FACULTY OF ENGINEERING
CHULALONGKORN UNIVERSITY
FIRE SAFETY RESEARCH CENTER

TYPE OF TEST : DETERMINATION OF THE FIRE RESISTANCE OF NON-LOADBEARING ELEMENTS OF CONSTRUCTION

TEST SPECIMEN : **Door Series: SFD FOR BI SMALL PROJECT (Bumrungrad International Hospital)**

The specimen is a doorset consisting of a single-sided composite door leaf having dimensions of 2054 mm x 925 mm x 45 mm and a steel door frame. The door leaf is composed of 1.6-mm thick cold rolled steel sheet and rock wool with a density of 100 kg/m^3. The specimen was mounted in a 15-cm thick reinforced concrete wall, which was installed on a 3 m x 3 m steel testing frame, with the door leaf opening away from the furnace. This installation was taken as representing a more severe fire exposure as gaps developed due to bowing of the door leaf were not concealed by the rebate of the door frame. The door leaf was installed within the door frame with a panic bar and five stainless steel hinges. Smoke seal was installed around the inner perimeter of the door frame. The details of the specimen are shown in Appendix C. The specimen was provided and installed by the client.

CLIENT : **SUPARICH CO., LTD.**
27 Ramintra Soi 48, Ramintra Road, Ramintra Khannayao, Bangkok 10230, Thailand

TASK INTERIOR LTD.
79/6-9 Soi Ramintra 14, Ramintra Road
Tha Raeng, Bang Khen, Bangkok 10230, Thailand

DATE OF TEST : October 24, 2023

TEST MACHINE : Large-scale vertical furnace at the Fire Safety Research Center (FSRC), Department of Civil Engineering, Chulalongkorn University in Bangkok, Thailand. The furnace is capable of producing a standard temperature-time relationship according to BS 476 Part 20: 1987.

TEST METHOD : The testing procedures follow the British Standard BS 476: Fire tests on building materials and structures

BS 476 Part 20: 1987: Method for determination of the fire resistance of elements of construction (general principles)

BS 476 Part 22: 1987: Methods for determination of the fire resistance of non-loadbearing elements of construction Section 6: Determination of the fire resistance of fully insulated doorsets and shutter assemblies.

TEST RESULTS : The non-loadbearing element of construction described above has the fire resistance of each criterion for the period stated:

(The test results only relate to the behaviour of the specimen of the element of construction under the particular condition of the test. They are not intended to be the sole criteria for assessing the potential fire performance of the element in use nor do they reflect the behaviour in fire.)

Criteria	Fire Resistance (hr:min)	Remarks
Insulation	0:07	The maximum temperature of the unexposed face of the specimen exceeded 180°C above the initial mean value of 31°C.
Integrity	2:00	The test was terminated by the client. During the test, all integrity criteria were fulfilled (no sustained flaming and no through gap such that the 6 mm diameter gap gauge could penetrate).

Date: November 7, 2023

Tested by: .....
(Associate Prof. Dr. Boonchai Sangpetngam)

Examined by: .....
(Professor Dr. Thanyawat Pothisiri)

Approved by: .....
(Associate Prof. Dr. Tirawat Boonyatee)
On Behalf of Head of Civil Engineering Department

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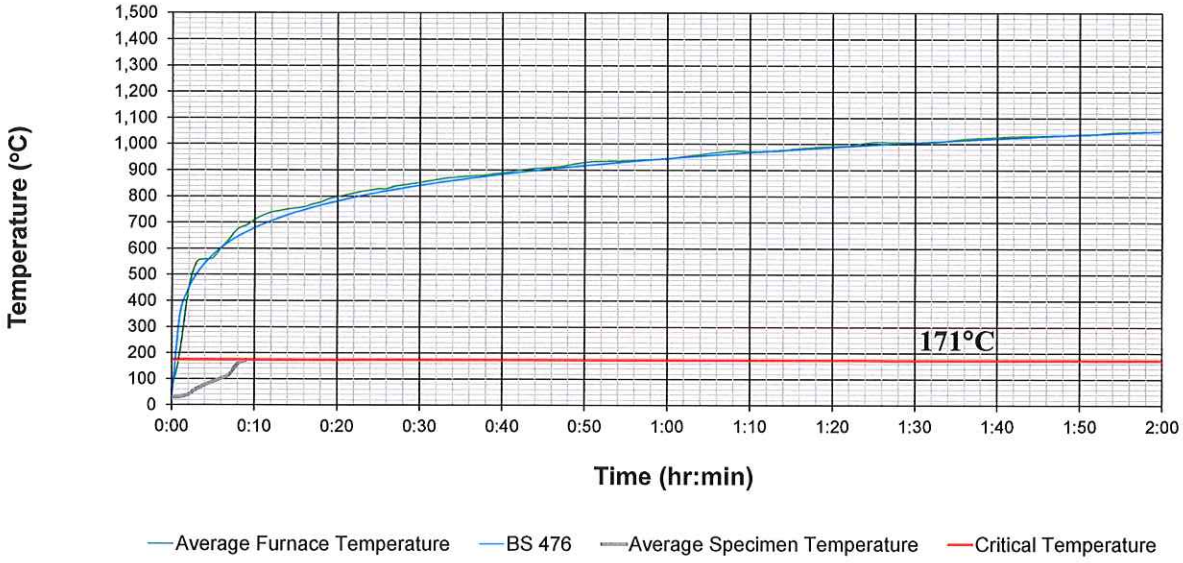
FURNACE TEMPERATURE



Comparison of area under the curve

Time (hr:min)	Furnace Temperature (°C)		Area under curve (°C min)		Percentage difference (%)	Standard tolerance ±%
	Standard	Furnace	Standard	Furnace		
0:05	576.4	563.4	2,138.1	2,052.6	-4.0	15.0
0:10	678.4	710.0	5,302.7	5,292.4	-0.2	
0:30	841.8	852.7	15,492.6	15,836.7	2.2	10.0
0:45	902.3	908.8	13,111.4	13,239.7	1.0	5.0
1:00	945.3	944.3	26,984.3	27,204.5	0.8	
1:30	1,006.0	1,006.8	56,315.4	56,665.6	0.6	
2:00	1,049.0	1,050.9	87,171.6	87,585.9	0.5	

(Dr. Sirichai Pethrung)
Authorized Testing Officer

APPENDIX A: TEMPERATURE OF THE FURNACE AND THE SPECIMEN

Time (hr:min:sec)	Furnace Temperature(°C)										Time	BS 476
	P1	P2	P3	P4	P5	P6	P7	P8	P9	Average	(hr:min:sec)	(°C)
0:00:00	40	50	76	37	50	80	60	63	49	56	0:00	20
0:01:00	77	193	204	131	213	421	193	240	146	202	0:05	556
0:02:00	217	466	370	476	569	638	393	456	331	435	0:10	659
0:03:00	451	575	519	518	670	606	461	608	521	548	0:15	718
0:04:00	523	572	560	452	628	598	504	623	564	558	0:20	781
0:05:00	536	572	578	445	613	616	521	622	568	563	0:25	821
0:06:00	561	616	614	504	660	661	550	661	596	602	0:30	842
0:07:00	598	655	648	551	694	687	578	694	631	637	0:35	865
0:08:00	664	695	690	585	713	711	617	723	681	675	0:40	885
0:09:00	675	706	701	604	726	726	627	735	692	688	0:45	902
0:10:00	694	732	719	634	751	747	643	756	715	710	0:50	918
0:11:00	713	747	734	655	766	760	657	773	733	726	0:55	932
0:12:00	730	760	743	668	774	767	672	783	746	738	1:00	945
0:13:00	742	766	749	674	779	771	678	790	754	745	1:05	957
0:14:00	749	772	754	682	784	776	683	794	761	751	1:10	968
0:15:00	754	776	758	687	787	779	688	798	766	755	1:15	979
0:16:00	759	780	764	694	792	784	689	802	772	759	1:20	988
0:17:00	766	790	773	711	803	797	699	813	781	770	1:25	997
0:18:00	772	796	779	721	811	803	704	820	788	777	1:30	1006
0:19:00	789	808	791	738	824	814	718	833	804	791	1:35	1014
0:20:00	797	816	798	743	830	822	723	839	811	798	1:40	1022
0:21:00	804	823	804	754	836	827	731	844	816	804	1:45	1029
0:22:00	811	830	811	763	843	835	738	852	825	812	1:50	1036
0:23:00	816	837	819	769	849	841	743	859	835	819	1:55	1043
0:24:00	820	842	825	777	854	843	744	865	842	823	2:00	1049
0:25:00	827	847	828	783	857	848	753	868	846	828		
0:26:00	827	847	829	783	857	848	752	868	846	828		
0:27:00	838	856	838	797	868	858	763	877	854	839		
0:28:00	842	860	843	802	871	864	770	879	860	843		
0:29:00	848	865	847	810	876	867	772	884	865	848		
0:30:00	854	868	851	814	880	872	780	888	869	853		
0:31:00	862	874	854	823	885	877	784	892	871	858		
0:32:00	869	881	860	830	892	884	789	896	875	864		
0:33:00	872	887	867	834	897	889	794	901	882	869		
0:34:00	875	889	871	838	898	892	797	906	886	872		
0:35:00	880	892	873	841	902	894	799	908	889	875		
0:36:00	882	894	875	843	904	896	803	910	890	877		
0:37:00	884	896	878	847	905	897	806	912	893	880		
0:38:00	886	898	880	849	908	900	806	914	894	881		
0:39:00	890	902	884	859	912	906	810	917	898	886		
0:40:00	896	907	888	864	916	908	816	920	902	891		
0:41:00	901	909	891	868	918	912	821	924	905	894		
0:42:00	905	916	896	874	924	917	824	929	912	899		
0:43:00	908	920	902	879	927	920	828	934	916	904		
0:44:00	912	923	904	882	930	923	834	936	920	907		
0:45:00	913	925	907	883	932	925	833	939	923	909		
0:46:00	917	927	909	886	934	928	837	940	925	911		
0:47:00	919	929	912	889	936	930	838	943	926	914		
0:48:00	923	937	916	901	942	936	844	946	933	920		
0:49:00	931	940	921	906	948	941	849	952	939	925		
0:50:00	939	944	925	913	952	945	855	956	942	930		
0:51:00	942	948	929	915	955	948	861	960	946	934		
0:52:00	942	950	931	914	954	948	859	962	948	934		
0:53:00	943	951	931	914	955	950	861	961	949	935		
0:54:00	942	951	933	916	957	950	859	963	951	936		
0:55:00	944	953	934	917	958	951	861	964	950	937		
0:56:00	946	954	935	920	958	953	864	964	951	938		
0:57:00	949	956	936	921	961	954	866	965	954	940		
0:58:00	951	958	938	922	962	955	866	966	956	941		
0:59:00	953	956	938	925	964	957	869	967	956	943		

(Dr.Sirichai Pethrung)
Authorized Testing Officer

Time (hr:min:sec)	Furnace Temperature(°C)									
	P1	P2	P3	P4	P5	P6	P7	P8	P9	Average
1:00:00	954	960	941	926	966	959	864	971	957	944
1:01:00	954	964	946	932	969	964	872	973	962	948
1:02:00	961	967	949	939	974	967	875	976	967	953
1:03:00	964	969	952	944	977	971	880	981	970	956
1:04:00	967	975	956	949	982	974	882	986	975	961
1:05:00	975	979	960	954	987	979	888	989	979	965
1:06:00	978	982	963	957	990	981	893	993	982	969
1:07:00	982	986	967	961	993	985	896	995	985	972
1:08:00	985	991	969	963	994	986	897	998	988	974
1:09:00	985	988	969	958	992	985	896	997	988	973
1:10:00	983	988	968	957	992	984	896	996	987	972
1:11:00	985	988	968	959	992	985	896	995	987	973
1:12:00	984	991	969	959	993	985	896	995	988	973
1:13:00	985	990	970	960	993	985	895	995	988	973
1:14:00	986	991	972	965	996	989	899	998	989	976
1:15:00	991	995	975	972	1002	993	901	1004	994	981
1:16:00	995	998	979	975	1005	996	902	1008	998	984
1:17:00	996	1000	981	976	1006	998	908	1009	1000	986
1:18:00	999	1003	984	979	1008	999	910	1010	1002	988
1:19:00	1001	1004	985	983	1009	1001	912	1011	1004	990
1:20:00	1001	1006	987	982	1009	1002	915	1013	1004	991
1:21:00	1003	1008	988	984	1011	1004	918	1012	1007	993
1:22:00	1004	1007	989	984	1013	1006	917	1015	1008	994
1:23:00	1010	1014	994	994	1019	1012	922	1020	1013	1000
1:24:00	1015	1019	998	998	1024	1016	927	1025	1017	1004
1:25:00	1018	1021	1002	1002	1027	1019	930	1028	1021	1008
1:26:00	1022	1023	1003	1000	1027	1018	931	1029	1023	1008
1:27:00	1020	1022	1002	998	1025	1017	930	1027	1021	1007
1:28:00	1019	1021	1002	999	1024	1017	929	1026	1021	1006
1:29:00	1019	1020	1002	998	1024	1018	931	1025	1020	1006
1:30:00	1018	1022	1003	998	1024	1017	932	1026	1021	1007
1:31:00	1019	1021	1003	998	1024	1017	932	1026	1022	1007
1:32:00	1018	1021	1003	1001	1024	1018	932	1027	1021	1007
1:33:00	1019	1023	1005	1003	1028	1021	932	1028	1022	1009
1:34:00	1023	1027	1008	1009	1032	1025	935	1032	1025	1013
1:35:00	1028	1030	1012	1012	1036	1029	938	1036	1030	1017
1:36:00	1031	1034	1015	1016	1039	1031	943	1039	1033	1020
1:37:00	1034	1035	1017	1018	1041	1033	946	1041	1036	1022
1:38:00	1036	1037	1018	1020	1042	1034	946	1044	1038	1024
1:39:00	1038	1040	1020	1021	1044	1036	948	1044	1039	1026
1:40:00	1039	1041	1022	1023	1044	1036	950	1046	1040	1027
1:41:00	1041	1044	1023	1025	1046	1039	953	1047	1042	1029
1:42:00	1042	1043	1025	1026	1048	1040	954	1048	1043	1030
1:43:00	1044	1045	1026	1027	1048	1040	955	1049	1044	1031
1:44:00	1045	1045	1026	1028	1049	1042	954	1050	1045	1031
1:45:00	1045	1045	1027	1027	1048	1042	955	1050	1045	1032
1:46:00	1045	1046	1028	1029	1050	1042	957	1051	1047	1033
1:47:00	1046	1048	1028	1030	1050	1044	957	1052	1048	1034
1:48:00	1046	1047	1030	1031	1051	1044	955	1052	1049	1034
1:49:00	1047	1048	1030	1032	1051	1044	959	1053	1049	1035
1:50:00	1047	1050	1031	1033	1052	1045	959	1053	1050	1036
1:51:00	1048	1050	1032	1033	1054	1045	956	1054	1050	1036
1:52:00	1051	1053	1034	1037	1056	1051	963	1057	1051	1039
1:53:00	1053	1057	1037	1040	1059	1053	963	1059	1055	1042
1:54:00	1056	1059	1040	1042	1062	1056	965	1061	1057	1044
1:55:00	1058	1060	1041	1044	1063	1056	969	1063	1057	1046
1:56:00	1059	1061	1042	1044	1064	1058	968	1064	1059	1046
1:57:00	1060	1062	1043	1045	1064	1058	969	1064	1060	1047
1:58:00	1061	1062	1044	1047	1066	1060	968	1066	1060	1048
1:59:00	1061	1063	1045	1048	1067	1066	969	1067	1062	1050
2:00:00	1062	1064	1047	1049	1068	1068	970	1068	1062	1051

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Authorized Testing Officer

Time (hr:min:sec)	Specimen Temperature(°C)											
	A	B	C	D	E	F	G	H	I	J	Max. (A-I)	Average (A-E)
0:00:00	31	32	31	31	31	32	31	30	30	31	32	31
0:01:00	31	33	32	31	31	37	31	30	31	31	37	32
0:02:00	-	55	37	34	32	56	31	32	34	31	56	40
0:03:00	-	101	61	45	38	96	33	36	47	31	101	61
0:04:00	-	123	85	57	45	99	37	43	71	31	123	77
0:05:00	-	137	104	67	52	114	43	50	92	31	137	90
0:06:00	-	151	120	76	60	123	67	55	93	32	151	102
0:07:00	-	170	141	88	67	128	87	62	95	33	170	116
0:08:00	-	217	204	128	87	146	99	89	99	36	217	159

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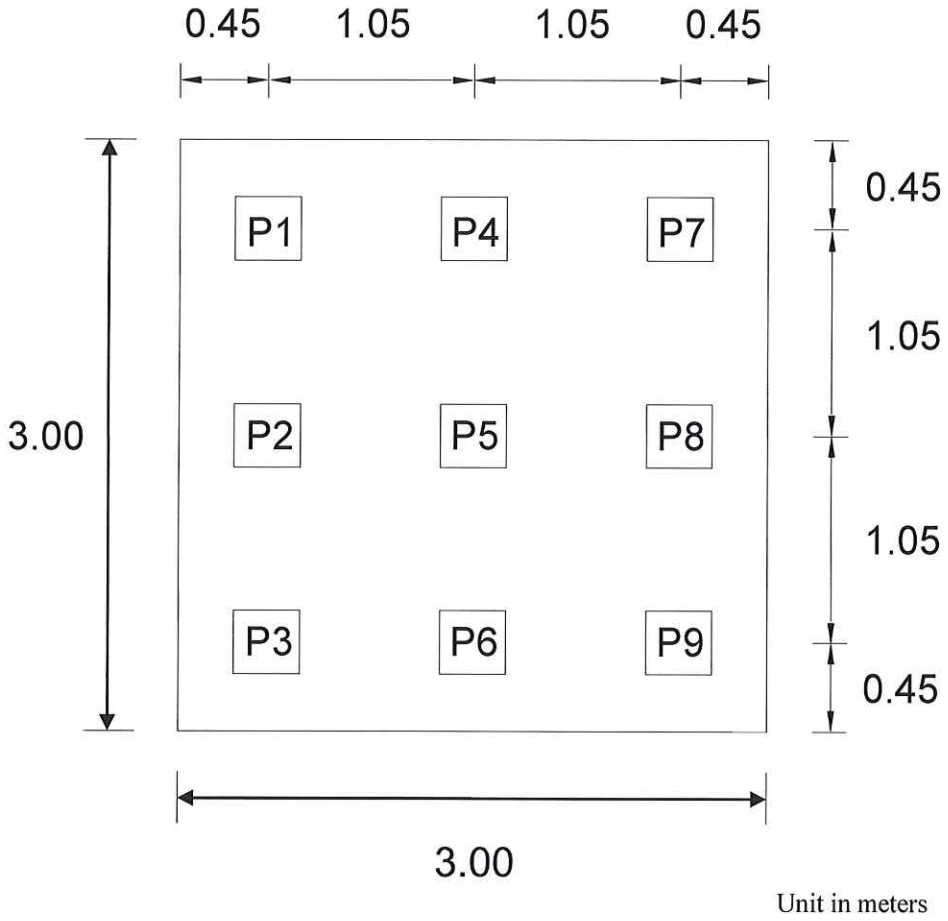

Figure A-1: Location of thermocouples inside the furnace

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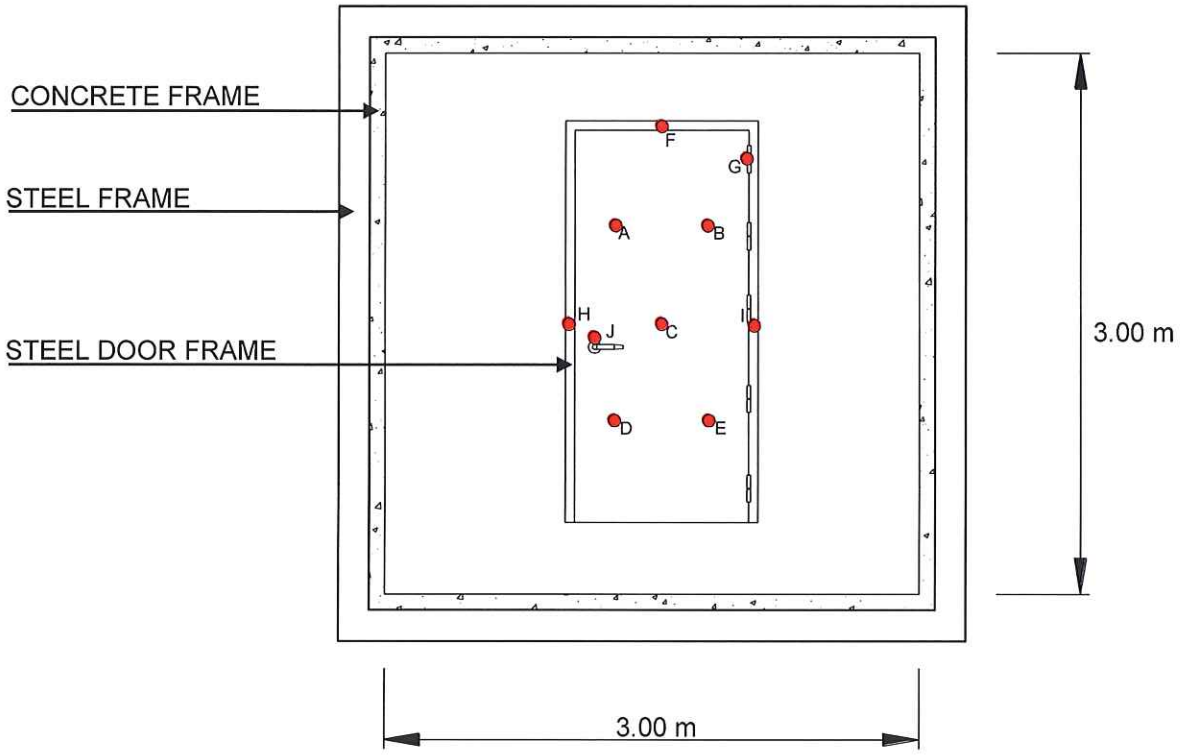

Figure A-2: Location of thermocouples on the specimen

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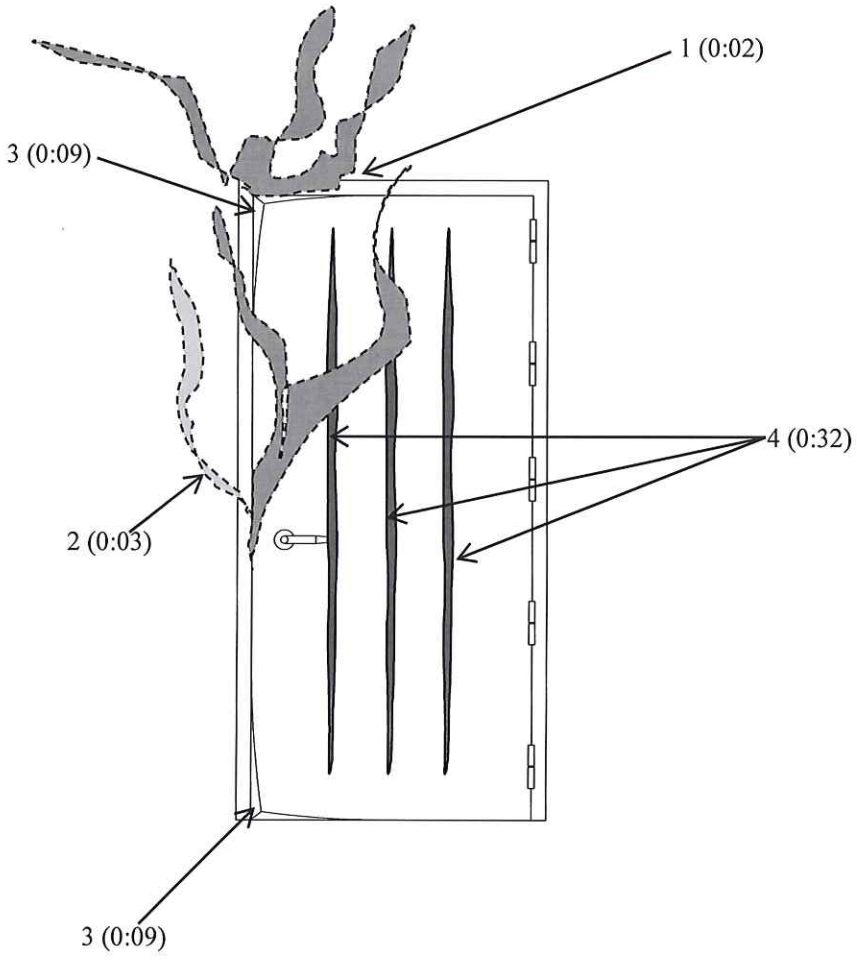
APPENDIX B: OBSERVATIONS

No.	Time (hr:min)	Observations
1	0:02	Smoke leaking from the upper edge of the door.
2	0:03	Smoke leaking from the left edge of the door.
3	0:09	The door leaf deflected outward at the upper and lower left corners.
4	0:32	Multiple burnt areas were observed on the unexposed face of the door.
5	1:00	No significant change was observed.
6	1:30	No significant change was observed.
7	2:00	The test was terminated by the client. During the test, all integrity criteria were fulfilled (no sustained flaming and no through gap such that the 6 mm diameter gap gauge could penetrate).



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APPENDIX C: DRAWINGS & DETAILS OF THE SPECIMEN

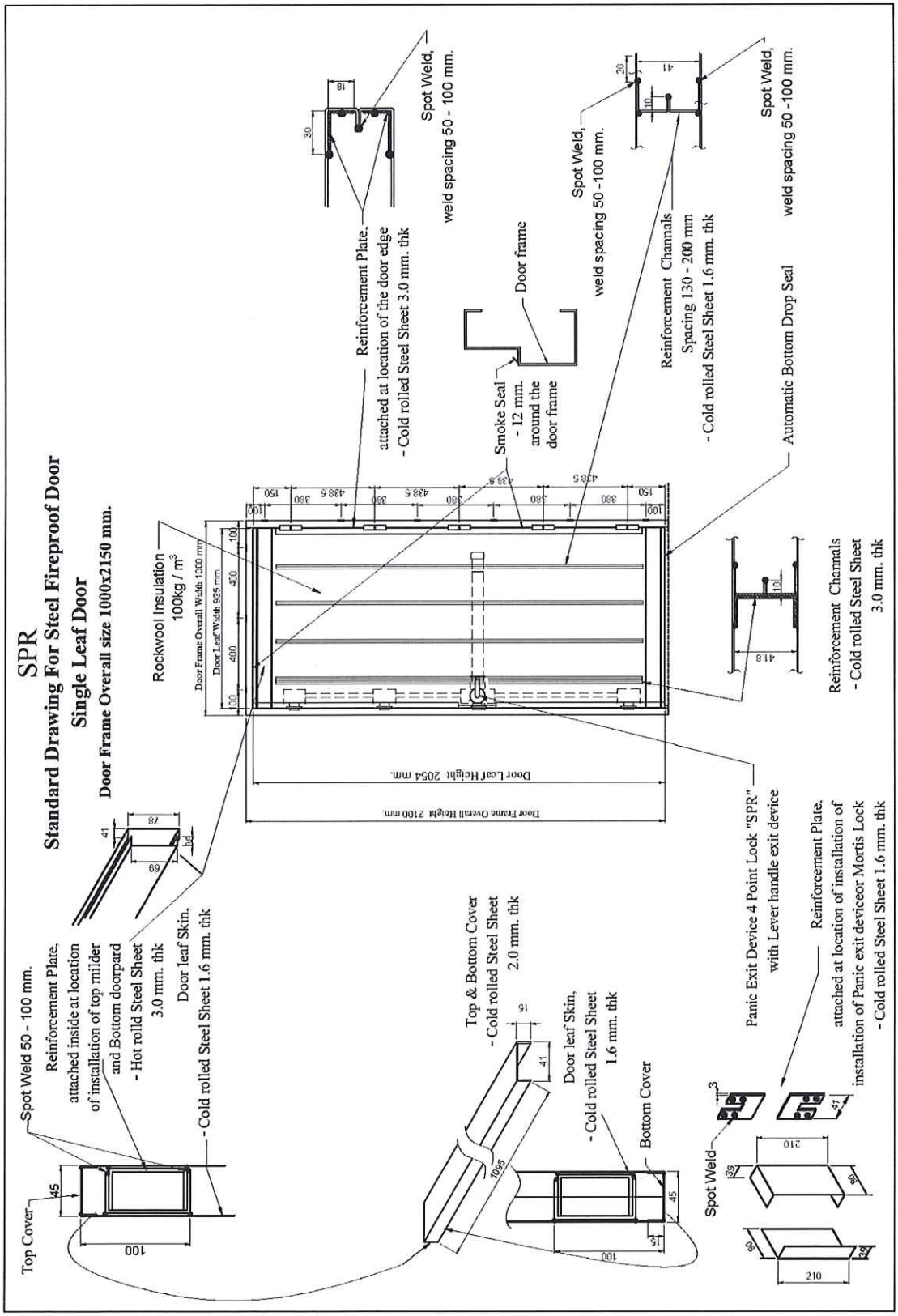

Figure C-1: Details of the specimen (as provided by the client)

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APPENDIX D: PHOTOGRAPHS

Figure D-1: Specimen preparation prior to the test

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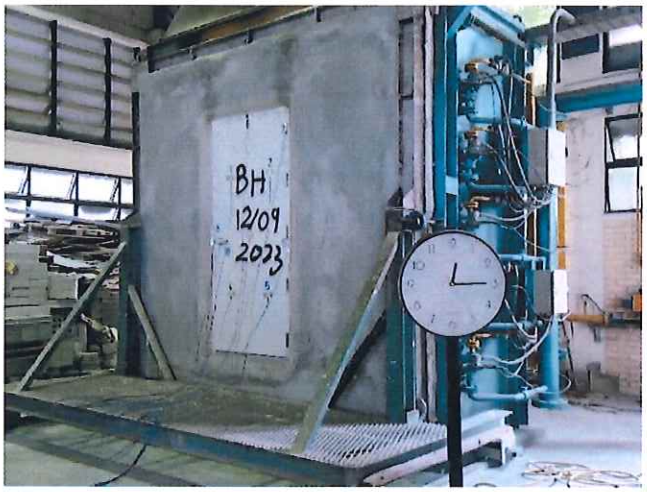
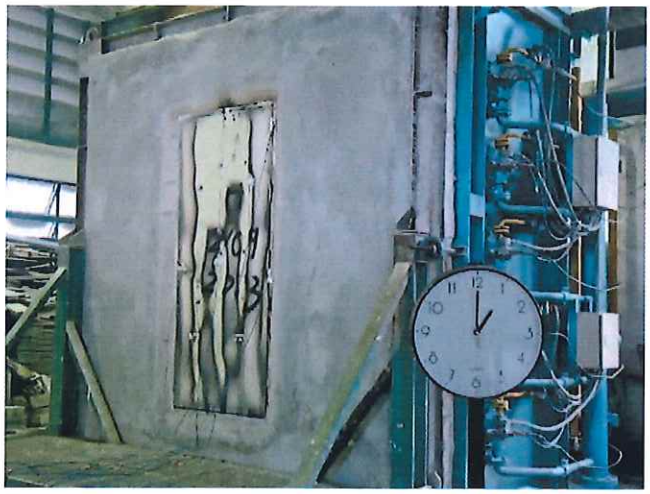
(a) 0:00 hr



(b) 0:15 hr

(c) 0:30 hr

(d) 0:45 hr



(e) 1:00 hr

(f) 1:15 hr

Figure D-2: The specimen during the test

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(g) 1:30 hr

(h) 1:45 hr

(i) 2:00 hr

Figure D-2 (continued): The specimen during the test

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Figure D-3: The specimen after the test

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