Malta Insurance Association

Risks in High-Rise Buildings

Report as at January 2009 on Behalf of MIA

dhi PERITI
Architects | Structural, Civil, Municipal Engineers | Valuers | Quantity Surveying Services
6/34, 2nd Floor, Europa Centre, Floriana VLT1400, Malta.
Tel: 356-21233376, 356-21221542 **Fax:** 356-21236444
E-mail: info@dhiperiti.com

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RISKS IN HIGH-RISE BUILDINGS

1.00 INTRODUCTION

Malta appears to have awakened to the symbolic power that radiates from high-rise buildings, which has always been an ideal means of displaying power and influence.

High rise-buildings had become possible with the mass production of iron and steelwork followed by the invention of the lift. Buildings between 25m and 150m are considered high-rise, with buildings over 150m in height classified as skyscrapers. If a storey height averages out at 3.5m, any building above 40 storeys high is considered a skyscraper. Europe's tallest skyscraper is presently being built in Moscow with the Russia Tower at 612m height. The tallest landmark tower is presently Dubai's Burj at 800m, however Kuwait has presently approved a plan to construct a 1,001m tall Burj Mukark Al-Kabir tower, whilst Saudi Arabia has presently unveiled plans for a 1.6km high-rise. On the other hand tall buildings for Malta signify 15 to 35 floors and then perhaps 45 storeys, as noted in MEPA's subsidiary report (Prof Ali).

With the exact definition being immaterial, various bodies have defined high-rise as follows:

The International Conference on Fire Safety in High-Rise Buildings, defined a high-rise as "any structure where the height can have a serious impact on evacuation". This then is based on the height that typical fire-department extension ladders and hose streams can effectively fight a fire. Thus a building with an occupied floor more than 23m above the lowest level of fire-department access is defined as a high rise. Fire fighting in a high-rise assumes that the firefighters must enter the building and go up inside the building to fight a fire.

Insurance has also played an important role in this area of structural engineering. Henry Ford gazing at the New York skyline had once observed, *"Skyscrapers would have been impossible to build without insurance for the obvious risks involved".*

1.01 RISKS TO BE CONSIDERED

This report is to be based on the following risks:

Construction Risks	-	fire, storm, flooding
Completed buildings	-	fire
	-	Windstorms/earthquakes
	-	ground conditions/ tsunami/ Flooding
	-	an awareness on terrorism

these risks are drawn on foreign experiences and then analyzed under the Maltese workmanship, specification, regulatory scenario.

1.02 DEFINING DISASTER RISKS

There are a number of different measures, which can be used to express estimated risk. These include individual mortality rates, societal mortality rates, fatalities per million, loss of life expectancy and death per unit measure of activity.

The setting of tolerability thresholds requires a baseline against which comparisons may be made. Maximum tolerable individual risk is deemed to be 1 in 1,000 workers for voluntary activities involving economic benefits or other profits a higher risk may be considered as acceptable. For somebody subjected to an involuntary or unnatural risk, from which he has no benefits at all, the target is substantially lower at 1 in 10,000 for the public, classified as 'very low' risk. Then for those living close to a nuclear plant or near a transport route of dangerous materials, having no profit whatsoever the target is set at 1 in 100,000. These limits for individual risks are defined as just tolerable and a minimal level below which further action to reduce risks may not be required. Between these levels, it depends on how much safety society really needs and what it is prepared to pay for that level, if society insists.

Table 1 gives the fatal accident rate (FAR), which is a comparison between the level of risk associated in participating in different activities. It is defined as the risk of death per 100 million hours of exposure to the activity. It is approximately the same as the probable number of fatalities from 1000 people working lives, each taken at about 100,000 hours.

A disaster is defined as a sudden low probability event, which when it happens, has such severe consequences in terms of loss, human, material and financial, for a given community that it causes tensions in the social fabric of this community. A disaster is defined if one or more of the following consequences result from one event over a relatively short period of time:

- 10 or more fatalities
- damage costs exceeds $1 million
- 50 or more people evacuated.

Table 1 – Relative risks of death activity

	ACTIVITY	RISK OF DEATH X 10^{-8}H: FAR	CLASSIFICATION OF UNLIKELY RISKS
1	**Plague in London in 1665**	15,000	High
2	**Rock climbing, while on rock face**	4,000	
3	Fireman in London air-raids 1940	1,000	
4	Travel by helicopter	500	
5	Travel by motorcycle and moped	300	
6	Police officer in Northern Ireland, average	70	
7	Workers in high-rise building industry	70	
8	"Tolerable" limit 1 in 1000/yr at work	50	Tolerable
9	Smoking	40	
10	Walking beside a road	20	
11	Offshore oil and gas extraction	20	
12	Travel by air	15	
13	Travel by car	15	
14	Coal mines	8	
15	Average man in 30s from accidents	8	
16	Average man in 30s from diseases	8	
17	Travel by train	5	
18	Constructions, average	5	
19	Metal manufacturing	4	
20	"Tolerable" limit 1 in 10,000/yr near major hazard	1	Very low
21	Travel by bus	1	
22	Accident at home, able-bodies	1	
23	Radon gas natural radiation "action level"	5	
24	"Tolerable" limit 1 in 100,000/year near nuclear plant	0.1	Minimal
25	Radon gas natural radiation, UK average	0.1	
26	Terrorist bomb in London Street	0.1	
27	1 in 1,000,000/year annual risk of death from fire in a home	0.01	Negligible
28	Malta earthquake MM – VII	0.0077	
29	Building falling down	0.002	
30	1 in 100,000,000 annual risk of death from a contaminated land fill (Wood & Grant, 2000[7])	0.0001	Insignificant
31	Malta earthquake MM -VIII	0.00073	

Table 1 gives low FAR value for fire in a home at 0.01 classified as a negligible risk, a Malta earthquake MM-VII is again considered a negligible risk at a FAR of 0.0077, whilst a building falling down even considered a smaller risk at a FAR No of 0.002. A Malta earthquake of MM-VIII is then considered an insignificant risk at a FAR No of 0.00073.

2.00 MEPA ON HIGH-RISE

2.01 MEPA'S DEFINITION OF HIGH RISE

With reference to MEPA's topic paper "A Planning Policy on the Use & Applicability of the Floor Area Ratio (FAR)" October 2006 downloadable from www.mepa.org.mt, defines tall buildings as "a building which is sufficiently higher than the built development in its local context". Significantly higher in the local context is considered to be when the building is more than twice as high as the maximum building height limitation for the locality as established in the Local Plan or more than 10 floors (40m) whichever is the lower, as measured from the lowest street level.

Medium-rise buildings are then defined as those which are higher than the statutory building height limitations but are not determined to be tall as they are equal to or less than twice the statutory building height or 10 floors (40m) whichever is the lower.

Designated locations for tall buildings, which require a minimum site area of 4,000m^2 have been identified in Pembroke (mixed use), Marsa Park & Gzira (office use), Qawra (tourism), Paceville (entertainment, Sliema Town Centre/Tigne (tourism/leisure) and Luqa International Airport with a 35m constraint, as outlined in Appendix A. These areas require that not more than 75% are built upon, the rest being provided as public open space of which at least 40% of this open space being soft landscaped.

In the MEPA Fulbright Sponsored report, drawn up by Prof Ali, it is suggested that there should be less than 6 sites, rather than more, with larger clusters in fewer sites, rather than more sites with smaller clusters.

Prioritisation of 6 proposed sites is than given in this order

Qawra
Gzira
Tigne
Paceville
Pembroke & Marsa

The 1st 2 above sites were chosen on potential for redevelopment & regeneration, close to services and not too close to historical areas.

2.02 PLANNING & HIGH-RISE HISTORY IN MALTA

Although Malta escaped the high-rise building boom for social housing and speculative offices occurring in European countries in the 1950s and 1960s, notable exceptions are the Residential Point Blocks in Qawra and the St George's Park Complex in Paceville.

The Town Planning Schemes of 1988, an updated remnant of the 1960's planning schemes, indicated statutory building heights which varied from one floor in bungalow areas, 2 floors in most urban areas and 4 floors in exceptional cases. However, they included 6 and 8-storey building heights for Sliema and St Julians. In 1993, a revision to the building heights policy allowed an additional floor in areas outside Urban Conservation Areas (UCAs) with a height limitation of 2 floors, subject to certain conditions. In the same areas, together with areas which already had a height limitation of 3 floors, the recent DC2005 permitted an additional setback floor at 3rd floor level. The DC 2007 then allowed a penthouse construction on a building height of 3 floors, instead as previously, allowed over 4 floors.

The control of building heights has been a key tool in Maltese Planning system aimed at controlling town space, the urban form and densities of development within designated urban areas. This tool was introduced in the Town Planning Schemes of the 1960s indicating mostly two Floors above ground level. This has contributed to the present pre-dominantly low-lying compact urban form.

The Structure Plan of 1990 introduced a new tool for control of building heights – namely the floor area ratio (FAR). Although not containing any policy guidance on tall buildings, this policy has now created 5 approved projects, 25 pending development applications and another 10 pre-submission requests with MEPA, with heights varying from 9 to 40 floors, concentrated mostly at Xemxija, Qawra, Sliema and Gzira.

2.03 MEPA'S POLICY ON TALL BUILDINGS

This concerns the evaluation of the relationship to the context, including topography and the urban structure, relationship to infrastructure, especially transport and the effect on the skyline, the architectural quality, the microclimate and the contribution to the public realm. Any tall building proposal must be sustainable, taking into account its environmental, social and economic impacts, based on costs and benefits throughout the whole life of the building.

MEPA recognizes that well-positioned and well-designed buildings:

1. Act as landmarks to help make the form of urban areas legible;
2. Signal the hubs of urban areas or act as gateways;
3. When designed as 1st rate work of architecture, serve as catalysts for regeneration and stimulate further investment.

The above are listed as criteria by MEPA totaling 12 in No, of which **SAFETY** is listed as the last criteria.

The cursory reference to **SAFETY** includes for all buildings *to meet all the current safety requirements related to the structure, fire protection and means of escape for all, especially in the event of an emergency or major accident. MEPA will consult all the relevant agencies to ensure that proposals do not create a safety hazard to any group of users.*

With regards to SAFETY, MEPA has no safety guidelines to be imposed on, but imposes on applicants that the written Design Statement which sets out the rationale for the proposal, its architectural concepts and design philosophy (to be submitted with application), includes for information to demonstrate that safety issues have been fully considered. Thus presently the onus of Safety in High-Rise Buildings rests squarely on the Developer.

The present "Design guidelines on Fire Safety for Buildings in Malta" issued by the Building construction Industry Department (BCID), relates only to buildings of maximum 10 storeys height.

MEPA's Topic Paper has a follow-up with a Fulbright sponsored paper "Urban Deisgn Strategy Report on Tall Buildings in Malta" by Min M Ali. This paper quotes that "Then they must function once built. The structure must be safe and capable of carrying normal and accidental overloads. The fire protection system is very important in tall buildings because of their large number of storeys and the psychological fear of people for being trapped during a fire event. Architectural planning must provide for egress and ease of excavation. Another important requirement is then communication systems that are essential for security and operation of the building.

3.00 PECULIARITIES INHERENT IN HIGH-RISE CONSTRUCTION

The cost of construction and operation of a high-rise building increases exponentially with its height. From the point of construction economy, high-rise buildings are the poorest conceivable solution, from the energy-intense construction and as much as the disproportionately high demolition costs. Exceptionally deep and large foundations require large local batching plants to produce concrete in the volumes and strength required. High-Rise concretes talk in the grade of C100, however do the materials exist to produce a grade of C65? *Salt contamination of the concrete structure can create problems in the future. Concrete is an unforgiving material and quality control during construction is essential. Regulatory control is needed to ensure quality of construction (as noted in MEPA's subsidiary Prof Ali report.* Is the specialist false work, formwork crainage and concrete pumping equipment needed for this construction available although the impression given is that local contractors are fully equipped to deal with these types of constructions. The A3 Paola high-rise construction shell works were completed in 10 months. Steelwork, on the other hand, is noted as being more expensive and requiring more fire safety measures. Moreover, high-rise buildings are made almost exclusively of materials which a construction biologist would take great pains to avoid, namely light metal, plastics and a variety of chemicals.

The framed construction system, together with the complete separation of the outside wall and supporting structure has shifted the main loading problem from that of not being a vertical load capacity dilemma, but the transmission of horizontal wind and earthquake forces poses a more serious hazard. Due to the relatively small area available per floor, fire-resistant elements (fire walls) are usually only to be found in the structurally strong core areas incorporating the elevators, stairwells, service and installation shafts, sanitary and ancillary rooms. A vertical breakdown into fire compartments is mostly obtained with the aid of fire-resistant floor constructions.

A high-rise building does not constitute any extra risk with regard to occurrences of the fire, but it certainly does with regard to the spread of fire, smoke and fumes. This is due to the vertical nature of the building, which greatly promotes the spread of fire in the main propagation direction, namely from the bottom upwards.

Compared with buildings below the limit for a high-rise building – regardless of definition – a high-rise building will always have significant disadvantages when it comes to rescuing people and fighting fires. People cannot be rescued from outside the building if they are trapped on floors out of range of fire ladders; they can only be located and rescued via the stairwells. The same applies to fighting the fire, since outside intervention is impossible. The fireman must concentrate on tackling the fire from inside the building and must make their way to the scene of the fire with their equipment through stairwells filled with smoke and heat. Firemen for greater heights must be trained for fire suppression and evacuation techniques.

High-rise buildings are the farthest removed from the ideal form as regards energy efficiency – namely the sphere, or the cube in the case of houses. That applies to both heating and cooling: some high-rise facades have to be cooled by day and heated by night. A well insulated low-energy house consumes 1/40th of the energy/m^2 than of a High-Rise. The "energy-balance" of High Rise buildings is also poor in the other respects such as the water supply, which usually only operates with the aid of booster pumps, whilst lifts also consume power. For tall buildings, however, there is less power grid loss due to agglomeration.

A water-column in a 300m high building exerts a stagnation pressure of 30 bar, with fittings at lower floors dimensioned accordingly making a major difference in costs. Sanitary dispensing points must be isolated from the building for sound-proofing reasons. Waste chutes are not advisable in high-rise as paper or plastic bags tear open as they fall with considerable noise being generated, with the fire hazard also being great. Standard practice today is to collect the waste separately at each floor and then transfer via the goods lift to a central basement collection point.

The more we know and learn about the harmful effects of modern materials and installation on health, the less probable it becomes that future generations will voluntarily accept this hazard. Acceptable alternatives are to be sought such as emission fire materials, installations, insulating and isolating materials, adhesives and coatings, as well as avoiding the use of chemicals which give off toxic gases in the event of a fire.

The World Trade Centre disaster showed that stair capacity wasn't enough and that some people were physically incapable of descending tens of storeys by stair. So now for tall buildings, lifts are being looked on as integral to the fire evacuation strategy. When high-rise was not more than 20 floors, every elevator led from the entrance level to every other floor in the building. High-rises are now being equipped with combinations of express and local lifts. High-speed lifts moving people over large number of floors can be double-deckers. Passengers then catch local lifts from transition zones to their destined floors. These high-speed lifts stop at sky lobbies normally located between every 30^{th} and 40^{th} floor, but a sky lobby in Taiwan has been located on the 16^{th} floor above a department store. The advantage of these lift systems is that the number of elevator shafts decreases towards the top of the building.

The above peculiarities of High-Rise construction carry with them their irrespective risks. This affects the health and safety issues of the construction sites. Despite its size, a high-rise building is an incredibly sensitive and vulnerable system. Even a brief power failure can result in operational and economic chaos. Lifts in 1852 paved the way for high-rise construction; the greatest horror scenario is not a fire, but a malfunction to the elevator system. The most commonly voiced reservations with regards to high-rise dwells on the social and ecological effect. High-rise apartment blocks are hostile to families and children due to the anonymity suffered by the people in these residential factories. *Communities in Malta are closely knit and tall buildings do not reflect this social context. The residents in tall buildings would have a lot of privacy but would lack intervention. People feel isolated, detached from the ground, and are concerned about security and fire safety. Towers work best for affluent people who are not really concerned about interacting with their neighbours with persons on the higher age groups keen on buying properties in towers.* Then high-rise apartments can rapidly cease to be attractive if compromises are made with regard to the building quality, maintenance or infrastructure due to the high maintenance costs. A building in disrepair will soon drive away the good tenants and become a slum, with the pro-crime environment fostered around the elevators, poorly lit corridors, refuse collection rooms, garages. The recent Paris riots is a case in point.