

The definition of planning criteria for safe workplaces in wineries

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Abstract

Surveys by the ISPESL [Higher Institute for the Prevention of Accidents and Security at Work] have highlighted numerous accidents at work in the wine industry related to building type and environmental conditions. To this end research was carried out in several wineries in Eastern Sicily. Analyses of the environmental, technological and organisational needs of work-spaces have produced the technical and functional characteristics of the pathways within and which link every work area. In relation to operative norms, it has been possible to identify design criteria to guarantee employee safety.

Keywords: work-place, safety, planning criteria, transit-way.

Introduction

ISPESL data for 2000 – 2006 highlights above average (650,000 annual) numbers of work related accidents particularly in the north and less so in Central and Southern Italy. The figures for Sicily are also on the rise with an annual average of 23,577 accidents. Palermo province has the highest number of registered accidents followed by the provinces of Catania, Messina, Ragusa, Trapani, Siracusa, Agrigento, Caltanissetta and Enna.

A detailed look at work-related accidents in Sicily from 2000 – 2006 for the Food Industry sector covering drinks and tobacco reveals 4,262 against 127,904 accidents nationally with an annual average of 609.

The category of 'Wine, Table Wine and Special Wine Production' registered 189 accidents against 3,887 nationally. The data raises several important issues which essentially lead to a growth in production which is not adequately proportional to aspects of structure, plant and organisation. Construction and organisational inefficiencies seem to involve all sectors of production since they correspond to large increase in work-related accidents notwithstanding the norms on safety.

The wine sector seems to be particularly hit by this problem. Wineries often have technical-structural characteristics which are not up to the work processes they wish to carry out (Cividino et al., 2005; Dioguardi, 2005). In particular, spaces, room sizes and their distribution, product and employee flow, are not very rational.

This is confirmed by ISPESL data on 'accident agents' for buildings and work areas. The greatest number of accidents in the category 'Wine, Table Wine and Special Wine Production' are: 435 cases of 'work surfaces and transit' (27 in Sicily); 120 cases of 'stairs and gangways' (4 in Sicily); then in descending order 'building features' and 'wall and floor openings' being the lowest of all for a total of 592 accidents. Closer analysis of 'accident agent', 'work surfaces and transit' and 'stairs and gangways' reveals that the main causes of risk are due to 'floors' and 'flights of steps and stairs' with 124 and 72 national accidents respectively.

This would lead one to believe that to date these problems have not been resolved. The lack of work safety is therefore due to breaching the law [D.Lgs. 626/94], the undervaluation of the risks or the lack of awareness of employees.

Another fundamental element worthy of consideration is the poor inspection of company safety systems (Safety Management Systems or UNI norms) which should be able to advise on product quality and safety by means of system management and improvement of the critical phases of production.

In wineries, work risk is above all due to vehicle transit during grape delivery and liquid transfer during control phases. Therefore it is indispensable there are 'safe work areas' designed to take into account employees' needs throughout the production phases and the inalienable hygiene requirements for food safety.

On the basis of the above, this study presents several Sicilian companies near Etna to identify the main risks involved with functional organisation and the environmental and construction characteristics of the transit-ways. Employee work activity was monitored and in particular the operations involving the transit of product or vehicles.

This winery research has led to criteria for design solutions which could help employees work in safety, taking into account the operative norms including D.Lgs. 81/2008 which substitutes D. Lgs. 629/94 regarding work-place safety.

Materials and methods

To identify work-place risk in wineries and suggest suitable design solutions, 5 wineries of different sizes were investigated which are noted in Eastern Sicily for the quality of their wines. The following company characteristics were noted: size (hectares cultivated), cultivar, workforce size, raw material transport, must in litres (daily average and maximum work capacity), bottled product (daily average and maximum work capacity), final product stock and waste disposal. For each work area in relation to the main means of transit, the transit-way characteristics considered to be fundamental for employee safety were analysed.

For each company, the data revealed refers to the following production areas: grape intake and pressing; fermentation; mellowing; bottling and storage. In each of these the following employee safety features were studied: work activity; transit routes: employees and/or vehicles; vehicle type; equipment and machinery; structural elements and functional surface features; signs and hazards. All the data has been reproduced in diagrams and graphs. Furthermore, taking into account employee work phases, the technical and functional characteristics of transit areas and the operative norms (D.Lgs. 81/2008, D.Lgs 493/96, DPR n. 547/55, ISO 22000:05) it was possible to identify certain design criteria for making transit 'safe'.

Results

Company analyses

By means of research into some venerable wineries in Eastern Sicily, those elements were identified which influence the planning of safe employee thoroughfares as regards, above all, environmental quality and the technological performance of floor systems, measurement and distribution of handling spaces in rapport with machinery and equipment.

Generally, the five companies have similar production characteristics both for the quantity of must and production in bottles (table 1). All the wineries use industrial technology given that the production phases are almost all mechanised. The number of employees is variable, increasing during the production season. The differences are essentially due to the distribution of handling spaces, the arrangement of machinery and equipment which is not₂

always compatible with production processes.

Table 1. Winery characteristics

Characteristics	Winery 1	Winery 2	Winery 3	Winery 4	Winery 5
Cultivar	- Nerello Mascalese	- Nero D'Avola - Frappato - Inzolia - Chardonnay	- Nero D'Avola - Nerello Mascalese - Inzolia - Chardonnay	- Caricante - Catarratto - Nerello Mascalese - Nerello Mantellato	- Nerello Mascalese
Cultivated hectares	17	32	32	25	19
Employees	5+seasonal	2+seasonal	2+seasonal	5+seasonal	2+seasonal
Raw materials transport	tractor +trailer	tractor +trailer	tractor +trailer	trailer	tractor +trailer
Average must L/day	3500	4600	4600	4500	3250
Must L/giorno (max production capacity)	4500	6000	6000	6000	4500
Average bottles/day	650	650	650	650	550
Bottles /day (max production capacity)	1400	1600	1600	1600	1000
Storage	12 bottle cases	6 bottle cases	6 bottle cases	6 bottle cases	6 bottle cases
Waste disposal	Distillery	Distillery	Distillery	Distillery	Distillery

The study has highlighted that safety requirements vary according to work spaces. In particular, the sections at highest risk are in 'grape pressing' and 'bottling/storage' since here there is the combined movement of several vehicles and employees.

In these areas, dangers emerge particularly when unloading raw materials because in most cases there is a drop between the truck height and the delivery level so employees risk falling down (wineries 2, 4 and 5)(fig. 1).

Furthermore, the bottling areas which ought to have their own space overlap with the storage area so the sizes of the vehicle lane and employee lane are insufficient to guarantee safe movement. By analysing employee flow it becomes apparent that it overlaps with vehicle flow (fig. 1).

Winery 2 suffers particularly from this overlap. The lack of space in the bottling area forces employees to use the 'mellowing' area as a temporary holding area for the latest consignments. However, the employees in both areas collude to make things work smoothly.

In all the wineries, employee and vehicle lane improvements have to be made especially in the initial and final phase areas of production.

By analysing the structural elements (fig. 2) the grape intake and pressing areas have earth, concrete or lava stone floors which are generally in good condition from a safety angle. Only in winery 4 are there some floor openings.

In the fermentation and mellowing areas risk is often determined by the inadequacy of space and its organisation considering all the vats present. In the fermentation area the main risk is from liquids on the floor making it slippery. Anti-slip solutions and sloping floors for better drainage are often insufficient. Most floors in this area are tiled (fig. 2). In the fermentation areas, restricted space and the use of stairs and gangways are the min elements affecting employee safety (wineries 1&5)(fig. 1).

The bottling department is one of the winery's areas at highest risk for employee safety. This is due to the machinery and work processes involved during which bottles may fall and break.

The risks are not only connected to moving machinery but also to liquids on the floor when the empty bottles are washed. Existing expedients often do not ensure the rapid total removal of liquids (fig. 2).



Figure 1. Diagramatic plans of the wineries

	Winery 1	Winery 2	Winery 3	Winery 4	Winery 5
Intake and Pressing					
Earth floor	Present	Present	Present	Present	Present
Concrete floor	Present	Present	Present	Present	Present
Lava stone floor	None	None	None	None	None
Floor openings	None	None	None	None	None
Non-slip floor	None	None	None	None	None
Sloping floor and drainage	None	None	Present	None	None
Stairs and catwalks	Present	Present	Present	Present	Present
Signs	None	None	None	None	None
Loading/Unloading ramps	Present	Present	Present	Present	Present
Lighting	Present	Present	Present	Present	Present
General surface condition	Functional	Functional	Functional	Non-Functional	Functional
Fermentation area					
Concrete floor	Present	Present	Present	Present	Present
Tiled floor	Present	Present	Present	Present	Present
Floor openings	None	None	None	None	None
Non-slip floor	None	Present	None	None	None
Sloping floor and drainage	None	Present	None	None	None
Stairs and catwalks	Present	Present	Present	Present	Present
Signs	None	None	None	None	None
Lighting	Present	Present	Present	Present	Present
General surface condition	Non-Functional	Non-Functional	Functional	Functional	Non-Functional
Mellowing area					
Concrete floor	Present	Present	Present	Present	Present
Terra cotta or lava tiles floor	Present	Present	Present	Present	Present
Tiled floor	Present	Present	Present	Present	Present
Floor openings	None	None	None	None	None
Non-slip floor	None	Present	None	None	None
Sloping floor and drainage	None	Present	None	None	None
Stairs and catwalks	Present	Present	Present	Present	Present
Signs	None	None	None	None	None
Lighting	Present	Present	Present	Present	Present
General surface condition	Non-Functional	Functional	Functional	Functional	Functional
Bottling and Storage area					
Concrete floor	Present	Present	Present	Present	Present
Tiled floor	Present	Present	Present	Present	Present
Cement and resin floor	Present	Present	Present	Present	Present
Floor openings	None	None	None	None	None
Non-slip floor	None	Present	None	None	None
Sloping floor and drainage	None	Present	None	None	None
Stairs and catwalks	Present	Present	Present	Present	Present
Signs	None	None	None	None	None
Lighting	Present	Present	Present	Present	Present
General surface condition	Non-Functional	Non-Functional	Non-Functional	Functional	Functional

Figure 2. Survey of building features regarding safety

lanes were in focus for the fermentation and mellowing areas.

Furthermore, for every area tables 3a and 3b show summaries of the safety norms and planning directions for lanes as they pertain to the following environmental and technological parameters: measurements, floors, signs, lighting and machinery.

Intake and Pressing

The intake and pressing areas should be large enough to cope with all the jobs of the special equipment needed and with the production capacity of the winery. For greater safety and functionality of the area, the machinery should be placed in 'cascade' providing a work scheme in hierarchical order. Any moving machinery at intake should not compromise the safety of any employees. There should be sufficient room for vehicle manoeuvre which is directly proportional to the size and turning circles of the trucks. From an environmental point of view, the intake area should protect employees from the weather and so the operating zone should have canopies as per the norms for work-place safety.

Planning criteria for lanes

The analysis and correlation of work processes together with the planning directions provided by other studies (Bonomo, 1999) regarding the environmental, organisational and technological characteristics in rapport with machinery, plant and safety provided definitions of some design criteria for lanes which can be taken as references when renovating wineries or planning new ones.

From a survey of the wineries the intake, pressing, bottling and storage departments are at highest risk as regards mechanised lanes, whereas the in the fermentation and mellowing departments the only risks are from pedestrian movement.

The following proposed criteria take into account the safety requirements during the periods of most activity when there are most vehicles in use, the space and structural requirements of the work areas, the transit of both employees and vehicles and even the health, protection and safety characteristics of the employees.

These criteria were defined for both the pedestrian and vehicular lanes in the areas of intake, pressing, bottling and storage, whereas only the pedestrian

Departments	Planning criteria for vehicular lanes	
	Norms	Parameters
Intake and Pressing	D.Lgs. 81/08 Titolo II e III; DPR 547/55 Art. 8 comma 3 e 4, Art. 11; ISO 22000:05	Measurements Vehicular lanes: width should guarantee transit and manoeuvring. Lanes should be linear and not cross pedestrian lanes
	D.Lgs. 81/08 Titolo II; DPR 547/55 Art. 8 comma 9 e 10, Art. 10 comma 1, Art. 11; ISO 22000:05	Flooring Durability should be adequate to use. Any floor openings should be covered seamlessly and well-marked. Should be dustless
	D.Lgs. 81/08 Titolo V; DPR 547/55 Art. 8 comma 5, 8 e 11, Art. 13, Art. 33; D.Lgs 493/96 Allegato V comma 1 e 2.	Signs Floor lane markings; 'pedestrians'; 'noise'; 'fire prevention'
	D.Lgs. 81/08 Titolo III capo III; DPR 547/55 Art. 28, Art. 29, Art. 30, Art. 31; Codice Civile Art. 2087; Legge 864/70 Art. 9; D.M. 26/08/92 Art. 7.1 lettera a)	Lighting Optimum lighting with artificial back-up in windowless areas; artificial lighting in outdoor work areas should night work take place
	D. Lgs 81/08 Titolo III capo III; ISO 22000:05	Plant engineering Plumbing for washing down all surface; good drainage for waste liquids; electricity installation
Bottling and Storage	D.Lgs. 81/08 Titolo II e III; DPR 547/55 Art. 8 comma 3 e 4, Art. 11; ISO 22000:05	Measurements Vehicular lanes: width should guarantee transit and manoeuvring. Lanes should be linear and not cross pedestrian lanes
	D.Lgs. 81/08 Titolo II; DPR 547/55 Art. 8 comma 9 e 10, Art. 10 comma 1, Art. 11; ISO 22000:05	Flooring Durability should be adequate to use. Any floor openings should be covered seamlessly and well-marked. Should be dustless. Non-slip and washable surface
	D.Lgs. 81/08 Titolo V; DPR 547/55 Art. 8 comma 5,8 e 11, Art. 13, Art. 33; D.Lgs 493/96 Allegato V comma 1 e 2.	Signs Floor lane markings; 'pedestrians'; 'nois'; 'fire prevention'
	D.Lgs. 81/08 Titolo III capo III; DPR 547/55 Art. 28, Art. 29, Art. 30, Art. 31; Art. 2087 Codice Civile; Legge 864/70 Art. 9; D.M. 26/08/92 Art. 7.1 lettera a)	Lighting Optimum lighting with artificial back-up
	D. Lgs. 81/08 Titolo III capo III; ISO 22000:05	Plant engineering Plumbing for washing down all surface; good drainage for waste liquids; electricity installation

Figure 3a. Summary of planning criteria and safety requirements for vehicular lanes

The durability of the floors should correspond to the physical-mechanical loads undertaken: high static and dynamic loads due to storage and vehicular transit. For the most part, floors are made of a bitumen mix or concrete; both are highly mechanically resistant and waterproof.

Stone slabs can also be used providing their thickness corresponds to the mechanical resistance they will be subjected to. Floors should also be non-slip, so they should incline to guarantee rapid drainage of wash water and rain water via drains and run-offs.

The intake area should directly connect with the pressing area to enable easy access for employees and product. The pressing machinery should be separate from service corridors which should allow inspection and operator control and the floors, apart from the above characteristics, should be able to remain hygienic.

Fermentation and mellowing

Wine vats should be in ordered lines with service corridors between which are wide enough for employee use. Vats should be at least 40 cm from the walls to accommodate cleaners and inspection. They should also be interspaced to allow lateral inspection. When the vats are very tall they need to be inspected from above so scaffolding and catwalks need to be provided. To guarantee employee safety and referring to current norms (D.Lgs. 81/2008), the catwalks should have non-slip surfaces and be protected by normal parapets with footguards or similar.

Departments	Planning criteria for pedestrian lanes	
	Norms	Parameters
Intake and Pressing	D.Lgs. 81/08 Titolo II e III; DPR 547/55 Art. 8 comma 1 e 2, Art. 11, Art. 15, Art. 16, Art. 27; ISO 22000:05	Measurements Pedestrian lanes: width should guarantee transit safety above all near machinery. Lanes should be linear and not cross vehicular lanes. Lanes close to variations in level should have railings. Holding lanes: work space must guarantee safety during plant inspection and maintenance
	D.Lgs. 81/08 titolo II; DPR 547/55 Art. 8 comma 9 e 10, Art. 10 comma 1, Art. 11; ISO 22000:05	Flooring Durability should be adequate to use. Any floor openings should be covered seamlessly and well-marked. Should be dustless
	D.Lgs. 81/08 Titolo V; DPR 547/55 Art. 8 comma 5, 8 e 11, Art. 13, Art. 33; D.Lgs 493/96 Allegato V comma 1 e 2.	Signs Floor lane markings; 'pedestrians'; 'noise'; 'fire prevention'; 'plant control panel'
	D.Lgs. 81/08 Titolo III capo III; DPR 547/55 Art 11 comma 6; Art. 2087 Codice Civile; Legge 864/70 Art. 9; D.M. 26/08/92 Art. 7.1 lettera a)	Lighting Optimum lighting with artificial back-up in windowless areas; artificial lighting in outdoor work areas should night work take place
	D. Lgs. 81/08 Titolo III capo III; ISO 22000:05	Plant engineering Plumbing for washing down all surface; good drainage for waste liquids; electricity installation
Fermentation and Mellowing	D.Lgs. 81/08 Titolo II e III; DPR 547/55 Art. 8 comma 1 e 2, Art. 11, Art. 15, Art. 16, Art. 27; ISO 22000:05	Measurements Pedestrian lanes: width should guarantee transit safety above all near machinery. Lanes should be linear and not cross vehicular lanes. Lanes close to variations in level should have railings and footguards. Holding lanes: work space must guarantee safety during plant inspection and maintenance
	D.Lgs. 81/08 Titolo II; DPR 547/55 Art. 8 comma 9 e 10, Art.10 comma 1, Art. 11; ISO 22000:05	Flooring Durability should be adequate to use. Any floor openings should be covered seamlessly and well-marked. There should be no obstacles or unevenness
	D.Lgs. 81/08 Titolo V; DPR 547/55 Art. 8 comma 5, 8 e 11, Art. 13, Art. 33; D.Lgs 493/96 Allegato V comma 1 e 2.	Signs 'Moving vehicles'; 'plant control panel'; 'fire prevention'
	D.Lgs. 81/08 Titolo III capo III; DPR 547/55 Art. 28, Art. 29, Art. 30, Art. 31; Codice Civile Art. 2087; Legge 864/70 Art. 9; D.M. 26/08/92 Art. 7.1 lettera a)	Lighting According to work need with artificial back-up
	D. Lgs. 81/08 Titolo III capo III; ISO 22000:05	Plant engineering Plumbing for washing down all surface; good drainage for waste liquids; electricity installation
Bottling and Storage	D.Lgs. 81/08 Titolo II e III; DPR 547/55 Art. 8 comma 1 e 2, Art. 11, Art. 15, Art. 16, Art. 27; ISO 22000:05	Measurements Pedestrian lanes: width should guarantee transit safety above all near machinery. Lanes should be linear and not cross vehicular lanes. Holding lanes: work space must guarantee safety during plant inspection and maintenance
	D.Lgs. 81/08 Titolo II; DPR 547/55 Art. 8 comma 9 e 10, Art.10 comma 1, Art. 11; ISO 22000:05	Flooring Durability should be adequate to use. Any floor openings should be covered seamlessly and well-marked. There should be no obstacles or unevenness
	D.Lgs. 81/08 Titolo V; DPR 547/55 Art. 8 comma 5, 8 e 11, Art. 13, Art. 33; D.Lgs 493/96 Allegato V comma 1 e 2.	Signs Floor lane markings; 'moving vehicles'; 'noise'; 'fire prevention'; 'plant control panel'
	D.Lgs. 81/08 Titolo III capo III; DPR 547/55 Art. 28, Art. 29, Art. 30, Art. 31; Codice Civile Art. 2087; Legge 864/70 Art. 9; D.M. 26/08/92 Art. 7.1 lettera a)	Lighting Optimum lighting and if necessary to include spot lighting above the bottling lines
	D. Lgs. 81/08 Titolo III capo III; ISO 22000:05	Plant engineering Plumbing for washing down all surface; good drainage for waste liquids; electricity installation

Figure 3b. Summary of the planning criteria and safety requirements for pedestrian lanes

Other aspects to be considered are the floor finishes which should be washable (also by law). They should be highly mechanically resistant especially since they are in contact with chemically aggressive liquids (must, wine and wash water). Today, the building materials industry have a variety of solutions with clinker tiles and other ceramic tiles. Resin claddings can also be easily applied to a concrete base producing viable flooring.

Bottling and Storage

The bottling department is one of the highest risk areas for employees. This is due to the type of machinery used during which work processes bottles can break compromising employee safety. Respecting the safety conditions laid down by the norms (D.Lgs.

81/2008) requires each machine be shielded; this means protective barriers which separate the operative areas of the machinery from those of the employees who, at this point in the production process, do little more than check the machines. In the bottling lines wherever employees are needed, raised shields are likewise needed to prevent direct contact with liquids.

The bottling phase inevitably leads to a large quantity of liquid on the floor which must be removed rapidly usually by means of a sloping floor with appropriately-sized run-offs and drains. The drains and channels need to be covered to maintain a seamless floor.

The choice of surface finishes must allow for washing and must resist acid corrosion (acetic acid, cleaning solutions); the floors should also be non-slip to safeguard employees since liquids are ever-present. For storage, the production and norm requirements are volumetric and must facilitate the rational organisation of loading and unloading so the vehicle manoeuvring area needs to be defined.

Conclusions

In this work, the main work processes involved in quality wineries located in Sicily have been analysed. This has led to specific criteria for planning transit areas, both for employees and vehicles, which answer the work-place safety requirements laid down by law. In particular, the resulting indications could contribute to construction and organisational precautions to limit work-place safety risks which arise during the more intricate production phases. Activating such measures, apart from answering safety and hygiene requirements, could reflect very positively on productivity and company management as regards:

- work organisation and productivity (checking production processes, data collection, optimum resource use, reduction of production times, etc.);
- plant efficiency, machinery and equipment (maintenance and correct use, energy saving, damage risk reduction);
- work quality (less fatigue, better hygiene, easier workforce availability);
- construction quality (reduction of covered areas, construction appropriateness);
- architectural quality (planning for maximum practicality, balanced use of space).

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