



CONSTRUCTION TECHNOLOGY – A NOVEL REVIEW IN CIVIL ENGINEERING FOR ECO FRIENDLY CONSTRUCTION

*“It is a great profession There is a fascination of It is a great profession.
There is a fascination of watching a figment of the imagination emerge
through the aid of science to a plan on paper. Then it moves to realization
in stone or metal or energy. Then it brings jobs and homes to men. Then it
elevates the standards of living and adds to the comforts of life. That is the
engineer’s high privilege.”*

-Herbert Hoover

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ABSTRACT

Construction Technology involves study on methods of construction to successfully achieve the **structural design** with recommended specifications and conditions of contract. It also includes study of **geotechnics**, construction **equipments**, and temporary works like scaffolding, falsework and formwork etc. required to facilitate the construction process conforming to health and safety regulations. Construction technology also include study of latest erection and fabrication processes. The modern trend is towards constructing lighter and **taller buildings** which is always a big challenge in an era of financial crunch. To achieve it successfully there is a need to have sophisticated equipments employed in the construction process. Excavation of foundation is also a challenging task in an area surrounded by existing buildings and a busy road. All of these factors should be considered while estimating the cost of the **construction project**. Construction technologist work very closely with construction managers and the **quantity surveying** professionals. Construction technologist should also have good knowledge about different types of **materials** used in construction along-with the testing procedures to assure quality control of these materials on site. • The modern trend is towards constructing lighter and taller buildings which is always a big challenge in an taller buildings which is always a big challenge in an era of financial crunch. To achieve it successfully there is a need of have sophisticated equipments employed in the construction process.

Key Words: Civil Engineering, Environmental Engineering, Construction Technology, Eco – friendly constructions.



Introduction

Construction Technology involves the study on methods of construction to successfully achieve the structural design with recommended specifications. It also includes study of construction equipments, and temporary works required to facilitate the construction process. Sociological changes, new technology in industry and commerce, new building codes, other new laws and regulations, inflationary economies of nations, and advances in building technology place an ever-increasing burden on building designers and constructors. They need more and more knowledge and skill to cope with the demands placed on them. One of the major demands is the variety of construction materials.

Construction Materials section is primarily concerned with the development of new or improved materials for constructing Civil Engineering structures, also involved in design of materials and methods to repair existing structures that may be damaged due to certain reasons. Information on latest research in materials is very important for construction technology and design of structures.

In this paper, the authors made an attempt to bring a newer idea and review on some of the materials that are being using in civil construction.

1. BELBIEN

BELBIEN is a decorative film with adhesive that is applicable on site. It is an ideal way to finish many environments with little or no down time. BELBIEN is used extensively for interior applications such as hotels, corporate lobbies and elevators as well as exterior applications.



Composition

BELBIEN is best characterized as an architectural design film, and is made primarily from PVC (Polyvinyl Chloride). It is sometimes referred to as a cladding or a vinyl laminate. Following are some of the many benefits that make BELBIEN the perfect solution to many decorative problems.

Weight

BELBIEN is lighter than most decorative products available in the market today weighing less than 370 grams per linear meter (11.7 ounces per linear yard). This is critical for projects where weight is a major factor such as elevators, movable partitions, office dividers, etc.



Thickness

Each of the BELBIEN series is only about 0.2mm (0.008 inches) thick excluding the release paper. Because of the thickness, BELBIEN can be used for such renovations as store fixtures, doors and frames, cabinets, elevator doors, etc.

Width and Length

BELBIEN is packaged in rolls, 1.2 meters (48 inches) wide and 50 meters (54 yards) long. This enables BELBIEN to be applied to most doors and partitions without creating seams.

Benefits

a. Flexibility and Conformability

BELBIEN can be applied to many two-dimensional decorative surfaces and tailored to a 90 to 180 degrees angle for such uses as doorframes, moldings and panel projects. Many of the BELBIEN patterns can also be stretched to conform to 3D surfaces by Certified Installers. This allows BELBIEN to be applied to many decorative surfaces with concave and convex surfaces.

b. Pressure Sensitive Adhesive System

BELBIEN's adhesive system is a remarkable features of the product. It will cure to its optimum bonding strength in just 8-12 hours following the application at 23°C (72°F). This strong adhesive system also allows BELBIEN to be installed in high-risk areas such as subways, bathroom partitions, etc.

c. Fire and Smoke Ratings

BELBIEN meets very high standards and carries Class A (Class 1) fire and smoke ratings (except for MT and SG). As such, BELBIEN can be installed in high-risk areas such as public transportation, airports, office complexes, cruise and marine, etc. Actual fire ratings include ASTM-E84 and UL-723.

d. Stain Resistance

BELBIEN offers excellent stain resistance to many substances. In most cases, stains can be easily removed using a soft cloth and household cleaner.

e. Exterior Application

BELBIEN EX series can be applied to exterior surfaces that are made of metals. Common exterior uses are metal signs, columns, doors and store facades.

f. Reparability

One of the greatest advantages of BELBIEN is that damages can be easily repaired. Further, a minimal down-time is required for renovation projects such as elevators, shopping malls, airports, etc. Often, this is the greatest benefit of all as the cost of down-time can be a large part of any renovation.

2. BONLEX

It is a decorative laminate material for use in vacuum molding, created from a combination of the high-level technological capabilities built up by our company over its years as an integrated plastics manufacturer, and our design & development know-how. It comprises a base material that can be molded three-dimensionally by vacuum molding into the required design.



Characteristics

a. Superior processing compatibility

Bonlex can be processed into three-dimensional forms that are difficult to achieve with olefin-based materials. It is compatible not only with vacuum molding but also with laminate processing techniques such as wrapping, and can be processed into a wide range of shapes including pull handles and hand holds.

b. Environmentally-friendly laminate materials

Bonlex is manufactured from polyester-based materials, and releases virtually no harmful gases even when burned. Bonlex burns at a relatively low temperature compared to other plastics, and therefore does little damage to incinerators. No formaldehyde, toluene or xylene is used in its manufacture. In addition, the fact that no solvents are used in finishing the product-unlike those that require painting-make it an extremely environmentally friendly laminate material.

c. Rich design potential

Bonlex is available in two finishes-mirror-surfaced (high-gloss) and matt (satin)-giving a high-class appearance with great depth. Coordinating this material



with thicker lino edge in beautiful designs, and edge tapes in the same design, gives an even higher level of product finish.

3. Waterproofing Geomembrane

Vynon Geomembrane is available in many materials and is supplied with reliable quality. There are several varieties in this.

1. Vynon PVC geomembrane

PVC based geomembrane for various waterproofing applications, which has many supply records and long history.

	<p>Characteristics</p> <ul style="list-style-type: none"> -Good mechanical strength -Excellent workability -Excellent chemical resistance and durability -Most suitable for waterproofing application -Economical
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Physical properties (1.5mm)

Test item	Test method	Unit	Standard
Thickness	JIS K 6250	mm	more than 1.5
Tensile strength	JIS A 6008	N/cm	Min. 1570
Elongation	JIS A 6008	%	Min. 300
Tear strength	JIS A 6008	N/cm	Min. 440

2. Vynon HDPE sheet

High density polyethylene waterproofing geomembrane with light weight and high mechanical strength and good chemical resistance.



Characteristics

- High mechanical strength
- Excellent chemical resistance
- Excellent weatherability
- Good welding strength



Physical properties (1.5mm)

Test item	Test method	Unit	Standard
Thickness	JIS K 6250	mm	1.5
Tensile strength	JIS K 6251	N/cm	350
Elongation	JIS K 6251	%	560
Tear strength	JIS K 6252	N	140
Welding strength	JIS K 6850	N/cm	160

3. Vynon LLDPE sheet

Low density polyethylene waterproofing geomembrane with light weight and high mechanical strength and good chemical resistance.



Characteristics

- Good cold resistance
- Excellent weatherability
- Excellent flexibility
- Easy to follow uneven surface
- High welding strength

Physical properties (1.5mm)

Test item	Test method	Unit	Standard
Thickness	JIS K 6250	mm	1.5
Tensile strength	JIS K 6251	N/cm	140
Elongation	JIS K 6251	%	400
Tear strength	JIS K 6252	N	70
Welding strength	JIS K 6850	N/cm	80

4. Vynon EF sheet

Vynon EF sheet is a Tunnel waterproofing geomembrane especially developed for NATM tunnel application



Characteristics

- Excellent water sealing effect
- Supplied with un-woven cloth
- Excellent prevention effect of concrete cracking



Physical properties

Test item	Unit	Standard	Test method	
Specific gravity	—	0.95 ±0.05	JIS K 6773	
Hardness	—	Max. 98	JIS K 6773	
Thickness	mm	Min. 0.8	ref. JIS A 6008*	
Tensile strength	+20°C	N/mm ²	Min. 16	JIS K 6773
	-10°C		Min. 30	JIS K 6773
Elongation	+20°C	%	Min. 600	JIS K 6773
	-10°C		Min. 500	JIS K 6773
Tear strength	N/cm	Min. 500	JIS K 6252	
Softening Point	°C	Max. -30	JIS K 6773	
Weight change rate in alkali	%	±1	JIS K 6773	
Adhesion strength at welded point	%	Min. 20	JHS 706	

5. Water Swelling Rubber Sealing Materials

Chloroprene rubber based hydrophilic water sealing material which has long durability and good chemical resistance, which is called Hydrotite.

1. HYDROTITE

It is a chloroprene rubber based hydrophilic water sealing material which has excellent long-terms durability and good chemical resistance.



Characteristics

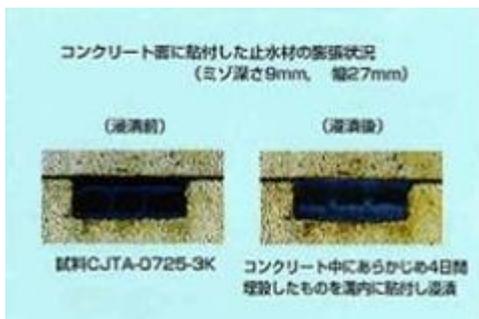
- Double packing effect with compression and expansion
- Good resistance to deformation
- Excellent workability
- Excellent durability
- Excellent chemical resistance

Physical properties

Test item	Test method	In-house standard		
		Unit	Hydrophilic rubber	Non-hydrophilic rubber
Hardness	JIS K 6253	—	A40+/-5	A45+/-5
Tensile strength	JIS K 6251	MPa	more than 3.5	more than 6.0
Elongation	JIS K 6251	%	more than 600	more than 600
Expansion rate	In-house test*	%	more than 100	—

2. HYDROTITE CJTA

It is advanced HYDROTITE CJ, which is coated with special coating dissolved by alkaline water and it minimize premature expansion by ground water or rain water before 2nd concrete is poured.



Characteristics

- Superior water sealing
- Easy handling and installation
- Controlled Expansion pressure
- Expansion only when it's required
- Various product range

Physical properties

Test item	Test method	In-house standard		
		Unit	Hydrophilic rubber	Non-hydrophilic rubber
Hardness	JIS K 6253	—	A50±5	A50±5
Tensile strength	JIS K 6251	MPa	more than 3.9	more than 8.8
Elongation	JIS K 6251	%	more than 600	more than 400
Expansion property	In-house Test	%	more than 100	—

3. **HYDROTITE** rubber packing various water swelling rubber packing are available.



4. Hydrotite Sleeve Ring - Water Swelling Seal for Pipe Penetration

Water leakage through penetration on pipes sometimes makes us troubles. Hydrotite Sleeve Ring, which has expansion characteristics when it contacts water, is developed specially to seal around Separators.





Features

1. Getting better sealing in pipe penetration joints
2. Only one step to get excellent water sealing, no glue and no cure-time
3. Blue rubber portion swell water and expand to seal water
4. Black rubber portion control expansion direction
5. Available supplying in ring shape
6. Applicable for both PVC pipes and Steel pipes

Characteristics

Item	Unit	Hydrophilic rubber		Non-hydrophilic rubber		Test method
		Spec.	Measured value	Spec.	Measured value	
Hardness	-	A45±5	A45	A50±5	A51	JIS K6253
Tensile strength	MPa	Min. 3.9	4.8	Min. 8.8	12.3	JIS K6251
Elongation at break	%	Min. 600	690	Min. 400	435	JIS K6251
Volume expansion rate (14days in distilled water)	%	Min. 100	170	-	-	In house test (at 23C)

5. PVC Waterstop

Conventional PVC Waterstops that can be used in any concrete structure joints. Super ATP that is combined with water swelling portion is also available.

1. Vynon PVC Waterstops

Conventional PVC Waterstops that can be used in any concrete structure joints. Since it has been developed, Vynon PVC waterstops has been used in a lot of Dam and civil engineering construction works.

Characteristics



- High quality control
- Satisfactory water-stopping effect
- Elastic and durable
- No effect on characteristics in low temperature
- Simple handling and easy work
- Economical



Physical properties

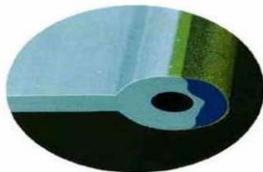
Test item	UNIT	Specification	Test method
Specific gravity	-	MAX. 1.4	JIS K 6773 9.3
Hardness (JIS-A)	-	MIN. 65	JIS K 6773 9.4
Tensile strength	MPa	MIN. 11.8	JIS K 6773 9.5
Elongation	%	MIN. 250	
Loss of weight on aging	%	+/-5	JIS K 6773 9.6
Softening point	°C	MAX.-30	JIS K 6773 9.8

Chemical resistance

Alkaline water (70C, 14DAYS)	Tensile strength	change rate %	+/-20	JIS K6773 9.7
	Elongation	change rate %	+/-20	
	Weight Loss	change rate %	+/-5	
Salt water (20C, 14DAYS)	Tensile strength	change rate %	+/-10	
	Elongation	change rate %	+/-10	
	Weight Loss	change rate %	+/-2	

2. Vynon Super ATP

It is a uniquely developed PVC Waterstops having water-expansion portion at both edges to provide further water-tightness.



Characteristics

- Composite structure with water expansion portion
- Applicable for expansion portion
- Alkali soluble protective coating
- Excellent physical properties

Physical properties (main body)

Test item	UNIT	Specification	Test method
Specific gravity	-	MAX. 1.4	ref. JIS K 6773 9.3
Hardness (JIS-A)	-	MIN. 65	ref. JIS K 6773 9.4
Tensile strength	MPa	MIN. 11.8	ref. JIS K 6773 9.5
Elongation	%	MIN. 250	
Loss of weight on aging	%	+/-5	ref. JIS K 6773 9.6
Softening Point	C	MAX.-30	ref. JIS K 6773 9.8



Chemical resistance

Alkaline water (70C, 14DAYS)	Tensile strength	change rate %	+/-20	ref. JIS K6773 9.7
	Elongation	change rate %	+/-20	
	Weight Loss	change rate %	+/-5	
SALT WATER (20C, 14DAYS)	Tensile strength	change rate %	+/-10	
	Elongation	change rate %	+/-10	
	Weight Loss	change rate %	+/-2	

6. Other Water Sealing Materials

Various items for water proofing which have unique characteristics, such as a water swelling butyl rubber seal and a water swelling sealant.

1. LEAKMASTER

It is a one component type water swelling sealant with excellent and unique physical properties.



Characteristics

- Easy handling and application
- Excellent Physical properties
- Well designed water expansion properties
- Good adherence to various substrate

Physical properties

General properties		Properties after curing	
Appearance	putty-like	hardness	A41+/-8
Color	grey	tensile strength	5.8+/-1.0 (MPa)
Specific gravity	1.3 ±0.10	elongation	1100+/-250 (%)
Extrudability	within 20sec. (at23C)	tear strength	13.7+/-3.9 (N/mm)
Slump	max. 3mm (at23C)		—

2. AQUA TACKSEAL

It is water swelling semi-vulcanized butyl rubber sealing material exclusively developed for joints in precast concrete structures.



Characteristics

- Self-tackiness
- Water expansion characteristics
- Excellent water-tightness
- Good physical properties

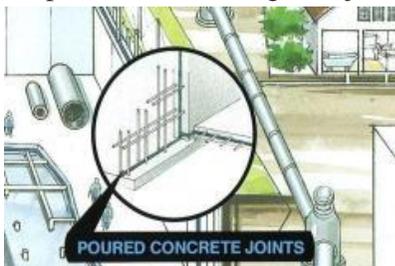


Physical properties

Test item	Unit	Standard	Test method
Tensile strength	kPa	min.88	ref. JIS-K-6301
Elongation	%	min.1500	
Adherence	kPa	min.196	In-house test
Expansion	%	min.50	In-house test

3. Butyl TACKSEAL

It is water swelling unvulcanized butyl rubber sealing material, which is used to precast concrete segment joint and cast-in-situ construction joint.



Characteristics

- Expansion Characteristics
- Self-Tackiness
- Good Elasticity
- Easy Installation
- Good Sealing Capability

Physical properties

EXPANSION PORTION			
TEST ITEM	TEST METHOD	UNIT	STANDARD
PENETROMETER	JIS K 2207 (24C)	—	60+/-10
SPECIFIC GRAVITY	JIS K 6268 (24C)	—	1.25+/-0.05
TENSILE STRENGTH	JIS K 6258	MPa	Min. 0.15
ELONGATION AT BREAK	JIS K 6258	%	Min. 1000
EXPANSION	In-house	%	Min. 40

Note: Above values are typical measured values and not specific values.

4. HYDROTITE HK sealant

It is a Polyurethane base hydrophilic elastic sealant for steel piles widely used for marine, river and ground construction.



Characteristics

- Easy application
- Excellent mechanical strength and rubber elasticity
- Good adherence to steel piles
- Water expanding
- Good water sealing performance
- Comply with drinking water standard of TOKYO

Physical properties

Test item	Test method		Unit	Results
Specific gravity	In-house test		—	1.09
Hardness	ref. JIS K6253		—	A29
Adherence	In-house Test		MPa	0.38
Tear strength	ref. JIS K6252		N/mm	10.6
Tensile strength	100% modulus	ref. JIS K6251	MPa	0.47
	300% modulus			0.76
	500% modulus			1.13

5. C. I. SEPARING

It has expansion characteristics when it contacts water, is specially developed to seal around separators.



Characteristics

- Water swelling seal
- Excellent water sealing property
- Various size

6. New Products and New Technologies

Introducing new products and technologies which are developed based on our long time experience in civil engineering and construction field.

Conclusion:

The development of these products has begun with the shared vision and challenges of the present day society. During the product development and providing product solutions in an efficient and timely manner, this initiative review seeks to solicit ideas about new products and construction materials from civil engineers, for promoting the concentration of resources on selected areas, which has been cultivated over the years in the forms of new construction materials, while aiming at further development. From this information, the civil engineers can engage in aggressive innovative activities in expanding the demand for new construction materials, and will strive to accelerate its development power with an eye to creating high added value. Meanwhile, the authors are addressing environmental issues as regard the



initiative as a main pillar of the societal policies. The "Zero Emission" program that has been started in April 2003 can be achieved its initial target of 1% or less industrial waste landfill CO₂ emissions by using these construction materials. Improving the technical strength and development power that put us beyond reach of other nations and by pursuing a highly efficient and low-waste production system through improved productivity, we can reduce our environment load on earth and realize our motto, "making friendly to people, the earth, and the future."