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**IDA: ADVANCED
DOCTORAL RESEARCH
IN ARCHITECTURE**

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Antonio Tejedor Cabrera, Marta Molina Huelva (comp.)

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FORMATO

Mesas temáticas

Las mesas temáticas son lugares de presentación de las metodologías y las experiencias de jóvenes doctores y de estudiantes de doctorado procedentes de las diferentes universidades. Son gestionadas por los propios estudiantes de doctorado que generan unas conclusiones para ser debatidas y reelaboradas en la sesión plenaria final. Las sesiones se desarrollan de manera simultánea con la presentación de los *papers* seleccionados en la *call*, organizados en cuatro áreas o líneas temáticas:

1. Tecnologías de la Arquitectura
2. Vivienda, Ciudad y Territorio
3. Patrimonio y Rehabilitación
4. Análisis y Proyectos Avanzados

Taller

El workshop del Congreso se orienta hacia el análisis de los problemas y las necesidades de gestión de los Programas de Doctorado con el fin de extraer conclusiones que pueden ser útiles a las Universidades implicadas. En el workshop participan los coordinadores de los programas de Doctorado en Arquitectura y los representantes de los doctorandos. Son temas de debate: las líneas de investigación, las metodologías, las necesidades organizativas de los programas de doctorado, el Doctorado Internacional y el Doctorado Industrial, y el futuro de la investigación doctoral.

Sesiones Plenarias

Las sesiones plenarias se realizan al inicio y al final del Congreso. En la primera sesión de bienvenida e introducción al Congreso se invita a participar a expertos investigadores del panorama nacional e internacional y a los coordinadores de los programas de doctorado. En la segunda sesión plenaria se propone un debate abierto para la reelaboración de las propuestas extraídas del taller y de las mesas temáticas. Sirve también de clausura con la presentación de las conclusiones finales del Congreso IDA_Sevilla 2017.

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FOREWORD

The Instituto Universitario de Arquitectura y Ciencias de la Construcción (IUACC), in collaboration with the Escuela Técnica Superior de Arquitectura (ETSAS) and the Escuela Internacional de Doctorado (EIDUS) of the University of Seville are pleased to welcome the heads of research from both Spanish and overseas universities, consolidated researchers and young doctoral researchers to the First International Congress of Doctorates in Architecture IDA Sevilla, from 27th to 28th November 2017.

The **IDA_Sevilla 2017** Congress offers a general perspective of doctoral studies in the field of Architecture and its related disciplines: urban planning, heritage, landscape, construction technologies and sustainability. In the new context generated after the elimination of the doctoral programs prior to RD 99/2011, it is necessary to carry out an analysis of the complex panorama that the former programs and the new doctoral programs have drawn up, in order to know in detail both what has been achieved so far, as well as the challenges of the future of advanced doctoral research in Spain, in the European and international context.

The startling changes that are taking place in our society call for a vision of research that is not compartmentalised into traditional disciplines or areas of knowledge. Doctoral research in Architecture must adapt to changes in society and to the sustainable productive needs of territory.

The congress will take place at the Escuela Técnica Superior de Arquitectura de Sevilla, organised in four simultaneous thematic tables, a workshop on the administration of doctoral programs and two plenary sessions.

The **thematic tables** are aimed at young doctors and doctoral students of the different participating universities who will present their experiences and methods of their research - in development or recently concluded. The participation in the thematic tables is carried out through the selection procedure with blind peer review established in the call for papers and through express invitations to the debate. The almost 70 communications have been structured in four thematic areas representative of the PhD programs in Architecture.

The **open workshop** will be held in two sessions with the participation of the coordinators of each of the collaborating programs of the Congress, and professors with extensive doctoral experience. Its objectives are multiple: to discuss the experiences undertaken in the different universities, exchange ideas about the approaches and models applied, address the challenges of internationalization and management, launch the new Industrial Doctorate with companies and public agencies, and so on.

There are two **plenary sessions**: one, a plenary session of introduction to the congress, with the participation of coordinators of national and foreign doctoral programs; and a closing plenary session, with an open debate for the going-over of the conclusions drawn from the thematic tables and the workshop, and the presentation of final conclusions.

We thank the Escuela Internacional de Doctorado of the University of Seville, and the Escuela Técnica Superior de Arquitectura de Sevilla for the support they have provided for the holding of this meeting, which contributes so much to the clarification of the future of doctoral studies in Spanish universities in the face of the great challenge of internationalization and the continuous improvement of the quality of research in Architecture. We also thank those responsible for the participating Doctoral Programs, the Architecture library of the US and all the participants and attendees.

Antonio Tejedor Cabrera
Marta Molina Huelva

PRÓLOGO

El Instituto Universitario de Arquitectura y Ciencias de la Construcción (IUACC), con la colaboración de la Escuela Técnica Superior de Arquitectura (ETSAS) y la Escuela Internacional de Doctorado (EIDUS) de la Universidad de Sevilla, se complacen en recibir a los responsables de investigación de universidades españolas y extranjeras, a los investigadores consolidados y a los jóvenes investigadores de doctorado en el I CONGRESO INTERNACIONAL DE DOCTORADOS EN ARQUITECTURA IDA_Sevilla, del 27 al 28 de noviembre de 2017.

El congreso **IDA_Sevilla 2017** ofrece una perspectiva general de los estudios de doctorado en el campo de la Arquitectura y sus disciplinas afines: urbanística, patrimonio, paisaje, tecnologías de la construcción y sostenibilidad. En el nuevo contexto generado tras la extinción de los programas doctorales anteriores al RD 99/2011 es necesario realizar un análisis del complejo panorama que han construido los programas extintos y los nuevos programas de doctorado, con el objeto de conocer con detalle tanto lo conseguido hasta ahora como los retos que depara el futuro de la investigación doctoral avanzada en España, en el contexto europeo e internacional.

Los vertiginosos cambios que se están produciendo en nuestra sociedad reclaman una visión de la investigación no compartimentada en disciplinas o áreas de conocimiento tradicionales. La investigación doctoral en Arquitectura debe adaptarse a los cambios de la sociedad y a las necesidades productivas sostenibles en el territorio.

El congreso se celebra en la Escuela Técnica Superior de Arquitectura de Sevilla organizado en cuatro mesas temáticas simultáneas, un taller sobre la gestión de los programas de doctorado y dos sesiones plenarias.

Las **mesas temáticas** están dirigidas a los jóvenes doctores y a estudiantes de doctorado de las diferentes universidades participantes que exponen sus experiencias y métodos sobre las investigaciones en desarrollo o recientemente concluidas. La participación en las mesas temáticas se realiza por el procedimiento de selección con revisión por pares ciegos establecido en la *call for papers* y por medio de invitaciones expresas al debate. Las casi 70 comunicaciones se han estructurado en cuatro áreas temáticas representativas de los programas de doctorado en Arquitectura.

El **taller** de puesta en común se realiza en dos sesiones con la participación de los coordinadores de cada uno de los programas colaboradores del Congreso y de profesores con amplia experiencia doctoral. Sus objetivos son múltiples: debatir sobre las experiencias desarrolladas en las distintas universidades, intercambiar ideas sobre los enfoques y los modelos aplicados, abordar los retos de internacionalización y de gestión, poner en marcha el nuevo Doctorado Industrial con empresas y agencias públicas, etc.

Las **sesiones plenarias** son dos: una sesión plenaria de introducción al congreso, con la intervención de coordinadores de programas de doctorado nacionales y extranjeros; y una sesión plenaria de clausura, con un debate abierto para la reelaboración de las conclusiones extraídas de las mesas temáticas y del workshop y la presentación de las conclusiones finales.

Agradecemos a la Escuela Internacional de Doctorado de la Universidad de Sevilla y a la Escuela Técnica Superior de Arquitectura de Sevilla el apoyo que han proporcionado para la realización de este encuentro que tanto contribuye a clarificar el futuro de los estudios doctorales en las universidades españolas ante el gran reto de la internacionalización y la continua mejora de la calidad de la investigación en Arquitectura. Damos las gracias también a los responsables de los Programas de Doctorado participantes, a la Biblioteca de Arquitectura de la US y a todos los participantes y asistentes.

Antonio Tejedor Cabrera
Marta Molina Huelva

OBJECTIVES

1. Analyze the research lines of the various programs and build a map of doctoral research in Spain with the support of coordinators, tutors / thesis supervisors, doctoral students and young doctors in the disciplines related to Architecture and their related areas.
2. To know the status of doctoral theses in progress or defended in the last three years, selected by means of a call with blind peer evaluation of the doctoral programs participating in the congress.
3. Discuss the structure and university management of doctoral programs in relation to employment challenges, collaboration with the productive sector and national research programs.
4. Exchange experiences with other international doctoral research programs on international mobility management, theses with international mention, co-supervised theses, theses with industrial mentions, etc.
5. No less important, consolidate a national and international network of Doctoral Programs related to Architecture, Urban Planning, Heritage, Landscape, Technologies and related disciplines.



FORMAT

Thematic tables

The thematic tables are places to present the methodologies and experiences of young doctors and doctoral students from different universities. They are managed by the doctorate students themselves, who generate conclusions to be debated and reworked in the final plenary session. The sessions are developed simultaneously with the presentation of the papers selected in the call, organized in four areas or thematic lines:

1. Architectural technologies
2. Housing, city and territory
3. Heritage and Rehabilitation
4. Analysis and advanced projects

Workshop

The workshop of the Congress is oriented towards the analysis of the problems and management needs of the Doctorate Programs, with the objective of arriving at conclusions that may be useful to the Universities involved. The coordinators of the Doctorate in Architecture programs and the doctoral students' representatives will participate in the workshop. The following are topics for debate: lines of research, methodologies, organizational needs of the doctoral programs, the International Doctorate and the Industrial Doctorate, and the future of doctoral research.

Plenary Sessions

The plenary sessions are held at the beginning and end of the Congress. In the first session of welcome and introduction to the Congress, researchers from the national and international scene and the coordinators of the doctorate programs are invited to participate. In the second plenary session an open debate is proposed for the going over of the proposals drawn from the workshop and the thematic tables. It also serves as a closing ceremony with the presentation of the final conclusions of the 2017 IDA_Sevilla Congress.

OBJETIVOS

1. Analizar las líneas de investigación de los diversos programas y construir el mapa de la investigación doctoral en España con el apoyo de los coordinadores, los tutores/directores de tesis, los doctorandos y los jóvenes doctores en las disciplinas relacionadas con la Arquitectura y sus áreas afines.
2. Conocer el estado de las tesis doctorales en marcha o defendidas en los últimos tres años, seleccionadas por medio de una *call* con evaluadores por pares ciegos de los programas de doctorado participantes en el congreso.
3. Debatir sobre la estructura y la gestión universitaria de los programas de doctorado en relación con los retos de empleo, colaboración con el sector productivo y los programas nacionales de investigación.
4. Intercambiar experiencias con otros programas de investigación doctoral a escala internacional sobre gestión de la movilidad internacional, tesis con mención internacional, tesis en cotutela, tesis con mención industrial, etc.
5. No menos importante, consolidar una red nacional e internacional de Programas de Doctorado relacionados con la Arquitectura, la Urbanística, el Patrimonio, el Paisaje, las Tecnologías y sus disciplinas afines.



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A STUDY OF THE ESSENTIAL CHARACTERISTICS OF A GLOBAL DANCE FLOOR SYSTEM

Turiel, Claudia ⁽¹⁾; García-Santos, Alfonso ⁽²⁾

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Abstract: To date, no single, global solution has been found for floors intended for dance. This is due both to the difficulty, since the floor has to meet many different needs for each type of dance, and to the lack of research in this specific direction.

Solutions to people's real problems can be given through research in architecture, especially when those problems originate from the interaction between people and their environment. But it is also especially appropriate when the problem has many different facets, which have to be examined in an integral way to give a solution that combines them, as in the present case.

The general objective of this research is to accurately define the characteristics required for a global dance floor, so as to improve the health and working conditions of the dancers. In order to do this, the question will be examined from three points of view: (I) the study of the floor/dancer interaction from a medical perspective, (II) the study of the regulations currently applicable (which do not contemplate the specific needs of dance), and (III) the study of current dance floor systems (including their assessment by professionals). It will be the combination of these three lines of analysis that will lead to the definition of the characteristics of a truly global solution.

From the outset it can be assumed that this system has to have basic characteristics that respond to the general needs common to all dances (predictably resolved with the structural basis of the floor system), and variable characteristics, controllable by the user, that conform to the specific and incompatible requirements of each dance (predictably resolved in the superficial section of the system).

Keywords: Floors, Dance, Regulations, Architecture, Research.

1. Introduction

Due to the difficulty of the question and the lack of research in this specific direction, there is currently no single solution for floors intended for dance.

The floor has to meet many different needs for each type of dance. For this reason, the current solutions are focused on meeting the specific needs of a discipline in a specific situation instead of looking for a global solution.

To quote the text "La interacción entre los profesionales escénicos y el pavimento" (Danza-T 2011):

According to the collected comments, there is no ideal floor. While a discipline such as ballet needs a floor with moderate flexibility and high adherence, flamenco requires a higher degree of damping and rebound, within a medium hardness; [...].¹

On the one hand, no specific values have been defined for the properties required of a dance floor. The currently applicable regulations refer to "multi-sport indoor floors" and do not address the specific needs of dance (DIN 18032-2 and UNE-EN 14904).

On the other hand, the problems that the inadequacy of the floor pose for the dancers in terms of their health have been widely researched (Werter 1985; Seals 1986; Hopper 2011; Wanke 2012; Wanke 2017), but no research line has been followed to provide a comprehensive solution to these problems.

¹ Authors' translation. Original: "No existe, de acuerdo con los discursos recogidos, un suelo ideal. Donde una disciplina como el ballet clásico necesita un suelo con una flexibilidad moderada y una alta adherencia, el flamenco necesita un grado de amortiguación y rebote mayor, dentro de una dureza media; [...]."

And, as already mentioned, the multiple systems that exist on the market try to meet the needs of specific groups in the world of dance by being very specialized for each dance and situation, and therefore very piecemeal.

We are, therefore, faced with a problem that affects a whole collective of professionals in society but has not yet been approached in a global way.

2. Objectives and method

The general objective of the research is to precisely define the characteristics required for a global dance floor that responds adequately to the needs of all disciplines of dance, thereby improving the health and working conditions of the social collective of dancers, as well as the quality of the artistic performances. The specific objectives that derive from the main objective can be summarized in determining and prioritizing the needs (both technical and perceptive) which the floor must meet for each category of dance, to relate and contrast the needs of different dances and, thereby, to determine the conditions that a global floor must fulfill. As a possible annex, propose a system that meets those needs.

The method used is specified below:

The first stage of the research is the choice of dances that serve as samples, dances that encompass the others in terms of their requirements, in order to have concrete objects of study.

Each type of dance differs from others in execution, demands of the activity, footwear, etc. These differences are more pronounced in some aspects than in others in each type of dance, so that it is possible to determine the truly defining characteristics of each one, from the point of view of the floor/dancer interaction.

Once the defining characteristics of each dance have been selected, the different modalities are compared and those whose characteristics define limits that easily encompass the others are selected. That is to say, those dances are chosen whose characteristics are capable of generating the framework to encompass all the necessities that a floor has to meet (both the general requirements valid for all of them and the specific requirements of each one).

Therefore, as a first step, the types of interaction that occur between the floor and the dancer during the performance of the dance are defined, from the point of view of the dancer's actions on the floor (excluding at this stage the analysis of the types of floors).

Table 1. Types of floor/dancer interaction

	Interaction	Description
T1	Support	Keeping a static position on the floor
T2	Impulse	With elevation, in jumps, or without elevation
T3	Impact	Falling, landing after jumps etc.
T4	Percussion	Using the floor as an instrument to generate sounds
T5	Walk	Walking
T6	Turn	Rotating, pivoting on one point of the body that is in contact with the floor
T7	Slide	Sliding the entire body or some part of it along the surface of the floor (non-rotational)
T8	Roll	Moving along the floor in a rolling fashion

As a second step, the elements that intervene in this interaction are defined and characterized: the dancer and the place/environment in which the interaction takes place.

These elements, in turn, are classified in relation to the different types of dance in:

- Common elements: those that appear in different disciplines, and whose characteristics include those of other dances that also include such elements.
- Differentiating elements: those that belong to a single specific discipline or to a limited set of related disciplines.
- Mixed differentiating elements: a particularly relevant and characteristic combination between a type of interaction and an element, typical of a single specific discipline or a limited set of related disciplines.

Subsequently, the conditions that must be met in order for the dance under analysis to be considered a sample dance are defined. They are the following:

- L1: Extreme physical requirements that imply the need for a floor with concrete and very specific characteristics.
- L2: Common use of a differentiating or mixed differentiating element.
- L3: Common, and for some concrete reason, characteristic use of one of the types of interaction.

According to these criteria, four dance modalities are selected as the so called “sample dances” of this study: classical ballet (meets the conditions L1 and L2: pointe shoes), contemporary dance (meets the conditions L1, L2: mixed differentiating element, and L3: T8), flamenco (L2: flamenco shoe, and L3: T4) and tango within social dances (L2: social dance shoe and indoor social dance hall).

Having established these bases, the research is being carried out following three lines of study that will be combined later to give a truly global and comprehensive answer to the present question.

These lines are (I) the analysis of the medical studies that deal with the interaction between the floor and the dancer, (II) the study of the currently applicable regulations, and (III) the study of current floor systems and their valuation on the part of dance professionals.

The relationship between the dancer and the floor from the dancer's point of view is analyzed through dance medicine, especially studies dealing with injuries of dance performers caused by external agents, including the floor.

The floor/dancer interaction will be analyzed from the point of view of the floor through a critical study of the applicable regulations and current dance floor systems.

These analyses will be supplemented with the testimony and opinions of different professionals in the field of dance in relation to the current floor systems of common use, which will be collected through interviews and surveys.

The three lines of analysis mentioned above will be applied not only to dance in general, but also to each of the sample dances specifically. In this way, it will be possible to determine the specific needs of each group which the floor has to meet.

Once the needs of each of the sample dances in relation to the floor have been classified and hierarchized from the three points of view mentioned above, these needs will be translated into characteristics that the floor has to present.

Once the above analyses have been finished, the data pertaining to the different dances will be compared in order to find correspondences, similarities and incompatibilities that exist between them. In this way it will be possible to determine which characteristics of a global dance floor must be constant and which must be adjustable by the user, being necessary for each dance but incompatible between them.

On the other hand, already in this initial phase of the research the possibility is being considered of including an annex with a first proposal of a system that would present a concrete technical solution to the problem of a global dance floor.

Depending on how the research progresses, this annex will be more or less extensive, possibly being limited to a proposal of a future line of research.

3. Discussion and results

The decision to follow three different lines of study is due to the fact that the problem that is presented is not one-sided, thus, it cannot be addressed from a single standpoint but requires a multifaceted approach that makes possible a global comprehension. It is not possible to attempt to find a solution to the problem of a global dance floor without an integrative vision of the needs which it has to meet.

The lack of a global dance floor represents a serious problem for this sector for different reasons, from the most urgent, concerning the health of the dancers, to the difficulty of maintaining the dance venues and the renunciation of artistic needs, in order to facilitate the performance logistics.

On the one hand, there is the question of inadequacy: a multitude of floor solutions that are currently used, both in rehearsal studios and stages, are not intended for dancing, which is why their characteristics, such as shock absorption, friction, and even the horizontality of the surface (Wanke 2017), are insufficient or inadequate, producing different kinds of injuries (Román 2009). From, for example, metatarsal injuries due to lack of shock absorption and lower back injuries due to wear of the non-slip layer of the floor to the rupture of patellar ligaments due to excessively adherent floors (Danza-T 2011).

On the other hand, there is the question of the variability of the surfaces on which one dances (Wanke 2017). This variation of surface type from one dance venue to another is due to a number of reasons, for example, the fact that, as there is no regulation specifically concerning dance floors, each owner has a great freedom of choice. Also, performance spaces, such as theaters, are shared by many other types of artists and are not exclusive to dance. Another factor is that neither the employers nor the professionals themselves give due importance to the adequacy of the work environment of the dancers (for various reasons, including the high demands and competitiveness of the sector, there is no culture of occupational safety; neither having it, expecting it nor demanding it) (Román 2009; Danza-T 2011).

Neither should it be forgotten that the current dance floor systems are designed for a single discipline, or a few related ones, making them very specialized and different from each other.

Therefore, it is difficult to find dance venues that actually meet the minimum acceptable conditions for dancing, and even when acceptable dance floors are installed the options available on the market are extremely diverse and usually vary greatly from one venue to another.

The fact that the surfaces used for dancing do not exhibit the same characteristics, not even within the same discipline, means that the risk of injury to the dancers increases considerably (Werter 1985; Seals 1986). It should be noted that dance is a very demanding activity and requires a lot of rehearsal. The body learns, memorizes, the response to certain floor conditions to be able to perform the movements; when these conditions change, the body has to re-adapt and modify its movement patterns. The bigger and more abrupt the change, the less reaction time the body has and the easier it is to make a movement that endangers one's health.

This ties in to another very important and widespread problem: the lack of homogeneity in the behavior of dance floors. It could be said that the reasons why this is dangerous are very similar to those pertaining to the variability of the surfaces, but as the change of response of the floor is much more abrupt and immediate, within one dance, the risk of injuries is much greater.

Among the reasons for this problem one commonly finds, for instance, the non-homogeneous wear of the superficial layer with anti-slip treatment and the lack of homogeneity in terms of flexibility and shock absorption, but also problems with joints, and not merely the aforementioned wear and tear, but actual breakage of the floor.

All this proves the need to embark upon the search for the characteristics of a single, global floor for all types of dance. This is neither more nor less than the search for a sufficiently broad but concrete basis for the normalization of one of the key elements in the environment of the execution of such a widespread activity in society as is dancing.

3.1. Lines of study

The following three lines of study have been chosen because each one takes into account different but key aspects of the question: technical characteristics of the floor itself and the environment, perceptual aspects, questions of use, health requirements etc.

(I) The most common approach to the question of dance floors has been the one concerned with dancers' health.

Numerous studies deal with the incidence of different types of factors in injuries to dancers, both professionals and students. They distinguish between internal and external risk factors. The floor appears as the most important of the latter.

There are studies that specifically focus on analyzing the floor as a risk factor in dance injuries (Werter 1985; Seals 1986; Hopper 2011; Wanke 2012; Wanke 2017).

Wanke (2012) points to the floor as the cause of 12.8% of all acute injuries (in his research on the floor as a cause of injuries in student and professional dancers in Berlin theaters during 17 years).

Already in his 1985 work, Werter focuses on two basic floor characteristics that most affect injuries in dance: resilience and traction. The majority of studies that have been carried out since maintain these two characteristics as the most important ones, but focus on dealing with the issue of shock absorption, and there is a great lack of more precise scientific research analyzing the influence of the traction of the surfaces on the health of the dancers.

On the other hand, issues related to the floor, that may influence the well-being and health of the dancers, but which fall outside the definition of injury, are overlooked in almost all research. An example

of this are the burns that occur with some frequency in the skin of the upper limbs of contemporary dancers because of their continuous friction with the floor.

The vast majority of these studies have several limitations when it comes to their usefulness as a tool in the search for a solution to the health problems they point out.

The fundamental problem is the lack of homogeneity in the research criteria (including, for example, the definition of "injury"), which makes it impossible to compare results in the majority of cases (Milan 1994; Liederbach and Richardson 2007; Baker 2010; Liederbach et al. 2012).

The works are mostly focused on a single type of dance, the most widely studied being classical ballet (Milan 1994; Nilsson 2001; Byhring 2002; Balding 2004; Sobrino 2014), while literature on disciplines such as ballroom dancing is far from extensive (McCabe 2013), which makes it probable that new studies or extensions of prior research will have to be carried out as this study progresses. Furthermore, there is a great shortage of research with an appropriate design to find causal relations in the medical problems that are analyzed (Milan 1994).

(II) On the other hand, by reviewing the applicable regulations, we find that the standards for dance floors currently in force are DIN 18032-2 and UNE-EN 14904. These regulations pertain to sports floors, and the chapter applicable to dance floors is that on multi-sport indoor floors.

In dance, unlike sports with greater social impact, there are no specific studies that are reflected in agreed norms on the characteristics required of the spaces in which dance is practiced. Thus, the standards to be met by floor manufacturers are imprecise and do not meet the special requirements of dance (Wanke 2017).

Dance is an activity with a very high level of physical exigency, perfectly comparable to that of elite athletes in its professional aspect (Koutedakis 2004; Russell 2013). That is why it is striking that the conditions under which it is to be practiced have not been regularized.

In this line of study, the analysis will not only focus on the wide ranges of values that are stipulated for the characteristics that are currently required of dance floors, but will also take into account the norms that pertain to sports that might be similar to dance in some respects, with the goal of specifying a more concrete basis for the requirements that should be made of a dance floor.

These data will, furthermore, be combined with the normative requirements of the spaces in which the activity of the dancers is commonly practiced, so as not to incur in incompatibilities when determining the characteristics of the floors.

(III) The other line of study fundamental to the research is to analyze the systems that are being used as dance floors.

This implies first researching the solutions that have been proposed over time up to the present ones, understanding the determining factors that led to their selection over other possible options (Seals 1983; Werter 1985; Hopper 2011; Wanke 2012).

In this respect, we find that the solution currently given to the problem of the variability and inadequacy of dance floors is to install portable floors: systems or floors that are placed over the existing surface at the performance location or even in training centers where the owners do not want to take the risk of investing in a fixed system.

These systems usually consist of a substructure or base, and a surface placed on top of it to adjust the superficial properties, as can be seen in Figure 1.

Liberty Portable (Stage) Panels

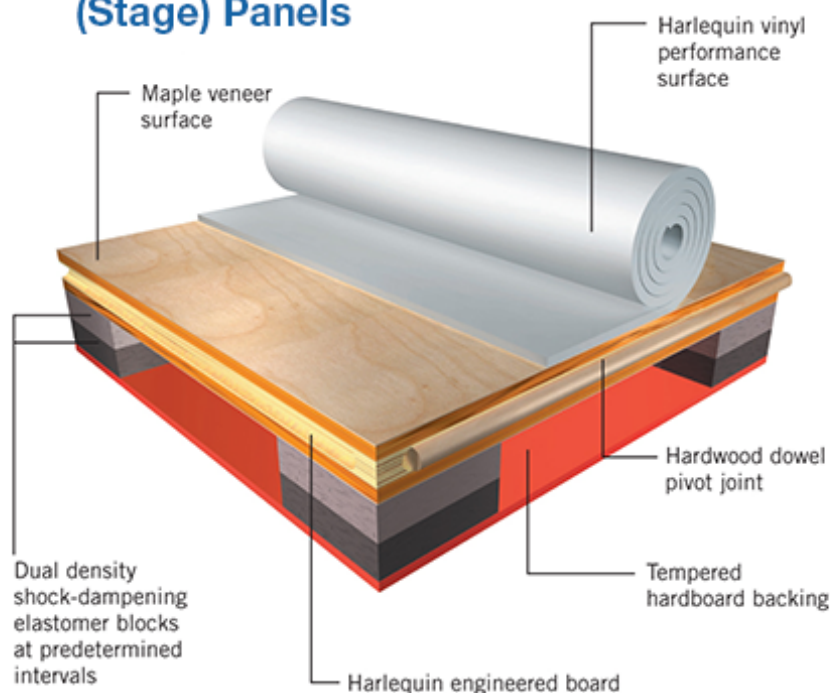


Fig. 1 Example of a portable dance floor system: Harlequin Liberty™ <http://us.harlequinfloors.com/> (accessed 10 Sep 2017)

This solution, however, is partial and not definitive. Each of the portable floors is still specific to only one type of dance. This implies that its characteristics respond perfectly to the demands of one discipline but are inadequate for others.

And given the need to store the systems that are not in use at the time, and their current price, it becomes unfeasible for the members of the sector and venue owners to have different floors at their disposal that can be changed according to the needs of every moment.

But even if an assortment of dance floors could be available, both interdisciplinary companies (in which dancers of different styles may be dancing at the same time in the same space) and schools (where different classes are usually taught in the same rooms) as well as social dance venues, are still faced with the same problem as with specialized fixed floors.

This analysis of what exists now and has existed before will provide a basis for continued research, the state of the art. But if all of this research is combined with the assessment of renowned dance professionals, it will become clear in which direction the sector needs to progress; a deeper understanding of the problems that the current systems present, but also of those of their characteristics that are adequate and of the reasons behind that.

As a reference for this line one can cite the doctoral thesis "Dance injury rates, perceptions and landing mechanics on dance floors with varied mechanical properties" (Hopper 2011). In it, the author compares injury rates in a professional ballet company with the mechanical properties of the floors they normally use, the perception of professional dancers and students of a variety of floors whose mechanical properties also were determined, and the landing mechanisms of the dancers (with the focus on the ankle) on different previously characterized surfaces. The combination of very specific and precise technical studies on the characteristics of the floors with the studies on the dancers' perception of the same surfaces makes this thesis a fundamental reference. It has, however, certain limitations as it focuses so specifically on issues of shock absorption and works only with classical ballet dancers.

Another study that deserves to be mentioned here is "La Interacción entre los profesionales escénicos y el pavimento. Una aproximación sociológica y prevencionista" (Danza T 2010-2011). This work collects testimonials from dance professionals about their work environment and combines them with a medical approach to the most frequent injuries caused by inadequate floors. The authors thus are able to compile tables in which inadequate floor types are linked to the typical injuries that they produce for each type of dance.

The study also shows the professionals' perception of their work environment and how the world of dance tends to mishandle the question of providing good working conditions for the dancers, specifically in relation to the floors.

All these data are of great interest for the present research, not only in the evaluation of the current systems by the professionals, but also because they put this assessment in relation to the line of study of dance medicine.

It can be seen that this line of research is perhaps the most complex, because it handles data and information of a multidisciplinary nature and is, from the outset, combined with issues that are also addressed in the other two lines of study.

4. Conclusions

The main objective of this research is to define the requirements for a global dance floor system.

It may be assumed at the outset that such a system must have basic characteristics, which meet the general needs common to all dances, and varying characteristics, controllable by the user, that meet the specific and incompatible requirements of each specific dance. The general needs can be expected to be met with the structural basis of the floor system, while it is reasonable to assume that the variable ones are met in the surface section of the system.

With this research, it will be possible, in the first place, to provide a concrete basis for the solution of the serious health problem of the dance collective due to the inadequacy of the floors.

Similarly, to open the way of technical/architectural research in this field and lay a first scientific basis of study that will help improve the working conditions of a sector of society that has always been overlooked in these issues.

In addition, to reinforce the role of architecture as the most appropriate means of research to deal with problems that involve the combination of purely technical issues with perceptual, social and environmental issues (where interdisciplinarity and the global and general view are fundamental issues).

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