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Production, Testing and Usage on Synthetic Slings and Round Slings

Authored by: **Mr. Alfred Lam**
Chairman of Hong Kong Professional Hoisting Engineering Association

Edited by: **Ms. Carmen Lam**
Vice-President of HKOSHA

Author's Profile:



Mr. Alfred Lam is the Chairman of Hong Kong Professional Hoisting Engineering Association(2019–2022). He is also the Owner of Mak Kee International H.K. Ltd which is a major importer and exporter of wire rope and lifting gears in Hong Kong. Mak Kee is a licensed fabricator of an innovative super round sling patented as SlingMax which is worldwide distributed for last 20 years. Alfred is also a partner of Gustav-wolf wire rope Manufacturing in Suzhou and Mak Kee is running their branches in Shenzhen, Shanghai, Macau as well as Singapore.

On 8 October 2021, Mr. Lam delivered a presentation at the HKOSHA webinar on Production, Testing and Usage on Synthetic Slings and Round Slings to our members.

Synthetic sling and round sling are becoming more common in lifting because of its features (See Table 1).

Features of Synthetic Sling	Samples of Related Sling		
• Light in weight • Flexibility • Standardization • Economical in cost • Fast in manufacture			
	Webbing Slings	High Performance Slingmax Twin-Path Slings	Round Slings

Table 1: Samples and Features of Synthetic Sling

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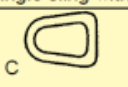
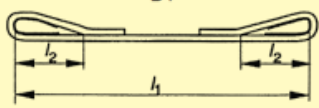
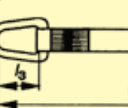
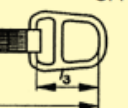
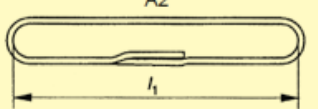
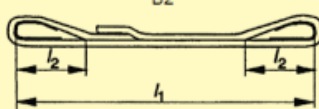
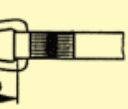
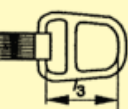
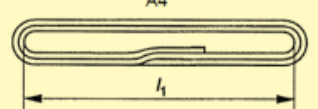
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It is very important to learn about different synthetic materials such as Nylon, Polyester, Polypropylene and HMPE (fibers), etc. as they are not with the same tensile, flexibility and durability.

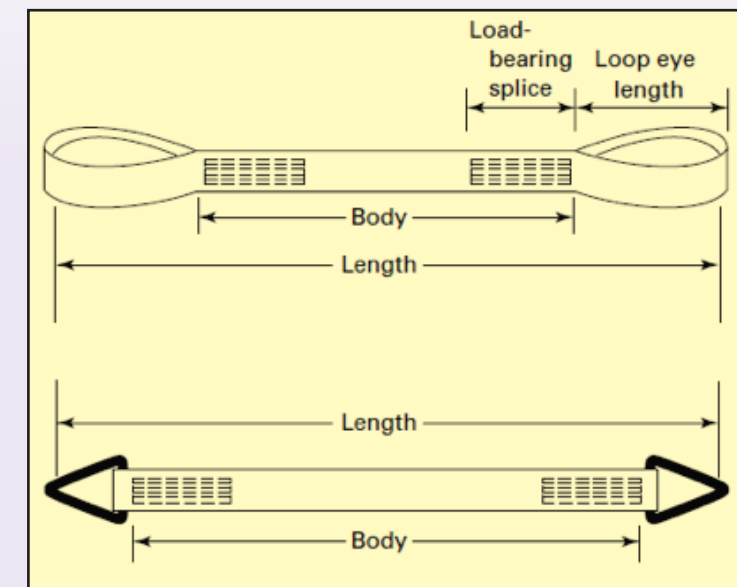
A Comparison of Synthetic Materials for Slings

	K-Spec® Core Yarn	Aramid	HMPE	Polyarylate	Polyester	Nylon
Mechanical Properties						
Tenacity (grams / denier)	31.5	20 – 29	25 – 41	23 – 29	7 – 10	7.5 – 10
Elongation at break %	3.6	1.5 – 4.6	2.5 – 3.9	3.3 – 3.6	12 – 18	15 – 28
Moisture Regain %	0.1	1.5 – 6.5	0.0	0.1	0.5	4.0 – 6.0
Specific Gravity	1.11	1.39 – 1.47	0.97	1.40	1.38	1.14
Creep Resistance	Excellent	Very Good	Fair	Excellent	Good	Fair
Chemical Resistance						
Solvents	Excellent	Excellent	Excellent	Excellent	Good	Good
Acids						
Weak	Excellent	Good	Excellent	Excellent	Good	Fair
Strong	Excellent	Fair	Excellent	Excellent	Fair	Poor
Bases						
Weak	Excellent	Excellent	Excellent	Excellent	Fair	Excellent
Strong	Excellent	Fair	Excellent	Fair	Poor	Excellent
Thermal Properties						
Maximum Temperature	180°F 82°C	300°F 150°C	158°F 70°C	180°F 82°C	194°F 90°C	194°F 90°C

Types of Synthetic Webbing Slings

Form	A - endless	B - single sling with reinforced eyes	C - single sling with fittings Cr - single sling with reeveable fittings
Load bearing webbing parts			 
Single load bearing part		single layer sling with reinforced eyes 	single layer sling with fittings  
Two load bearing parts	single layer sling 	two layer sling with reinforced eyes 	two layer sling with fittings  
Four load bearing parts	two layer sling 		

Synthetic Webbing Sling Nomenclature

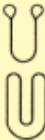


Proof Test Requirements

- Prior to initial use, all synthetic webbing slings incorporating previously used or welded fittings and all repaired slings shall be proof tested by the sling manufacturer or a qualified person.
- All other new synthetic webbing slings and fittings are not required to be proof tested unless specified by the purchaser. (According to ASME B30.9-2014)

Essential Rigging Practices

- The sling shall be hitched in a manner providing control of the load.

WLL of sewn webbing component	Colour of sewn webbing component	Working load limits in tonnes								
		Straight lift	Choked lift	Basket hitch			Two leg sling		Three and four leg slings	
										
				Parallel	$\beta =$ 0 to 45°	$\beta =$ 45° to 60°	$\beta =$ 0 to 45°	$\beta =$ 45° to 60°	$\beta =$ 0 to 45°	$\beta =$ 45° to 60°
		M = 1	M = 0,8	M = 2	M = 1,4	M = 1	M = 1,4	M = 1	M = 2,1	M = 1,5
1,0	Violet	1,0	0,8	2,0	1,4	1,0	1,4	1,0	2,1	1,5
2,0	Green	2,0	1,6	4,0	2,8	2,0	2,8	2,0	4,2	3,0
3,0	Yellow	3,0	2,4	6,0	4,2	3,0	4,2	3,0	6,3	4,5
4,0	Grey	4,0	3,2	8,0	5,6	4,0	5,6	4,0	8,4	6,0
5,0	Red	5,0	4,0	10,0	7,0	5,0	7,0	5,0	10,5	7,5
6,0	Brown	6,0	4,8	12,0	8,4	6,0	8,4	6,0	12,6	9,0
8,0	Blue	8,0	6,4	16,0	11,2	8,0	11,2	8,0	16,8	12,0
10,0	Orange	10,0	8,0	20,0	14,0	10,0	14,0	10,0	21	15,0
Over 10,0	Orange									

M = Mode factor for symmetrical loading. Handling tolerance for slings or parts of slings, indicated as vertical = 6°

M = Mode factor for symmetrical loading. Handling tolerance for slings or parts of slings indicated as vertical $\approx 6^\circ$



- (2) Slings shall be shortened or adjusted only by methods approved by the sling manufacturer.
- (3) Slings shall not be shortened or lengthened by knotting or twisting.
- (4) Slings in contact with edges, corners, protrusions, or abrasive surfaces shall be protected with a material of sufficient strength, thickness and construction to prevent damage.
- (5) Shock loading should be avoided.
- (6) Loads should not be rested on the sling.
- (7) Slings should not be pulled from under a load when the load is resting on the sling.
- (8) Twisting shall be avoided.
- (9) During load handling activities, with or without load, personnel shall be alert for possible snagging.
- (10) When using multiple basket or choker hitches, the load should be rigged to prevent the sling from slipping or sliding along the load.
- (11) When lifting with a basket hitch, the legs of the sling should contain or support the load from the sides, above the centre of gravity, so that the load remains under control.
- (12) Slings should not be dragged on the floor or over an abrasive surface.
- (13) In a choker hitch, the choke point should only be on the sling body, not on a load-bearing splice or fitting.
- (14) Slings should not be constricted, bunched, or pinched by the load, hook, or any fitting.
- (15) The load applied to the hook should be centered in the base (bowl) of the hook to prevent point loading on the hook, unless the hook is designed for point loading.
- (16) An object in the eye of a sling should not be wider than one-third the length of the eye.

Effects of Environment

- (1) Slings should be stored in an area where they will not be subject to mechanical, chemical, or ultraviolet damage or extreme temperatures.
- (2) When extensive exposure to sunlight or ultraviolet light is experienced by nylon or polyester webbing slings, the sling manufacturer should be consulted before use.
- (3) Slings incorporating aluminum fittings shall not be used where fumes, vapors, sprays, mists, or liquids of alkalis or acids are present.

Removal Criteria

A synthetic webbing sling shall be removed from service if any of the following conditions are present:

- (1) Missing or illegible sling identification
- (2) Acid or caustic burns
- (3) Melting or charring of any part of the sling
- (4) Holes, tears, cuts, or snags
- (5) Broken or worn stitching in load-bearing splices
- (6) Excessive abrasive wear
- (7) Knots in any part of the sling
- (8) Discoloration and brittle or stiff areas on any part of the sling, which may mean chemical or ultraviolet/sunlight damage
- (9) Fittings that are pitted, corroded, cracked, bent, twisted, gouged, or broken
- (10) For hooks, removal criteria as stated in ASME B30.10
- (11) For rigging hardware, removal criteria as stated in ASME B30.26
- (12) Other conditions, including visible damage, that cause doubt as to the continued use of the sling

Repair

- (1) Slings shall be repaired only by the sling manufacturer or a qualified person.
- (2) A repaired sling shall be marked to identify the repairing entity.
- (3) There shall be no repairs to a load-bearing splice.

Apart from this, the design and manufacturing methods also make a lot of differences between each type of slings. Users should take more cautions in choosing them and how to protect the sling during usage.

防塵減塵我有計 健康第一沙塵仔



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Digital Transformation for Construction Safety & Health (Part 1)

Authored by: **Mr. Au Ling Ming, Stephen**
Managing Director and founder of MTECH Engineering Company Limited

Author's Profile:



Mr. Au Ling Ming, Stephen is the Managing Director and founder of MTECH Engineering Company Limited since 1995. MTECH is a pioneer to offer leading Product Lifecycle Management (PLM) & Building Information Modelling (BIM) technology for manufacturing and construction industry. MTECH received the Award of Hong Kong Most Valuable Companies - Greater China, Most Innovative Building Engineering and Consulting Services Company in 2017 and several BIM awards from 2015 till now. Mr. Au got the award of Outstanding Hong Kong Polytechnic University Alumni 2017 and China's 2007 Top 100 Innovative Enterprise Leaders in recognition of his distinguished professional accomplishments and significant contributions to the industry and the community.

(Editor's note: Due to page limitation, this article would be published by parts in this and coming Bulletins.)

Abstract:

Today the construction industry has entered into the digital transformation journey including BIM, Digital Works Supervision System, Virtual Reality, IoT and Big Data for productivity, quality and sustainability improvement. Occupational safety & health still sits in the highest concern. There were 16 industrial fatalities in 2019 and 18 in 2020. We foresee the fatalities in 2021 is not optimistic. Traditionally, company safety programs are paper-based and reactive, actions are taken only after a worker is injured. Preventive procedures are not enough to reduce the accidents. In addition, there is no process to receive real-time alert of risky, unsafe condition. With the evolution of digital construction technology, we will discuss how it is applied to do the safety planning, execution, monitoring and training. So proactive steps can be taken before an accident occurs. This is of the utmost importance as reducing accidents is not only the right thing to do to keep workers safe, but also makes better financial sense as well.

1. Safety Culture and Leadership

"Safety culture is a sub-facet of organisational culture, which is thought to affect members' attitudes and behaviour in relation to an organisation's ongoing health and safety performance."⁽¹⁾ The Advisory Committee for Safety in Nuclear Installations, subsequently adopted by the UK Health and Safety Commission (HSC, 1993), defined it as "the product of individual and group values, attitudes, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisation's health & safety programmes".



Figure 1) Construction work in the roadside

Copper⁽²⁾ mentions 3 types of Effective Safety Leadership Styles: Transformational, Transactional and Servant that can improve the safety behaviour, increase employee engagement and create supportive environment as illustrated in Figure 2.

However in Hong Kong, we can easily find quite a lot of construction operations not in compliance with safety regulation and standard. Inspection and reporting are in passive mode.



Figure 2) Safety Culture

2. Safety Management Model

Organizations with a positive safety culture are characterized by communications founded on mutual trust, by shared perceptions of the importance of safety and by confidence in efficacy of preventive measures. There must be a joint commitment in terms of attitudes and values. The workforce must believe that safety measures put in place will be effective and followed even when financial and performance targets may be affected.

Reference to the HSE's model for successful health and safety management, namely POPMAR is shown in Figure 3 (HSE, 2002b).

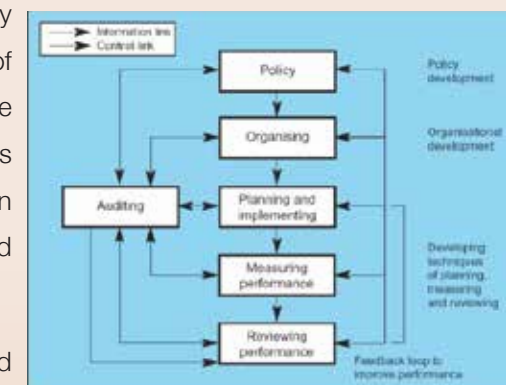


Figure 3) POPMAR – HSE model for successful health & safety management

Safe companies clarify and define desired safety leadership behaviours that can be enacted, reinforced and measured, and document them in a competency matrix linked to activities in their safety management system. Ideally, these defined behaviours include prioritizing safe design, execution, communicating frequently and

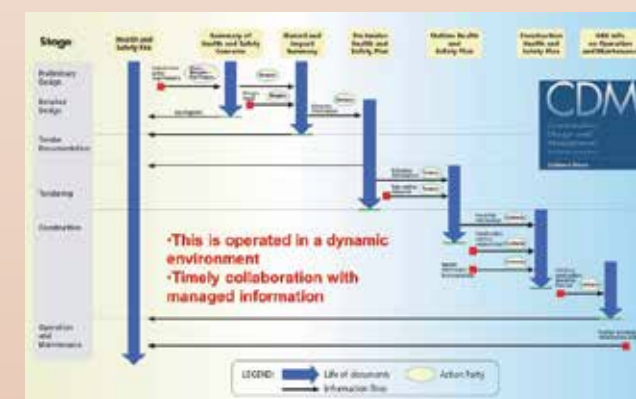


Figure 4) Safety Operation integrated with construction Design and Management (CDM)

regularly on safety in multiple ways; encouraging comprehensive and meaningful employee involvement in safety; helping instant change at-risk behaviours; and following up with employees and resourcing corrective & preventive actions. Once defined, a company should provide high-quality training to ensure that each stakeholder is informed about the company's safety management standard; offer training that targets the defined competencies and operation procedures so that everyone can exhibit the prescribed desired behaviours; and offer ongoing organizational support to enable zero risk. On-site workers must participate as well. For example, management relies on employees to report potential or actual incidents, follow procedures, identify hazards and work safely. Finally the whole operation is integrated with the Construction Design and Management (CDM) to form an integrated and closed loop system as Figure 4, that enable the approach of **Design & Construction For Safety**.

Innovative Design for Safety - Working at Height

Authored by : **Mr. Andy Lo**
Member of HKOSHA Executive Council, MSc, CFIOOSH, RSA, RSO

Author's Profile:



Mr. Andy Lo has accumulated many years of industrial experience which including project management in civil engineering works as well as higher education and training experience in occupational safety and health.

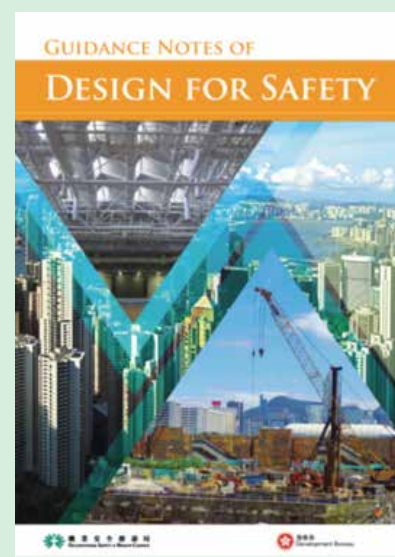
During his prolonged years of service with the MTR Corporation, Andy had attained substantial construction safety management experience which including the implementation of design for safety and constructability. Related nature of works including tunneling construction, bridges and viaducts, railway stations, rolling stocks, and other heavy ventilation plant buildings. The working at height issue remains one of his favorite subjects.

Introduction

Design for Safety is defined as the integration of hazard analyses and risk assessment methods early in the design and engineering stages and taken the actions necessary so that risks of injury or damage are minimized. UK studies reveals that 60% of accidents on construction sites were due to design deficiency and lack of planning. Both Australia and US research revealed that about 37% and 42% of fatalities were probably due to design deficiencies respectively.

Design for Safety

The Development Bureau - Following the review on the experience from overseas suggested that design for safety could help in accident prevention, the Development Bureau of Hong Kong SAR issued a "Guidance Notes of Design for Safety" in 2015. The Development Bureau's approach to design for safety is similar to that of Construction (Design and Management) Regulations (CDM) in the United Kingdom, but in Hong Kong there is greater emphasis on the role and responsibility of the maintenance supervisor.



The key objectives of the Guidance are to promote effective cooperation and communication to all stakeholders; to clarify safety roles and responsibilities of the client, designer, contractor and the maintenance supervisor; and to identify the application process and risk reduction measures. The Guidance involved in the innovative application of buildability, usability and maintainability. It also emphasis the design for safety at different project stages, from preliminary design; risk and cost implication analysis; through to tendering; construction planning; operation and maintenance.

Figure 1) Guidance Notes of Design for Safety

The UK CDM regulations – mainly emphasis on the identification of health and safety at the early stage and throughout the life cycle of the project with timely involvement of relevant stakeholders and provision of necessary health and safety related information. In addition, a clear definition of roles and responsibilities for coordinating and communicating risk-related data at all stages of the project. In the CDM regulations, the commercial client will need to ensure that controls of the risk are adequately addressed in the project and briefed to the designers. The designers in return, will need to understand and aware of significant risks with right skills, knowledge and experience. Health and safety are adequately resourced for the project. Contractors will need to plan and manage health and safety under their control, including to co-operate and communicate with other duty holders and consultation with their employees. In return, employees will need to co-operate with their employers, fellow workers and other duty holders.

In the BS 8560:2012 – "Code of practice for the design of buildings incorporating safe work at height" emphasizes designers to assess, as early as possible in the design process, how work at height could be minimized, and where required the provision of practical, efficient, cost-effective solutions for the safety of those who work at height. A number of practical solutions to work at height such as from the simplest method of using of a long pole for cleaning from ground, use of mobile working platforms, mass climbing working platforms, suspension working platforms to permanently mounted working platforms from roof. Others like the anchor life lines and work restrain system, were elaborated.

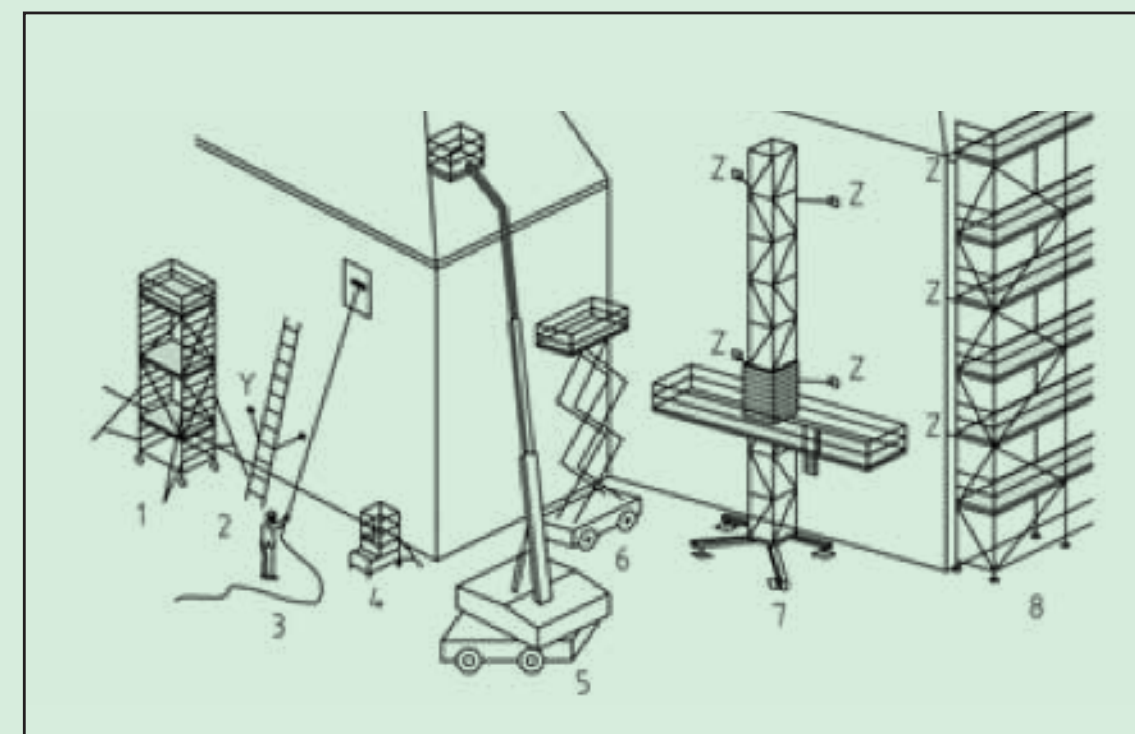


Figure 2) Ground and floor based equipment (Source: BS8560:2012)

From the Housing Authority – a safety workshop on “From Cradle to Cradle – Workshop on Planning and Design for Safety in Project Life Cycle for Public Housing Developments” was held on 31 March 2010. With a charter signed by all signatories pledging commitment to observe and drive planning and design for safety. The document was reviewed in 2017 which was further elaborated on the essentials of using precast units to eliminate the working at height hazards. Examples such as precast facades, precast stairways, floor slabs and even the whole precast kitchen and bathroom.



Guard rails were provided at falling edges for the protection of cleaning workers and other servicemen.

Figure 3) Lifting of Precast Bathroom

The Airport Authority – sets a good example in achieving design for safety concept by using prefabrication and modularization where the roof structures were prefabricated on ground and other E&M piping were modularized on ground before lifting to their final position. Both processes would certainly reduce the risk of being working above ground and hence eliminate the falling risk.



Figure 4) Prefabrication of Roof Structures at Hong Kong International Airport

The Way Forward

Design for safety is new to Hong Kong, without relevant legislation and lack of safety data and reference materials for designers and stakeholders. Hong Kong may need a longer time to enhance design for safety for accident prevention. However, there is a strong belief that design for safety is one of the key elements in enhancing the occupation safety and health for the construction industry.

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HKOSHA NEWS

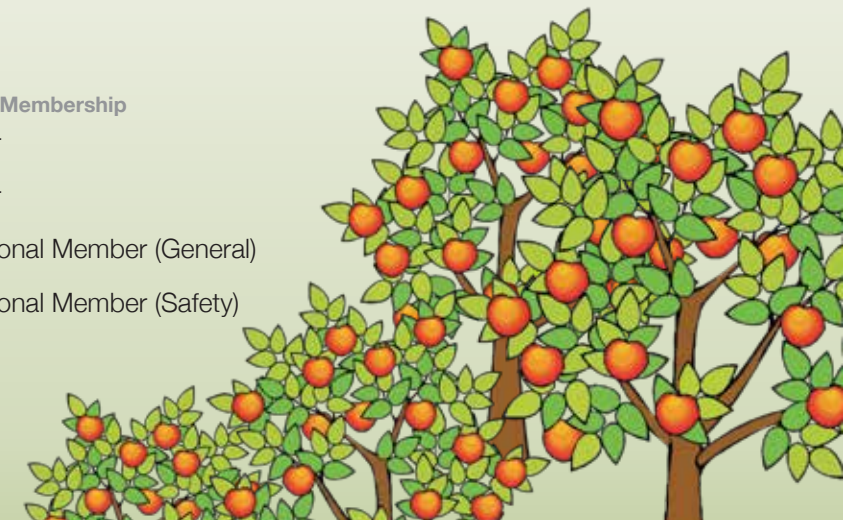
New Members

As of end of October 2021, there are 455 members in HKOSHA.

The following membership applicant were approved in September and October 2021

A. Approval of Membership

Name	Grade of Membership
CHAK Wai Kit	Member
NG Chun Yiu, Hindley	Member
LEE Hoi Chun	Professional Member (General)
TSANG Hiu Lit	Professional Member (Safety)



建造業前線管理人員之職安健領導及溝通技巧

OSH Leadership and Communication Skills for Site Supervision (Construction Industry)

本課程旨在讓建造業前線管理人員能掌握和應用有效的領導及溝通技巧，鼓勵及推動工友合作，在工作時遵守安全要求，減低出現不安全行為的機會，繼而提升工地的安全表現。

課程內容：

1. 建造業前線管理人員在職安健方面的角色與責任
2. 如何作為安全領導者
3. 如何與工友在主持早會、查詢危險行為、鞏固安全行為時溝通
4. 如何應用良好「溝通」、「說服」及「指導」技巧
5. 如何在動態風險評估時推動工友發揮情境意識
6. 個案分享及實習

目標學員： 建造業安全督導員、管工及其他負責管理工地的人員
授課期： 共須上課7小時 (完成課程可獲「認可安全督導員(建造業)」專業進修計劃之7小時訓練時數)
入學條件： 學員須具有閱讀及書寫中文的能力並具建造業工作經驗
授課語言： 粵語輔以中文講義
學費： \$490 (原價) / \$440 (職安健大使及綠十字會員學費) / \$245 (中小企學費)

請瀏覽本局網頁 <http://www.oshc.org.hk/tchi/main/training/> 下載有關課程資料及報名表格，或直接按「會員專區」於網上報名及繳交學費。

