

17 December 2013

Mr Stephen Brown-Thomas
Airways Nominees Limited
C/- KCL Property
PO Box 44
New Plymouth 4340

Dear Stephen

Re: Airways Corporation, ADC2 Seismic Strengthening Concept and Quantitative DEE Update

Structex has been engaged to complete seismic strengthening concepts for the three buildings currently tenanted by Airways Corporation on Sir William Pickering Drive, Christchurch. This letter and its attachments cover the strengthening concept for the ADC2 building to a level sufficient for initial pricing along with updated information relating to the Quantitative Detailed Engineering Evaluation.

Seismic Strengthening Concept to 100% NBS:

As requested, we have assessed the seismic strengthening concept at Importance Level 2 with a target of 100%NBS (refer Appendix B for sketches).

100% NBS Roof bracing strengthening:

- Install a new bay of roof bracing between grids 3 and 4;
- Add new steel SHS struts at each end of the roof bracing and use epoxy bolts to connect the strut to the concrete shear walls;
- Retrofit double purlin cleats at selected roof locations to drag the lateral load into the roof bracing system and internal shear walls;
- Retrofit roof bracing cleats by increasing the thickness;
- Retrofit the Reidbrace32 connection details to meet the latest Reid specification.

100% NBS General strengthening:

- Four new concentrically braced steel frames in the across direction at ground floor (310UC96.8 frame) and one at first floor level (250x9.0 SHS frame);
- Three new concentrically braced steel frames in the along direction (250x9.0 SHS frame);
- Three new steel PFC tension ties to be installed to the underside of the suspended floor in the along direction.

Please refer to Appendix A 'Reference Plan' for along and across directions as well as grid lines.

This strengthening is required to reduce the load on the existing internal shear walls by transferring load to the new bracing.

Further recommendations:

To increase robustness during an earthquake larger than design level, you may wish to consider strengthening the first floor diaphragm connection to the façade panels. This could be achieved relatively easily with a bolted steel angle within the ground floor ceiling space. This connection is critical to the seismic performance of the building. The current connection provides a strength >100%NBS but falls short of the current concrete code requirements for robustness.

Note this is an optional item to increase robustness for an earthquake greater than the 100% NBS design level.

Quantitative DEE Update:

A Quantitative DEE has previously been completed for ADC2, which was issued to Airways Nominees Ltd on 21 October 2013. During the process of conceptual strengthening design, it was identified that there are isolated components of the structure with a capacity less than the overall assessed building capacity stated in the previous report. These are:

- Suspended floor diaphragm-mesh tension tie capacity near panels 39 and 37 (refer appendix A for panel locations);
- Roof bracing to concrete shear wall connections at grid A4-5 and D4-5 (critical structural weakness).

The suspended floor diaphragm is required to drag earthquake load into the concrete shear walls. The evaluation of 38% and 52% NBS at two walls is governed by the ability of the mesh to drag seismic load into panels 39 and 37 at each location during an earthquake in the one direction.

With regards to roof bracing, two different types of connections between the roof bracing and the concrete shear walls at grids A4-5 and D4-5 have been evaluated. These connections have a capacity of 24%NBS (four trubolts) and 18%NBS (two chemsets) under the roof bracing load induced by the design level earthquake. As this has a brittle failure mechanism, it is considered to be a critical structural weakness (CSW). The remaining steel roof bracing system is evaluated at 48%NBS governed by the steel brace cleat capacity. The pin connecting the reidbrace banana end to the steel rafter is anticipated to slog out the hole in the cleat, eventually leading to a tension tear-out failure of the cleat. Refer to the attached 'roof bracing system capacities' in Appendix A for other roof bracing components strength. In addition, secondary load paths within the roof are present, therefore the connection strength does not directly impact the overall seismic %NBS of the structure. This secondary load path consists of a plywood roof structure which will distribute the seismic load between the steel rafters (by bending), which in turn transfers the load into the concrete shear walls. This load path has not been considered as a primary load path as it was not specifically detailed as a diaphragm.

Minimum strengthening recommendation:

Should you not wish to strengthen the building to 100% NBS, we would recommend at least strengthening the following items to maintain robust primary load paths.

- Tension tie capacity of the diaphragm near panels 37 and 39;
- Roof bracing elements (purlin cleats, brace cleats and connections to shear walls).

This would involve using a steel member running parallel to panels 37 and 39 underneath the suspended floor, retrofitting brace and some purlin cleats and installing an additional strut along grid lines A and D, between grids 4 and 5 only and epoxy anchoring it to the concrete shear walls. Strengthening to a minimum of 67%NBS is recommended on these elements. Refer to the Appendix C for further details.

We trust that you find the above information useful. If you wish to discuss further, we would be happy to meet with you at your convenience.

Yours sincerely
Structex Harvard Ltd



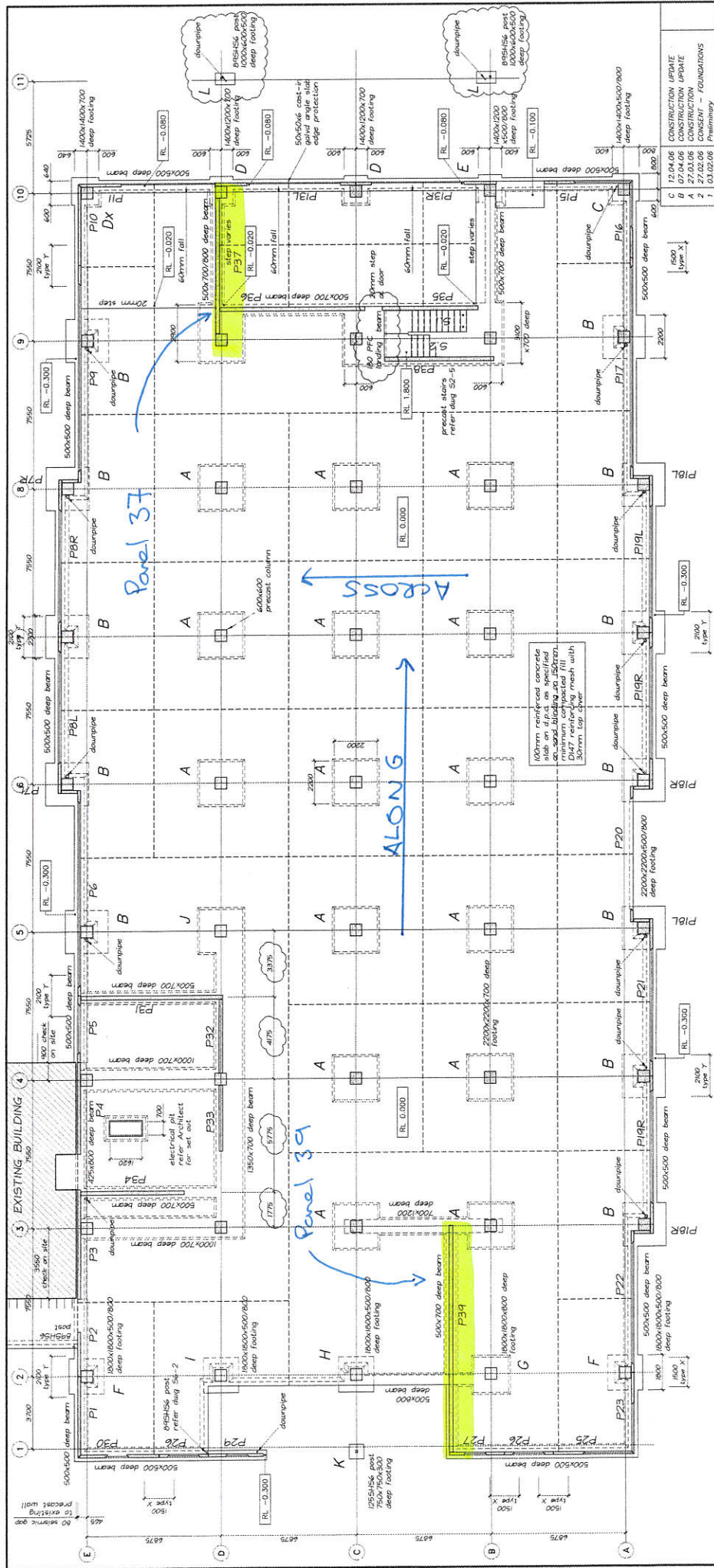
Blair Ramsay
Structural Engineer
BE(Hons), GIPENZ



Geoff Banks
Managing Director
BE(Hons), MIPENZ, CPEng, IntPE

Appendix A: Report information

- Panel Locations
- Roof bracing capacities



Ground Floor RL 0.000 = RL 33.000 on Architectural drawings.

refer dwg 51-2 for footing reinforcing

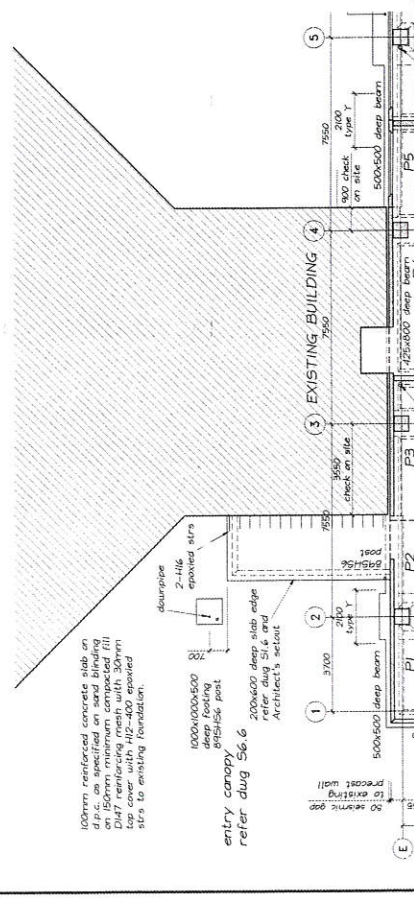
refer Architectural drawings for all downpipe and sewer pipe details

denotes 3x30mm deep slab sawcut located mid-grid as shown.
grout fill prior to placing floor coverings

Reference

BR #3740

16/12/2013



DATE	CONSTRUCTION UPDATE	CHECKED
12.04.06	CONSTRUCTION UPDATE	
07.04.06	CONSTRUCTION UPDATE	
A 27.03.06	CONSTRUCTION	
27.02.06	CONSENT - FOUNDATIONS	
03.02.06	Preliminary	
DATE	AMENDMENT	CHECKED



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ARCHITECTS
LIMITED

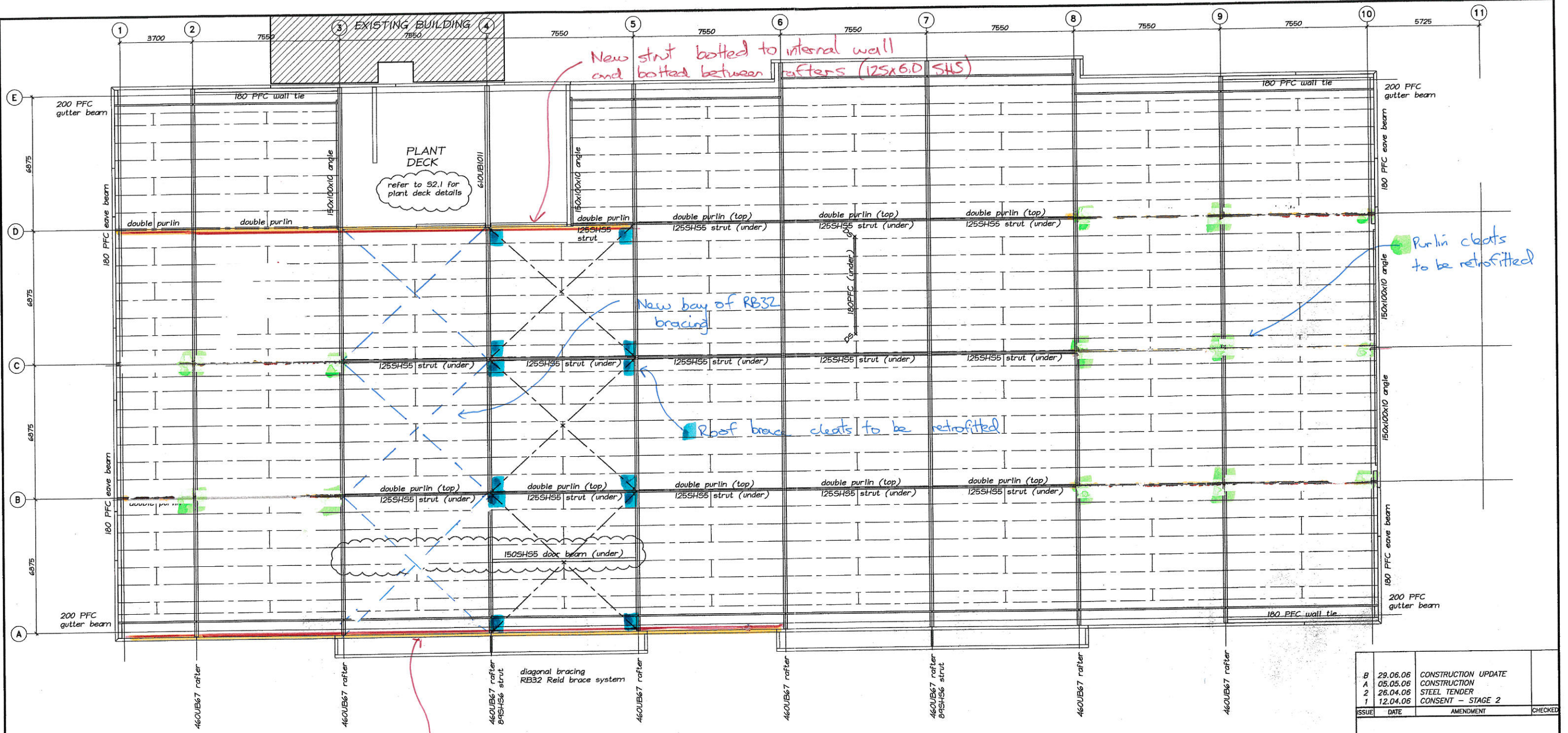
AIRWAYS NEW ZEALAND
TECHNOLOGY PARK
CHRISTCHURCH

GROUND FLOOR PLAN

CONTRACTOR MUST VERIFY ALL DIMENSIONS ON SITE			
SCALES: 1:100		DESIGNED DRAWN CHECKED	01/06 RD
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THIS DRAWING IS COPYRIGHT ©			OF - SHEETS
DATE PRINTED:			11.02.2006

Appendix B: Strengthening to 100%NBS

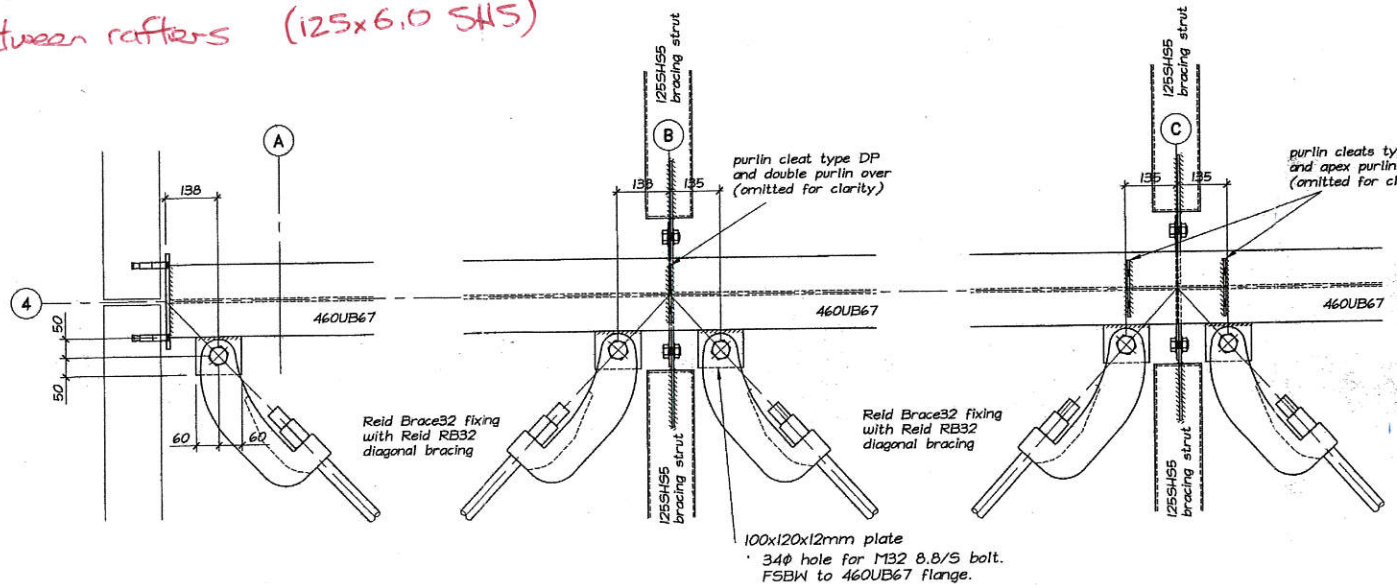




ROOF FRAMING PLAN
Scale: 1:100
all purlins to be DHS 250-13 steel purlins with 1 row of bracing channels.

New strut bolted into facade panels and bolted between rafters (125x6.0 SHS)

ADC2 Strengthening Option (Roof)
#3740
BR
SK01



DIAGONAL BRACING DETAILS

B	29.06.06	CONSTRUCTION UPDATE	
A	05.05.06	CONSTRUCTION	
2	26.04.06	STEEL TENDER	
1	12.04.06	CONSENT - STAGE 2	
ISSUE	DATE	AMENDMENT	CHECKED
POWELL FENWICK CONSULTANTS LIMITED Your quality engineering partner. consulting engineers heating + ventilation mechanical structural electrical acoustic civil fire Unit 3, Armut Park One Bealey Ave & Church St P.O. Box 25-108, Christchurch New Zealand (03) 366-1777: phone (03) 378-1626: fax engineering@pfc.co.nz: email www.pfc.co.nz: website			
ARMITAGE WILLIAMS CONSTRUCTION IAN KRAUSE ARCHITECTS LIMITED			
AIRWAYS NEW ZEALAND TECHNOLOGY PARK CHRISTCHURCH			
STRUCTURAL STEEL ROOF FRAMING PLAN			
CONTRACTOR MUST VERIFY ALL DIMENSIONS ON SITE			
SCALE:	1:100, 1:10	DESIGNED	KD 04/06
		CHECKED	
SET	JOB NO.	SHEET NO.	ISSUE
	050818	S6-1	B
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DATE PRINTED:			

30 JUN 2006



ADC2 Strengthening Option (Walls) - First floor

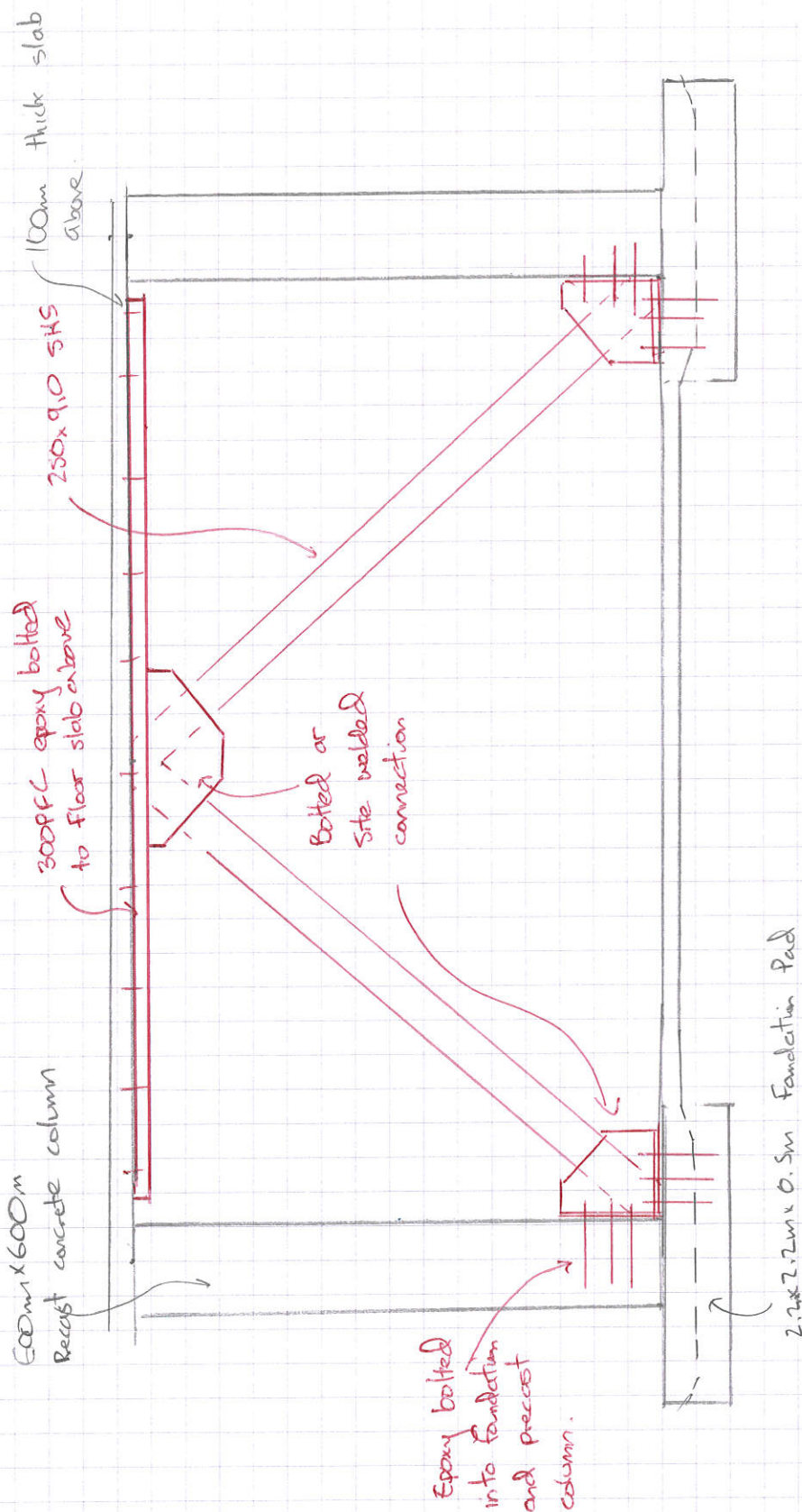
#3740

BR

SK03

Typical CBF along direction

Issue	Amendment	Origin	Date	Drawn	Date	Origin Chk	Date	Design Chk	Date	Approved	Date	 making your world possible	Airways Development Centre Building Layout First Floor Room Layouts								
D	Com and Network Engineering areas updated.	AF	6.8.08	DC	7.8.08	.	.	.	.	.	.		Approved:	Sheet	4	of	-	Sheets	Drg. No.	31693	Issue H
E	Room updates	MD	10.9.08	DC	10.9.08	.	.	.	.	.	.			Origin	PDS	30.04.07					
F	Layout updates.													Drawn	DC	02.05.07					
G	Layout updates.													Origin Chk							
H	Base Plan and Room Layouts on separate sheets.	DC	04.09.09	DC	04.09.09	.	.	.	.	.	.	Design Chk			Date:	Airways Corporation of New Zealand Limited					

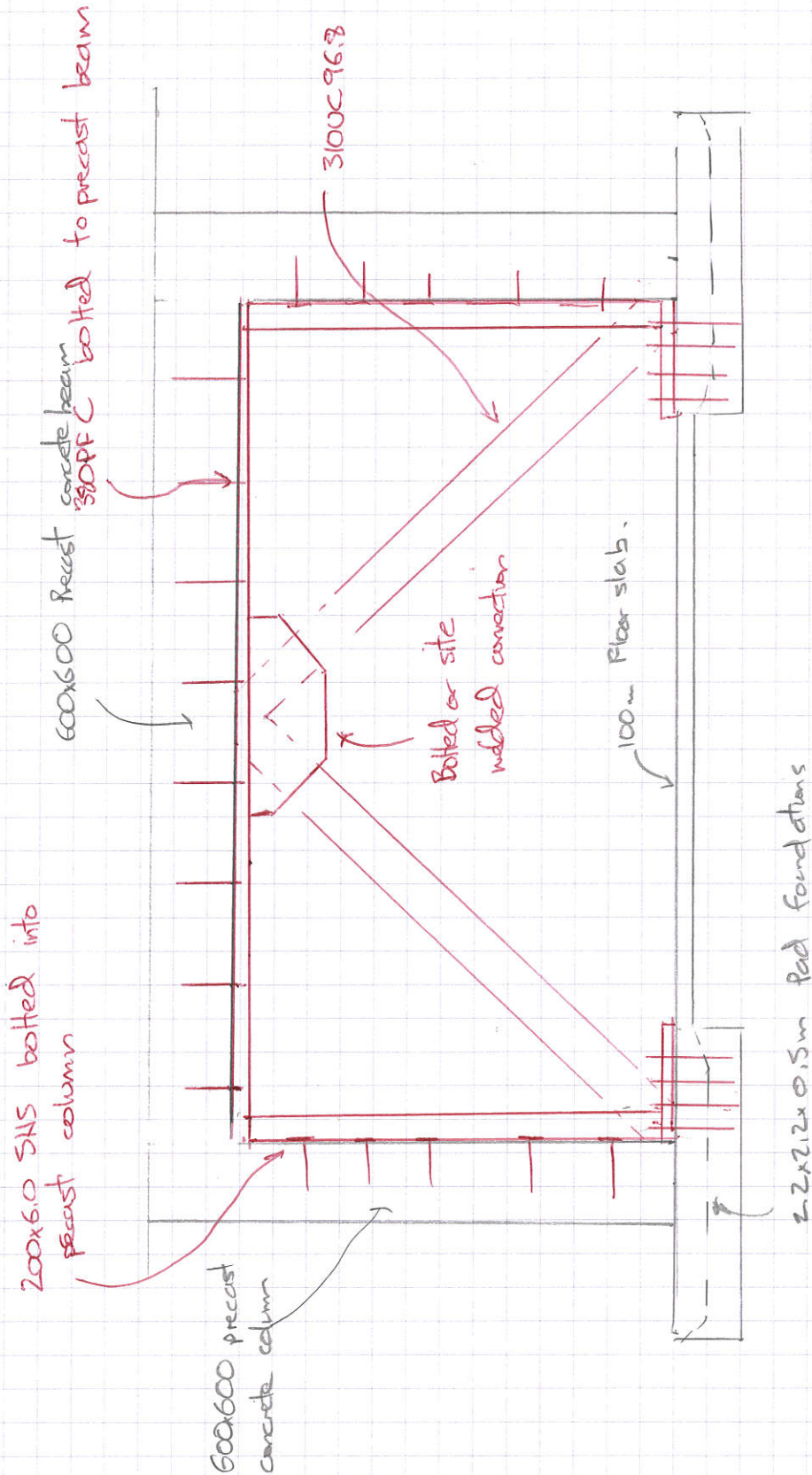


NOTE: - These braces can be reversed to form a 'V' formation:
- Additional columns may be required

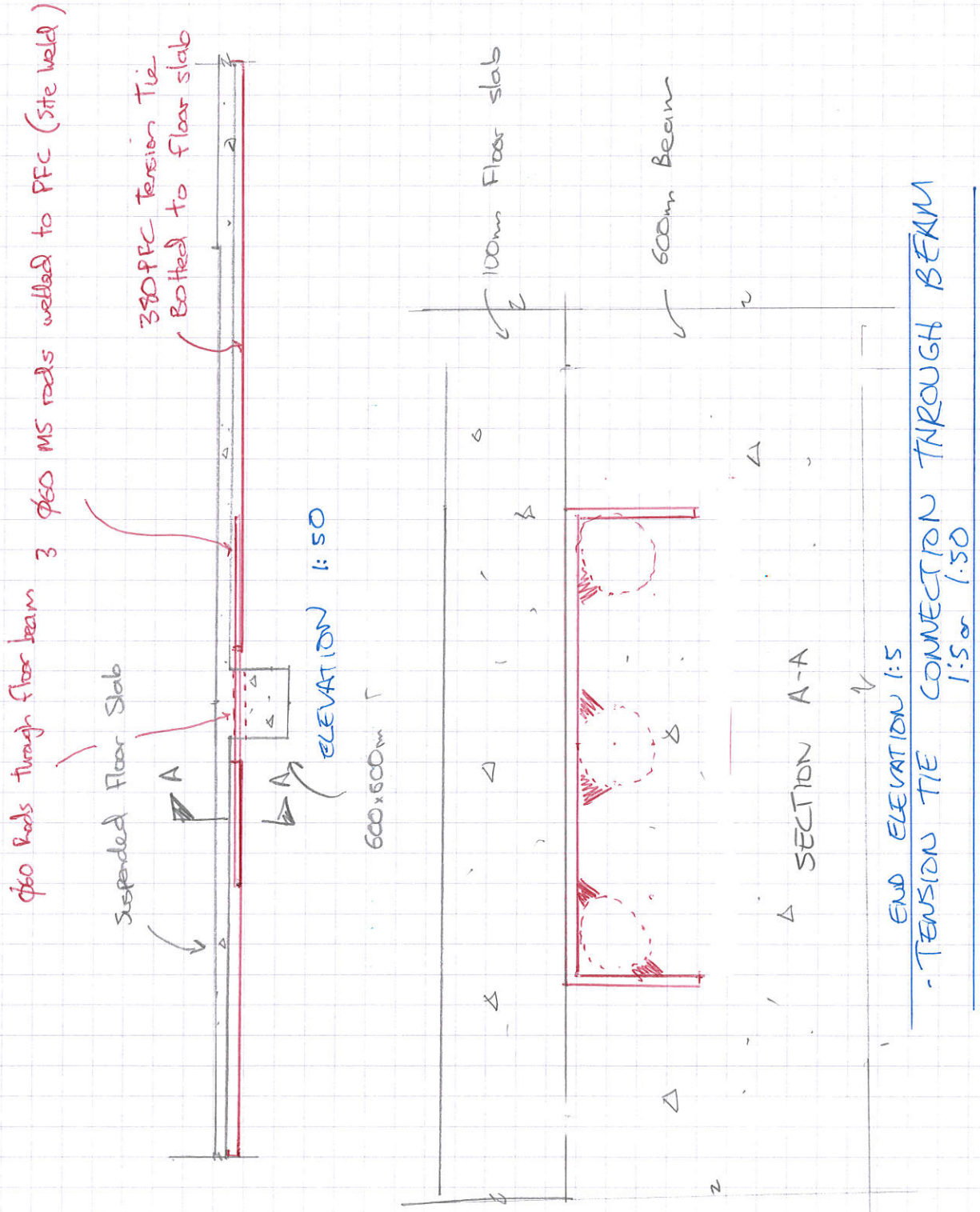


TYPICAL ALONG DIRECTION CBF

1:50

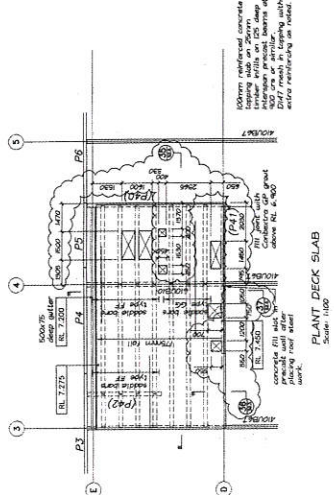


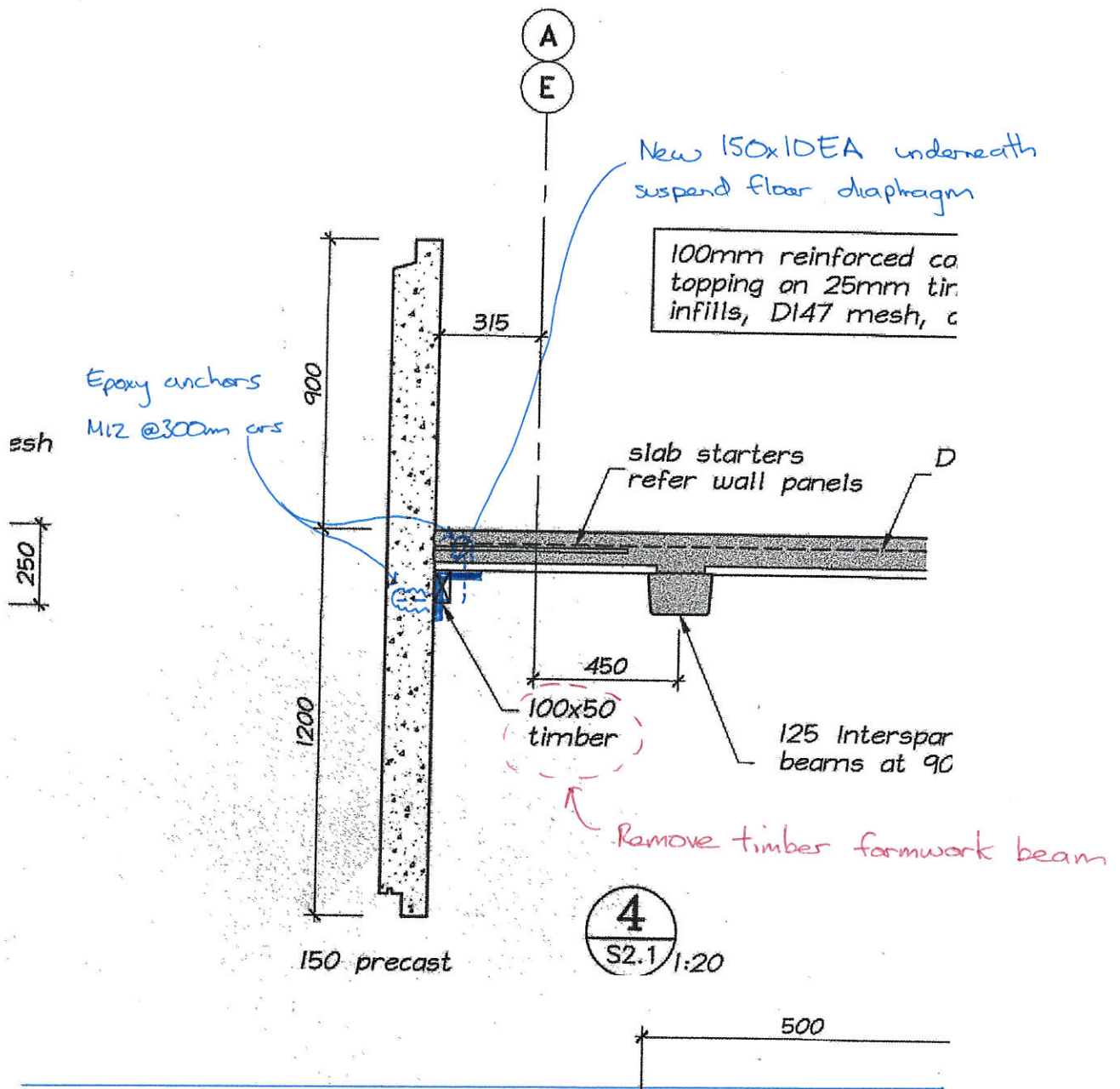
TYPICAL ACROSS DIRECTION CBF
1:50



M12 epoxy anchors @ 300mm centres.

M12 epoxy anchors @ 300mm centres





Typical Strengthening of Diaphragm to wall connection

#3740 BR

16/12/2013

REIDBRACE BRACING SYSTEM

DESCRIPTION

Reidbrace™ is rapidly becoming the preferred option for tension tie bracing and provides an economic off-the-shelf solution for bracing structures, tie-back applications and temporary bracing.

FEATURES

- Eliminates expensive threaded rods. Reidbrace™ uses seismic grade 500E Reidbar™ for tendons.
- Eliminates welding and threading. Reidbar™ is available in either black or galvanised bar in standard 6 metre lengths and can be joined using standard couplers and locking nuts. (Longer Reidbar™ lengths by order).
- Over length bar can be cut without dismantling the bracing assembly.
- Substantial cost savings in labour and materials.
- All components sold as kits or separately.
- Engineered design - tested and certified to exceed the yield capacity of the 500E grade Reidbar™ (with the exception of RBRACE32, refer to Table1.)
- Designed to fit over structural steel flanges or cleats to provide double shear connection. The bracket thickness will influence the strength of system. Refer to Reid for design advice.
- Supplied with pin and clip for connection to structure - no need to source separate HS bolt.
- Reidbrace is galvanised for added corrosion protection.

APPLICATIONS

- Wall and roof bracing
- Retro fitted seismic bracing
- Retaining wall tie backs
- Cross ties
- Temporary Bracing
- Beam Strengthening

REIDBRACE KITS & PRODUCT CODES

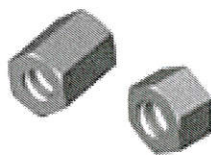
The Reidbrace Kits comprise of six major components and includes all the pins and safety clips for ease of ordering and installation. The kits are available in 12, 16, 20, 25 and 32mm sizes.



RBRACE Banana End plus pins and safety clips



RBRACE-END plus pins and safety clips



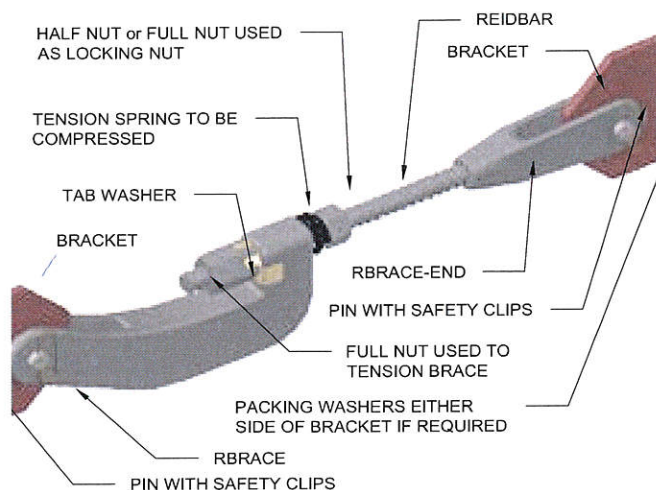
Reid Full Nut and Half Nut



Reid Tension Spring



Reid Tab Washer



Bar Size	Kit Code (includes all fittings including pins)
12mm	RBRACE12-SET
16mm	RBRACE16-SET
20mm	RBRACE20-SET
25mm	RBRACE25-SET
32mm	RBRACE32-SET

Ph 0800 88 22 12 | www.reids.co.nz

Range effective Sept 2011. Reid™ reserves the right to adjust range without notification. For more up-to-date details visit our website.
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REIDBRACE SPECIFICATION

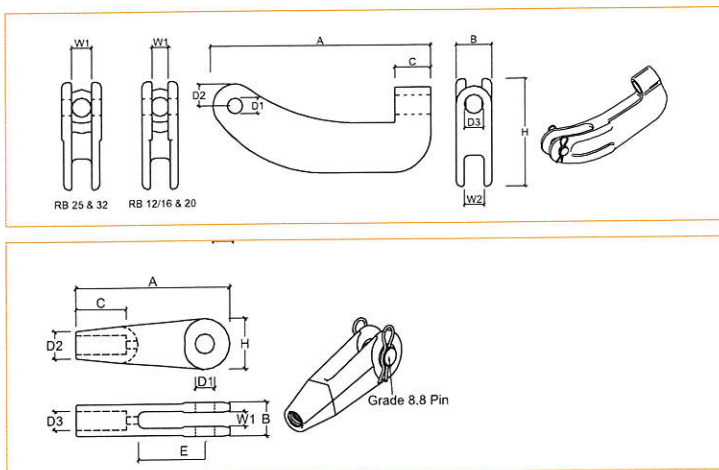
Table 1: CHARACTERISTIC STRENGTHS - min ultimate strength in kN

RBRACE Size	RBRACE Banana	RBRACE End	Reidbar FULL NUT	Reidbar HALF NUT	Min Yield	Reidbar Min UTS
12mm	>116	>65	79	34	56.5	65.0
16mm	>116	>116	141	60	100.6	115.6
20mm	>181	>181	220	94	157.0	180.6
25mm	>282	>282	344	147	245.5	282.3
32mm	>430	>462	462	241	402.0	462.3

Table 2: PRODUCT SPECIFICATION - DIMENSIONS OF RBRACE BANANA AND RBRACE END

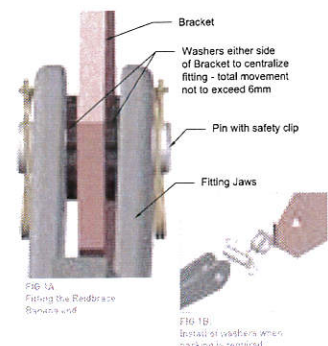
Reidbrace Banana										
Size	A	B	C	D1	D2	D3	E	H	W1	W2
12/16	276	36	46	17	25	19	-	107	16	20
20	345	45	58	21	32	24	-	134	21	25
25	382	53	73	31	40	29	-	149	26	29
32	436	68	72	31	44	38	-	170	36	36

RB-End										
Size	A	B	C	D1	D2	Pin ø	E	H	W1	
12	145	32	50	17	-	16	50	40	16	-
16	160	36	55	17	30	16	67	50	16	-
20	195	45	60	21	35	20	88	60	21	-
25	247	50	80	31	43	30	108	80	26	-
32	265	62	85	31	55	30	120	88	32	-



INSTALLATION SPECIAL CAUTION:

The Reidbrace must be centralised on the bracket to ensure central loading forces.



For further technical information and CAD drawings, please refer to the Reid website www.reids.co.nz or call 0800 88 22 12. All specification information is also contained in the Reidbar Technical Catalogue.

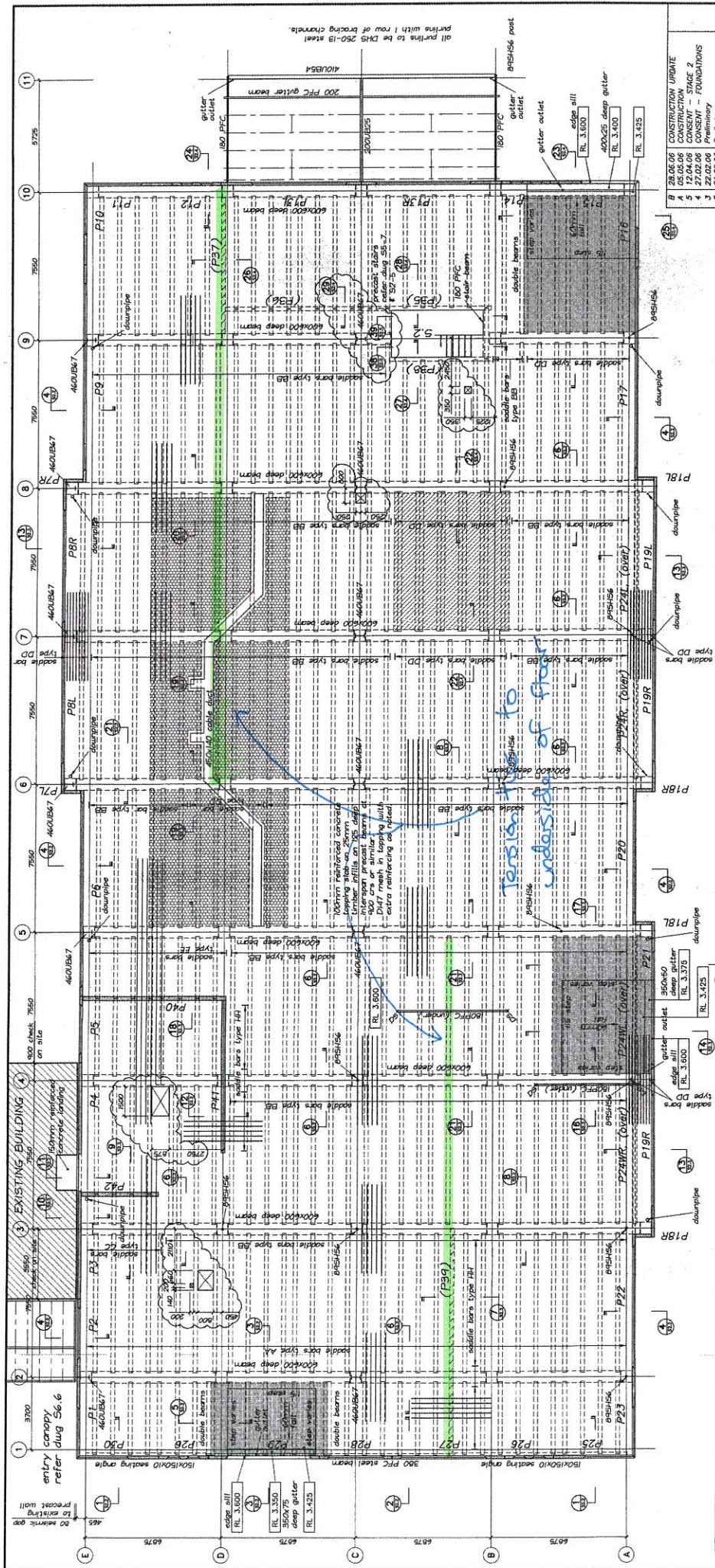
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Appendix C: Minimum Strengthening Recommendation





Tension tie extent for
minimum strengthening
recommendation

BR

16/12/2013

#3740 SK10

beam saddle bar reinforcing

- type AA H12-250 4500 long
- type BB H12-250 4500 long
- type CC H12-250 4500 long
- type DD H16-150 4500 long
- type EE H12-250 2000 long
- type FF H12-250 4000 long
- type GG H16-250 4000 long
- type HH H16-250 4000 long

saddle bars type BB

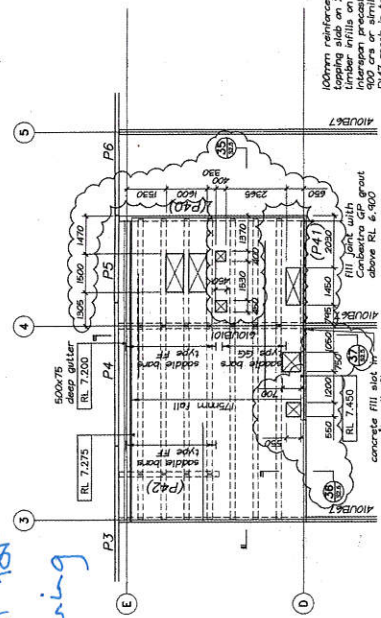
denotes lowered intertrap
on outside of outdoor
terraces slabs.

denotes 100mm reinforced
25mm timber infills on 2-125
deep intertrap precast beams
at 100 c/s or similar.

denotes 80mm concrete topping on 60mm
timber infills on 25mm
deep intertrap precast beams at 125
c/s or similar. refer drawing 52-3 for 450x140mm
deep concrete floor slab.

100mm reinforced concrete
topping slab on 25mm
timber infills on 125 deep
intertrap precast beams at
100 c/s or similar. refer
drawing 52-3 for 450x140mm
deep concrete floor slab.

PLANT DECK SLAB
Scale: 1:100



CONSTRUCTION UPDATE 28.06.06 CONSTRUCTION UPDATE 12.04.06 CONSTRUCTION UPDATE 27.02.06 CONSENT - FOUNDATIONS 22.02.06 Preliminary 21.02.06 Preliminary		CHECKED DATE AMENDMENT
POWELL FENWICK CONSULTANTS 100-105-106-107-108-109-110-111-112-113-114-115-116-117-118-119-120-121-122-123-124-125-126-127-128-129-130-131-132-133-134-135-136-137-138-139-140-141-142-143-144-145-146-147-148-149-150-151-152-153-154-155-156-157-158-159-160-161-162-163-164-165-166-167-168-169-170-171-172-173-174-175-176-177-178-179-180-181-182-183-184-185-186-187-188-189-190-191-192-193-194-195-196-197-198-199-200-201-202-203-204-205-206-207-208-209-210-211-212-213-214-215-216-217-218-219-220-221-222-223-224-225-226-227-228-229-230-231-232-233-234-235-236-237-238-239-240-241-242-243-244-245-246-247-248-249-250-251-252-253-254-255-256-257-258-259-260-261-262-263-264-265-266-267-268-269-270-271-272-273-274-275-276-277-278-279-280-281-282-283-284-285-286-287-288-289-290-291-292-293-294-295-296-297-298-299-300-301-302-303-304-305-306-307-308-309-310-311-312-313-314-315-316-317-318-319-320-321-322-323-324-325-326-327-328-329-330-331-332-333-334-335-336-337-338-339-340-341-342-343-344-345-346-347-348-349-350-351-352-353-354-355-356-357-358-359-360-361-362-363-364-365-366-367-368-369-370-371-372-373-374-375-376-377-378-379-380-381-382-383-384-385-386-387-388-389-390-391-392-393-394-395-396-397-398-399-400-401-402-403-404-405-406-407-408-409-410-411-412-413-414-415-416-417-418-419-420-421-422-423-424-425-426-427-428-429-430-431-432-433-434-435-436-437-438-439-440-441-442-443-444-445-446-447-448-449-450-451-452-453-454-455-456-457-458-459-460-461-462-463-464-465-466-467-468-469-470-471-472-473-474-475-476-477-478-479-480-481-482-483-484-485-486-487-488-489-490-491-492-493-494-495-496-497-498-499-500-501-502-503-504-505-506-507-508-509-510-511-512-513-514-515-516-517-518-519-520-521-522-523-524-525-526-527-528-529-530-531-532-533-534-535-536-537-538-539-540-541-542-543-544-545-546-547-548-549-550-551-552-553-554-555-556-557-558-559-560-561-562-563-564-565-566-567-568-569-570-571-572-573-574-575-576-577-578-579-580-581-582-583-584-585-586-587-588-589-590-591-592-593-594-595-596-597-598-599-600-601-602-603-604-605-606-607-608-609-610-611-612-613-614-615-616-617-618-619-620-621-622-623-624-625-626-627-628-629-630-631-632-633-634-635-636-637-638-639-640-641-642-643-644-645-646-647-648-649-650-651-652-653-654-655-656-657-658-659-660-661-662-663-664-665-666-667-668-669-670-671-672-673-674-675-676-677-678-679-680-681-682-683-684-685-686-687-688-689-690-691-692-693-694-695-696-697-698-699-700-701-702-703-704-705-706-707-708-709-710-711-712-713-714-715-716-717-718-719-720-721-722-723-724-725-726-727-728-729-730-731-732-733-734-735-736-737-738-739-740-741-742-743-744-745-746-747-748-749-750-751-752-753-754-755-756-757-758-759-760-761-762-763-764-765-766-767-768-769-770-771-772-773-774-775-776-777-778-779-780-781-782-783-784-785-786-787-788-789-790-791-792-793-794-795-796-797-798-799-800-801-802-803-804-805-806-807-808-809-810-811-812-813-814-815-816-817-818-819-820-821-822-823-824-825-826-827-828-829-830-831-832-833-834-835-836-837-838-839-840-841-842-843-844-845-846-847-848-849-850-851-852-853-854-855-856-857-858-859-860-861-862-863-864-865-866-867-868-869-870-871-872-873-874-875-876-877-878-879-880-881-882-883-884-885-886-887-888-889-890-891-892-893-894-895-896-897-898-899-900-901-902-903-904-905-906-907-908-909-910-911-912-913-914-915-916-917-918-919-920-921-922-923-924-925-926-927-928-929-930-931-932-933-934-935-936-937-938-939-940-941-942-943-944-945-946-947-948-949-950-951-952-953-954-955-956-957-958-959-960-961-962-963-964-965-966-967-968-969-970-971-972-973-974-975-976-977-978-979-980-981-982-983-984-985-986-987-988-989-990-991-992-993-994-995-996-997-998-999-1000-1001-1002-1003-1004-1005-1006-1007-1008-1009-1010-1011-1012-1013-1014-1015-1016-1017-1018-1019-1020-1021-1022-1023-1024-1025-1026-1027-1028-1029-1030-1031-1032-1033-1034-1035-1036-1037-1038-1039-1040-1041-1042-1043-1044-1045-1046-1047-1048-1049-1050-1051-1052-1053-1054-1055-1056-1057-1058-1059-1060-1061-1062-1063-1064-1065-1066-1067-1068-1069-1070-1071-1072-1073-1074-1075-1076-1077-1078-1079-1080-1081-1082-1083-1084-1085-1086-1087-1088-1089-1090-1091-1092-1093-1094-1095-1096-1097-1098-1099-1100-1101-1102-1103-1104-1105-1106-1107-1108-1109-1110-1111-1112-1113-1114-1115-1116-1117-1118-1119-1120-1121-1122-1123-1124-1125-1126-1127-1128-1129-1130-1131-1132-1133-1134-1135-1136-1137-1138-1139-1140-1141-1142-1143-1144-1145-1146-1147-1148-1149-1150-1151-1152-1153-1154-1155-1156-1157-1158-1159-1160-1161-1162-1163-1164-1165-1166-1167-1168-1169-1170-1171-1172-1173-1174-1175-1176-1177-1178-1179-1180-1181-1182-1183-1184-1185-1186-1187-1188-1189-1190-1191-1192-1193-1194-1195-1196-1197-1198-1199-1200-1201-1202-1203-1204-1205-1206-1207-1208-1209-1210-1211-1212-1213-1214-1215-1216-1217-1218-1219-1220-1221-1222-1223-1224-1225-1226-1227-1228-1229-1230-1231-1232-1233-1234-1235-1236-1237-1238-1239-1240-1241-1242-1243-1244-1245-1246-1247-1248-1249-1250-1251-1252-1253-1254-1255-1256-1257-1258-1259-1260-1261-1262-1263-1264-1265-1266-1267-1268-1269-1270-1271-1272-1273-1274-1275-1276-1277-1278-1279-1280-1281-1282-1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