DESIGN AND TECHNOLOGY. PEOPLE, SYSTEMS, ENVIRONMENT

MUR DM 117/Ecophon - Acoustic design for schools and offices

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Context of the research activity	The research aims to identify solutions to ensure good acoustical quality in the case of new construction or renovation of public or private school and office buildings. Acoustical quality is crucial in the case of energy efficiency interventions or interventions for the safety of these types of buildings. The research is consistent with the investment lines of the PNRR 1.1 "Plan for the replacement of school buildings and energy requalification" and 1.2 "Efficiency of judicial buildings." The requirements are expressed by the law on CAM (Minimum Environmental Criteria) for public buildings of 2017, which recall the UNI 11532 parts 2 and 3 (the latter being completed), respectively for schools and offices. In particular, in the context of schools, the research aims to address the design of school environments with the aim of positively affecting the teaching and learning of teachers and students, as indicated by the PNRR. The correct acoustic design of classrooms for all the schooling levels, is crucial for the learning and well-being of learners and for the vocal health of teachers. There are many references in the literature on the importance of noise reduction and optimal reverberation especially for the lowest levels of education and for children with specific learning disorders. In the context of offices, the scientific evidence of the influence of "irrelevant" speech noise on the well-being and productivity of the occupants is relevant, especially in the case of shared or open-space offices. Furthermore, after the COVID 19 pandemic, the office environment won't be used in an exclusive way. We are moving towards the shared office environment model, for which the environmental comfort needs will be maximized, as it will be possible to carry out activities characterized by different communication or concentration needs.

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Objectives	Acoustic design of offices and relationships on Indoor Environmental Comfort In collaboration with Ecophon The research aims to identify solutions to ensure good acoustical quality in the case of new construction or renovation of public or private office buildings. The requirements are expressed by the Italian law on CAM (Minimum Environmental Criteria) for public buildings of 2022, which recall the UNI 11532 part 3 (under approval) on acoustic comfort in offices. In the context of offices, the scientific evidence of the influence of "irrelevant" speech noise on the well-being and productivity of the occupants is significant, especially in the case of shared or open-space offices. Furthermore, after the COVID 19 pandemic, the office environment won't be used in an exclusive way. We are moving towards the shared office environment model, for which the environmental comfort needs will be maximized, as it will be possible to carry out activities characterized by different communication or concentration needs. The activity will be focused on the provision of guidelines on the acoustic treatments of the different office typologies where the acoustic requirements of UNI 11532 part 3 will be pursued. Reference will also be to ISO 3382-3, ISO 22955, NF S31-080, and specific literature. The study will be carried out in a shared office-laboratory of about 10 workstations at the Politecnico di Torino, where at least two different acoustic solutions will be tested with measurements and subjective outcomes. The subjective outcomes will be both cognitive and aim to investigate the well-being of the occupants in agreement with the most updated certification protocols. The acoustic solutions will be designed with appropriate GA software and implemented in the office with Ecophon acoustic panels. The research program will be based on the following rough scheduling: Y1: State Of the Art, choice of the case studies and planning of the experiments, preliminary evaluation in Ecophon (Sweden) of several, three or more, acoustic configurations in a shared office and choice of the two best configurations to be tested in field in Torino; Y2: in-field implementation in Torino of the best 2 acoustic solutions tested in Sweden and gathering of in-field data across at least 3 months each; Y3: data analysis, thesis writing and dissemination. The period of 6 months to be spent in Ecophon (Sweden) can be arranged along Year 1 (3-4 months) and Year 3 (2-3 months). Another extra period abroad of about 2 months along Y1, can be in Turku (Finland) to Prof. Valtteri Hongisto. The acoustic monitoring will be completed with the monitoring of other quantities of the other environmental quality aspects, such as thermal, visual and indoor air quality. Thanks to a parallel research project, called PROMET&O (PROactive Monitoring for indoor EnvironmenTal quality & cOmfort), we are providing 10 devices that will acquire all the environmental quality indexes (IEQ indexes) and the comfort experienced by occupants. Indoor Environmental Quality represents the objective characterization of indoor environments in terms of thermal, acoustic, lighting and air quality domains. IEQ significantly affects occupants' comfort, well-being, health, and work productivity. There is a lack of multi-domain approaches for IEQ assessment, but nowadays it is possible to deepen the research performing intensive long-term monitoring thanks to the use of multi-domain low-cost sensors, within the IoT framework. Another issue is related to the continuous collection of occupants' subjective feedback. However, the proper

	methodology, devices to be used, adequate frequency of subjective feedback are still under investigation and a sole strategy deemed to be effective is not available yet. The use of office environments have changed after COVID-19. Further, a new standard for office environments, UNI 11532 part 3, is in progress and will be launched during 2023, with requirements regulated by CAM. There is a need to increase the knowledge of how to fulfill the demands, as required by the law, but also for how to ensure good sound environments for people in office environments that are now used differently. This research aims at providing such knowledge by studying the relation between different acoustic measures; objective parameters and subjective and cognitive aspects of the environments. The results of this research will support architects, acousticians and other practitioners in their choice of acoustics materials, in order to create good sound environments for people.

Skills and competencies for the development of the activity	Conoscenze di acustica di base, di acustica architettonica, acustica delle scuole e degli uffici, design dello spazio ufficio