ENVIRONMENTAL CONDITIONS VERIFICATION IN FACILITIES DESIGNED FOR NEW DEVELOPED PRE-SCHOOL LEVEL BUILDINGS IN THE EDUCATIONAL SECTOR IN HERMOSILLO, SONORA DURING 2007-2008.

Francis María Quintero Díaz[1], Manuel Sandoval Delgado[1]

[1]Departamento de Investigación y Posgrado
Instituto Tecnológico de Hermosillo.
Ave. Tecnológico y Periférico Poniente S/N Colonia Sahuaro.
Hermosillo, Sonora 83170

Corresponding author's e-mail: francis_mquinterod@hotmail.com, msandoval@ith.mx

RESUMEN: Alrededor de todo el mundo, en el seno de toda clase de comunidades, con independencia de condiciones económicas, u otras características físicas, existen escuelas en condiciones precarias que se constituyen en barreras, a veces infranqueables, para que tanto los estudiantes, como profesores y personal técnico y administrativo desarrollen sus actividades normales dentro de los planteles con éxito. Tales condiciones pueden ser los niveles de ruido, iluminación, temperatura y ventilación a los que están expuestos diariamente, es por eso que hace dos años en la ciudad de Hermosillo sonora se empezaron a construir escuelas de nivel preescolar diseñadas para que estas condiciones no afecten las actividades de las personas que laboran en ellas.

El propósito de esta investigación es realizar un estudio comparativo entre la normatividad correspondiente que rige el diseño y construcción del salón de clases donde laboran los niños y el personal de las instalaciones de los edificios de nueva creación del nivel preescolar en el sector educativo, en cuanto a medio ambiente se refiere; tales como ruido, iluminación y temperatura, con los parámetros realmente encontrados en dichas instalaciones.

ABSTRACT: Around the world, within all kind of communities, regardless of the economic condition or any other physical characteristic there are schools in such poor conditions that create, sometimes insurmountable, barriers for students, teachers, as well as technical and administrative staff to successfully develop their diary activities within school. Such conditions are related with: noise level, lighting, temperature and ventilation which users are daily exposed to. As a response to this situation, the pre-school level facilities that were designed so that the environmental

conditions could not affect the daily activities of their users, started to be constructed two years ago in Hermosillo Sonora.

The aim of this research is compare the corresponding regulations ruling the design and construction of classroom where children work and the personnel of pre-school level new facilities in the educational sector in terms of environment such as: noise, light and temperature with parameters actually found in these facilities.

1. INTRODUCTION

From the very moment of our birth we find ourselves immerse in a physical environment essential for life; however, if that environment degrades, it might become an enemy of our health that would chase us until the end (González, 1990).

According to the Instituto de Infraestructura Física Educativa (INIFED) (*Institute of Educational Physical Infrastructure*), the classroom is where children and young people can reach through knowledge a great number of better opportunities; therefore, it is necessary that all Mexican students have access to quality education and schools that inspire and motivate the learning (INIFED, 2008).

2. OBJECTIVE

Decide if the design of facilities for new developed pre-school level buildings in the educational sector meets criteria established by the official standards regarding the design of the working environment (noise, lighting, temperature and ventilation).

3. METHODOLOGY

The methodology carried out in this research is accordance with the Official Standards ruling the design of working environment, such as:

3.1 Federal Regulation of Security, Hygiene, and Working Environment.

This regulation establishes the necessary measures to prevent accidents and illness of work, trying to get the work done under safe, health and appropriate environmental conditions for workers, in accordance with the Federal Labor Law and the International Trade held and ratified by the United Mexican States related to these matters (Federal Regulation of Security, Hygiene, and Working Environment), (1997)

3.2 Mexican Official Standards.

3.2.1 Mexican Official Standard NOM-011-STPS-2001, security and health conditions in workplaces where noise is produced.

Data collected in Appendix B evaluation of the level of exposure to noise tells the following:

To evaluate noise in a permanent workplace the previous rule recommends that measuring spot must be located in the place the worker usually takes (in this particular case, the child) otherwise, as close as possible to it without hinder his/her work. In the same way, when a person works seated, the microphone has to be placed at the workers head average level. Measurements were taken as recommended.
Measurements were taken to the following conditions:

- ✓ Children singing.
- ✓ Children performing current activities (NOM-011-STPS-2001), (1994).

3.2.2 Mexican Official Standard NOM-015-STPS-1994, regarding to the labor exposure of high or low thermal conditions in workplaces.

This rule makes some recommendations to take measurements, among them:

- ✓ The position of the measuring spots depends on needs and characteristic of each area and/or workplace. In this case, measurements were taken in the classroom central spot.
- ✓ The height of the measurement equipment was set in accordance with the height of the children's work area (table): 60 cm.

- ✓ The evaluation must be made at least three times during the 8 hour working day. Since children work day lasts 3 hours, it was decided to take measurements every hour, starting from the time they get in until the time they get of (NOM-015-STPS-1994), (1994).

3.2.3 The Mexican Official Standard NOM-025-STPS-1999, lighting conditions in workplaces.

The following activities were carried out according to law recommendations mentioned before:

- ✓ Workplace reconnaissance.
- ✓ Since sunlight and electric light are used, both conditions' measurements were taken. For the electric light, lamps were turned on 20 minutes before.
- ✓ Measurement spots were set in accordance with the working area by the following formula:

$$IC = \frac{(x)(y)}{h(x+y)}$$

Where:

$IC =$ Working area index/rate.

$x, y =$ Working area dimensions (length and width) in meters.

$h =$ Lamps height regarding the working surface, in meters.

In this case: $x = 8, y = 6, h = 2.89$

$$IC = \frac{(8)(6)}{2.89(8+6)} = \frac{48}{40.46} = 1.18635$$

The number above is placed in the following table:

Table 1. Proportion between the working area index and the number of measurement areas

Index of area	Minimum number of areas to be evaluated	Number of areas to be considered by the limitation
$IC = 1$	4	6
$1 \leq IC < 2$	9	12

$2 \leq IC < 3$	16	20
$3 \leq IC$	25	30

Therefore, 9 areas were evaluated. Once the measurements were obtained, the % of Reflection Factor was calculated (to compare information later on) by the following method:

Measurement spots must be the same as those set in the previous item.

Calculation of the surface's reflection factor:

1. A first measurement (E1) is taken, with the luxmeter's photocell facing the surface, at 10 cm ± 2 cm distance, until the reading remains constant;
2. In order to measure the incident light, the second measurement (E2) is taken with the photocell on the surface facing the opposite direction;
3. The surface Reflection Factor (Kf) is calculated with the following equation:

$$K_f = \frac{E_1}{E_1}(100) \qquad (2)$$

(NOM-025-STPS-1999), (1999).

3.3 Instituto Nacional de la Infraestructura Física Educativa (INIFED). (Institute of Educational Physical Infrastructure) The INIFED (2009) is the organization of the Federal Public Administration responsible for the construction, restoration, maintenance and equipment of the national educational physical infrastructure. It is important to mention that this institution does not say how to take measurements, it only provides parameters that must be met regarding the working environment; in addition to that it is based on the Mexican Official Standards.

4. RESULTS

Results shown below were collected in three classrooms during summer time.

4.1 Noise:

Table 2. Results of the Noise Factor's (Lux) measurements.

	1		2		3	
	Max	Min	Max	Min	Max	Min
Children singing	89	47.5	85	51.3	86.4	45.6
Current activity	87.5	43.8	75.6	42.6	8	43.8

4.2 Temperature.

Table 3. Result of the Temperature Factor's (Lux) measurements.

		1	2	3
09:30 a.m.	Min	24.5	22.8	24.7
	Average	25.9	24.8	26.6
	Max	27.3	26.7	28.4
10:30 a.m.	Min	28.9	28.4	29.8
	Average	29.5	29	29.7
	Max	30.2	29.7	29.7
11:30 a.m.	Min	33.3	32.4	34.2
	Average	33.7	33.2	34.7
	Max	34.1	34	35.2

4.3 Lighting.

Table 4. Results of the Lighting Factor's measurements, classroom 1.

	LIGHTING (Lux)				**% REFLECTION FACTOR**			
	Natural Lighting		Electric Lighting		Natural Lighting		Electric Lighting	
	Max	Min	Max	Min	Max	Min	Max	Min
Classroom								
Measurement #1	264.7	233.3	640	590	40.0075	30.7758	28.5762	27.5937
Measurement #2	534	486	748	716	26.7790	27.8600	29.2647	28.3798
Measurement #3	547	478	947	756	27.7879	30.9205	29.2647	28.8359
Measurement #4	912	892	1285	1234	24.4517	24.0022	25.0405	24.7081
Measurement #5	1113	1070	1389	1373	29.3800	22.6168	26.3570	24.4136
Measurement #6	1181	1139	1439	1434	22.5402	22.8709	23.3009	21.9456
Measurement #7	494	398	918	891	30.6072	26.4070	27.1132	23.1986
Measurement # 8	632	483	980	726	30.8723	26.2456	25.5478	21.6591

Table 5. Results of the Lighting Factor's measurements, classroom 2.

	LIGHTING (Lux)				% REFLECTION FACTOR			
	Natural Lighting		Electric Lighting		Natural Lighting		Electric Lighting	
	Max	Min	Max	Min	Max	Min	Max	Min
Classroom								
Measurement #1	318	299	525	506	32.7044	33.7792	36.1904	36.5612
Measurement #2	347	323	614	607	39.7694	41.7956	32.8990	32.1252
Measurement #3	735	712	651	636	27.4829	26.1235	37.6344	27.9874
Measurement #4	668	654	812	803	38.4730	36.5443	36.8226	33.7484
Measurement #5	597	557	955	814	38.3584	39.1382	42.1989	39.9262
Measurement #6	606	591	787	761	40.4290	32.4873	39.7712	40.3416
Measurement #7	395	347	758	682	40.5063	44.6685	37.2031	39.8826
Measurement # 8	465	446	872	832	38.9247	39.4618	37.2706	30.8894

Table 6. Results of the Lighting Factor's measurements, classroom 3.

	LIGHTING (Lux)				% REFLECTION FACTOR			
	Natural Lighting		Electric Lighting		Natural Lighting		Electric Lighting	
	Max	Min	Max	Min	Max	Min	Max	Min
Classroom								
Measurement #1	290	276	535	518	35.5172	36.5942	35.3271	35.9073
Measurement #2	325	305	624	607	39.3846	43.9344	32.0512	32.1252
Measurement #3	680	677	635	628	29.5588	28.0649	36.2204	27.0700
Measurement #4	670	655	821	807	29.5522	28.5496	35.3227	31.7224
Measurement #5	620	598	859	851	28.8709	26.7558	46.5657	38.0728
Measurement #6	586	580	789	771	29.0102	28.2758	39.5437	39.6887
Measurement #7	405	398	759	682	35.3086	35.4271	36.8906	39.8826
Measurement # 8	486	476	921	897	26.3374	25.8403	35.1791	28.6510

4.4 Ventilation.

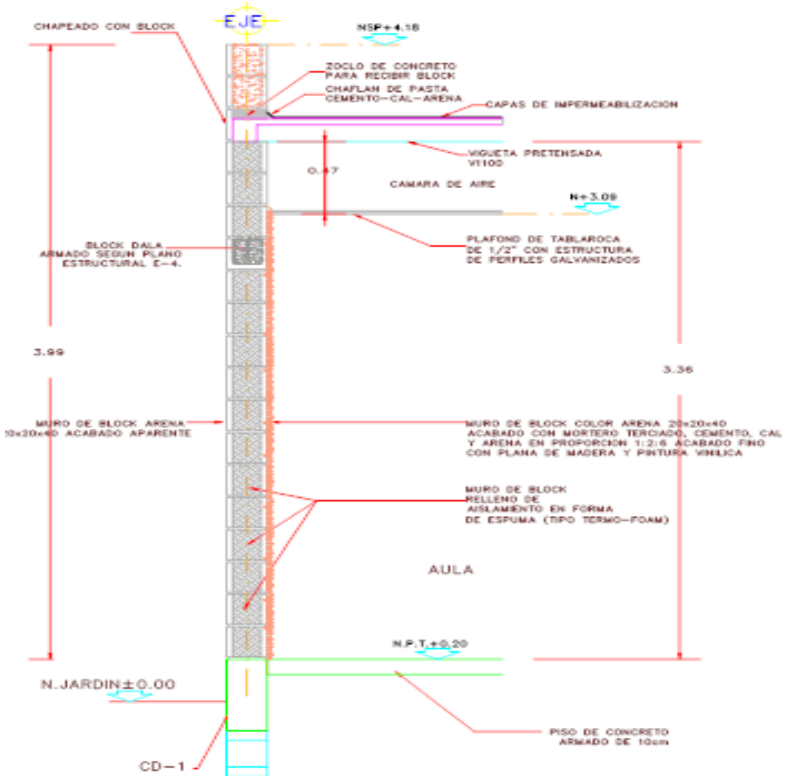

Figure 1. Windows view.

5. CONCLUSIONS.

The Mexican Official Standard number 011 concerning to noise indicates that a hazardous situation occurs when dBs number surpasses 90. In this case the noise did not exceed the limit, at least not when children were there.

The INIFED states that the advisable environmental conditions for working in a comfortable area, in the case of classrooms, are 18 to 25 Celsius, noticing that this condition is not fulfilled since most measurement exceeded 25 Celsius.

According to the prevoiusly analized NOM 025, the lowest lighting level must be 300 (lux) for older people. As is noticed in the prevoius measurements, this parameter is not met, so that we can infer that light is not well distributed. The reflection on the furniture where kids work was another important issue that was evaluated and according to INIFED standards, the reflection highest value should be 50%, and as it is noticed in the previous measurements, does not exceed such level.

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