

Security in the restoration erecting yards : a model for the analysis of the space superimpositions

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In the organisation of a building erecting yard, in order to the workers' security and health, the problem of the space-temporal superimpositions is often neglected.

The high number of accidents prove this problem, accidents which are related to the co-presence of different works.

We have located the management-organisation problem and we have drawn up a model on mathematics-geometrical basis, in order to represent the erecting yard in its temporal evolution, handling these superimpositions.

The model represents the erecting yard as a tridimensional space, in which the subjects, interested in different works, move and organize themselves following particular production logics.

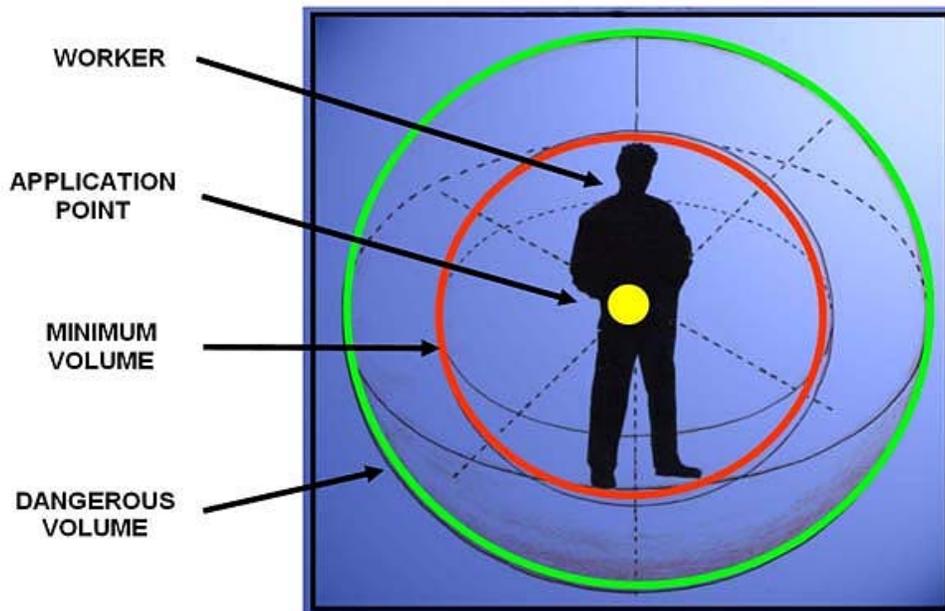
Giving to the workers distinctive volumes and fixing the direction and speed of their movements, following the good construction rules, we are able to point out in advance all possible situations of space-temporal intersection of the volumes, and in consequence the different potential phase critical situations.

It is possible to define three new units :

application point; is the center of the sphere of minimum volume. It is given through the space coordinates, in respect to an orthogonal Cartesian reference system, this application point gives the possibility to determine the position of the subjects in the erecting yard.

minimum volume; it is related to the worker and it is influenced by the type of work and by the type of worker. It is possible to identify this minimum volume with a sphere, where its radius will change according to the sociological anthropometrical data and according to the equipments used.

dangerous volume; in relation to the risk, function of the quantity (quantity of damage) and in relation to the possibility of happening, it is possible to dimension the inviolable space to avoid a dangerous situation (pointed in the application point). The geometrical representation is again identified with a sphere.



The model finds its correct application in the restoration erecting yard which often presents the impossibility to program in advance single interventions, which otherwise will be defined during the work. The work program is not so foreseeable and needs continuous adjustments in according to the sector contribution of the different disciplines which contribute in defining the project.

To manage the model, taken into consideration the several and complex unknowns, it is necessary to use a procedure which makes use of calculators, which is able to manage the given and unknown data and it is able through a computer, to start an elaboration process. This elaboration process must be able to point out, not only the physical intersection of the works but also, and it is the most important thing, the parameters through which it is possible to control the space superimpositions.

After having considered the given definitions and the collected data, it is possible to formulate a programming supposition which is presented through macro work phases.

PHASE 1 : geometrical representation of the erecting yard on the reference plane xy with the subdivision in levels of the unknown z in the different specified levels in: building floors, work levels etc.

PHASE 2 : specification of workers number N_i with $i = 1, \dots, n$

PHASE 3 : settlement of the processing application point N_i , given through its Cartesian coordinates (x_i, y_i) , as well as level (z_i) .

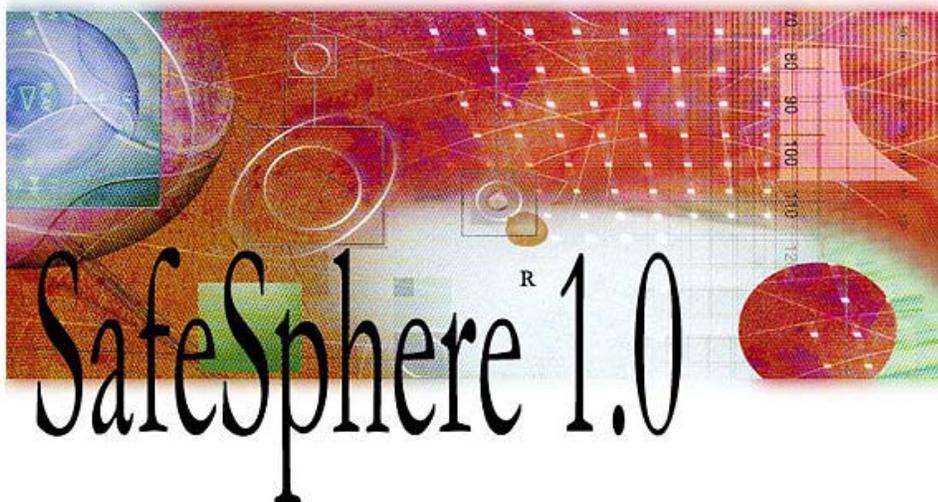
PHASE 4 : settlement of minimum volume and dangerous volume for each kind of workers present in the erecting yard.

PHASE 5 : settlement of direction of each worker through the deterministic method and settlement of moving speed (in option : probabilist method).

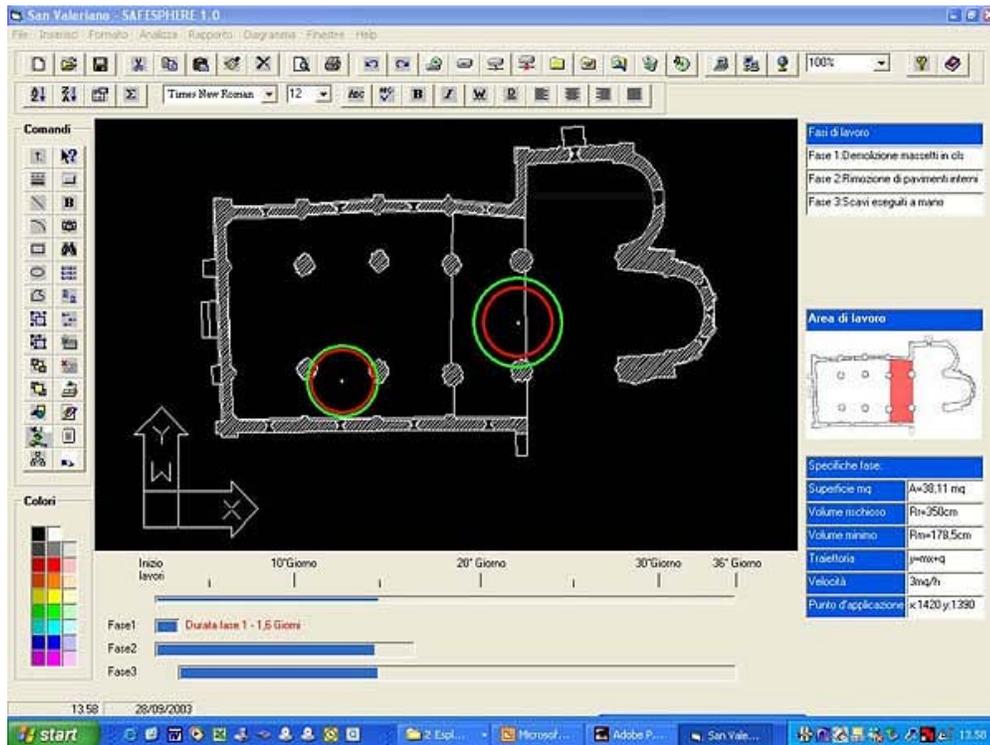
PHASE 6 : beginning of the simulation : moving test of the application points with meeting check of the minimum and dangerous volumes. The simulation has the purpose to calculate the number of dangerous situations which happen on a certain temporal space and has the purpose to give the possibility to specify the parameters to control these situations. The conclusion of our work is the realisation of a software named : SafeSpheare 1.0 Demo, which is able to show practically all that is in evidence in our treatment even if is limited to a practical example of application on the erecting yard of San Valeriano in Robbio (PV).



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