]. In figure 2 are presented proper sanitary drawings that should be taken into account in particular monitoring schemes and the maintenance of associative construction management facilities with ventilation manufactures.

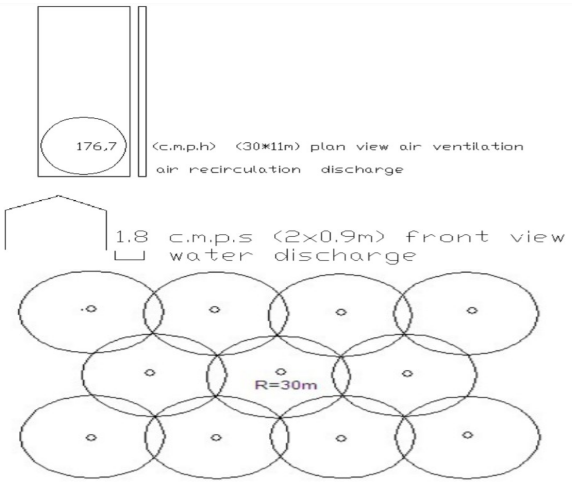

Figure 2. Sanitary drawings that are useful for ventilation demand control at indoors for particular monitoring schemes at buildings and maintenance of construction facilities for public health protection.
Source: [23, 48]

In figure 2 is presented the right use of sanitary drawings for monitoring purposes. The latter use of them is needed in terms of health – safety, maintenance operational principles of openings at shear walls and decision making in case that particular risks have been identified like hazardous landfill gases emissions, fire events or flood events combined with probable leakage of leachates from landfill sites or other combinations of them subject to horizontal earthquake loading or other combinations of dynamic loads [23, 27, 48, 63, 64, 87].

The proper architectural design, orientation of openings for particular building facilities that are located close to landfills should take into account local meteorological frequent wind magnitudes and all the above in order to avoid big magnitudes of carbon dioxide or other trace gases, V.O.C's that are hazardous for public health [24, 28, 43, 46, 48].

Continuous maintenance of construction designs,

applying properly health – safety regulations, useful utilities and proper project management are necessary for the right monitoring and good operation of the particular construction facilities like shear walls with openings at that exist at particular building facilities at corridors, foot bridges within sustainable construction designs. Useful results for safe operational shear walls with openings have been presented in this study.

The presented results could be taken into account for future more detailed proper simulation scenarios that should take place for specific case studies and innovative robust shear wall designs with openings at the renew of non reinforced masonry at particular existing old building designs. More experimental projects and proper training facilities for graduates, stakeholders are needed so as to exclude useful facility management tools in term of health and safety for an integrated green circular economy within efficient sustainable designs.

3. RISK ASSESSMENT AND EFFICIENT PROJECT MANAGEMENT AT CONSTRUCTION FACILITIES

In addition to the above presented monitoring schemes of openings at particular construction facilities, building infrastructures for the good operation and safe storage of goods at post COVID-19 pandemic era the safe earthquake design of openings at shear walls should be taken into account.

Several useful methodologies and tools have been investigated in the literature for the simulation of structural behavior of shear wall designs with/without openings subject to dynamic loads in terms of health - safety at building facilities [29, 30, 31, 32, 64, 67, 68, 69, 71, 72, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86]. Finite element method has been used for safe shear wall designs for examining structural members in earthquake dynamic loading combinations as well structural analysis software utilities have been used according to the literature in particular combinations with several experiments in order to extract useful results [22, 35, 37, 38, 39, 40, 41, 42, 45, 46]. According to the literature based on the particular masonry's engineering properties of examining simulations , experiments subject to investigated mortars, thickness, heights, and geometrical variations in the shear walls' openings it yields changes to the stiffness of the relative structures and strength of them subject to earthquake dynamic loads or other combinations of dynamic loads taking the right decisions for repair, maintenance [38, 40, 41, 42, 56, 64, 76, 78, 79, 85, 86, 87].

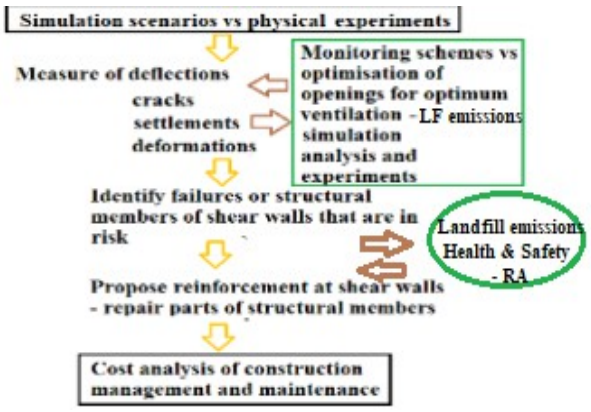

Figure 3. Flow chart of a risk assessment framework at shear walls with openings for ventilation at buildings next to sanitary landfill bioreactors and mitigation of particular health – safety risks through proper monitoring, repair, maintenance.

In figure 3 is presented a useful risk assessment (RA) control framework for the right decision making and efficient construction management of particular construction facilities related to shear walls with openings at building infrastructures that located close to probable hazards from sanitary landfill bioreactors'

emissions.

Based on the above risk assessment framework at shear walls with openings for right ventilation at buildings and mitigation of particular health – safety risks through proper monitoring, repair, maintenance several proper methodologies could be applied for the right simulation of shear walls with openings. The latter methodologies could use either finite element method, or other discrete element methodologies where the results could be useful for training proper artificial intelligence architectures using proper Artificial Neural Network (ANN) computational schemes.

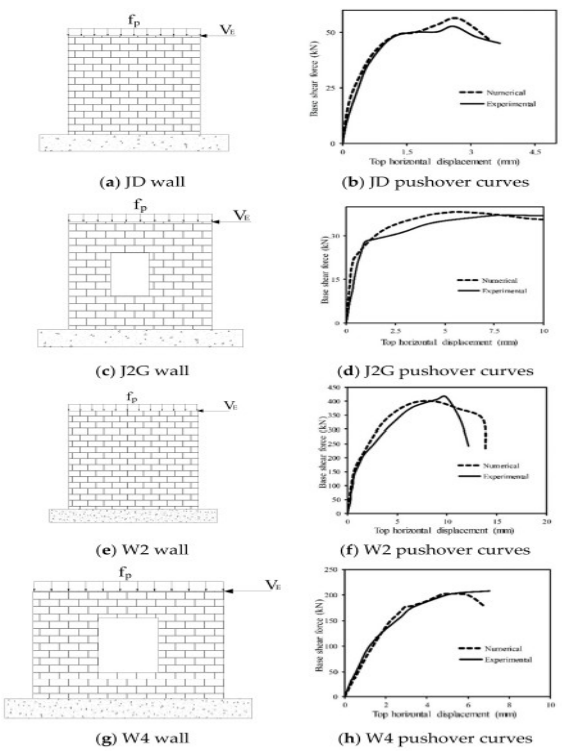

Figure 4. Validation of multi-pier modeling with experimental data. Source: [76]

In figure 4 are presented indicative experiments for examining shear force loads between 30 and 200 KN at particular dimensions of shear walls with openings in relation to their respective indicative displacements at examining numerical simulations versus experiments for the top horizontal displacement that varied between 0 and 10 (mm) according to the realized experiments [76].

Moreover, in figure 5 different geometries are presented according to the literature that have been investigated to identify useful computational formulas of parameters in efficient shear wall design like next ones: I. Po / P the ratio of load bearing capacity of a perforated masonry wall to a solid one and II. Ko / K the reduction in the initial stiffness of the perforated masonry wall compared to the solid wall one based on proper ANN architectures for simulation analysis [76].

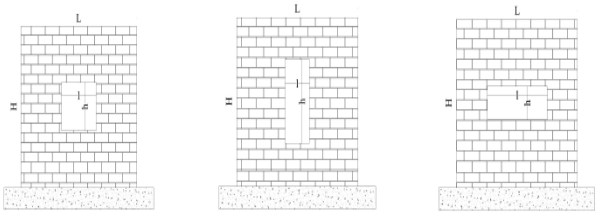

Figure 5. Investigated geometries using proper ANN tools to validate their use for right decision making at construction management of shear wall design with opening shapes and areas subject to horizontal loading. Source: [76]

Proper Artificial Neural Network simulation analysis has been trained based on the results of multi-pier approach as a discrete element method for the right identification of Po / P and Ko / K parameters in shear wall design with openings [76]. Based on the latter research study equation 1 has been investigated that describes the Po / P parameter, which is the ratio of the load bearing capacity of a perforated masonry wall to a solid masonry wall, h is the opening height, l is the opening length, H is the wall height, and L is the wall length (see figure 6).

$$P_O/P = \left[\left(0.2887 \times \left(\frac{h}{H}\right)^2\right) - \left(0.716 \times \left(\frac{h}{H}\right)\right) + 0.6898\right] \times = \left[\left(0.1089 \times \left(\frac{l}{L}\right)^2\right) - \left(0.6568 \times \left(\frac{l}{L}\right)\right) + 1.563\right] \quad (1)$$

Also based on the latter research study equation 2 has been investigated that describes the Ko / K parameter, which is the reduction in the initial stiffness of the perforated masonry wall compared to the solid wall [76].

$$K_O/K = \left[\left(0.3563 \times \left(\frac{h}{H}\right)^2\right) - \left(0.987 \times \left(\frac{h}{H}\right)\right) + 0.8582\right] \times = \left[\left(0.1137 \times \left(\frac{l}{0.4}\right)^2\right) - \left(0.768 \times \left(\frac{l}{0.4}\right)\right) + 1.669\right] \quad (2)$$

Although that have examined an included data base of 49 unreinforced masonry walls (UMW) with different opening areas and aspect ratios,the results of the latter research study present a satisfied relative sensitivity analysis for examined shear walls' geometries with openings subject to horizontal loads [76]. Hence, limited computational data-sets exist without taking other combinations of dynamic loads. More experiments are needed for other combinations of dynamic loads and site specific designs.

Based on the results of the above investigated important parameters for safe shear walls with openings, we can see that for particular input loads at masonry's geometries the magnitudes of investigating parameters vary in relation to the geometries of the examining dimensions of investigated openings' areas and wall shapes. More experiments are needed for specific site designs making right decision making for efficient shear wall designs with openings mitigationg associated risks like displacements and environmental health protection at indoors due to particular hazards from probable nearby landfill emissions at post COVID-19 era.

However, more computer computational simulation data-sets are needed combined with any available physical field data experiments so as to modify properly the particular input data using the right calibration parameters making useful conclusions for specific case studies in terms of sustainability, health – safety at construction facilities and public health protection at post COVID-19 era. Thus computer numerical simulations are useful applying proper methodologies combined with ANN that their results can be used at above presented risk assessment framework guide so as to take right monitoring schemes in time, making the right health-safety for repair, maintenance at particular sustainable community health building facilities, associated health tourism construction facilities protecting public health.

Therefore, in this way are mitigating probable risks of particular community health building facilities located close to sanitary landfill bioreactors whre renewable resources from landfill emissions are used at particular green development designs to support tourism infrastructures that are in crisis at post COVID-19 era. The above presented framework could be applied properly for particular safe construction facilities using the right simulation tools for specific sites providing design solutions due to particular combinations of earthquake risks, other dynamic loads, right geotechnical designs so as to mitigate associated risks i.e. earthquake load in combination with blast wave dynamic load due to probable landfill gas explosions [67, 69, 80, 87, 88, 89].

Moreover, more detailed physical experiments are needed combined with computer simulation of shear walls in dynamic loads for specific case studies making useful conclusions in operational management of particular land uses within efficient optimised robust structural designs. Proper monitoring schemes are necessary based on the simulation results, using properly the euro-codes at proper construction facilities' management with right use of ventilation manufactures. The results could be demonstrated properly for monitoring, repair, maintenance and vocational education, training purposes for stakeholders. In this way sustainable building designs could be investigated to be monitored properly mitigating associated risks due to dynamic loads in relation to particular landfill emissions.

Furthermore, in figure 9 are presented solutions that have to be investigated in more details for particular

specific case studies at probable locations that need repair, maintenance, support at old buildings. The latter should be taken into account proper additional supporting construction design that is necessary for reinforcement of damaged non reinforced masonry with old construction regulations at particular old buildings after high earthquake magnitudes.

Moreover, for the good health and safety at old buildings continuous maintenance and repair is needed after earthquake events in combinations with associated risks from particular landfill emissions or other hazards from operational productive land uses. Proper maintenance and repair of construction facilities is needed based on the mapping out results for particular structures due to their damages after extreme earthquake dynamic loads and combinations with other dynamic loads [38, 53, 62, 63].

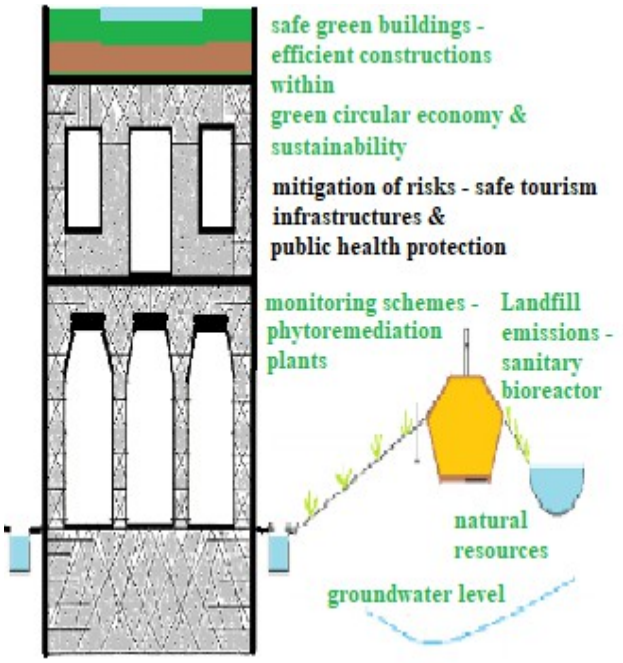

Figure 6. Efficient sustainable safe construction facilities for sustainability and reinforcement of shear walls next to openings for their protection in particular dynamic loads.

According to figure 6 an indicative reinforcement support is presented for old buildings that should exist at shear walls, critical locations of masonry, next to openings to particular structural elements that have been damaged or are under risk due to combinations of dynamic loads after strong earthquake events. More experiments are needed so as to develop relative useful numerical simulation tools for specific designs in relation to health – safety sustainability and environmental health protection at post COVID-19 era. Proper computer simulation numerical structural analysis experimental results could be useful so as to identify right monitoring locations for maintenance for specific designs at old buildings that should be applied reinforcement at old masonry due to big magnitudes of earthquake loads. All the above presented should be followed properly at particular constructions so as to promote attractive green health tourism infrastructures that will become necessary at post COVID-19 era.

Moreover, the above presented principles should be demonstrated properly at students, graduates, vocational educational training projects and stakeholders for public health protections and sustainable development, proper sanitary designs, clean technologies within green circular economy at post COVID-19 era [26, 27, 28, 40, 42, 48, 57, 58, 59, 60, 61, 62, 74, 75]. However, the above principles could be combined properly at building infrastructures for integrated safe food services combined with qualitative sports tourism infrastructures [49, 50].

4. CONCLUSIONS

Useful monitoring schemes presented in this study for right health – safety at building facilities that are located close to landfill sites. The presented sanitary drawings should be followed properly at particular sustainable tourism infrastructures at post COVID-19 era so as to mitigate the associative risks for sustainability and public health protection. Also proper computer numerical simulation experiments could be useful for efficient construction designs and monitoring schemes at future specific case studies using right ventilation manufactures for qualitative

environmental health following the right sanitary principles at particular construction facilities and public health protection at post COVID-19 era.

Furthermore, more detailed experiments are needed for specific case studies making useful conclusions in operational management of particular land uses within efficient optimised robust structural designs according to euro-codes at proper construction facilities' management with right use of ventilation manufactures for monitoring, repair, maintenance, vocational education and training purposes for graduates, health inspectors, managers, stakeholders.

Moroever, a useful risk assessment control framework presented in this study which is necessary for the proper maintenance of particular construction facilities for safe shear wall openings at building infrastructures that exist close to sanitary landfill bioreactors. The relative guidelines should be followed properly during the surveillance services by stakeholders after high earthquake magnitudes events or other combinations of dynamic loads for the right decision making at associated construction designs in terms of health – safety and public health protection.

All the above projections presented in this study should be demonstrated properly at students, graduates, vocational educational training projects and stakeholders using proper e-learning technologies, web utilities and media for public health protection. Proper demonstration should exist to students, graduates, stakeholders using the right training tools in terms of health – safety, monitoring schemes, risk assessments and information utilities.

More detailed physical experiments are needed combined with computer simulation of shear walls in particular dynamic loads making useful conclusions in operational management of particular land uses within efficient sustainable development construction designs, right use of manufactures with opportunities in the exploitation of clean technologies related to landfill emissions, sustainable tourism infrastructures within green circular economy at post COVID-19 era.

Proper modification of computer computational simulations could exist based on experimental data for investigated specific case studies. The presented results could be useful to set up the base for further research for efficient integrated sustainable tourism projects that promote sustainability in order to exploit old closed tourism construction infrastructures that are in crisis in E.U like the old closed Xenia hotels in Greece providing solutions to protect public health at post COVID-19 era. Moreover, updated guidelines about COVID-19 from World Health Organization, others [74, 75, 76, 93, 94] should be followed properly by stakeholders for public health protection.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest between them.

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