

The support of graphic representation for the analysis of the distribution and the preparation of temporary works in the post-pandemic period

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EDITORIAL

2020, what a year it has been. The world has seen the worst health crisis in more than a century with the Covid-19 pandemic. Public institutions across the globe are still facing unprecedented challenges in dealing with this global crisis, which scale has caught us by surprise. It is fair to say that global interconnectivity has certainly contributed to how fast the virus has spread and to the scale of the pandemic. Though we like to think of our world as technologically advanced this pandemic is showing us that we are still very much vulnerable to threats that have been known to us for a long time. In turn, the Covid-19 pandemic has disproportionately affected already vulnerable populations around the world whether in developed or developing countries. Beyond access to quality healthcare other factors have emerged as contributing to the spread of the virus as well as creating challenging conditions in the pandemic. Dense urban centers have emerged as places where the virus has spread significantly due to the nature of people's interactions, socially, at work or while commuting. Dense urban centers face specific challenges when dealing with an airborne pandemic due among other things to limited open outdoor spaces, socially active lifestyles and outdoor air quality. In that context the widespread model of dense urban centers as the only model of dynamic economic development may need to be re-evaluated.

This pandemic has in fact brought about a number of issues that are being investigated in the current issue of Vitruvio.

One of these issues deals with how people interact inside buildings and how architectural design can reduce the spread of airborne diseases through space planning, managing human flows, minimizing surface contact and adequate mechanical systems. These types of issues are not only relevant for public and office buildings but also for housing and more specifically multi-family buildings. In fact, multi-family apartment buildings can be studied in order to address the shift in working habits that has occurred in the past 10 months. As a large number of people have been

working from home for months it has become clear that their living spaces were not originally designed to integrate that new function. Notions of flexible and multi-use spaces are interesting concepts to explore especially as the trend of working from home at least part time is likely to increase in the future.

Another subject discussed deals with providing quality public spaces and emphasizing the need for green and blue infrastructure in urban areas. These types of spaces, including play areas for children, become crucial pressure valves in times where peoples' mobility is very limited. As a broader theme the quality of dense urban spaces is especially important as cities remain a unique driver in terms of economic growth and social aspirations. On the other hand, there seems to be new opportunities for people to relocate outside major city centers. The trend of working remotely was already developed and will continue to grow as it increases flexibility, lower commute time as well as the burden on transportation and infrastructures. It can also contribute to improve outdoor air quality by reducing pollution. This trend may provide opportunities to revitalize rural communities in dire need of new residents and allow the development or upgrade of a series of infrastructures and services. This would provide a counterbalance to the over densification of urban centers where life overall remains costly.

In the context of students having to shift to a completely virtual space for learning this year, we can see the emergence of promising technology. In fact, VR and AR are providing opportunities for students to communicate but also to design in a co-presence environment where they can interact in real time with their fellow students or their instructor. The use of whiteboard applications such as Miro, Concept Board or Murals has also brought new opportunities to share information in a purely digital environment. In terms of pedagogy the past 10 months have shown us that digital tools have inaugurated new ways to interact and exchange information successfully but it is also clear that these tools cannot replace our need and longing for face-to-face interaction.

As expected with acute challenges the Covid pandemic has revealed complacencies and weaknesses in terms of infrastructures, resources allocations and social behaviors but also shed light on the false expectations that "all will be fine" with minimum efforts from our part. In some way the Covid pandemic is a condensed version in time of the upcoming challenges associated with climate change and its impact on future generations. In all fairness it is always hard to deal with a situation that we have not yet experienced to the fullest but nevertheless our current challenges show us that the human enterprise is still very much vulnerable despite what we would like to think. To conclude on a positive note this pandemic has highlighted a number of areas related to architecture, urban design and construction where there are great opportunities to develop design related innovations that will make us more resilient.

Olivier Chamel



View of the courtyard of the Norberto Bobbio Institute: the intervention of architect Alberto Sartoris and the permanence of the Bona wool mill.

#NEWNORMAL

The support of graphic representation for the analysis of the distribution and the preparation of temporary works in the post pandemic period

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ABSTRACT

The spread of the Coronavirus19 has pushed the world community to re-evaluate the meaning of "normality", introducing new concepts in their daily habits, such as social distancing, use of personal protective equipment, implementation and introduction of temporary works. Thus defining a #newnormal, which has inevitably translated into the need to redesign and re-adapt the environments usually dedicated to social life, work and education. Hence the need to introduce a tool capable of supporting the actors involved in the adaptation of environments in the operational phases, to introduce codes and methods of representation suitable for proper communication. It will be possible to represent the above, through the presentation of a case study of school building proposing a useful tool for the design and adaptation of existing buildings, through the introduction of temporary works and structures, elements of communication and sizing of the areas.

KEYWORDS

representation, project codes, project drawing, BIM, space management

1. THE NEW NORMALITY, #NEUNORMAL, AS A STIMULUS FOR THE REPRESENTATION OF NEW NEEDS

The coronavirus emergency is a worldwide phenomenon that is enabling us to assess the actual 'organisational' resilience of communities and individuals. Changes due to a shock, such as the current world pandemic, not only represent moments of crisis and depression, but must be interpreted as moments of growth and stimulation, during which, by applying new opportunities brought by change, it is possible to build and rebuild stronger communities, willing to sustain a 'new normality' and a new standard of living to which it is 'inevitably' necessary to adapt and get used. The term '#newnormal'¹ is discussed daily, but what does it really mean? And what kind of change does it really represent for the life of individuals within communities? Can graphic representation play a role in helping to understand the phenomena and to organise new ways of living in the coming months? From the new Protocols of the National Technical Scientific Committee in implementation of the Italian Government's D.P.C.M., and from the various regional and municipal ordinances² was born the need to redesign models of environments that meet the characteristics dictated by the new Covid-19 normality, updating the concept of 'common' places, rethinking new forms of health care, new ways of living, new concepts of workplaces, new ways and places of learning, new environments for commerce. The main design challenge, represented by rewriting and rethinking a sociality through the new rules of social distancing, was summarized in some key words, such as physical distancing, use of protection devices, realization and introduction of temporary works. However, security, social distancing and the prohibition of grouping must coexist with the need for sociality: space, once 'lived' with relationships and conviviality, today stands out from the images of the past because of the presence of temporary physical 'barriers'³ aimed at protecting individuals, limiting contagion and making people feel safe among others (Lewis et alii 2020). As restrictions are relaxed,

places around the world reopen to communities with changed faces and different habits, with priority being given to workplaces and learning places.

At the end of the national lockdown⁴, the teaching environments have prepared for the reopening, but everything seems to be very different from what we are used to: in schools, as in companies, protocols and procedures have been and will be issued, to be applied in order to contain the contagion and protect the health of students and operators. A new normality has been defined and introduced, linked to dimensions and geometric rules consistent with the needs of spacing, to be differentiated according to the orders and grades of the schools: a conceptualisation of spaces and flows has been redefined, through controlled access, new physical layouts of classrooms and common areas, and particular attention has been paid to areas destined for canteens and recreation, introducing temporary elements for the identification of routes and horizontal communication elements for the definition of areas with specific destinations (Fig. 1). The new organisation of spaces is changing the behaviour of users, leaving room for new habits and needs (Cahapay, 2020). It is precisely the need to respond to the recent needs that have emerged from the pandemic that leads us to think of buildings as intelligent architectures⁵, aimed at monitoring flows and managing new organisational needs, responding in an agile and intuitive way to the demands of professionals. From the growing need for adaptation of spaces and management of areas in order to contain the spread of the virus, this contribution aims to present a process and a method to operate promptly in a health emergency on existing buildings open to the public, with the presentation of a case study on a school building, through the realization of its digital model developed in a BIM environment. A first picture of the state of the art will be presented, relating both to the guidelines drawn up by national and international professionals, and to the presentation of some IT tools to support the evaluation of the interventions to be carried out in the reorganization of spaces and evaluation of the works to be carried out in the emergency phase.



Figure 1.
Some images related to horizontal and vertical communication related to social distancing and the use of the mask in the world. Images of some Italian cities, Turin and Milan, and of some metropolises in the world: London, Cambridge, New York, Dubai and Singapore.

2. NEW TOOLS FOR REDESIGNING SPACES

Many academics have worked in recent months to create tools to support the actors involved in the decision-making and operational phases, in order to establish and verify the conditions necessary for the reopening of workplaces, education and sociality, ensuring maximum safety for users. To date, there are no 'official' guidelines implemented by the Ministry of Health, national, regional or municipal bodies in charge of the management of the health emergency and the definition of actions aimed at containing and monitoring the spread of the virus. Within this scenario, both national and international, groups of professionals⁶ have been created that have developed guidelines capable of correctly interpreting and representing the new rules introduced by the Covid-19 world pandemic (Fig. 2). International groups of professionals include the MASS Design Group, which specialises in the design of living environments during the spread of viruses or infections⁷, while still having control over them.

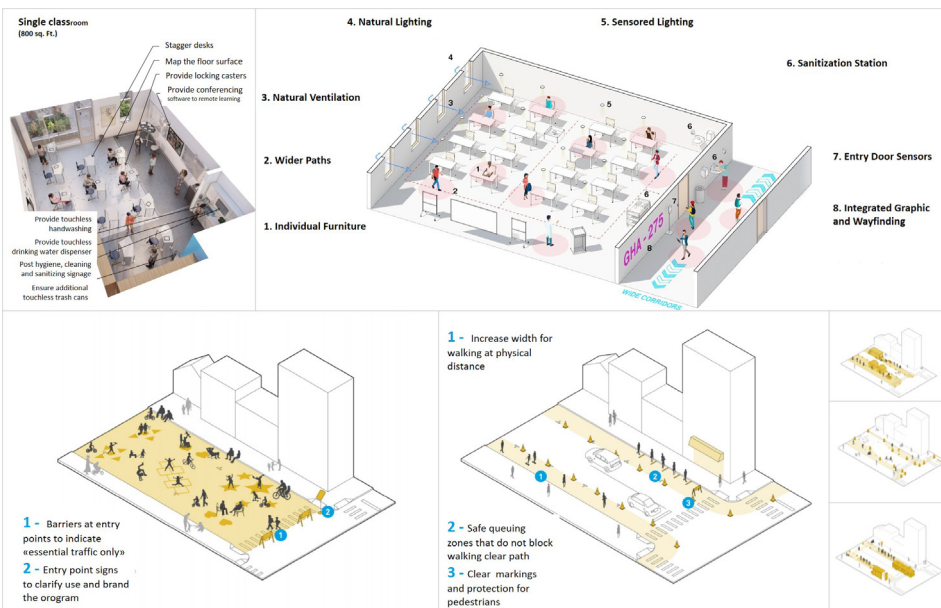


Figure 2.
Some examples of possible redesign solutions. Above are two relative examples of classrooms, proposed within the guidelines created by AIA and Gow Hastings Architects. (credits: content.aia.org, gowhastings.com). Below is an example of road reorganization in order to create areas for outdoor activities or to increase pedestrian areas. The road reorganisation study was produced by NACTO (credit: globaldesigningcities.org).

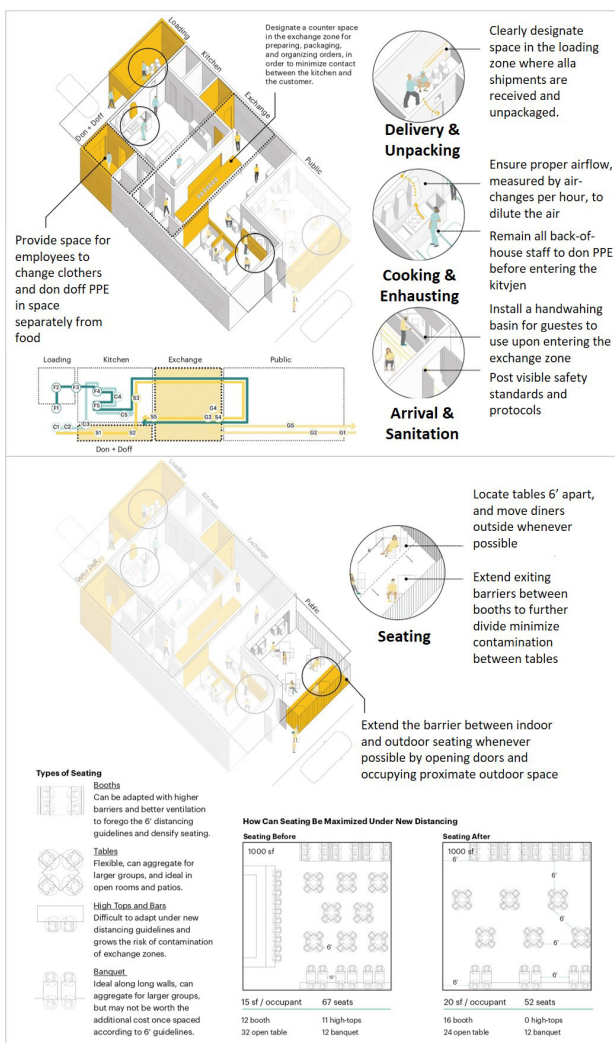


Figure 3. Some design suggestions proposed within the document drawn up by the international MASS Design Group (credits: <https://www.dezeen.com/2020/05/29/mass-design-strategies-restaurants-in-response-to-coronavirus/>).

The MASS group has developed guidelines for optimising spaces for operators in the sectors most affected, in order to allow the community to safely resume socialising. In May 2020, *The Role of Architecture in Fighting Covid-19 - Spatial Strategies for Restaurants in Response to Covid-19*⁸ (Fig. 3) was published, in which suggestions were made available to operators in the catering industry for the reconfiguration of spaces. Similarly, in Italy, Working Groups (WGs) have been set up in order to produce technical documents in which suggestions for the redesign of existing spaces have been collected: in August 2020, in view of the opening of schools in September, the WGL, composed of the Agnelli Foundation and the Future Urban Legacy Lab of the Politecnico di Torino, produced the document *Fare Spazio - Idee Progetti per Riaprire le Scuole in Sicurezza*⁹ (Fig. 4). The aim of the document is to provide suggestions to school managers and professionals to be promptly implemented and to identify solutions applicable within existing school environments through reversible and economically sustainable actions (Robiglio et alii, 2020). In parallel, digital tools have been developed to support the reorganization and adaptation phases, which support users in the application of best practices. From what emerged in this first phase of reopening, current technologies (such as Building Information Modeling, Geographic Information System and Cloud), thanks to the integration between different environments, for example, can be used to obtain advanced tools for the control, analysis and monitoring of activity data useful to prevent or limit the spread of contagion from Covid-19 and to define containment measures to be adopted indoors.

One of the main objectives to be achieved in the early stages of experimentation is to be able to communicate effectively with the multiple users of the spaces. In order to address a heterogeneous public and support all phases of the decision-making and implementation process relating to the reorganisation of the spaces and the introduction of new flows, design and representation 'procedures' and 'protocols' have been determined in advance, through the introduction of defined graphic codes that will facilitate the interpretation and reading of the reorganisation operations of the environments

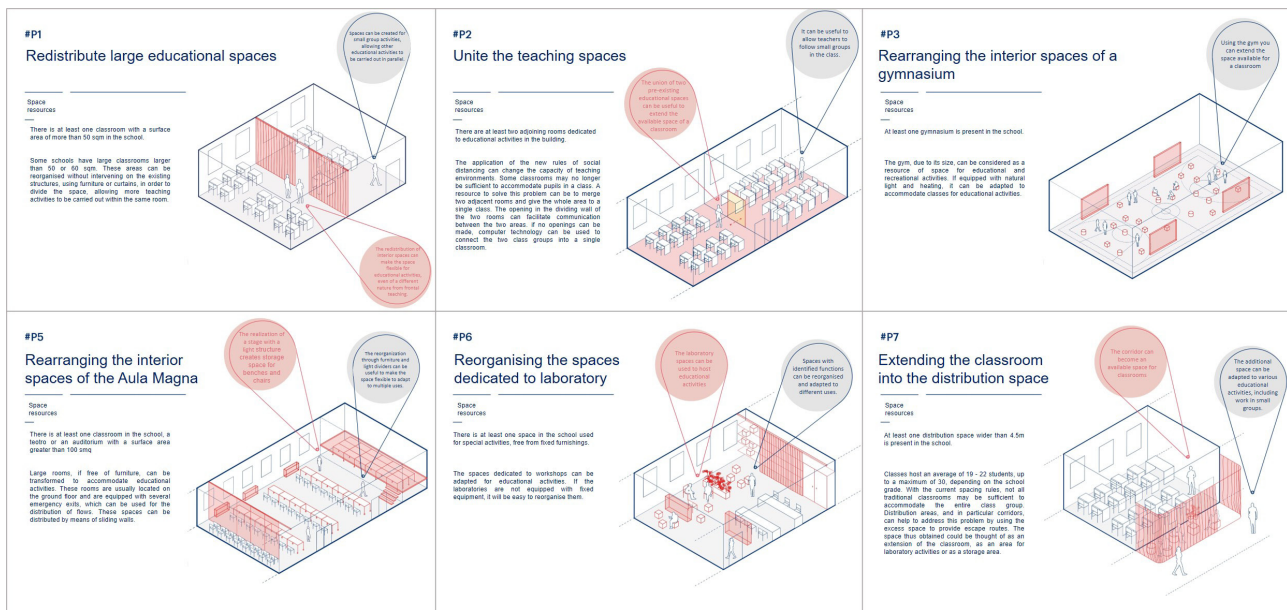


Figure 4. Some project ideas proposed in the *Fare Spazio* manual, edited by the *Agnelli Foundation*. The 14 proposals (9 for indoor spaces and 5 for outdoor spaces) aim to present 14 design ideas for a fast, light and effective transformation of school building environments (credits: www.fondazioneagnelli.it, 2020).

and spaces available. Focusing on what has been developed for the work environment and, more specifically, for school environments, different types of design tools have been compared, released to support users in reorganising spaces, in creating new workstation layouts, respecting the new spacing rules. From a first analysis, it was immediately possible to evaluate how all the tools developed are based on three-dimensional representations, whether these are simple representations aimed at visualizing possible interferences, i.e. representations developed through applications usually used in the early stages of concept design, such as the SketchUp CoviDistance Calculator plug-in (Fig. 5), or developed within intelligent environments, such as the Open BIM tool Covid-19¹⁰ (Fig. 6), where it will be possible to carry out more advanced queries and insert specific geometric rules. In both cases, however, being applications developed for national or international diffusion, it is not possible

to completely customise the environments, inserting all the specific parameters introduced and required by local regulations¹¹. It is possible to use these tools for the visualization of environments, when they fall within the same category of premises and therefore require the application of the same regulatory restrictions; however, it is more complicated to characterize spaces according to real needs, indicating their specificity and inserting differentiated requests, in order to apply different regulatory indications. In order to carry out a correct evaluation that coherently and completely responds to what is introduced in the regulations in force, it is necessary to develop an ad hoc model from time to time, which includes all the specificities of the environments subject to evaluation, especially if it is necessary to develop models of particular environments, such as, for example, the spaces intended for the laboratories of a Secondary Education Institute, which do not reflect the standard needs of the classrooms, but are dynamic environments, where students have their own workstation, but at the same time the need to move from it to perform ad hoc work (see in the case of the Istituto Alberghiero the cooking, pastry or ice-cream laboratories).

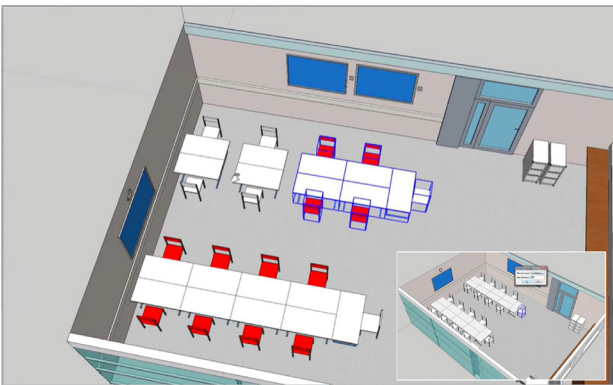


Figure 5.

Two representations developed within a visualization software that has made available to professionals a plug-in aimed at visualizing possible interferences within the environments, such as the proximity of two workstations, and therefore the non-respect of the social distancing imposed by current regulations (credits: modelur.eu).

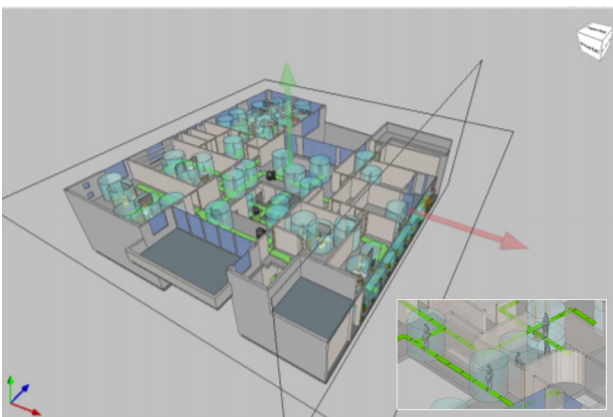


Figure 6.

Two representations elaborated within a BIM environment, in particular within an Open Bim tool, where the safety distance is represented by creating a cylindrical around people, whose diameter represents a parameter that the user can enter manually in order to comply with the indications of the regulations in force (source: www.cype.net).

3. THE CASE STUDY: THE REPRESENTATION OF THE NEW CODIFICATIONS OF THE #NEUNORMAL AT I.I.S. NOBERTO BOBBIO OF CARIGNANO

The proposed case study represents an application conducted in the context of the adaptation of a school building, through the implementation of the model in a BIM environment, in order to adapt the existing environments in compliance with the protocols and regulations issued for the reopening of schools in September 2020¹².

It is part of a wider collaboration between the Politecnico di Torino and the Municipality of Carignano conducted under the scientific direction of Professor Giorgio Garzino. The identified building houses the Noberto Bobbio Institute of Secondary Education in Carignano¹³, the Professional Institute for the Services Sector for Food and Wine and Hotel Hospitality, and is part of the industrial complex where the former Bona Wool Mill, once the Santa Chiara Convent, was located. The Institute's headquarters is a heterogeneous complex of buildings that over the years has maintained the original layout of a lot characterised by the presence of industrial buildings which, since 1975, has undergone three renovations, the most important of which was carried out by architect Alberto Sartoris (Fig. 7).

The renovation of the lot and its buildings was largely carried out with EEC funding, evidence of the exceptionality of the recovery plan implemented (Sartoris, 1995). The Bobbio Institute was identified as a case study not only because it is part of a complex of particular architectural importance and evidence of a building fabric of industrial archaeology of particular value, but above all because inside it contains atypical environments for traditional school building, housing not only classrooms, changing rooms, canteen, gyms and offices, but also a technical kitchen for the training of students, a restaurant room, several laboratories (packaging, ice cream and pastry) and hospitality areas with rooms and suites (Fig. 8).

Due to the particular use of the premises of the Bobbio Institute, it was necessary to extend the

Figure 7.

General axonometric perspective, transparent axonometric perspective of the reinforced concrete structure and axonometric cross-section of the renovation work carried out by architect Alberto Sartoris on the lot of the former Bona Wool Mill in Carignano, 1995.

study of the current regulations for containing the spread of the virus, starting from the analysis of the reference regulations for schools, but integrating it with the protocols used in the workplace, food and drink administration and hospitality premises. From this contamination of premises and destinations of use, there is the need to create an ad hoc information model that reflects the Institute's special features so that, in a second phase of research, we can discretize the most recurrent issues, create standard case studies and create an abacus of possible solutions that can be adapted to other environments. From this point of view, an abacus of solutions and actions for the redesign of spaces represents a dynamic tool, able to move within the realities that need adaptable interventions, maintaining a global and systemic vision of the field of application (Garzino et alii, 2020). The introduction of information systems for the building industry and new techniques for the management of school buildings, of every order and grade, in the emergency phase allows us and will allow us, during the phases of updating the regulations, to adapt and redesign the environments in an interactive and expeditious way, with constant verification of suitability and reporting of unsuitable situations, through effective graphic representation systems. The work environment in which to operate is therefore a dynamic environment, able to adapt to the sudden changes dictated by the updating of health regulations in force, shaping itself according to the adaptation of the 'anti-accounting protocol' through the application of measures for protection, protection and prevention of the risk of virus transmission and contagion. (Fig. 09).

By creating and orienting the building's BIM model to the management phase, it becomes a simulation, planning and implementation tool for the facilities manager (Lo Turco and Bocconcino, 2017).

The flexibility of the information tool and the possibility of introducing 'rules' and 'constraints'

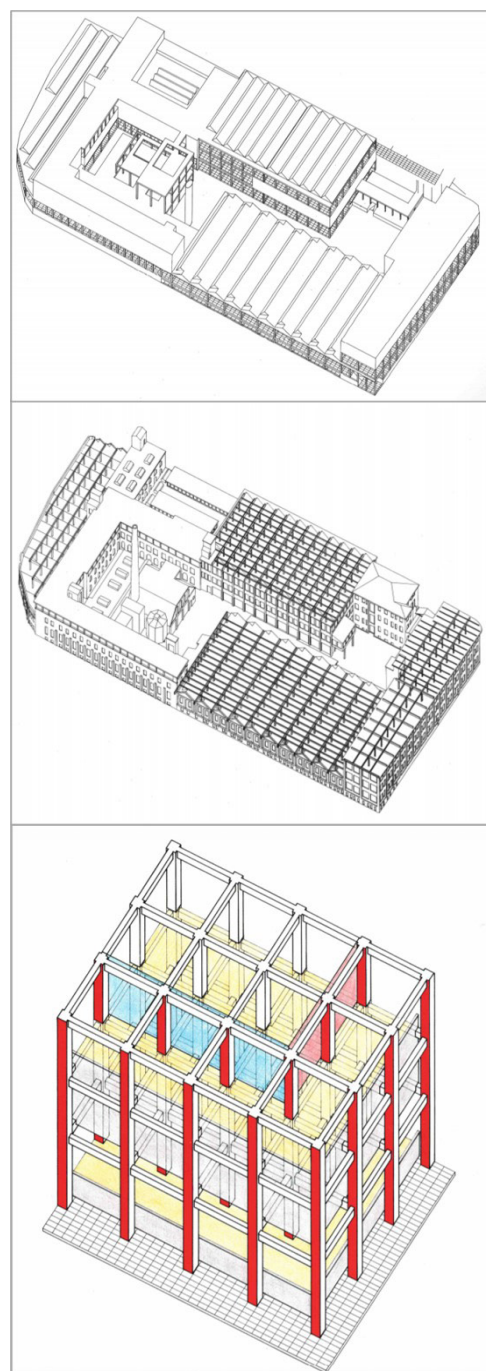
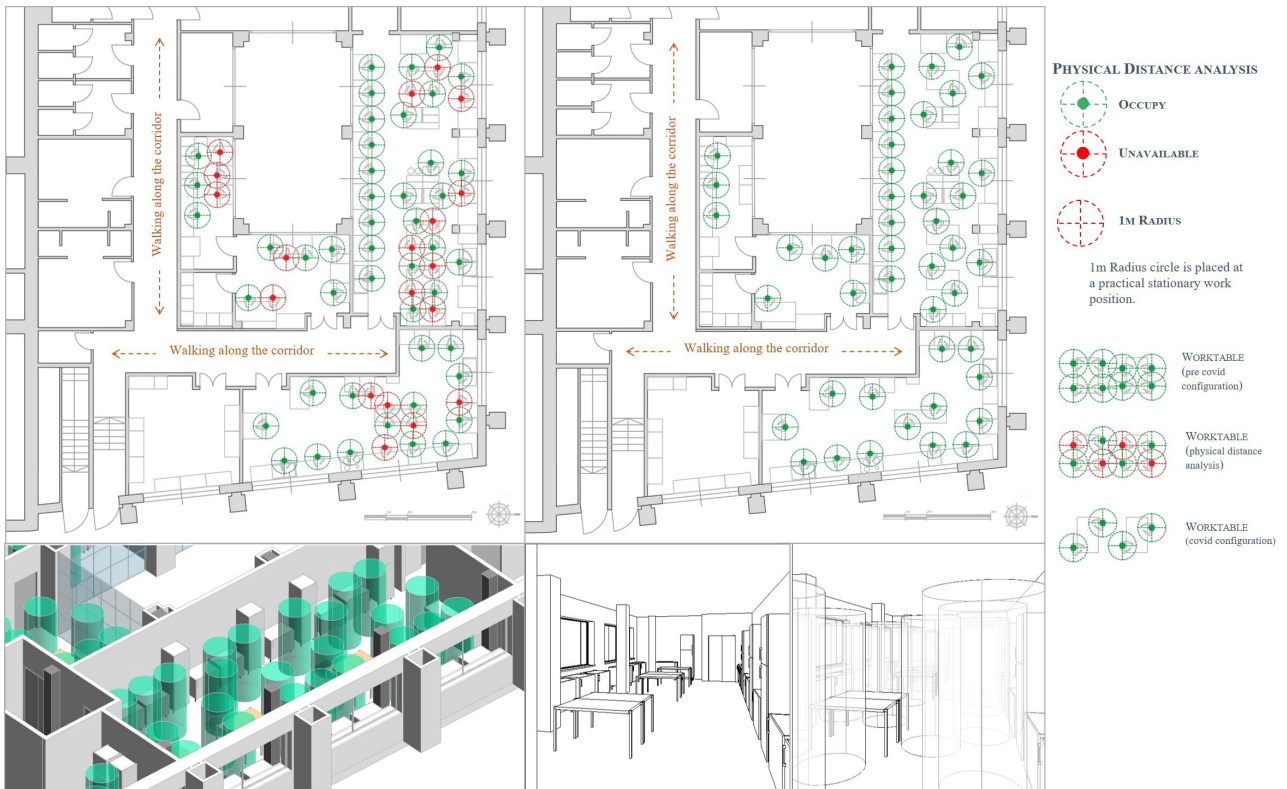


Figure 8. Ground floor plan, with indication of uses and areas of competence for access to the various users: identification of student areas, teacher areas and staff areas.



Figure 9. Examples of alternative configurations proposed by the model, created by modifying a geometric parameter. The same changes can also be automatically represented for flows.



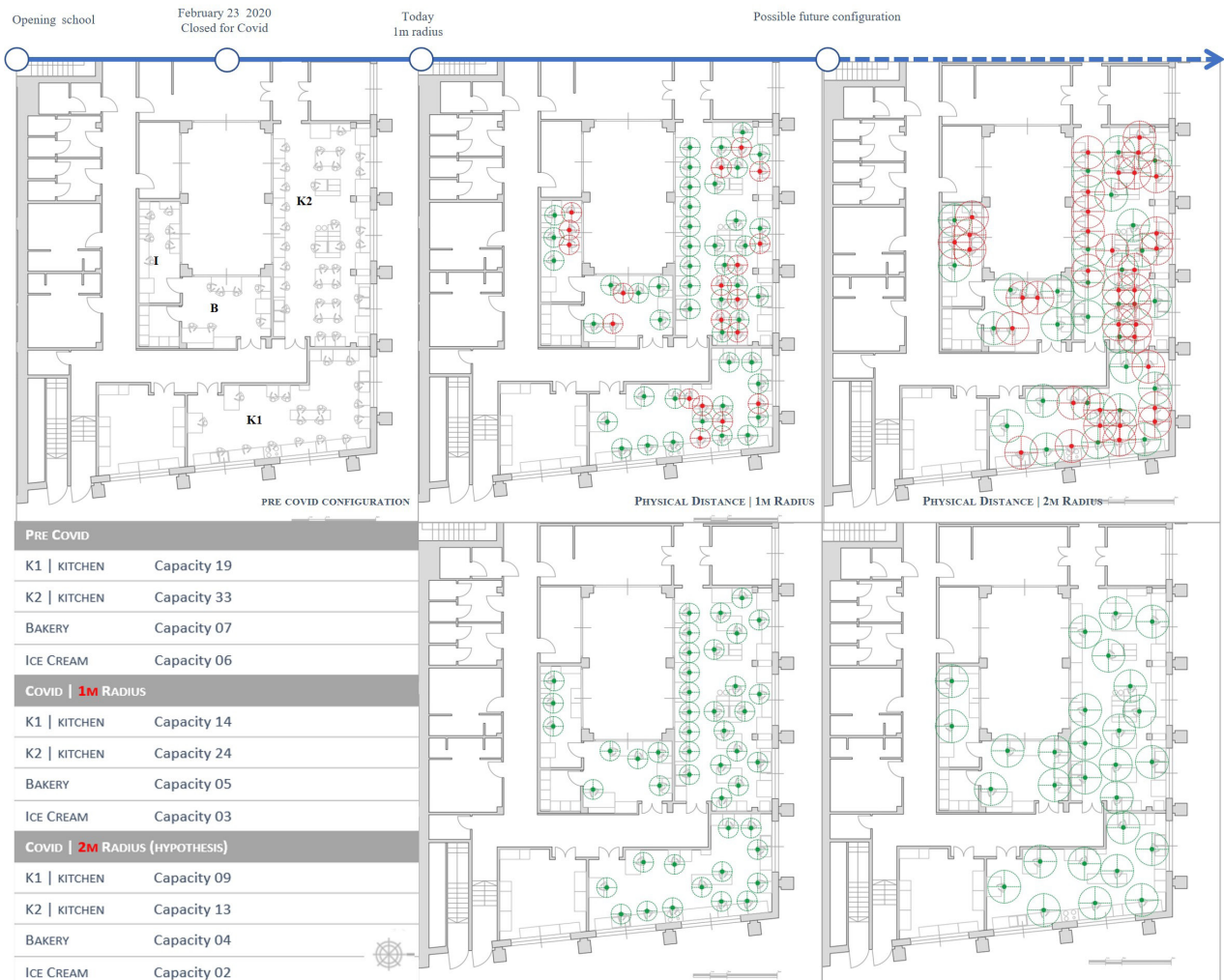
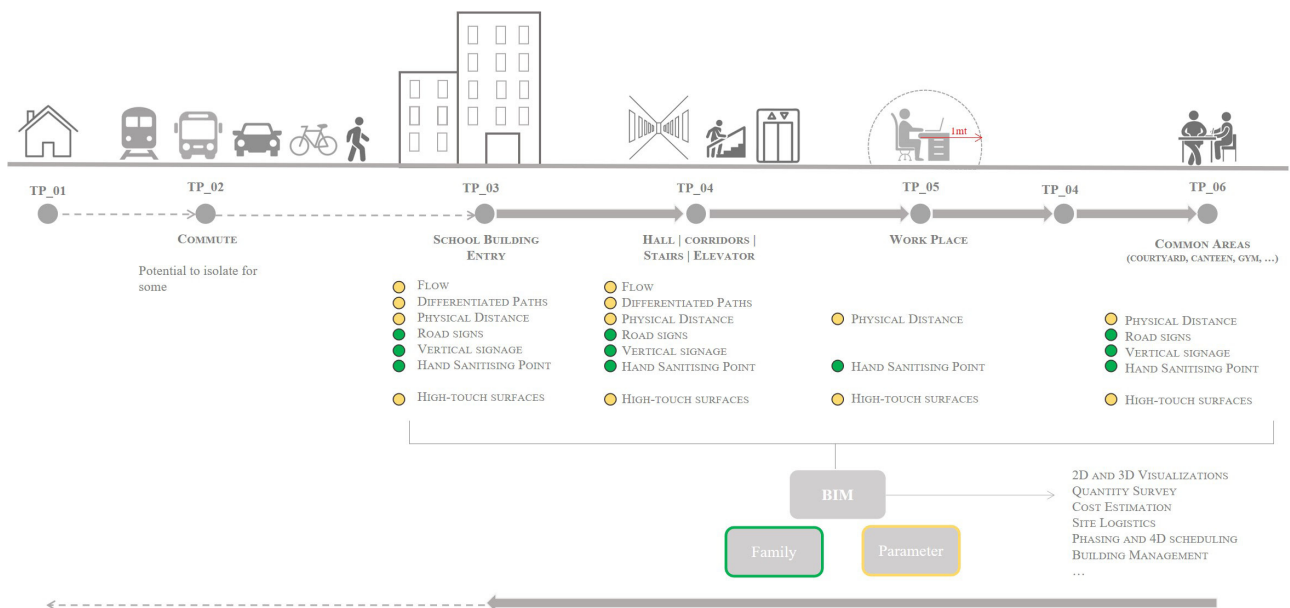


Figure 10. Examples of representations relative to the maximum capacity of the kitchen and laboratory area: the physical distance is represented by cylinders with a diameter of one metre, being a geometric parameter, it can be modified according to the indications present in the regulations in force. The calculation of the maximum capacity of the rooms has been developed automatically inside the building model, introducing geometric rules and dimensional constraints.

to which existing environments can be subjected, modelling and redefining the available environments according to emerging needs, is only one of the innovative features of the use of digital parametric models (digital twins) created to meet the needs of 'space management'. (Fig. 10). In the specific case of the Istituto Bobbio model, geometrical rules have been introduced aimed at creating alternative configurations, which can respond both to the questions of social distancing or the rules related to the sizing of flows, and to indicate any configurations no longer suited to the needs introduced by the nine regulations, identifying and highlighting obsolete configurations, overcome by the introduction of new boundary conditions. Traditionally, the management of spaces and the installation of temporary works, takes place through the use of two-dimensional plans: the introduction of BIM methodologies for the management of works related to emergencies allows

to address and represent them in a comprehensive and complete way. Themes such as the actions to be carried out following particular standards, temporal processes, implementation procedures and representations for communication, through specific graphic codes, have been applied during the different phases of the temporary installation through visualizations also three-dimensional, coherent with numerical, graphic and tabular representations, such as axonometric splits for the signalling of flows and compartments, or perspective views for the visual prefiguration of new spaces. In the first phase of the study, all the nodal points that make up the route maps of the users who habitually use the places of education were tackled with a gradual and multi-faceted approach, differentiating them, when necessary according to the target: from the home-school route, to the entrance to the

Figure 11.
Customer Journey of the student from his/her home to the school building: representation of the touched points elaborated within the BIM model, through the creation of families and the insertion of personalized parameters.



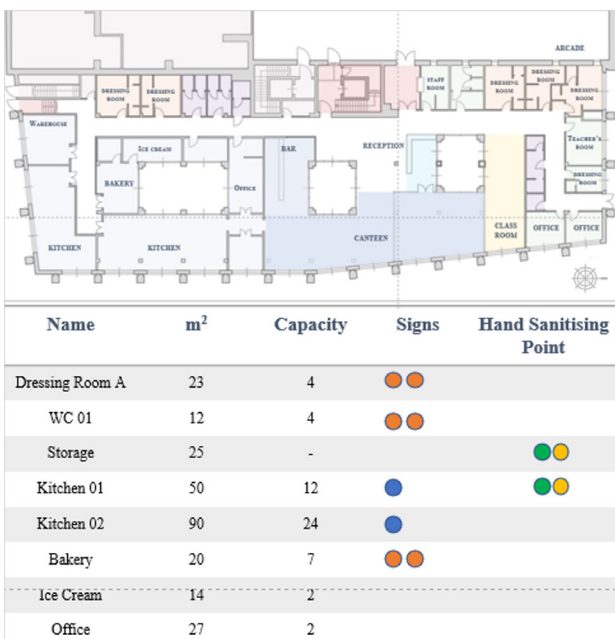


Figure 12. Abacus abacus/caps, vertical communication signs and hand sanitizing stations for the ground floor rooms.

Figure 13. Ground floor plan with indication of the positions of some categories of communication signs.



building, until reaching their own location (Fig. 12). The attention of the research focused on the 'student' target, intended as a true protagonist and actor, through careful planning of his needs and the changes he will have to get used to in order to live actively and safely in a #newnormal condition. In order to achieve an exhaustive project and a representation consistent with the introduction of new codes, the project of the school in the Covid-19 era was developed on two essential points: the building was divided and articulated into cells, each of which represents areas organized for different functions, in order to be able to analyze flows and capacities (Fig. 13); around the building, spaces for relations with the city have been identified, both to assess the existing relationship with the urban context at different times of the day, and to underline the existence of spaces for relations that are currently under exploited, such as courtyards and open spaces, which can be used for teaching or leisure. Thus a #newnormal has been defined and introduced, but above all a new spatial organisation linked to the new dimensions and new geometric rules to be applied:

- controlled accesses, by means of hourly programming and monitoring of staggered entrances, in order to avoid groups at the entrance/exit of the building, and defined and structured paths, easy to understand, aimed at separating the flows and guaranteeing their independence;
- new layouts of the internal spaces (classrooms, changing rooms, laboratories and rooms accessible to students and professionals) and reorganisation of the external spaces, to guarantee maximum indoor capacity in terms of users, minimum safety distances and social distancing;
- sanitising stations, for the necessary sanitising measures for users;
- horizontal and vertical signage, for sanitising stations and to communicate good practice actions (Fig. 14).

What has been listed has been transferred and represented within the building model: all the information and data structured hierarchically - both by modelling families¹⁴ of ad hoc objects and by inserting parameters and geometrical constraints within the premises - have been introduced in order to be able to manage in a single environment all the data relating to temporary set-ups necessary to guarantee correct preparation and adequate safety of the environments and users.

The creation of a BIM model has allowed us to create an information system for the building, based on standards that can be managed through a structured database, which collects the data that characterize the architectural organism. All the information constituting the model is parametric and interconnected through constraints and geometric rules defined during the creation of the model, guaranteeing both formal and constructive coherence of the virtual model and accurate control over the quality and coordination of the documents produced (Lo Turco, 2015) (Fig. 15).



Figure 14.
Some images related to the temporary installations of the spaces of the Noberto Bobbio Institute (credit: C. Torta, 2020).

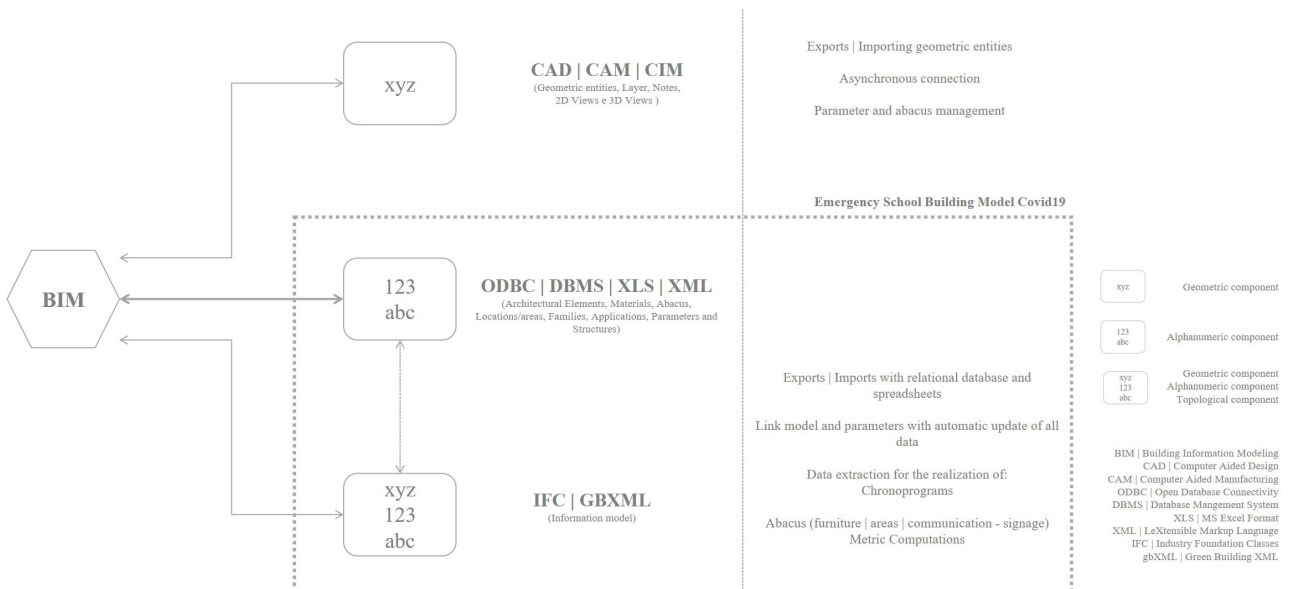
4. THE NEW TOOLS FOR THE REPRESENTATION AND DESIGN OF #NEWNORMAL

The analysis of the national and international responses provided by professionals to support the adaptation and re-functionalisation phases of the spaces, have allowed us to have a picture of current issues and the state of the art, linked to the nascent needs due to the spread and containment of the virus and to correctly plan future expectations. The application of the theoretical principles of research to a unique case study, such as the Bobbio Institute in Carignano, was fundamental for the applied experimentation from which emerged the problems to be solved and the proposals for innovation to be

deepened and disseminated. The model elaborated in the BIM environment allowed to draw great benefits linked to a wide range evaluation of the programmable interventions on the existing building heritage, and therefore to analyze the effects that these interventions have not only in architectural but also urban and social terms. Through this tool it will be possible to monitor the building resources and the foreshadowing of architectural design solutions, in order to allow preventive evaluations of management and construction hypotheses (Lo Turco and Bocconcino, 2016).

The potential of the system is expressed in its ability to answer complex questions, providing specific information related to the various possible solutions (Bianchini, Inglese and Ippolito, 2016). In this way it is configured as an irreplaceable operational

Figure 15.
Procedural workflow referred to the different activities carried out for the modeling of buildings: from two-dimensional representations processed in CAD environments, to the representation of the building in BIM environment for the management of project parameters (source: Bocconcino et al., 2015).



tool capable of elaborating a correct planning of interventions, selecting suitable implementation paths and avoiding the implementation of solutions whose negative effects often only show themselves after considerable investments both in terms of time and in economic terms. From this point of view, the model created, in order to be useful for the redesign of existing spaces, will have to be elaborated with 'dynamic' software of the BIM type able to allow simulations on technical and economic feasibility in real time, for a consequent timeliness in the adaptation and implementation of the interventions.

However, the need to create the model in a BIM environment, and therefore to use a system that can only be consulted by professionals, leads us to imagine, in order to overcome the limits imposed by the tool used, the creation of a web application capable of representing and communicating the design choices to those working in the school sector, such as the school manager and his collaborators. The subsequent operational development of the research will therefore be represented by the possibility of creating a web application where, through the use of simple graphic interfaces, school staff can view the virtual model of the building in which the communication and containment elements for the spread of the virus have been inserted.

NOTES

1. The term 'new normal' was introduced in the economic and financial sphere after the 2008 economic crisis, and today it has been adapted to the new emergency linked to the spread of the Covid-19 virus. Today, having become part of the world of communication and social media, #newnormal represents an invitation to a resilient response by individuals to adapt to the changes dictated by the pandemic to a new lifestyle, learning to live with a phenomenon that goes from extraordinary to ordinary.
2. We cite some main regulatory references introduced for the reorganization of spaces and environments in schools: Ministry of Education, Memorandum of Understanding to ensure the start of the school year in compliance with the safety rules for the containment of the spread of Covid 19, Register Decrees R. 87 of 06/08/2020 [Online] Available at: www.istruzione.it/rientriamoascuola/norme.html; Ministry of Education, Ordinance concerning the measures for the resumption of teaching activity in the school year 2020/2021 in compliance with the measures to contain the epidemiological emergency by Covid-19, AOOGAMI 83, Ministerial Ordinance of 05/08/2020 [Online] Available at: www.edscuola.eu/wordpress/?p=133048 [Accessed 05 November 2020]; Communication Extraordinary Commissioner of 03/09/2020, Prot. n. 1317, Distribution to Italian schools of the desks and sessions acquired by the Emergency Commissioner Covid-19 [Online] Available at: www.edscuola.eu/wordpress/?p=134526 [Accessed 05 November 2020].
3. The 'breather barriers' were introduced in the shared Protocol of 24 April 2020, Annex 6 of the D.P.C.M. of 26/04/2020. [Online] Available at: www.lavoro.gov.it/notizie/Documents/Protocollo-24-aprile-2020-condiviso-misure-di-contrasto%20Covid-19.pdf [Accessed 05 November 2020].
4. Among the containment measures to minimise the spread of the Covid-19 virus, in Italy, as in many other parts of the world, a national lockdown period has been introduced. In Italy, the lockdown lasted 69 days: from Monday 9 March 2020 to Monday 18 May 2020. During the lockdown, restrictive measures were introduced regarding travel within the municipalities and the closure of all production activities considered non-essential or strategic.
5. Quoting architect Tadao Ando "The role of architecture is to provide intelligent answers and solutions to the problems of our society".
6. Only two groups of professionals who have developed or are currently working on guidelines for the reorganisation of closed environments have been mentioned in the article. There are many national and international groups involved in the drafting of guidelines. Below, other illustrious examples: on the online platform bim.acca.it/category/bim-covid-19/ it is possible to find guidelines for the reopening of veterinary surgeries, mechanical workshops, dental surgeries, etc.; the Dahlin Group has a section on its website where you can read in-depth articles on Covid-19 (www.dahlingroup.com/covid-19/); the AIA group has developed the Reopening America -

Strategies for Safer Buildings project, available at www.aia.org/resources/6299247-reopening-america-strategies-for-safer-bui?editing=true&tools=true&utm_medium=website&utm_source=archdaily.com.

7. The international MASS Design Group team is made up of more than 120 professionals who worked during world pandemics, responding in the field to the needs dictated by the spread of the virus: construction of hospitals, reorganization of facilities for the elderly, design of air purification systems, etc.
8. For more information on The Role of Architecture in Fighting Covid-19 - Spatial Strategies for Restaurants in Response to Covid-19 please visit the web page: massdesigngroup.org/sites/default/files/multiple-files/2020-05/Spatial%20Strategies%20for%20Restaurants%20in%20Response%20to%20COVID-19_.pdf [Accessed 05 November 2020].
9. For more information on Making Space please visit www.fondazioneagnelli.it/2020/08/03/faespazio/ [Accessed 10 August 2020]. Sergio Poretti, Srtuttur(e)alismi, in *Modernismi Italiani. Architettura e costruzione nel Novecento*, 2008, pp. 255-269.
10. The Covid-19 Open BIM application is integrated into the Open BIM workflow through BIMserver.center. The application is available at: open-bim-covid-19.cype.it/ [Accessed 10 August 2020].
11. Cf. Sergio Poretti, L'exploit dell'ingegneria, in *Within the Open BIM Covid-19 Open BIM workflow it is possible to insert protection 'elements'*. The following belong to this category of objects: a) people or groups of people, defined by the introduction of certain parameters including gender (man, woman, boy, girl), interpersonal safety distance (with manual value input), the presence of a mask, the workstation or the route to be taken; b) separators, defined according to dimensional parameters, such as thickness and height, protection elements, that is: PPE (Individual Protection Devices) acceptance/reception point, mask dispenser, glove dispenser, sanitising gel dispenser, waste collection bins (where there is no container sorting), communication elements (where it is possible to geometrically parameterise the signals present in the library).
12. To cite some of the latest Decrees - all available on the website of the Ministry of Education - Ministry of University and Research www.istruzione.it/coronavirus/norme.html - Prime Ministerial Decree of 03 November 2020; Note no. 1927 of 25 October 2020; Prime Ministerial Decree of 24 October 2020. Implementation instructions; Prime Ministerial Decree of 18 October 2020; Prime Ministerial Decree of 13 October 2020; Law no. 35 22 May 2020 Conversion into law, with amendments, of Decree-Law no. 19 of 25 March 2020 on urgent measures to deal with the epidemiological emergency from COVID-19. (20G00057) (OJ General Series no.132 of 23-05-2020).
13. The Norberto Bobbio Institute of Secondary Education in Carignano hosts in two separate locations the high school premises - located in an old renovated building, originally a patrician villa (end of the 18th century) with annexes and a park of 19th century design, to which a modern wing is added - and the spaces dedicated to the Professional Institute, which we have dealt with in our studio.

14. Within a BIM model there can be different types of families - by family we mean a 'group of elements with a group of common properties, called parameters, and a related graphic representation'. The families can be of three types: system families (e.g. basic elements to be assembled on site, such as walls, roofs, floors, pipes, etc.); loadable families (which can be used to create building components that are installed inside or outside the building, such as internal and external fixtures, furniture, plants, etc.) and local families, i.e. the creation of a unique element, specific to the current project and not always reusable in other projects because of its characteristics linked to the model in which they are inserted.

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